

## Introduction

Since times immemorial, natural and environmental disasters have caused great loss of life, human suffering and immeasurable economic damage. In addition to their toll in lives and material, disasters amplify various forms of vulnerability.

Over the last two decades of the previous century (1980-2000), victims of disasters reached a toll of 1.5 million people who perished as a result of an earthquake, a volcanic eruption, a cyclone, floods or some other natural disaster.

The earthquake which hit west Sumatra in Indonesia, and the subsequent Indian Ocean Tsunami (December 2004), alone killed 300 000 people.

The impact of natural disasters and such phenomena accrues in severity growing with time in tandem with the expansion of human activities.

Disasters themselves are increasing in number and frequency, a direct result of the global changes experienced by the world in the form of climate change, and of the worsening vulnerability that affects a large swathe of the earth's population.

According to the World Bank, the number of people affected by natural disasters has recorded a steady annual increase of 6% during the last three decades of the previous century. Accordingly, natural, environmental and technological disasters have left 3 million dead and 1 billion homeless, of whom 89% live in developing countries.

Such figures only confirm that developing countries are more prone to and more severely affected by the repercussions of natural and environmental catastrophes. Poverty only exacerbates the impact of these phenomena and the precariousness of the economic environment where these societies evolve.

Along with the escalation of these risks, awareness has also increased worldwide about the need to mitigate the damage caused by these phenomena, improve good governance in their management and integrate them in development schemes.

Following is a brief overview of the major decisions and measures taken internationally in this regard:

1. The UN General Assembly designated the last decade of the previous century (1990-2000) as the International Decade for Natural Disaster Reduction (IDNDR). The objectives laid out for this decade were:
  - To increase public awareness about the endeavors to mitigate the negative impacts of natural disasters.
  - To request all countries to set up, before 2000, natural disaster risk assessment systems.
  - To invite all countries to include disaster reduction in their development plans.
2. Other important stations that marked international policy in this regard include:
  - The Earth Summit (Rio conference on Environment and Development (1992), the Cairo Conference on Population, the Stockholm Conference on Development and Society (1995), and the Istanbul Conference on Human Settlements (Habitat II, 1996), all of which dedicated a major part of their proceedings to the reduction of natural, technological and environmental disasters.
  - The World Conference on Disaster Reduction in Yokohama, Japan, (1994) which placed the Strategy for Disaster Reduction under the motto 'A Safer World'.
  - The meeting of the UN Division for Sustainable Development (1996) to promote fruitful interactions between Agenda 21 and the Yokohama Strategy.

3. The most salient event of the current decade was the World Conference on Disaster Reduction held in Kobe, Japan in 2005. The Conference drafted a mid-term framework plan of action (2006-2015) that gives body to the Yokohama Strategy and Plan of Action for a Safer World. The Kobe conference issued the Kobe-Hyogo Declaration which urged states and human communities in general to become better prepared against disasters by adopting a global strategic approach towards the reduction of vulnerability and disaster impact.

This Plan of Action comprises the following axes:

- Governance, which encompasses the organizational, legal and the political framework.
- Risk identification and assessment through observation, monitoring and early warning systems.
- Information management and education (resistance)
- Mitigating secondary or indirect risk factors (prevention).

Disaster reduction has become a matter of crucial importance in sustainable development, provided that necessary mechanisms are put in place, and appropriate policies are adopted to integrate disaster-prevention programs in sustainable development, and that the capacity of individuals and communities to confront disasters is built up.

Unfortunately, when drawing up their development plans, countries rarely earmark resources to priorities such as disaster-related damages, especially since no country, regardless of its economic position or degree of social development is immune to natural disasters.

Governments should therefore place further emphasis on the efforts to reduce possible threats and engage the civil society in such endeavors. Modern technologies and scientific data can be put to contribution in identifying high-risk areas and devising the means and ways of containing these risks. This calls for international as well as national cooperation as lessons are drawn from previous catastrophes.

Natural disasters do not only cause devastation, but also delay social and economic development back through their side-effect or indirect repercussions. The issues of natural disasters and the environmental crisis (pollution and other disruptions of ecosystems) have given rise to many undertakings and a global scientific initiative that tackles the prospects of managing land and marine environmental systems, the bowels of the earth and the higher strata of the atmosphere.

Naturally, Islamic countries have also taken a keen interest in this dilemma, starting with the identification and assessment of the disasters jeopardizing their safety and security, and taking the preventive measures necessary to alleviate the damage of each type of disaster. They also undertook the identification and assessment of climate change-caused damages, and finally the preventive measures that may be taken to avoid or contain these damages.

In the Islamic perspective, modern environment problems are blamed on the category of human beings peopling the earth, on production and consumption modes, on the issues of sustainable development and environment protection, as well as the factors inherent to man's vice-regency, his harnessing of resources, accountability and reward.

On natural and environmental disasters, many Muslim scholars continue to believe that these natural manifestations are Allah's punishment for man on his evil acts. A more contemporary interpretation by Imad Eddine Khalil (Islamic Interpretation of History, 1991) sees that the wrath of nature is one of the two forces that Allah unleashes to mark His divine word against man's loss of faith and arrogance. The author corroborates his theory with many verses from the Quran, including:

*"Say: "He is able to send retribution from above you or from below your feet, or He will make you belong to opposing factions, then He will let you taste the might of each other." See how We cite the revelations, perhaps they may comprehend." (Al Anaam, verse 65)*

*"Do the people of the towns feel secure against the coming of Our wrath by night while they are asleep? Or else do they feel secure against its coming in broad daylight while they play about (care-free)?" (Al Aaraf, verses 97-98)*

*"Do then those who devise evil (plots) feel secure that Allah will not cause the earth to swallow them up, or that the Wrath will not seize them from directions they little perceive?- Or that He may not call them to account in the midst of their goings to and fro, without a chance of their frustrating Him?" (Annahl, verse 45-47)*

*"Do ye then feel secure that He will not cause you to be swallowed up beneath the earth when ye are on land, or that He will not send against you a violent tornado (with showers of stones) so that ye shall find no one to carry out your affairs for you? Or do ye feel secure that He will not send you back a second time to sea and send against you a heavy gale to drown you because of your ingratitude, so that ye find no helper. Therein against Us?" (Al Israa, verses 68-69)*

No matter what, in mankind's relationship with the environment, Man, fed by his tyranny and arrogance, displays his ability to master the situation with scientific progress and technological development which grants him the ability to tame and harness nature and to bend it to serve his interests and his need for civilization development. This he does by, inter alia, diversifying production modes and the excessive consumption of renewable and non-renewable natural resources.

*"Mischief has appeared on land and sea because of (the med) that the hands of men have earned, that ((Allah)) may give them a taste of some of their deeds: in order that they may turn back (from Evil)."* (Arrum, verse 40)

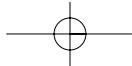
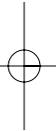
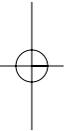
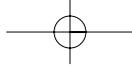
Mention should be made here of the Quran's description of environmental balance in Allah's saying:

*"And the earth We have spread out (like a carpet); set thereon mountains firm and immovable; and produced therein all kinds of things in due balance. And We have provided therein means of subsistence,- for you and for those for whose sustenance ye are not responsible. And there is not a thing but its (sources and) treasures (inexhaustible) are with Us; but We only send down thereof in due and ascertainable measures."* (Al Hijr, verses 19-21)

*"Verily, all things have We created in proportion and measure".* (Al Qamar, verse 49)

*"Do no mischief on the earth, after it hath been set in order."* (Al Aaraf, verse 55)

This balance is our ultimate goal and in the following chapters we will detail the axes that give structure to this study.



## Chapter I

# Definition and Categories of Natural and Environmental Disasters

## 1. What is a disaster?

The United Nations Office for Coordination of Humanitarian Affairs defines disaster as a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using its own resources.

The following aspects come into consideration when disaster occurs:

- Disruption of lifestyles and behavior patterns,
- Impact on Man and other living creatures,
- Impact on the social infrastructure and eco-structure, buildings, transport systems and other vital interests such as the food chain,
- Social amenities such as housing, food, drinking water, shelter and medical care.

UNDRO (United Nations Disaster Relief Organization), which operated from Geneva, Switzerland, until the early 1990s of the previous century, had the following definition for natural disaster which combines the physical phenomenon with its socio-economic repercussions: 'An event anchored in time and space during which society (or a human community) becomes at great risk and sustains loss of life and property to such extent that social structures are disrupted and unable to discharge some or all of their main functions.'

Another definition, although limited to sudden events, is widely used in the United Kingdom:

*'A catastrophe is a dangerous disruption of life which cannot be predicted, either partially or totally. It kills; it maims, deprives or threatens to make homeless numbers of people that exceed the capacity of the otherwise relevant public services and therefore requires a special mobilization of these services'.*

## 2. Disaster Categories

There are two distinct types of disasters:

- Natural geological disasters which originate from the depth of the earth such as earthquakes, volcanoes and tsunamis (which are giant waves -or series of waves- created by a sea quake or other movement in the depth of the sea or ocean).
- Hydro-climatic disasters which occur on the surface of the earth such as storms (cyclones, hurricanes...), floods and droughts.
- Other catastrophes of which the origins are both subterranean and superficial such as landslides.
- Environmental disasters are caused by excessive or harmful human activity that leads to climate change manifestations such as more frequent floods and drought spells, desertification, wildfires, the appearance of species of insects, rodents and plant diseases, locust infestations, and the emergence of new lethal diseases that kill large numbers of people.
- Technological disasters that reveal the correlation between natural and technological disasters.

## 2.1 Natural disasters of a geological source

These disasters include earthquakes, volcanoes, and Tsunamis and occur along the boundaries between colliding plates of the earth's crust.

There are three types of boundaries separating these plates:

- Divergent boundaries such as oceanic ones.
- Convergent boundaries (colliding) as in the case with oceanic plates with a concentration of volcanoes. The seismicity of Islamic Asian countries falls within this category.
- Transform boundaries (or fault lines) as is the case in North African countries (west Mediterranean) from Morocco to Egypt, and in Turkey (east Mediterranean).

Earthquakes are the most dangerous and deadly of all disasters as they can destroy in a few minutes what took man years or decades to build, leaving behind desolation, destruction and terror (devastating economic, social and psychological damages), in addition to dozens of thousands of dead or injured people and hundreds of thousands, at times even millions, of homeless people.

The magnitude of an earthquake is measured by the surge of energy it releases when it occurs (measured on the Richter scale). For example, the Sumatra earthquake (ML: 9.3, December 2004) released energy equal to two billion tons of explosives (10/9 x 2 tons).

The same earthquake triggered a tsunami (tidal waves more than 24 meters in height) which crashed on the coasts of 12 Asian countries around the Indian Ocean and claimed the lives of more than 100 000 people and another 170 000 people in Indonesia.

Sometimes the tsunami is linked to a volcanic eruption at sea; in which case the magnitude is measured on a scale that determines wave height according to distance and gives an indication of the time it would take the first high wave to reach a given location, thus providing the benefit of an early warning.

Like earthquakes, volcanoes are a manifestation of the earth's core energy which has always been active throughout geological ages. Volcanic activity occurs mainly in the boundaries between tectonic plates. 90% of ocean volcanoes are basaltic, a category that is less dangerous than the volcano which erupted in Colombia in 1985 and killed 25 000 people.

## 2.2 Hydro-climatic Disasters:

Water is the main culprit in hydro-climatic natural disasters. These disasters include hurricanes (tropical or other), cyclones, storms, as well as landslides, erosion, floods and droughts. These hazards are also associated with other phenomena such as forest fires which are linked to drought in a direct or indirect manner. These disasters affect all Islamic countries at varying degrees.

Storms, hurricanes and extreme events are the result of interactions between water and air. These interactions cause severe disruptions on the surface of the earth, and threaten the safety and property of inhabitants. These interactions give rise to cyclones, long spells of drought, deluges and catastrophic floods. These include:

- Cyclones which occur when heavy rain is accompanied by strong winds of which the speed exceeds 200 km/hour.
- Extreme disturbances (hurricanes) occur when the wind speed exceeds 120 kilometers/hour.
- Ordinary rainstorms in which heavy rains are accompanied by wind running at a speed of less than 65 km/hour.

Contrary to other natural disasters, droughts lack the element of surprise and take months to settle in, only to last for years.

Desertification is the process by which a semi-arid area or one with low humidity slowly transforms into an arid area.

Floods cause the worst damage of all hydro-climatic disasters. Water covers vast areas (sometimes seawater), destroying crops, property, infrastructure and water and electricity supply chains, spreading at the same time all sorts of waterborne diseases. In addition to being hydro-climatic natural hazards, floods and droughts are also environmental disasters.

### 2.3 Environmental Disasters

The UNDP Centre for Urgent Environmental Assistance (UNCUEA) defined an environmental disaster as an event or a sequence of events that result in a dangerous disruption of human, social and environmental systems and jeopardize their essence, requiring swift intervention, rehabilitation or reconstruction operations.

These disasters are caused by climate changes, pollution (water, air and soil) and technological accidents.

Contrary to natural disasters which are 'natural processes' associated with a living planet (earth), environmental disasters are mainly the result of man's activities causing global changes. The climate change which flows from these global transformations is becoming a major source of alarm for the entire human race in view of its disastrous impact on water, agriculture, forests, fisheries and biodiversity.

Prominent among environmental disasters is desertification. This environmental manifestation was the first ever monitored and affects 3.6 billion hectares (1/4 of the earth's entire surface areas). Desertification, the result of climate change and soil-damaging human activities in arid areas, is unfolding at a slow pace. It may worsen with the rise of the earth's temperature owed to climate change and with the expansion of such human activities as irrigation, industrialization, tourism and overgrazing (particularly in African Sahel countries).

Over the past half century, desertification has reached alarming proportions, prompting the United Nations to call at the Earth summit of Rio (1992) for a Convention to Combat Desertification.

Excessive grazing remains the major cause of desertification (90% of affected lands), in addition to deforestation and excessive and soil-depleting over farming of land.

The 1996 drought resulted in an official death toll of 74 000.

Similarly, the incidence of floods has alarmingly speeded up as a result of transformations in the local ecosystems. The absence of proper water channeling systems, informal and haphazard settlements which encroach upon river beds, shrinking plant cover and lack of planning, all exacerbate the impacts of these floods.

Faced by such situation, the international scientific community came together to devise a number of programs, projects and initiatives aimed at analyzing global changes, at the top of which comes change.

### 2.4 Technological Disasters

These disasters cover all risks generated by energy and production sectors at various stages of their operation, from production, to the stocking, and then to transporting hazardous material.

Technological risks include all industry, nuclear and biology-related hazards, as well as dam fissures or ruptures. They also include health hazards inherent to the use of construction material and exposure to electromagnetic rays (high voltage power lines). Each of these hazards has its own specificity but they all converge at their source, human activity.

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The United Nations dedicated the last decade of the previous century to reducing natural disasters. Many demanded that protection against technological disasters be included in a bid to mitigate the repercussions of natural disasters, knowing that the latter cause greater suffering than technological disasters.

Yet, it is often the case that a technological disaster inflicts immense damage on the environment. This was the case with Chernobyl, Ukraine, Bhopal, India and Sevezo, Italy, as well as other catastrophes such as the Chasseral fire in Switzerland, and the AZF Toulouse disaster in France caused by the explosion of a chemical factory. Although the accidents themselves may have caused the immediate death of a few hundred or thousand people, many victims died only months and sometimes years after the accident.

Sometimes, natural disasters are the main cause of technological ones. This happens for example when an earthquake destroys vital lines and facilities such as gas pipelines, drinking water pipes or dams, etc.

Furthermore, population density in cities and insalubrious housing conditions in shanty towns, misjudgment when identifying safe areas for the implantation of industrial zones or human settlements, the escalating industrialization pace, the increasing number of industrial and chemical accidents, the lack of resources specialized in disaster prevention-preparedness and intervention, all these factors make technological accidents an increasingly recurrent element in disaster scenarios.

Showalter and Myers, from the Colorado University Natural Hazard Centre, introduced the concept of Natural Technology, a science that studies the relationship and interaction between natural disasters and technological ones. It only stands to reason that the increase in the number of chemical plants, storage facilities and pipelines would inevitably be accompanied by a noticeable escalation of accidents where there is interplay between natural and technological disasters.

The UNDP Human Development Report for 1994 argues that disasters in developing countries are an integral part of their poverty cycle. Poverty causes disasters and disasters exacerbate poverty. Only sustainable human development-which increases the security of human beings and of the planet we inhabit-can reduce the frequency and impact of natural disasters.

Natural disasters cause terrible loss of life and property and derail the development process, disrupting various human activities and shaking the sense of social security in the aftermaths of a disaster. Some of their effects on society include displacement, impoverishment, diseases and environmental deterioration.

It is obvious that exposure to disasters is climbing as a result of environment deterioration. The impacts of these disasters cannot be reduced without addressing the underlying obvious causes which are poverty and population density. Making matters worse in developing countries, construction activities seldom adhere to safety and prevention regulations when these exist, resulting in human settlements in areas exposed to earthquakes, landslides, volcano eruptions, floods, droughts and other phenomena.

It is an established fact that poverty and disasters feed off each other.

### **3. Major Disasters Affecting Islamic States**

Following is a detailed account of the major disasters that took place in Islamic countries:

#### **3.1 Indonesia**

Largest Islamic country, Indonesia is more affected than any other country by terrible earthquakes, calamitous tsunamis and frightening volcanoes and such disasters that destroy life, economy and the environment. Examples of these disasters include:

- **The December 2004 earthquake** (ML: 9.3) was one of the most violent earthquakes ever experienced by humanity. It was subsequently followed by a tsunami that left thousands dead and untold damage in 12 countries across the Indian Ocean. In Indonesia alone, the earthquake of west Sumatra left 170 000 dead people, hundreds of thousands of wounded and millions of homeless people.
- **The earthquake of southwest Java** (ML: 7.7) followed by a Tsunami that killed 5400 people, injured 2000 others and left hundreds of thousands of homeless people on the southwest coasts of Java, destroying in the process 80% of the houses in Bantul and Yogyakarta.
- **The Marabi volcano:** the Papua earthquake (ML: 6.2) triggered the dormant Marabi volcano. Burning gas emissions began late in June 2009, heralding an immense eruption. The threat resulted in the evacuation of tens of thousands of people with eruption remaining a direct threat to more than one million people. Currently, there are a number of other active volcanoes such as Dempo, Karakatoa and Symiroa.
- **Wildfires:** In the past few years, the frequency of forest fires has increased in Indonesia exponentially with the El Nino phenomenon. The year 1997-1998 represented a peak period for these fires which destroyed 9 billion dollars' worth of tourism revenue alone. This situation speeded up the conclusion in 2002 of a Convention on reduction of Trans-boundary Air Pollution resulting from forest fires in Southeast Asia.

### 3.2 Bangladesh

Floods are the major risk to Bangladesh, given that the fact that this country is a great Delta where the Ganges and the Brahmaputra, two of the world's largest rivers, meet. Highlands in the country do not exceed 8% of its entire surface area. When the two rivers flood, it usually coincides with high tide when the level of seawater rises and floods lands sometimes as far as 400 kilometers inland. At such times, Bangladesh becomes a vast water-covered valley, knowing that the country's south, most exposed to floods, is known for agriculture, farming and fish cultures.

This is exactly what happened in 1970 when floods killed 500 000 people, and in 1974 when floods devastated one third of the country, bringing famine and diseases. The 1991 floods killed 138 000 persons and hurricanes almost regularly batter this poor and vulnerable country engaged in a battle against natural elements. Some of these storms include:

- **Sidr** (2007), which killed 330 people with another 800 gone missing, wounded thousands people, affected 8.7 million people and caused 1.5 billion dollars in damage.
- **Aila** (2007), which killed 81, predominantly children, left 430 000 people homeless and caused 1.33 billion dollars in damage.
- **Nargis** (2007), which killed 138 000 people in Bangladesh and in Myanmar.

Compounding the situation is the fertile soil erosion caused by recurrent floods and which threatens the future of the entire country.

### 3.3 Pakistan

Pakistan is at risk of earthquakes. Previous events include:

- The earthquake which struck the Northern provinces (Kashmir) on 8 October 2005 (ML: 7.6) killing 74 000 people and leaving 3.5 million homeless.
- The earthquake of Southwest Pakistan (Baluchistan, ML: 6.4), killing 215 people and utterly devastating entire villages in the region. The earthquake left thousands homeless and destroyed thousands of houses and hundreds of schools.

Pakistan is also not safe from monsoon floods.

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### 4.3 Iran

The earthquake of Bam, an ancient city in southeast Iran (December 2003, ML: 6.3) killed 41,000 people, injured 30,000 people, left 100,000 homeless and destroyed 70% of the town's buildings. Less than a year later, another earthquake struck the province of Kerman in southeast Iran (ML: 6.4). Given the depth of its epicenter (42km), this earthquake killed only 40 people and wounded 900 others. During the 20<sup>th</sup> century, earthquakes cost their lives to 170,000 people and the Bam one was only one in a long series of earthquakes that target one of world's most seismically active countries. Iran is in fact situated on the fault line of many tectonic plates that shift rapidly, particularly the continental collision of Eurasia in the north and the Arab Peninsula in the South. Iran is also affected by floods in its southwestern and northern provinces.

### 3.5 Turkey

**The earthquake of Izmet** on the Marmara coast (August 1999, ML: 7.8) was one of the most devastating earthquakes of the last decade of the 20th century. The shock killed 12,000 people and injured 27,000 others, causing massive damage within a 200 kilometers radius from the epicenter. During the last 60 years, 10 major earthquakes occurred on the same fault line which crosses Izmet as it moves from east to west, placing Istanbul at the heart of the earthquake risk zone.

Turkey also experiences floods and mudslides as well as forest fires which inflict huge financial and environmental losses every year.

### 3.6 North Africa (south of the Mediterranean)

- **Morocco:** The Al Hoceima earthquake (February 2004, ML: 6.3) was the most recent of a long series of earthquakes experienced by the region. It killed 628 people, wounded 9269 others and left 15,230 homeless. In February 1960, the city of Agadir was hit by a devastating earthquake (ML: 8.5) which killed 12 000 people and injured another 25,000.

Morocco equally experiences a fair share of floods (Mohammedia 2002), drought, desertification and forest fires (3500 hectares every year).

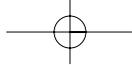
- **Algeria:** The Zemmouri earthquake (May 2003, ML: 8.6), Chinwa Tibasa (October 1989, ML: 6.0), and Chelf (October 1980, ML: 4.7)

The Zemmouri earthquake alone caused the death of 2162 people, injured 8965 and left tens of thousands homeless.

Algeria also experiences devastating floods (Algiers and Gherdaya), forest fires, drought spells and water scarcity.

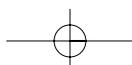
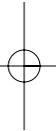
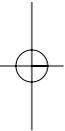
- **Tunisia:** Although Tunisia is exposed to the same type of hazards as Morocco and Algeria, its seismicity remains lower than both countries. The Tunis earthquake (December 1970, ML:5.4) wrought havoc with many buildings and caused many injuries. According to a report of the 'Health and Environment Association' on 'Floods, Environment and Health' (January 2004), floods are a recurrent event in Tunisia, killing many people and leaving thousands homeless. These floods affect mainly the north and east of the country.

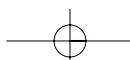
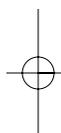
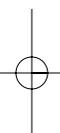
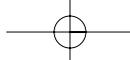
- **Libya:** is not totally safe from the risk of earthquakes but its seismicity is much lower than that of Tunisia.



### 3.7 Sahel Countries

The drought which affected the Sahel countries in Africa from Somalia to Senegal, down to Mauritania, Mali, Burkina Faso, Niger, north Nigeria, Chad, the Sudan and Djibouti in the sixties lasted several decades and left behind 100,000 casualties and a much larger number of displaced people. Timothy Shanahan (2009) believes that drought spells will last several decades and that the rise in temperature which results from the current climate change will place this region, West Africa, at the mercy of droughts in the near future. Droughts exacerbate the humanitarian crises experienced in Somalia where 19,000,000 people are now threatened by starvation.





## Chapter II

# Strategic Elements for Natural and Environmental Disaster Prevention Indicators, Measures and Monitoring

### 1. Introduction :

As it is the case with military defense, civil defense or protection resorts to a set of measures to mitigate the 'assaults' that take the form of geological disasters such as earthquakes, volcanoes and tsunamis, hydro-climatic disasters such as hurricanes and floods, and environmental or technological disasters such as droughts, fires, dangerous air and soil pollution and climate change with its severe repercussions.

Conscious that natural disasters cause calamitous loss of life and property, derail the march of development and disrupt various human activities and social security, what are the means to prevent these dangers or at least mitigate their repercussions? What strategy can make this a reality?

### 2. Elements of the Strategy

The strategy for the disaster reduction and risk management relies on the following:

- Continuous improvement of risk assessments by strengthening surveillance systems, and most importantly setting up or developing early warning networks.
- Preparing for risk reduction and taking the necessary steps to decrease vulnerability in general and ensure better risk management.
- Rapid intervention and relief in case of emergency and improving their means and tools.
- Restoration, reconstruction and eradicating all forms of vulnerability.

Managing disasters is a chain of interconnected phases.

- Monitoring and surveillance is an ongoing process and is not an independent loop of this chain.
- Prevention and preparedness are stages that precede the disaster and therefore run on a semi-continuous basis in the mid and long terms. They are integrated within sustainable development programs.
- Rapid intervention and relief only come into play after the disaster strikes. Their effectiveness is therefore conditional upon the state of alertness and other preventive activities, although they remain an emergency measure that is run within a given timeframe.

These various stages are addressed in more detail in the Following:

### 3. Monitoring and Observation: Indicators and Measures

Monitoring and observation networks use telecommunications and information technologies, remote sensing, geographical information systems (GIS), modeling, digital simulation and early warning systems which are crucial for identification and analysis of disaster phenomena. They

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require scientific and technical human resources that are highly qualified in monitoring, projection, data analysis and the publication of results. They also require cooperation with experts in disaster prevention and relief to reduce impacts of hazards, and with decision makers and citizens in general.

Monitoring relies on providing the data and information necessary to identify and assess the impact of natural, environmental and technological disasters.

Surveillance (S) is the result of the interaction between observation (O), whether on site or through remote sensing, and forecasting models (M).

$$M \times O = S$$

Observation and surveillance are closely associated with scientific and technical research to guarantee a good cataloguing of disastrous manifestations in time and space, improve the performance of monitoring, observation and early warning networks, and enhance understanding of the devastating impacts of disasters to better prevent them. Scientific research thus remains the cornerstone of long term projections. Simulation and data analysis through statistical and predetermined methods are essential for projections. Monitoring methods differ from one disaster to another but the goal remains the same, to record the event and its characteristics and assess its impact and implications. Monitoring also relies on early warning when it is possible. Whatever the case, a good risk assessment is the first and most crucial step in a good risk management strategy.

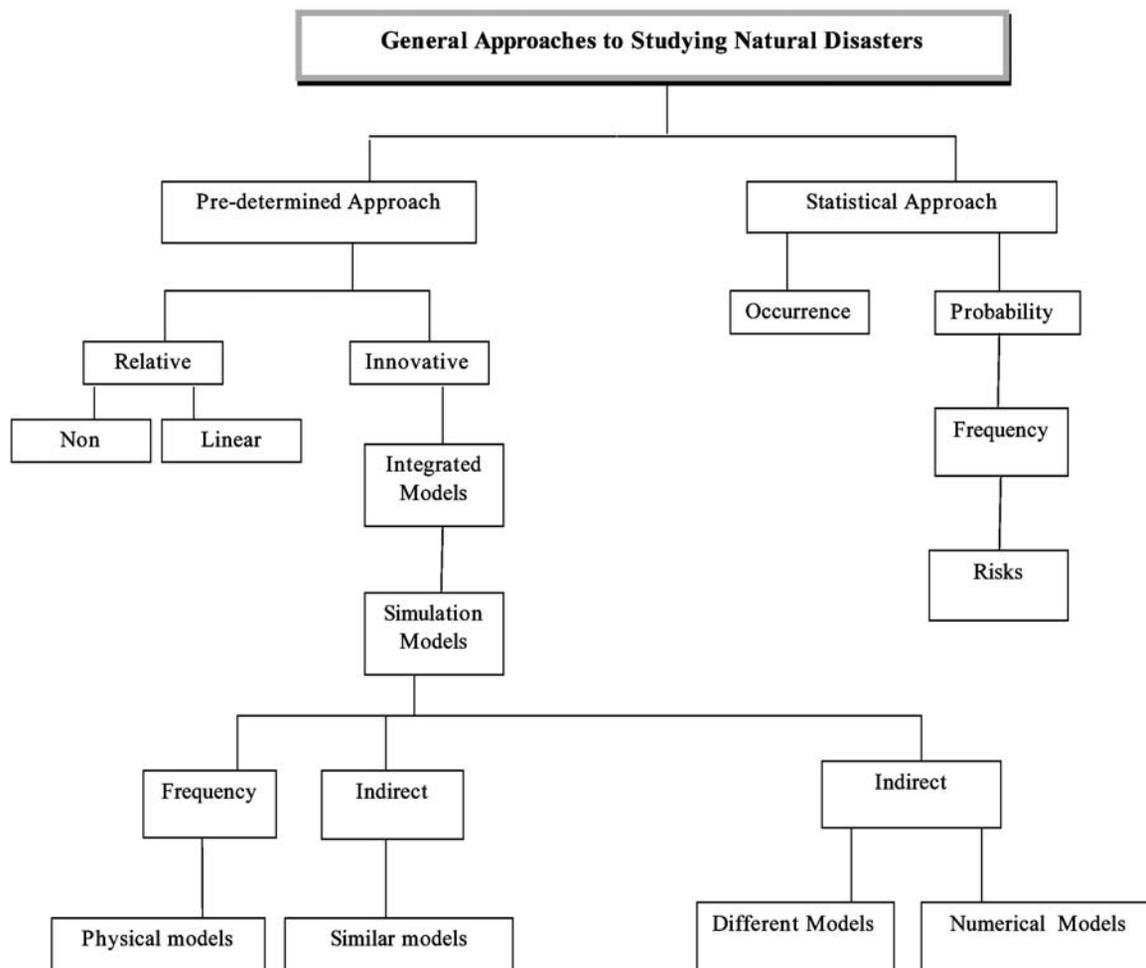
### 3.1 Earthquake Monitoring Network and Global Positioning System (GPS)

Modern earthquake monitoring systems provide a quasi instant monitoring of seismic activity. They operate with sensing equipment to record vibrational waves in severe earthquakes. As data are digitally recorded, it is possible to process and publish them almost in real-time. Seismic monitoring networks have been consolidated with global positioning systems which, thanks to their infinite precision, provide many advantages and applications in geodynamics, geodesics and in monitoring global changes such as climate change. Obtaining such accuracy and precision requires fine-tuning the mechanical and environmental interferences that affect these measures, as well as the effect of tidal variations and orbital changes of satellites before processing the signals captured.

Tsunami early warning systems are made up of seismic stations and equipment monitoring tidal movements as well as a highly effective communication system. Such early warning system is in operation around the Indian Pacific and makes it possible to reduce life loss and material damage by warning coastal settlements sometimes a few hours before the 'water wall' crashes onto the coast destroying everything on its path. If such system had existed around the Indian Ocean before the Indonesia earthquake (24 December 2004) and the ensuing tsunami, that catastrophe would not have been so terribly devastating.

The Sumatra catastrophe prompted the setting up of an early warning network around the Indian Ocean. Similar networks for the Atlantic Ocean and the Mediterranean Sea are expected.

As for volcanoes, many earthquakes and volcanic eruptions are connected in some tectonic formations, particularly in the depths of the sea (cases of plate convergence). This applies for example to the Marabi volcano in Indonesia, 'awakened' by the Papua earthquake. In addition to the local seismic monitoring station, the early warning system is made up of facilities for the observation and analysis of volcanic emissions to predict possible eruptions and warn and evacuate inhabitants before the eruption.



### 3.2 Hydro-climatic Monitoring Network – Hydrological Monitoring

Meteorology networks play a major role in monitoring and forecasting weather conditions in the short and medium terms. This role is supported by local hydrological observation systems. The aim is to identify risk factors and monitor their course for early warning purposes. Monitoring resorts to a system (monitoring and exploring tools and models) that forecasts the occurrence of hydro-climatic disasters, from short-term but violent geographically limited events such as cyclones, to large scale phenomena such as drought, desertification and El Nino.

Meteorological stations constantly measure temperatures (all types), humidity, evaporation, air pressure, solar radiation and wind speed. In meteorology, monitoring and early warning systems have reached an advanced level of sophistication and reliability. Further efforts are however needed to:

- Create regional networks of databases and information systems.
- Provide a more accurate definition of the vulnerability of ecosystems and housing agglomerations.
- Develop and use an environmental data information system.
- Conduct more in-depth scientific and technical studies.

### 3.3 Satellite Monitoring – Remote Sensing

The action of land-based monitoring networks is consolidated with environment monitoring through remote sensing from space. Remote sensing opened the door before immeasurable progress in space science and sciences in general, including socio-economic applications in agriculture, forests, population, health...

Remote sensing is used to monitor global phenomena at the international and regional levels as well as on the national and local ones. Satellite monitoring plays an important and complementary role for measures taken on site by seismic, meteorological, geophysical, oceanic, environmental monitoring stations and others

Remote monitoring also helps to evaluate and measure major factors, sensing and other operations that are part of the risk evaluation process. As a result, it has become possible to identify priority intervention areas. Through the free exchange of data, remote sensing helps to reinforce protection and relief, improve environment quality and promote the sustainable development of countries.

International cooperation in this regard is highly fruitful and indispensable.

### Chapter III

## Preventive Measures against Impacts of all Disaster Categories

### 1. Definition of a Prevention Strategy

The fundamental objective of any disaster management strategy, whether it is natural or man-made or the result of climate change repercussions, is to effectively limit the number of victims, mitigate the material and financial losses resulting from these disasters, and the part these disasters play as major vulnerability causes (be it collective or individual) and their impact on the social and economic circumstances of the population in distress.

The strategy is based on preventive measures that kick in before a probable disaster strikes.

### 2- Principles and Objectives of Prevention

Acquiring higher scientific and technical expertise enables mankind to be better equipped to predict not only the place but also the time when some category of disaster would probably strike. Needless to say, some of these natural events are beyond Man's power and will.

However, Man can reduce the impact of some of these disasters by improving preventive actions (preparedness) against probable disasters. In other words, if a disaster is unavoidable, its impact can at least be mitigated by putting in place warning systems and emergency plans in the areas most at risk in order to save the largest number of lives and sensibly diminish material damage.

An appropriate approach to matters of construction, land use, risk analysis, training and education programs and sensitization, is likely to guarantee effective and sustainable protection against natural disasters. On the other hand, prediction and pre-planning should be part and parcel of development and planning policies. The protection of environment, combined with sustainable development, is a fundamental element in prevention and reduction of disaster impacts on environment in particular.

### 3-Prevention functions

Prevention remains the ideal tool in mitigating the impact of any type of disaster. Risk (R) is the result of the interaction of disaster (A) with vulnerability (V).

$$R = A \times V$$

The mitigation of damage lies in ability to curb one of the V or A factors, or both at the same time. This task lies with the 'Monitoring, Alertness and Precaution Centers', an instrument for information management and exchange for mapping risks at various scales. In the case of earthquakes, prevention involves technical and organizational measures such as drawing up or updating laws on seismic construction in new buildings, reinforcing infrastructure such as dams, roads and bridges, and other essential pipelines such as potable water pipes, drainage networks, power supply means and transport, all for the sake of limiting the terrible impacts of disasters.

Prevention revolves around two axes: early warning systems and preparedness (or alertness).

## 4. Early Warning Systems

Early warning systems are about monitoring, observing and predicting catastrophic phenomena, whether these have geological, hydro-climatic or environmental origins (droughts, desertification, fires, locusts and other pests' invasions, ravagers attacking crops...).

Early warning systems differ from one type of disaster to another:

### 4.1 Geological catastrophes:

In the absence of short term predictions of the time and location of earthquakes, the early warning system remains more practical and useful for volcanoes. The local seismological network and volcano monitoring network make it possible to predict explosions and dangerous flows, thus the population is warned in advance and evacuated away from the risk areas.

Global positioning Systems is opening promising avenues. GPS-supported regular measures taken over a ten-year period make it possible to observe and identify movements and minute deformations in areas of seismic activity, the aim being the ability to pinpoint in time the point of 'release' that causes earthquakes. GPS makes it possible to identify areas with the highest probability of earthquakes by monitoring the pressures that build up in these areas, without being able at present determine the exact time when the earthquake might hit.

In the near future, GPS recordings in zones of seismic activity may be used as an early warning tool.

For tsunamis, the warning system is made up of seismological stations, equipment monitoring tide movements and a telecommunications network.

This system issues warnings about the arrival of giant waves to coastal areas within tens of minutes to a few hours depending on the distance between the epicenter of the seaquake behind the tsunami and the coasts.

The early warning system is effective and has been in operation in the Pacific Ocean for many years. A similar network was set up in the Indian Ocean after the December 2004 disaster. As for the Atlantic Ocean, and although it is not as highly at risk as the Pacific or Indian ones, it is still not equipped with such a system despite the risk, albeit low, of tsunamis west of the eastern coasts of the Atlantic Ocean coast between the Azores Islands and Gibraltar. This same situation prevails in the Mediterranean Sea which has witnessed several destructive tsunamis through history.

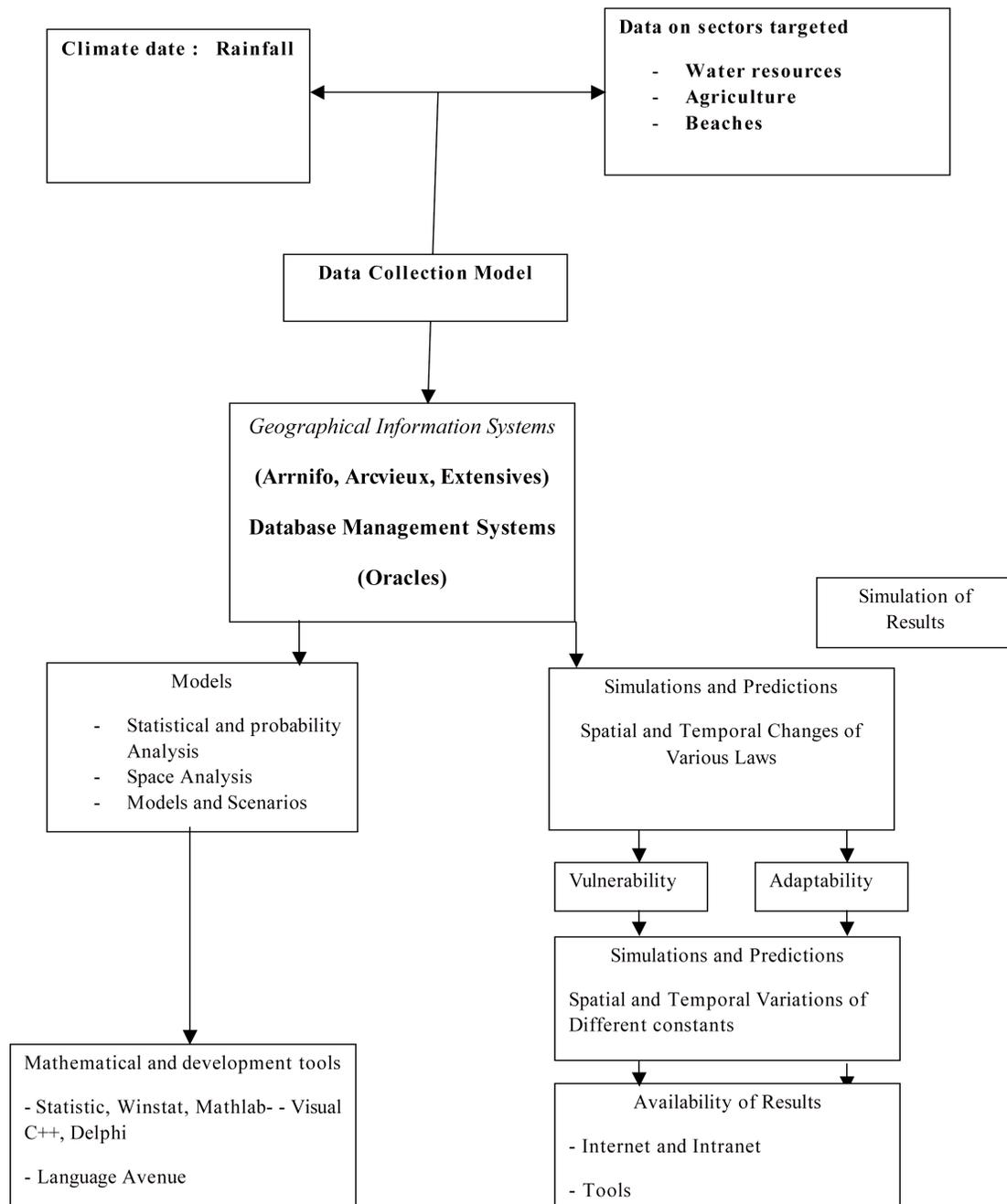
### 4.2 Hydro-climatic Disasters

Extreme weather events in various climate types differ in their forecasting times. These time frames vary from a few minutes for sand storms to many years for the El Nino phenomenon, and in between a few months for predicting cyclical or tropical weather, and a few days for cyclones (mid-term weather forecast). There are various time scales for predicting extreme weather conditions in various climates. Even for these phenomena, warning systems differ. There are new mechanisms that help predict these phenomena such as the models used in weather forecasts. Thanks to these, it has become possible to predict a few days early the occurrence of a killer hurricane for example, which facilitates rescue operations and the evacuation of people to unaffected or less affected convergence areas. It is also possible to predict the speed at which a hurricane builds up, the strength, speed and direction of its winds, thus giving the authorities enough time to warn populations.

Modeling is used in the case of floods. Simulating the flow of rivers takes into consideration hydrological and aquatic patterns as well as the pattern of water basins.

Simulated models predict in real time floods in areas using three data sources: geographical information system, local numerical simulations and space monitoring data, as detailed in the chart.

It is necessary to predict the overflows of rivers and monitor those using specific forecasting tools and following up on rainfall movements with radars playing a primary role in the monitoring process. Forecasting and monitoring rely on the physical description of the site or region to be studied, determining the positioning of the hydro-climatic instruments part of the monitoring system and which usually includes a land rainfall measuring network, a river level measuring network, meteorological stations, stations monitoring static activity in clouds, and a hydrological radar to measure rainfall. This last tool is the most important field instrument in issuing warnings and an early alert about heavy rainfalls a few hours before they occur.



Behind crisis management, there are two logics that depend on the expected level of rainfall and which determine and organize the warning:

- The logic of the permanent network of average rainfall
- The logic of managing river overflows in heavy or unusual rainfall.

This presupposes developing and consolidating the process of early warning and makes its continuous operation a matter of necessity.

This process combining vulnerability assessment with the response to warning is one of the preventive measures. It relates to developing and using data and to placing it at the disposal of decision makers to ensure the implementation of local authority decisions benefitting the population.

## 5. Preparedness and Alertness

Preparedness involves a series of short and long terms measures to promptly react to disaster when it occurs. Their prime goal is to save lives and control material damages. Among the measures that preparedness is based on is training, information and sensitization of the population. Civilian protection, on the other hand, operates by making emergency intervention plans: a master plan and specific plans for every category of catastrophe.

Preparedness involves the entire population and aims to achieve:

- The recognition, awareness and understanding by citizens of these dangers.
- A national action plan to redress and develop tools, qualified human resources and training, as well as preparation of the necessary sensitization tools to hand out to local communities.
- Regional action plans to coordinate activities and guarantee the safety of citizens within their specific situation.

In frequent rescue simulation exercises and higher level of preparedness lies the strength of rescue teams and volunteers to fight weaknesses, panic and confusion.

Thus, emergency services, medical and social facilities and rescue bodies play a crucial role as the team ready to face any disaster.

Creating a warning system remains the most effective and practical method to ensure preparedness and convey at the right moment vital and accurate information to the population at risk (a reliable early warning system in the case of danger). Early warning is the strong link between preparedness, prevention and monitoring.

The upgrading and regular review of the state of preparedness while focusing on the most vulnerable human groups is a matter of crucial importance.

Instruments that need to be activated include good knowledge of the nature of risks faced by a given party, determining the response then preplanning, integrating the risks and their impacts into the developmental schemes at decision-making levels, mobilizing public authorities at all intervention levels as well as watch authorities, armed forces and rescue services.

Special education, training, sensitization and communication programs are necessary to ensure cognizance of how emergency services work through information dissemination and issuing warnings. No disaster prevention or management policy can be successful unless it is fully accepted and understood by the civil society. This being the case, school education and training at various levels and for diverse categories of professionals and volunteers play a beneficial role, as does sensitization and preventive information, in enabling all social categories to benefit from advice and technical information through the radio, cds, internet and mosques, and to muster a

firm and effective response to disasters. Furthermore, prevention, preparedness and risk management requires the devising of an information, education and communication strategy which we will address in further details at a later stage.

The UN system has early warning capacities and endeavors to improve the system and ensure better coordination for an optimal response and the reduction of natural disasters and other catastrophes that cause loss of life, property and environment.

## 6. Information, Education and Communication

In view of the crucial importance of prevention and risk management-gearred information, education and training, following are the broad lines of what a strategy of this nature should contain:

### 6.1 Objectives

To establish environmental ethics on the basis of Quranic ruling concerning environmental responsibility and interplay between development and environment. Among the balances to preserve are the balance between the utilization and management of natural resources, and the protection of environment in fiqh rules and Shariah principles.

- To integrate the environmental dimension as a basic component in economic and social development.
- To introduce environmental culture in education and training programs.
- To develop partnerships with non-governmental organizations.

### 6.2 Methodology

- Developing coordination and partnerships in environmental sensitization and communication and raising awareness about social intermediaries.
- Providing reliable and timely information to inform decision-making.
- Integrating environmental education in primary and secondary school curricula.
- Devising mechanisms for cooperation with NGOs and promoting the activities of associations.

### 6.3 Targeted Population

- Role-players from the media sector, counselors, speakers, teachers, training experts and non-governmental organizations.
- Priority beneficiaries such as children and women, elects and economic partners, decision-makers and non NGOs.

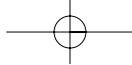
### 6.4 Channels and Media

- At the national level: the television and radio and other audio-visual media and pamphlets, conferences and symposia, cds.
- At the community level: mosques, market places and festivals.

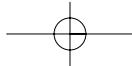
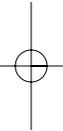
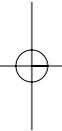
## 7. Protection and Relief

This process is based on protection and risk reduction and at the same time on rehabilitation, construction and reinforcing the necessary infrastructures to reduce disaster impact (dams, barriers, canals, bridges) and other networks that are essential for people wellbeing and safety (drinking

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water network, sanitation, energy, communication). Mobilizing the appropriate human and material resources, raising public awareness through sensitization activities, education and training, strengthening self-protection mechanisms (volunteering), preparedness for possible disasters, warning and evacuation drills, disaster scenarios, special organizational schemes, are all among the best protection means.



## Chapter IV

# Climate Change: Impacts and Implications

## 1. Introduction

Climate change has taken centre stage in the world's preoccupations. Its impacts are sometimes disastrous both for social and economic activities and for water resources, forestry, cattle farming, maritime fishing and, mostly, biodiversity.

Considering the magnitude of this problem, the international scientific community came together to conduct several activities, programmes and initiatives in the study of climate change and its overall impacts. One of these scientific and technical mechanisms is the Intergovernmental Panel on Climate Change (IPCC) in charge of identifying scientific and technical means to gain control over all global aspects of climate change.

As stated before, the roots of these climate changes are either natural or related to human activities.

## 2. Climate Change Caused by Nature

Climate is the fruit of a complex interaction process between a number of data and variables such as the atmosphere, oceans, the ozone layer, ice (inland and at sea) and the earth's surface. The complexity lies in the fact that the interactions between all these elements are non-linear.

Solar radiation stands behind these climate phenomena. The climate has and will always continue to experience natural changes caused by:

- Solar activity and movements.
- Plate formation, earthquakes and volcanic eruptions.
- The atmosphere's chemical composition.
- The astronomical theory of Paleoclimates and variations in the earth's orbital movement.

With regard to the last factor, slight variations in the earth's orbit and the resulting solar energy fluctuations result in climate changes that may disrupt the balance of biological and biogeochemical cycles. The latter may in turn result in changes in the quantity of carbon dioxide released into the atmosphere. In counteraction, all these changes exacerbate primary climate change. At the same time, natural elements of solar or volcanic activity may change the radiative forcing which becomes negative (inducing low temperatures) when too much energy is outgoing. If the energy reaching the earth is the only factor that is subject to change, astronomical predictions indicate that we may be heading towards another ice age with a cooling rate that could reach 0.01 C a century over the next sixty thousand years.

## 3. Man-made Climate Change

Man's activities are closer to a dangerous geophysical experiment on planet earth and hold the potential of substantially changing the earth's climate.

The industrial society weighs heavily on the environment with direct impacts (waste accumulation, forest destruction, isolated cases of pollution) and other more insidious effects that run on the long

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term such as a growing greenhouse effect or a thinning ozone layer. The assessment of the impact's extent is still a matter of debate, yet it is certain that the environment is being directly affected and modified by human activities that are detrimental to air quality and to biodiversity. This in turn has an overall impact on climate and on the entire atmosphere.

Greenhouse gas emissions accumulate in the air, with the most important of these being in decreasing order:

- Carbon dioxide (CO<sub>2</sub>), accounting for 61% of all emissions.
- Methane (CH<sub>4</sub>), representing 15%.
- Chlorofluorocarbons (CFC) and Freon, representing 11%.
- Nitrogen Dioxide (NO<sub>2</sub>), approximating 4%.
- Sulfuric fluoride (SF<sub>6</sub>) and fluorocarbon.

The atmosphere is similar to an air-conditioned glasshouse which allows sun rays through and traps heat inside, although it is this greenhouse effect that accounts for life on earth as it makes temperature rise from -18 C to +15 C.

The concern arises when large quantities of greenhouse gases accumulate as was observed over the last years. Currently, forty thousand tons of carbon dioxide gases are flowing into the air every minute. In its 1998 annual report, the World Water Foundation (WWF) warns that should the situation remain as it is, the quantity of gas floating to the atmosphere will double by 2070 compared with its levels before the era of industrialization (1850).

Deforestation only increases the volume of carbon dioxide released in the air, but fossil fuels consumption remains the number one culprit behind this situation and not the industrial combustibles released into air.

The road transport sector is high on the factor list and accounts for 38% of the above-mentioned increase. Industry produces an annual 27% per person of carbon dioxide, the tertiary sector and construction account for 26%, agriculture for 5.7% and electricity generation for 1.5%.

Globally, the increase of gas emissions leads to the warming up of the earth and the space. These higher temperatures induce a melting of the arctic rivers and glaciers and higher sea levels, impacting negatively on climate in the long run and providing evidence of global warming and its repercussions.

In the carbon dioxide emission classification, the United States stands out with 40% of all emissions per year. As for the per capita classification, the United Arab Emirates ranks first with 40 tons of CO<sub>2</sub> generated per capita (according to the WWF).

The greenhouse effect is therefore a crucial element in assessing the earth's energy input. Any change in this course may have a substantial effect on all climate elements: average temperatures, disruptions in temperature distribution according to longitude and latitude, seasons, rain cycles, evaporation, wind strength and speed...

On another level, the particulate matter floating in the lower levels of the atmosphere (0 to 10 kms), the result of fossil combustion and biological masses, cause what is known as negative forcing.

Although there is a concentration of negative forcing in some areas and continental regions, the said particular matter may in fact influence climate factors on a larger scale.

On a local level, negative forcing is more important than the positive one which results from the greenhouse effect gases. However, unlike these gases, particulate matter has a very short lifespan in the atmosphere.

Although some doubts continue to persist, especially with regard to impact on the local and regional levels, these changes and this development are evidence of man's hegemony over the climate.

A lot of progress has been achieved in understanding this phenomenon thanks to the efforts of the Intergovernmental Panel on Climate Change (IPCC).

#### 4. IPCC Action and the UN Framework Convention on Climate Change

The World Meteorological Organization (WMO) has played an important part in clarifying the hotly debated question of climate change by creating the Intergovernmental Panel on Climate Change (IPCC) in 1988 with the United Nations Environment Program (UNEP). The Panel was tasked with evaluating existing data on climate change and its ecological and socio-economic effects, and devising strategies to reduce these risks. The Panel has so far produced four reports (1990, 1995, 2001 and 2007).

The first report (1990) stated that the unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more.

The second report (1995) stated that the balance of evidence suggests that there is a discernible human influence on global climate.

The third report (2001) confirmed the existence of indisputable evidence that the global warming observed over the past fifty years is attributed to human activities.

The fourth report (2007) noted that most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. The report confirms that the atmospheric concentration of GHGs has tremendously increased since the beginning of the industrial era. The report states that eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature with a 100-year linear trend (1906-2005) of 0.74 (+1.18!C). In other words, the linear warming trend over the 50 years is nearly twice that for the 100 years from 1906 to 2005 and has specific significance for different parts of the world. Temperatures increased in some parts (southeast of North America and in Latin America) and decreased in other regions (Mediterranean Sea, South African and South Asia). The incidence of extreme weather conditions such as torrential rains, floods and drought has also increased.

According to projections for 2100, it is expected that temperature increases will continue with more frequent heat waves and less extreme cold spells, as well as increased global evaporation and rainfall with region-specific variations in the form of increases or drops. According to projection scenarios, sea levels are expected to increase by 19 to 58 centimeters causing the flooding of entire lowland coasts in such countries as Bangladesh.

Climate change-induced diseases (respiratory and cardiac irregularities, allergies, malnutrition) will aggravate.

Projections contained in the 4th report are far from reassuring as they predict a temperature increase ranging between 1.1 and 4.6 C by 2100, with more frequent heat waves, diminished rainfall in subtropical regions and the opposite effect in high altitudes. This is confirmed by the climatic pattern linking the atmosphere and the oceans and which shows that global temperatures increase by 2.5 C when carbon dioxide emissions double in volume.

#### 5. Climate Change-Induced Damage

While some regions are more affected than others by natural disasters, the latter remain universal phenomena that affect all parts of the world at varying degrees, hence the absence of geopolitical boundaries standing in their way.

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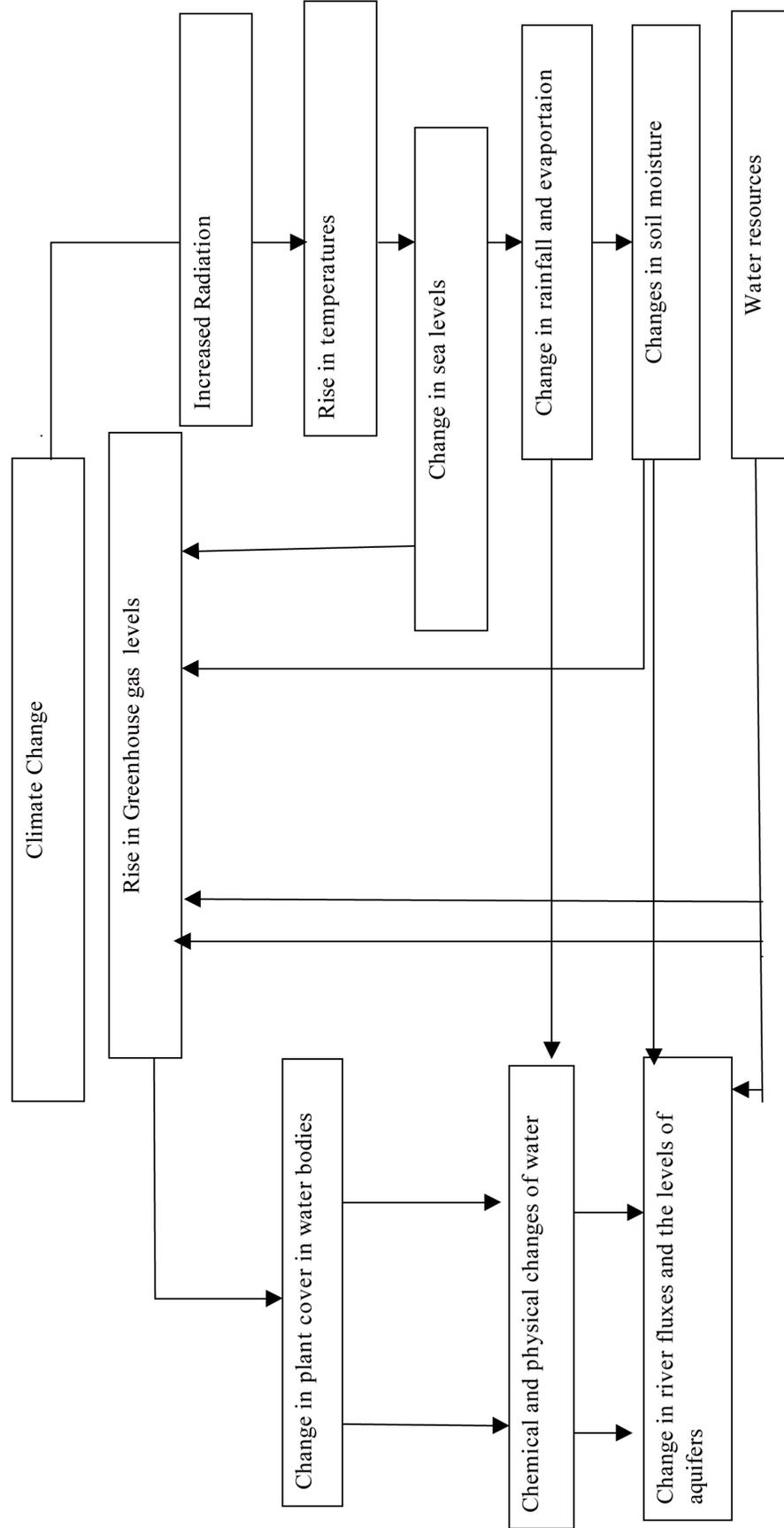
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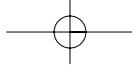
- Damage caused by natural disasters is steadily aggravating, particularly in developing countries in view of the following:
- Demographic growth and population density in cities.
- Degrees of assault on environment and the changes caused thereto.
- Damage caused to houses and public buildings.
- Non-compliance with safety standards in building.
- Vulnerability of basic infrastructure and communication and their susceptibility to hazards
- Settlement in high-risk zones such as flood-risk river valleys and fertile areas covered with volcanic matter.

Climate changes affect the " **Rcarbon cycle** " and another more sensitive climate element, namely the " **Rhydrological cycle** ". The hydrological cycle is crucial for energy distribution and vital for ecological orders and mankind (continuous flow of fresh water across the continents). Changes in water volumes and distribution directly affect the satisfaction of household and industrial needs, irrigation and power generation requirements. The only tool likely to provide a simulation of the climate system in terms of quantity in the past, present and future would be through digital climate modeling.

### Impact of Climate Change on the Hydrological Cycle

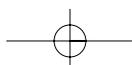
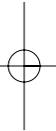
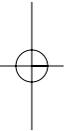
Sources: IPCC/SAR (1995)





This “disruption” of the hydrological cycle, caused by climate changes, results in:

- Heat waves, storms and floods that have killed and continue to kill large numbers of people and harm even larger numbers. For example, the heat wave which hit Europe in 2003 resulted in the death of 35000 persons, while the 1998 floods in China caused material losses affecting 250 million people.
- Fluctuations in rainfall patterns, higher sea levels and other stress factors that affect climate and cause food and drinking water shortages in many parts of the world. They also trigger huge human migratory waves and the marginalization and impoverishment of millions. The rise in sea levels is likely to result in coastal flooding that may in turn create 100 million ecological migrants.
- In this regard, the fourth report of the Intergovernmental Panel on Climate Change predicts that by 2080, between 200 and 600 million people will be at risk of famine, and that between 1.1 and 3.7 billion people will suffer from water scarcity. At the same time, 7 million homes will be at risk of floods as a result of global warming.
- Tropical diseases will spread under the effect of global warming and will cost their lives to many. According to the World Health Organization (WHO), by 2000, climate change-related deaths have exceeded 150 000 per annum.



## Chapter V

# Greenhouse Effect Reduction or Prevention Measures

### 1. Introduction :

The successive studies carried out by the Intergovernmental Panel on Climate Change (four SAR) have shown that human activity is the main cause behind the climate changes we are experiencing today. Huge amounts of GHGs are released into the atmosphere, with carbon dioxide topping the list of these gases and accounting for 60% of this greenhouse effect. The damaging effects of climate change we are experiencing and the more frequent environmental disasters place the entire humanity in grave danger.

### 2. Characteristics of Climate Change Impacts

Some of the characteristics of climate change impacts are:

- 2.1 Activities that generate greenhouse gases** are increasingly responsible for climate change (direct or indirect energy consumption).
- 2.2 The problem of climate change is of a global nature** and therefore requires global solutions.
- 3.2 The difficulty of providing accurate, precise** and detailed data on the impacts of climate change, knowing that future generations will be the ones to suffer the full negative impact of global climate change.
- 2.4 The widening the gap between the wealthy** (emitters of greenhouse effect gases) and those who incur the repercussions of this phenomena. This equation raises the question of climate change ethics.
- 2.5 The escalating vulnerability of the prejudiced parties**, aggravated by local factors such as haphazard settlements in risk areas, real estate speculation, the impact of galloping demographics, the tremendous pressures on ecosystems and natural resources, dwindling crops and biodiversity and the inexorable deterioration of plant cover.

### 3. Proposed Solutions and Preventive Measures

Faced by the universality of climate change, the international community has mobilized to find collective solutions and save humanity from this dilemma, particularly after it was scientifically proven that GHGs such as carbon dioxide are responsible for climate change. Chief among those solutions is the **Kyoto Protocol**.

The proposed climate governance is founded on three major conventions:

- 3.1 The UN Framework Convention on Climate Change** which was put forth for adoption in 1992, came into effect in 1994 and was ratified by 198 countries including the United States of America and Australia.
- 3.2 The Kyoto Protocol** which followed from this Convention was adopted in 1997 and came into effect in 2005. The protocol was ratified by 172 countries and has so far not been ratified by the United States of America.

### 3.3 The Global Greens Charter

adopted by some green parties in the world, including US political parties where the signatory parties pledge to carry specific activities benefiting the environment.

The objective of the signatory parties to the Convention on Climate Change is to limit GHGs emissions to quantities that make impossible dangerous human disruptions of the climate system.

Signatories pledged to take pre-emptive or protective measures to predict, prevent or reduce the factors behind climate change and practically limit its negative effect. Countries are requested to announce the volume of their greenhouse gas emissions and draw up and implement national programmes with tangible activities aimed at reducing climate change impacts.

The Kyoto Protocol goes even further and draws up a timetable for the reduction of the greenhouse gas emissions behind global warming in the last 50 years. 38 industrialized countries undertook to reduce by 5.2% their emission levels by 2012 against 1990 levels.

Every year, UN climate change summits are held to discuss the executive mechanisms of the Kyoto Protocol, the licenses negotiated, clean development and the respect of the Kyoto commitments.

At all events, and since the spread of carbon dioxide is largely responsible for warming, it is only normal that every measure would be taken to limit its emissions. Trapping carbon dioxide through natural means (forestation) or technological ones is an ideal way to limit its rise.

## 4. Forestation

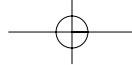
One of the solutions and preventive measures proposed to reduce the impact of Greenhouse gas emissions is forestation which plays a vital role in trapping carbon dioxide. Photosynthesis through ground and aquatic plants, and in the long run, industrial photosynthesis, should serve as a foundation of all acceptable carbon dioxide absorption from the atmosphere.

Since climate change affects large surface areas, a huge forestation operation is not economically viable to absorb the large quantities of carbon dioxide floating in the atmosphere. A coal-operated power generation station with a 35% productivity level would need 20000 to 24599 square kilometers of forest land. Recourse to genetic engineering to speed up the growth of trees may help reduce by half the planted surface. This being said, preventing the emission of greenhouse gases at the source remains the best solution (at the power generation station for example). This promising technique is still at a budding stage and following is a review of the progress achieved so far in this regard.

## 5. Other Techniques against Carbon Emissions

These include:

- 5.1 Capturing and storing carbon dioxide through gas pipes.
- 5.2 Capturing carbon dioxide during the heat generation of hydrogen.
- 5.3 Current scientific research efforts: these efforts remain promising in terms of reducing the cost of carbon dioxide accumulation.



## Chapter VI

# Legal and Legislative Texts to Reduce Human Causes of Disasters

## 1. Introduction

The Holy Quran contains many descriptions of the harm inflicted upon the environment, establishing a link between environmental wealth and man's behavior and actions. The Quran addresses environmental problems and the responsibility man carries in this regard, and presents perspectives and solutions through environment-related Shariah principles. The developmental and environmental dimension of environment protection bypasses the limits of the earth and worldly life to the promise of reward in the hereafter.

*'Whoever works righteousness, man or woman, and has Faith, verily, to him will We give a new Life, a life that is good and pure and We will bestow on such their reward according to the best of their actions.'* (Annahl, verse 97)

The consumption and production process allows for sustainable development by preserving resources from squandering. With equity as the basis of sustainability in any environment, Islam strongly emphasizes the need for equity in the utilization of resources, the absence of which would give rise to societies devoid of any sense of wellbeing or of the much needed spiritual and social security.

Environment protection is addressed in Islam through many fiqh rulings and Shariah precepts that govern the processes that Allah ordained for man to help organize his relationship with Allah, with the others, with the universe and his approach to life.

This Quranic framework can provide a legal and legislative background that we propose to supplement and consolidate what already exists in Islamic countries.

## 2. Description of the Legal and Legislative Framework of Disaster Prevention

The legal and legislative framework is part and parcel of any strategy to reduce natural hazards, whether these are environmental or technological. This strategy should in turn be part and parcel of a global strategy of sustainable development.

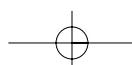
In order to keep pace with escalating and spreading environmental problems, the legal and legislative arsenal should ensure the following:

- Harmony with the framework of ethics set by Islam and with the legal and Shariah rules contained in the Holy Quran.
- Be an integral part of governance and determine the responsibilities of stakeholders at all disaster management levels.
- Appropriate institutional coordination and creation of positive and fruitful synergies among various role players to rationalize means and improve the outputs of the proposed strategy.
- A continuous ongoing updating of laws applicable in disaster prevention.

Whatever the case, the framework must be easy and clear, not only in terms of the results expected from it, such as early warning system application, hazard management, intervention and relief, but also in terms of training, sensitization and environmental education.

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Needless to say, the human being is an essential element and plays a crucial role in addressing environmental issues, be it pollution, water scarcity, energy, health, poverty or the loss of psychological balance and sense of safety in the present or the future.

Following are broad lines of how we think this legal framework should present itself at the national level:

### 3. Main Objective of the Legal Framework

This objective is to provide a legal framework that is suitable for a country's economic and social status, the nature of disasters striking locally and the global problems generated by these hazards. This includes anti-pollution laws, measures taken to combat droughts, desertification and floods and laws governing the management and protection of coastal areas and beaches.

### 4. Methodology to be followed

- Creating progressive legislation, applicable measures and sealing the loopholes existing in laws and systems in operation.
- Involving relevant decision makers, professionals, NGOs and the civil society and coordinating their actions.

### 5. Legal and Legislative Principles in the Strategy for the Reduction of Natural and Environmental Disasters

Each environment protection strategy has four pillars:

- 5.1 Inventorying and reviewing existing laws.
- 5.2 Sealing legal loopholes with the help of new laws.
- 5.3 Striking a balance between the old and new in creating an advanced legislation and applicable executive mechanisms.
- 5.4 Compatibility with international and regional agreements.
- 5.5 . Drawing up a general law on the environment.

### 6. Determining priority activities such as:

- 6.1 Normalization: Sets the maximum limits of what can be released in water or in the atmosphere.
- 6.2 Codification: Stipulates the creation of projects specific to laws on environment protection, waste management, beach management, air quality and integrating and implementing international and regional agreements.
- 6.3 Information to make legal and organizational resources available and create a database of legal data.

### 7. International and Regional Conventions

The Kyoto Protocol constitutes a focal point in international conventions on mitigating the effects of climate change and therefore limiting carbon dioxide emissions in particular and other GHGs in general. All Islamic countries have signed this agreement and the United Nations Framework Agreement on Climate Change.

## Chapter VII

# Environmental, Social and Economic Impact of Various Hazard Categories

### 1. Introduction :

Disasters, whether natural, environmental or technological, have a direct and adverse impact on economic conditions and socio-economic achievements, through main and secondary, direct and indirect effects. Alleviating the damage inflicted by a given disaster becomes crucially important for sustainable development as the latter is perceived internationally. Let us briefly touch on the principles of sustainable development:

- The Polluter Pay Principle: This includes financial, economic and legal incentives and integrating environmental costs within overall expenses.
- The Precautionary Principle: It is based on preventive measures applied through monitoring, scientific follow-up, sensitization and research.
- The Proximity Principle (interdependence of actions): This involves thinking globally but acting locally. These principles are conducive to international cooperation.
- The Participation Principle: This is the driving force of sustainable development.
- The Transparency Principle: It should prevail in all actions and interactions and is a must for all economic and social role players involved with environment.
- The Accountability Principle (at the local level): This element is of utmost importance in modern public policies. Intellectual, scientific and international forums and organizations have all called for a return to the spiritual dimensions that define man's perception of and his interaction with the environment. This echoes Islam's call when it links the protection of environment with development. A wealth of Quranic verses and hadiths urge men towards a better management of Allah's creation and towards seeking the reward promised for preserving and nurturing this creation. A number of principles relating to rites and transactions stand witness to this, and all of these promote the creation of a sound environment that achieves harmony between man and his surroundings.

On the other hand, Islam considers the non-depletion of natural resources through unnecessary acquisitions one of its nature preservation teachings, including the injunction against squandering or polluting water and the good utilization of natural resources such as marine, mineral and energy riches. As such, natural environment concerns have extended to the social and economic ones as well as the legislative and institutional ones. The environmental dilemma has thus become an unavoidable element in the development strategy and its funding and in proceeding with sensitization, information and educational programmes.

### 2. Causes and Effects of Environmental Deterioration

The serious problems arising from pressures on resources, pollution and global change place man's existence on earth at risk, or at least jeopardize the ability of future generations to cover their needs.

Behind this deterioration of the environment are factors such as:

- 2.1** The extraordinary changes that occurred over the 20th century at the demographic, technological, ecological, economic, social and commercial levels.
- 2.2** Development patterns that stand out by their arbitrary exploitation of natural resources through industrial and agricultural developments, living styles and consumption.
- 2.3** Industrial pollution which affects water, air and soil. Its manifestations are apparent in biological ecology and on the entire land and marine ecosystems. Pollution is also visible through the many damage affecting public health, the quality of life and the beauty of natural surroundings.

Air pollution becomes part of the atmospheric cycle, affecting the hydrological cycle and leading to climate change. To air pollution are attributed events in the upper atmosphere (acid rains, fog) and within the stratosphere (ruptures of the ozone layer or the stratum dividing the troposphere from the stratosphere (greenhouse effect)).

The greenhouse effect is the result of gases that trigger global warming. The atmosphere's rising temperature causes the melting of glaciers, the recession of ice shelves, the disruption of seasons and rise in sea levels. It also triggers the vicious cycle of floods and droughts, thus increasing the incidence of hydro-climatic disasters.

### 3. Social Impact of Disasters

Some of the damage caused by disasters are the results of climate change. Storms or floods, heat waves, droughts and desertification, or changes in various rainfall patterns, all of these will cause higher death tolls and leave larger numbers of people homeless and displaced (ecological immigrants). They will induce the melting of glaciers, the rise of sea levels, and the spread of tropical diseases and plant ravagers, all of which comes with the impoverishment and marginalization of huge numbers of people.

Forest depletion, soil and other types of erosion are largely owed to human activities such as overgrazing and other pressures on resources and ecosystems. All these factors contribute towards impoverishment and migration within the country and abroad.

The warming up of the atmosphere plays a decisive role in the earth's energy balance. Any disruption of this balance has critical impacts on all climate elements, and consequently on environmental systems.

In the absence of gigantic efforts to stop the flow of greenhouse gases into the atmosphere (particularly carbon dioxide) through reforestation and other techniques and to preserve the balance of nature, yesterday would have been better than today and today will be better than tomorrow and future generations will inherit the most adverse effects of global climate change.

Warming also presents an ethical dilemma for the current generations vis-à-vis future ones. It is therefore important for the present generations to decide whether they want to contain these risks or leave the matter in the hands of our grandchildren to fend for themselves.

Yes, the major environmental challenges arising from pressures on the environment, pollution and climate change place life on planet earth at risk or at the least influences the capacity of future generations to meet their needs.

A number of socio-economic imbalances directly linked to the social environment, affect social services in general and alter the social characteristics of the population, a situation further compounded by the impoverishment of a large swathe of the population who ultimately resort to immigration (economic and environment immigration).

## 4. Economic Effects of Disasters

### 4.1 Escalation of Disaster Costs

The economic cost of disasters is mind-boggling and has been escalating through the years, a stumbling block to all development endeavors. To mention but the financial costs of natural, environmental and technological disasters, the volume of these losses has increased from US\$ 75.5 billion in the sixties to US\$ 660 billion in the nineties, only to reach US\$ 100 billion from 2000 to 2002 (Munich, ER). This volume in turn was surpassed by the sole earthquake of Indonesia (December 2004).

While material losses of industrialized countries over the last decade of the previous century were three times higher than those of developing countries, their volume represents a mere 2% of their GDP as against 13% of the GDP of developing countries (Munich, ER).

In general terms, only a handful of experts and relevant international organizations have provided statistical data on the economic impact of such disasters as desertification and cyclones. According to UNDP's Human Development Report for 2007, desertification is behind the loss of US\$ 42 billion. Global warming and the ensuing rise in sea levels hold the potential of causing the displacement of 100 million people away from the coasts at risk.

The annual cost of cyclones has tripled between 1950 and 2000 according to the Hasseville Meteorological Data Centre in the United States.

Mankind's awakening to environmental realities at the end of the last century has placed environment at the heart of its concerns, compelling its inclusion in development strategies and their funding by international organizations.

### 4.2 Green Accounting

The science of economics has developed a new discipline called environmental accounting or green accounting. Many schools and opinions exist in this regard, giving rise to environmental means that have evolved over two decades within the natural and human environment. The purpose of green accounting is to come up with an environmental evaluation based on the principle of benefits and disadvantages of a project from the moment work starts in building the factory to when it goes into operation or even after it closes down as this also generates other environmental, social and economic concerns.

Sustainable development is achieved through the preservation of resources and their protection from squandering because man's ability to consume soundly and for a good cause is so much lesser than his inclination to consume blindly in satisfaction of his whims and desires and to feed his love for possession and control.

### 4.3 The Ethical Dimension

The economic impact of natural, technological and ecological disasters, especially the effects of climate change, can be addressed from the angle of ethics. In an article on "The Ethics of Climate Change", published in Science Magazine (10 and 11 October 2008 edition), J Broome calls upon Economists to make hard ethical judgments including weighing our own prosperity against the chances that climate change will diminish the well-being of our grandchildren. The present generation must decide, with the help of expert advice from economists, whether to aggressively reduce the chances of future harm or to let our posterity largely fend for themselves. Economists have a major part to take in providing ethical guidance and advice in this regard.

Yes, in the practice of their daily life, individuals cause emissions of greenhouse gases (driving a car, using electricity, buying processed products ) which contribute to climate change and make

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everything we do for our own wellbeing and prosperity detrimental to others. Thus, the first ethical principle would be to refrain from such actions and compensate people for the harm we cause them.

This entails gauging benefits against costs, and the question that arises on the ethics of cost and benefit according to Broome is how far we should go in our sacrifices today to ensure a better life for future generations who might be richer than we are today.

As for the principles of interests and priority, there is a difference in opinion in the theories evaluating the social value of an equal distribution of riches between the rich and the poor. The principle of priority, if given to the poor, confers a higher social value on a given rise in death.

## Chapter VIII

# Summary of Recommendations and Executive Mechanisms for the Strategy

### 1. Introduction :

No Islamic country is immune to the effects of natural or environmental disasters, or to the impacts of climate change. Preventive measures may help mitigate the damage caused by the phenomena when their occurrence is unavoidable.

The fundamental priority of any government is to protect the population and the safety of their infrastructure. It also strives to protect other components of the population's cultural heritage and their social and economic assets from the aftermath of unavoidable disasters such as earthquakes that can strike for a few seconds and destroy the work of years or decades, thus crushing the development of an entire region or a whole nation.

Having reviewed the disasters that struck at the Islamic world and their dire repercussions on man and his social and economic environment, we propose a strategy for managing such hazards. This strategy builds its action around cooperation and information and experience sharing and takes up the challenge. It pursues the following general and specific objectives:

### 2. General Objectives

- Reduce and mitigate the impact and effects of disasters.
- Develop good governance within sustainable development and in coordination with its programmes, projects and initiatives. Priority is given to partnership, ongoing training and improving the quality of life.
- Encourage constructive research, build up and utilize information and draw benefits from everything achieved by the Kobe Action Plan.
- Encourage cooperate among Member States on the basis of takaful and experience sharing.

### 3. Specific objectives

- Build capacities at all levels and develop information tools and mechanisms to facilitate dialogue among the partners.
- Build information management networks and databases to develop common tools, sound applications and expertise sharing.
- Support decentralization by supporting local role-players.
- Cooperate with universities and research centers to develop information and communication technologies for the prevention and management of disaster risks.
- These objectives will undoubtedly help develop and enforce the cultures of prevention and preparedness which are crucial elements in the strategy for the management of disaster.

## 4. Culture of Prevention

The culture of prevention is founded on:

- Developing and using information.
- Establishing various maps and mapping out many risks.
- Reinforcing and improving the performance of early warning systems.
- Developing geographical information systems to incorporate and clarify data.
- Setting up projection modeling and simulation of systems to inform decision making.
- Taking preventive measures such as earthquake resistance construction laws, building flood-prevention works, forestation

## 5. Culture of Prevention and Preparedness

- Managing news items and advertisements, and sharing information on risks and population protection.
- Sustaining exchanges among the various role players and at different levels.
- Education through the Kobe Action Plan and diverse other channels (informal training and ongoing training).
- Professional training at various levels and training volunteers.
- Sensitizing the public through the Kobe project and other channels.

## 6. Prerequisites of Good Disaster Management

### 6.1 Reinforcing governance in disaster management and integrating relevant programmes

The disaster management strategy requires political will (responsibility for the safety of citizens and their property), and full commitment to creating permanent preventive and relief programmes that clearly delineate the responsibility of each of the sectors in charge of protection.

**6.2 appropriate organizational and legal framework** in order to implement the strategy adopted, conduct the necessary coordination and restructuring and issue the appropriate legislation.

**6.3 Training in various techniques and ongoing training** as a contribution towards building capacities and human resources, devising at the same time regional programmes to support the national ones and to facilitate information and experience building.

### 6.4 Required means for risk management:

Risk management requires the use of several prevention and intervention means and conducting each with efficiency:

- Pre-programming which relies on existing data, on the results of research (reports, summaries, studies, maps, etc) and on possible scenarios of events, taking into consideration all role players, circumstantial elements and aggravating factors.
- Assistance to decision-making that collates all information at the moment of the crisis by choosing the best among developmental scenarios.
- Close coordination between all role-players and at the professional levels and in vital sectors.
- Community mobilization: Attracting and involving the civil society to guarantee true effectiveness of each crisis management policy.

- School education on risks and their prevention, sensitization and preventive information to enable all social categories to obtain advice and technical information at the time of the crises, using audio channels to facilitate information, sensitization and training.

### 6.5 Implementation of Risk Management Strategy

This strategy requires the following:

- Creating and developing geographical information systems to peruse all data and the results of various scenarios.
- Integrating data, patterns and databases within an information system to inform decision-making.
- Improving environment management and decision making by integrating the possible impacts and repercussions of natural and environmental disasters in the planning and decision-making of major projects and national programmes.

### 6.6 Research and Development

The aim of research and development is to reduce the margin of doubt in understanding violent natural phenomena and environmental disasters and their forecast, building national capacities in sciences and technology, consolidating the scientific and technological base for an integrated and multi-disciplinary research seeking to understand disasters and their impacts.

### 6.7 Role of Decision-Makers

This role involves the correct interpretation of scientific information and research outcomes in order to devise appropriate preventive measures and draw up strategies for protection and reform within the framework of sustainable development.

### 6.8 Requirements of Risk Management

The protection against and reduction of water-related risks requires the following:

- Diagnosis, inventorying and follow up of critical cases.
- Analytical evaluation (frequency, magnitude, various patterns).
- Prediction.
- Protection through early warning and assistance to decision-making.
- Reducing risks (monitoring) to limit damage. This involves organizing relief, water and food supply, creating special guarantees and ensuring job guarantee (preserving the economic power of the population).

Protection from this type of disasters was particularly successful in India. Measures taken in this regard covered the following six aspects:

- An early warning system.
- Preplanning.
- Preservation measures.
- Stability of agricultural production.
- Measures guaranteeing access to food.
- Preserving the purchasing power of farmers.

International cooperation and international conscience plays an important role in protection from direct and indirect hydro-climatic dangers as well as those resulting from man-made climatic changes.

## 7. Cooperation and Experience Sharing in Major Pilot Projects

Some Islamic countries have launched large scale projects aimed at preventing and reducing natural and environmental disasters and climate change impacts. Of these projects we can mention the following:

**7.1 A project for micro-seismic maps**, intervention and relief scenarios and other preventive measures for Tehran in Iran, and Istanbul in Turkey.

**7.2 The Dhaka project** of planting 100 million trees to guard against floods and mudslides.

**7.3 To set up and operate an early warning system** against tsunamis covering the Pacific, the Atlantic and the Mediterranean Sea.

These projects can be considered pilot projects and applied on a wider scope in the Islamic countries running the risk of tsunamis or earthquakes, particularly large cities such as Cairo, Tripoli, Tunis, Algiers and Casablanca on the one hand, and the countries south and east of the Mediterranean for tsunamis, on the other. The forestation aspect would be applicable to all Islamic countries in view of its role in preserving soil and preventing erosion, desertification, increased levels of carbon dioxide.

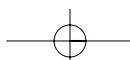
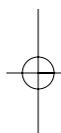
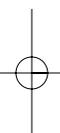
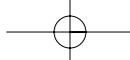
The creation of an Islamic fund to finance these major projects would have spiritual, material, educational, social, economic and environmental dimensions. This said, a more in-depth study of this proposal would certainly prove its viability or the absence thereof.

Last but not least, we propose a theoretical system for disaster management.

Following is a summary of the contents of this study in the form of recommendations and an action plan to implement these recommendations:

## Outline of the Action Programme

1- Governance / Disaster Reduction	3- Education and training/ knowledge applications (Culture of Resistance)	4. romoting the Culture of Prevention	5. Renforcement de la préparation (veille) stratégies de communication
<p><b>2. Risk Assessment/ Reinforcing Early Warning systems</b></p> <p><b>1.1 Institutional and Legal Framework</b></p> <ul style="list-style-type: none"> <li>- An integrated disaster management system</li> <li>- A legislative framework for protection against disasters (legislative strategy)</li> </ul> <p><b>1.2 Resources</b></p> <ul style="list-style-type: none"> <li>- supporting designs and programs and financing priorities</li> </ul> <p><b>1.3 Encouraging partnerships</b></p> <ul style="list-style-type: none"> <li>- Networks</li> <li>- Strategic management of resources</li> </ul> <p><b>2.1 Risk Assessment</b></p> <ul style="list-style-type: none"> <li>- Mapping various risks</li> <li>- A statistical and social study</li> <li>- Geographical information systems</li> </ul> <p><b>2.2 Early warning</b></p> <ul style="list-style-type: none"> <li>- Early warning systems and the means of integrating them in decision-making and emergency management systems</li> </ul> <p><b>2.3 Capacities</b></p> <ul style="list-style-type: none"> <li>- Encouraging research, monitoring and mapping, projections and reduction of vulnerability and disaster effects.</li> <li>- Databases</li> </ul> <p><b>2.4 Regional and international cooperation</b></p>	<p><b>3.1 Risk Management and Exchanges</b></p> <p><b>3.2 Data on risks</b></p> <ul style="list-style-type: none"> <li>- Consolidating networks between various parties and multidisciplinary networks</li> <li>- Scientific cooperation and developing dialogue among users</li> <li>- Information public opinion about prevention measures</li> </ul> <p><b>3.3 Education and training (strategy)</b></p> <ul style="list-style-type: none"> <li>- Integrating information on disaster reduction in educational curricula</li> <li>- Training of volunteers</li> </ul> <p><b>3.4 Research</b></p> <ul style="list-style-type: none"> <li>- Assessment of various risks and their impact on vulnerability</li> </ul> <p><b>3.5 Sensitization of public opinion</b></p>	<p><b>4.1 Managing environment and natural resources</b></p> <ul style="list-style-type: none"> <li>- sustainable use and management of ecosystems</li> <li>- Strategies for the reduction of disaster effects and adapting to them</li> </ul> <p><b>4.2 Developmental, Economic and Social Applications</b></p> <ul style="list-style-type: none"> <li>- Food security</li> <li>- Public health</li> <li>- Preserving schools, hospitals and vital networks</li> <li>- Insurance and reinsurance mechanisms</li> <li>- Private-Public partnership</li> </ul> <p><b>4.3 Integrating the reduction of disasters in civilizational design and rural development.</b></p> <ul style="list-style-type: none"> <li>- Upgrading the set of laws governing construction laws.</li> </ul>	<p><b>5.1 Mitigating disaster impacts and losses with good preparation.</b></p> <ul style="list-style-type: none"> <li>- Building regional capacities</li> <li>- Reinforcing communication mechanisms, processes, systems and designs for a swift response.</li> <li>- Upgrading preparedness with special focus on sensitive and fragile regions.</li> <li>- Creating a fund for pilot projects and building pilot project creation mechanisms (generalization of success stories)</li> </ul>



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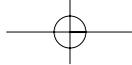
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