

Towards improved public awareness for climate related disaster risk reduction and management in the Arab region



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Preface

Nature has many thresholds that we discover only when it is too late. The impacts of disasters, whether natural or man-made, not only have human dimensions, but environmental ones as well. Environmental conditions may exacerbate the impact of a disaster, and vice versa, disasters have an impact on the environment. There is a direct link between environmental management and risk reduction, disaster preparedness, mitigation and recovery, as natural disasters have a long-lasting adverse impact on the environment. Mitigation and preparedness are vital to reduce the damage and cost of natural disasters like floods, earthquakes and landslides in the developing world — where economic losses exceeded billions of dollars. Social vulnerability to disasters is a function of human action and behaviour. It describes the degree to which a socioeconomic system or physical assets are either susceptible or resilient to the impact of natural hazards and environmental changes.

Over the last decades, the Arab region has experienced unprecedented growth in population and standards of living. Many of these developments have increased stresses on the environment, and made populations more vulnerable to natural disasters. Climate change, spread of arid lands and desertification, pollution of marine and freshwaters and all contribute to changes in ecology of natural resources on which people depend for survival, and make them more vulnerable to weather and other geophysical risks. Global warming is increasing the intensity of major disasters. The region experiences a range of 'natural disasters' including bushfires, floods, severe storms, earthquakes and landslides. These events cause great financial hardship for individuals and communities, and resulted in loss of life. Increasing frequency and intensity of natural disasters pose serious challenge to the sustainability of development investments and the stability of economic growth in the region.

Within the framework of the UNESCO Cairo Office Ecological and Earth Sciences, and Disaster Risk Reduction Programmes on raising public awareness about natural disasters in the Arab region, and implementation of appropriate behavior strategies and development policies, the United Nations Educational Scientific and Cultural Organization (UNESCO) Cairo Office has produced this explicit and practical standardized document providing guidance and examples. This document tackles logical means and thematic basis for the exchange of knowledge and expertise between Arab countries in the field of natural disasters, especially those climate-related. The geographical coverage of this document encompasses the Arab countries that are bounded by history, geography and culture, including areas and watersheds that are highly affected by natural disasters, and comprising more than 347 million people (according to Wikipedia, 2009).

This document should be used in a flexible and creative way. It presents an open platform for professionals, researchers, experts, agricultural and rural management authorities, decision-makers (including politicians as well), and the public at large to benefit from. A general descriptive exposing of the natural sudden climate disasters status in the Arab region (with case studies from several countries under consideration) has been offered. The general linkage between disaster reduction and natural resources management, land-use planning, climate change adaptation and environmental protection is provided also. This document presents as well the appropriate measures to react swiftly in the event of natural disaster, and tackles the formulation of appropriate behavior strategies and development policies for informing the population to apply before, during and after natural disasters. It exposes as well the role of stakeholders (government ministries, department and agencies, disaster prone communities, scientific institutions, registered NGOs, voluntary organizations, and the private sector) for an effective disaster management. In brief, this document can be used as part of mass media campaigns to achieve a better understanding how to face natural disasters in the Arab region. It can secure synergy among efforts to combat the negative effects of natural disasters, and supports exchange expertise and information pertinent to natural disasters among Arab countries.

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1. Background

Natural disasters (e.g., floods, landslides, sand/dust storms, etc.) have become during the past four decades widespread dangerous problems in many parts of the world (**Figure 1**), including the Arab countries, thus contributing to increase poverty and threatening food security. Today's society becomes ever more rapidly vulnerable to natural disasters due to climate changes, growing urban populations, severe human degradation of marginal lands and disturbance of formerly stable ecosystems (deforestation, erosion, over-cultivation, overgrazing, etc.), as well as a lack of natural resource management, land use planning and preparedness.

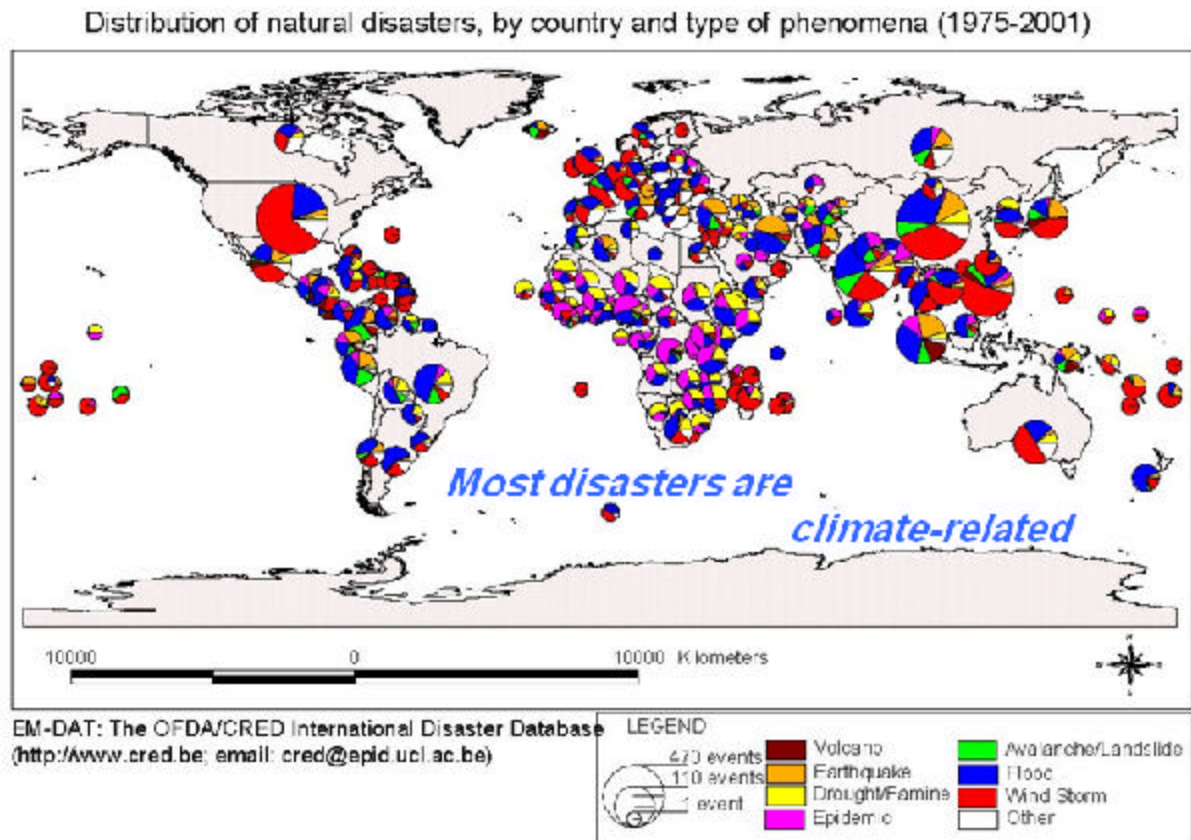


Figure 1. Distribution of natural disasters worldwide

The escalation of severe disaster events triggered by natural hazards and related technological and environmental disasters (**Figure 2**) is increasingly threatening both sustainable development and poverty-reduction initiatives. During the past four decades, natural hazards have caused major loss of human lives and livelihoods, the destruction of economic and social infrastructure (**Figure 3**), as well as huge environmental damage. Economic losses have increased almost 10 times during this period (between 1975 and 2005) (**Figure 4**). For example, floods in more than 80 countries have caused hardship for more than 17 million people worldwide since the beginning of 2002 according to the World Meteorological Organization (WMO). Almost 3,000 people have lost their lives while property damage is amounting to over thirty billion US dollars.

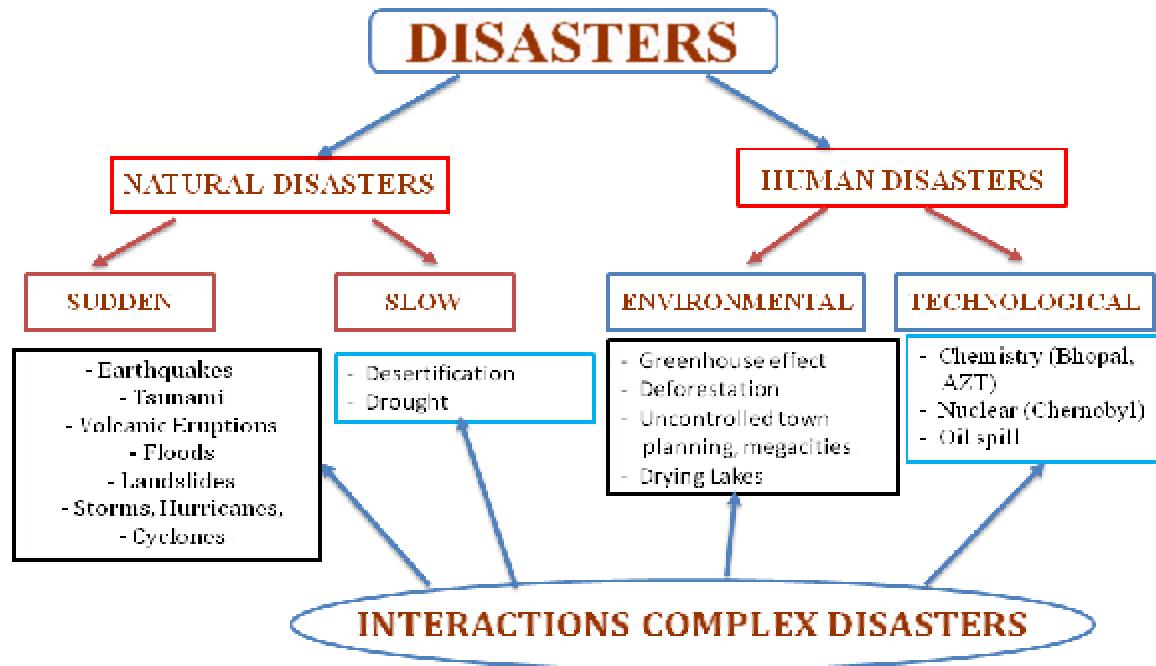


Figure 2. Interactions between natural and human-induced disasters

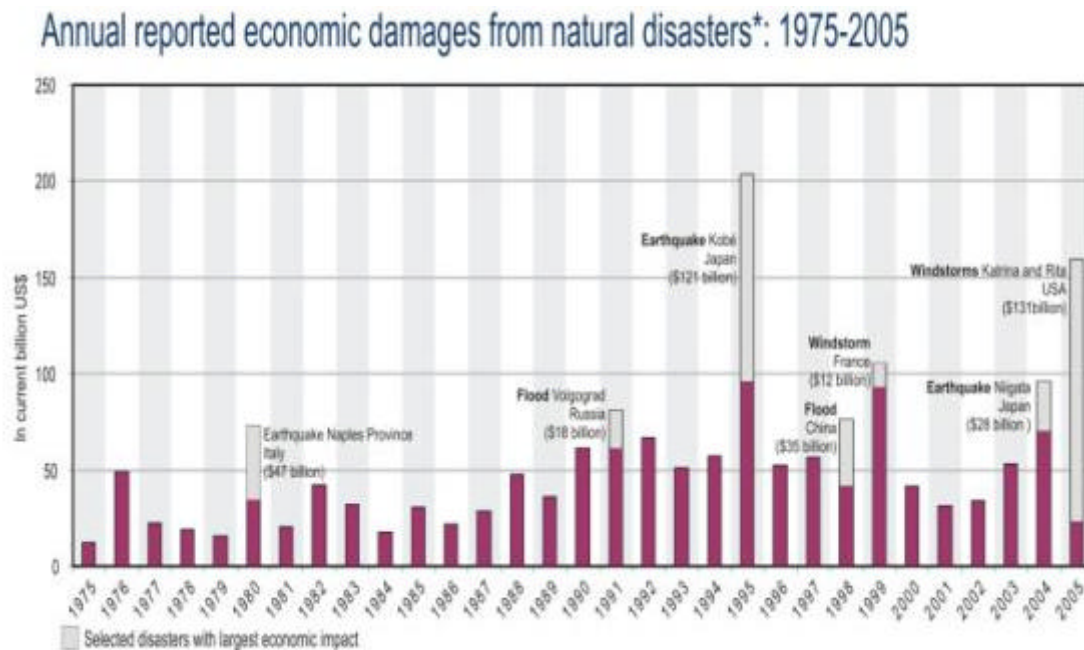


Figure 3. Economic damages from natural disasters (Source SEI, IUCN, IISD, 2001)

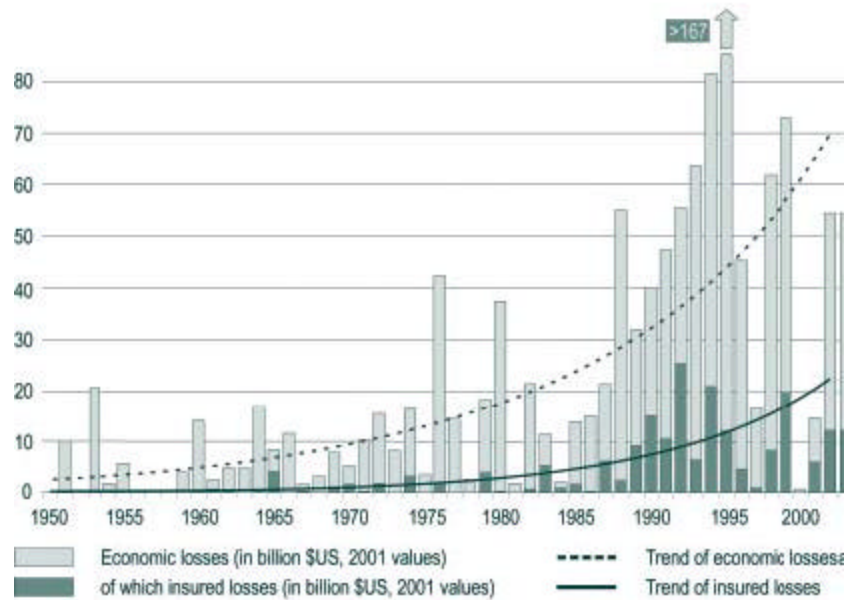


Figure 4. General trends of economic and insured losses for great natural disasters between 1950 and 2002 (Munich, 2000)

According to Noji (1997), hurricanes produced 16 of the 65 greatest disasters of the 20th Century (in terms of deaths) and the greatest number of deaths from 1947 to 1980 (499,000). Earthquakes produced 28 of the greatest disasters and 450,000 deaths, whereas floods produced four of the greatest disasters and 194,000 deaths. Other significant natural hazards include volcanic eruptions with nine of the greatest disasters and 9,000 deaths, landslides with four of the greatest disasters and 5,000 deaths, and tsunamis with three of the greatest disasters and 5,000 deaths. There is significant variation by country, with developing countries in Asia, Africa, and South America accounting for the top 20 positions in terms of number of deaths from 1966 to 1990. Since the 1990s natural disasters kill 58,000 people on average each year and affect another 225 million people. In addition to the projected estimate of 100,000 lives lost each year due to natural hazards, the global cost of natural disasters is anticipated to exceed \$300 billion annually by the year 2050 (SEI, IUCN, IISD, 2001), if the likely impact of climate change is not countered with aggressive disaster reduction measures. The environmental impact of natural hazards, in particular the loss of environmental services (water, forest, biodiversity, ecosystem function, etc.), is still difficult to assess and is often underestimated. Indirect economic losses of 'market share', following the disruption to trade after a disaster, can also go largely unnoticed.

Natural disasters strike rich and poor countries alike but have a greater impact on developing countries where high levels of poverty (Figure 5), disease and/or conflict exacerbate people's vulnerability and deepen their poverty. An estimated 97 percent of natural disaster related deaths each year occur in developing countries (World Bank, 2000) and, although smaller in absolute figures, the percentage of economic loss in relation to the Gross National Product (GNP) in developing countries far exceeds that in developed countries. Low-income countries suffer approximately 3,000 deaths per disaster whereas the corresponding figure for high-income countries is approximately 500 deaths per disaster. Moreover, these disparities appear to be increasing because the average annual death toll in developed countries declined by at least 75% between 1960 and 1990, but the same time period saw increases of over 400% in developing countries (Berke, 1995). According to UNDP (2001), of the world's 49 least developed countries, 24 face

high levels of disaster risk. Of these, six are hit by between two to eight large disasters every year, with long-term consequences for human development. Asia and Africa suffer the greatest losses in human life due to disasters. Approximately 88 per cent of all people reported killed and 96 per cent of the people reported as being affected live in these two regions alone (CREC, 2002).

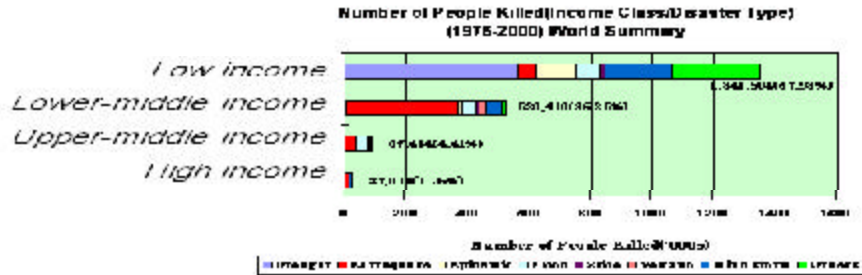


Figure 5. Most vulnerable people to current natural disasters and expected climate change impacts (Source EM-DAT, CREC, University of Louvain, Belgium)

Disasters and conflicts can impact the environment in ways that threaten human life, health, livelihoods and security. Around 188 million persons are threatened by natural disasters between 1991 and 2000, versus 31 million affected by conflicts (**Figure 6**). Disaster managers and humanitarian workers must therefore identify and address acute environmental risks quickly and consistently as an integral part of effective emergency response.

Worldwide, countries, multilateral institutions and the private sector are recognizing that hydro-meteorological disasters are increasing in frequency and magnitude due to global climate change being felt around the world, indicating a trend towards an increase in mean temperature of 1.5 to 2°C and more torrential episodes of rainfall. In all, 80% of the natural disasters occurring worldwide are hydro-meteorological or climate-related. There is, however, no evidence of more frequent or intense earthquakes or volcanic eruptions.

**Number of persons affected annually (in millions)
1991 - 2000**

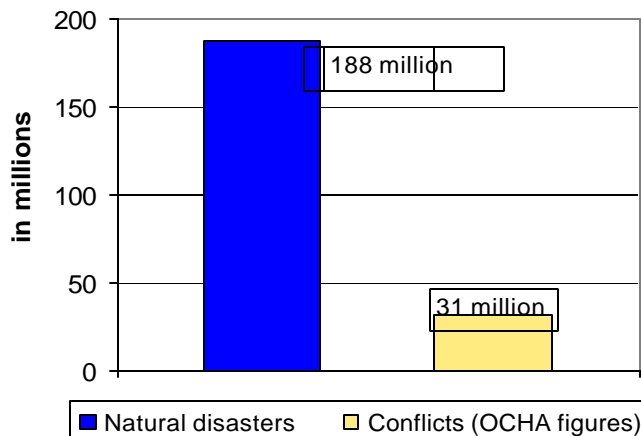


Figure 6. Trends in impact of natural disasters versus conflict (Source EM-DAT, CREC, University of Louvain, Belgium)

For these geological hazards, the reasons for increased losses are found in the global rise of people vulnerability, induced by increasing population and inadequately planned urban growth. Physical infrastructure has expanded rapidly as well, and has generally hindered sustainable construction practises and safe building standards. Poor planning decisions have led to the establishment of potentially hazardous facilities, such as nuclear power plants, chemical factories and major dams, in earthquake prone zones and densely populated areas. The effects of climate change and the risks posed by the increasing environmental degradation, epitomized by deforestation, loss of biodiversity and associated knowledge, reduced water supply and desertification, can contribute to increased climate-related disasters (particularly flash floods and landslides). Flash floods are expected to be among the highest increase of environmental-related disasters. They are considered as the most destructive of all natural disasters, with tragic consequences including annual financial losses, casualties, destruction of houses and agricultural lands, decease of cattles, tremendous damages to structures, utilities and public services (electricity, communications, etc.), and huge landslides.

The loss of human lives and the rise in the cost of reconstruction efforts and loss of development assets has forced the issue of disaster reduction and risk management higher on the policy agenda of affected governments, UN agencies and Non Governmental Organizations (NGOs). This trend led to the adoption of the International Strategy for Disaster Reduction (ISDR) by governments to succeed and promote implementation of the recommendations emanating from the International Decade for Natural Disaster Reduction (IDNDR, 1990-1999). As the many ramifications of a changing global climate also become more apparent, it must be expected that certain zones which to date may not have experienced serious impacts of natural disasters may in future become more vulnerable to such events. Although natural disasters impact negatively on economic, social and environmental situations, there is still a lack of awareness or ignorance about its medium and long-term impacts by the politicians (decision-makers) and the public at large. This problem needs to be presented for this audience in a way that relates to their everyday life in order for funds to be made available for research, education and mitigation. The question is how to use mass media campaigns for influencing public opinion about particular environmental issues? Another challenge will be to ensure that action plans and laws are designed to solve different complex environmental disaster issues at the same time. The formulation of appropriate strategies and development policies can reduce natural disaster risks, especially those climate-related. They involve the adoption of suitable regulatory and other legal measures, institutional reform, improved analytical and methodological capabilities, financial planning, education and awareness (among which mass-media coverage). Risk reduction should be seen as a comprehensive process that goes beyond traditional response to the impact of individual national hazards. This process should be multi-sector and inter-disciplinary in nature and comprise a wide range of interrelated activities at the local, national, regional and international levels.

2. Extent and magnitude of sudden climate-related disasters in the Arab region

Natural disasters, especially those sudden climate-related (floods, landslides, sand/dust storms, and forest fires) abound in the Arab countries. Coupled with the projected increased rain intensity in these countries, is the increase in the frequencies and intensities of flash floods, causing tragic environmental (including huge landslides) and socio-economic destruction (**Figure 7**). Sandstorms and dust storms are expected to increase also with climate change in the Arab region, especially in the semi-arid and arid environments. More frequent seasonal temperature variability will increase forest fires as well in the Arab countries. These fires can have a potential impact on global CO₂ atmospheric emissions.

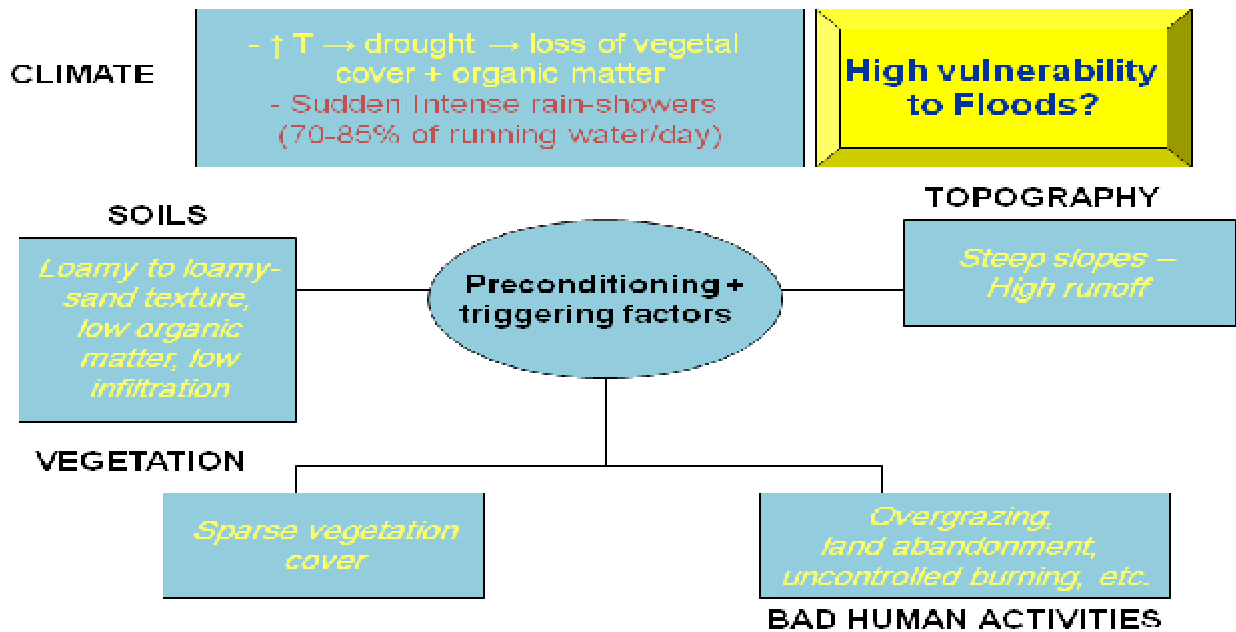


Figure 7. Why floods and landslides are so high in the Arab countries ? Causative factors?

Empirical evidence suggests that Arab countries which suffer most from the aforementioned natural disasters are those in which environmental degradation is most severe (**Figure 8**), i.e. those with severe deforestation, over cultivation, overgrazing and chaotic urban expansion. Deforestation continued to take place over the last few decades in the countries of the Arab region at annual rates ranging from 0.8 to 2.4 per cent (FAO, 2005). Such high rates of deforestation over extended years caused the decline of the total forest land in the Arab region to reach an estimated 4 per cent by the year 2000. This deforestation results in an increased concentration of surface runoff and hence flooding, and destabilized slopes can result in devastating landslides. Some examples can highlight the seriousness of deforestation in the Arab countries. For instance, the Comoros forest was cleared over time, and it experienced the highest rate of deforestation in Africa (7.4 per cent per year) between 2000 and 2005 (UN, 2007a). Extreme poverty has forced much of the population to heavily depend on natural resources for their survival. Increasing energy needs (468.000 m³ in 1995 for households and 800 m³ for wood coal) (NASA, 2009a) as well as the absence of appropriate land management measures have resulted in widespread deforestation in Comoros. The total forest cover (including both natural forests and plantations) in Iraq has deteriorated during the last 40 years leading to a forest cover reduction from 1.8 million ha in 1970 to about 799,400 ha in 2000 (FAO, 2001).

Global Trends (risk)-

Disasters are NOT natural

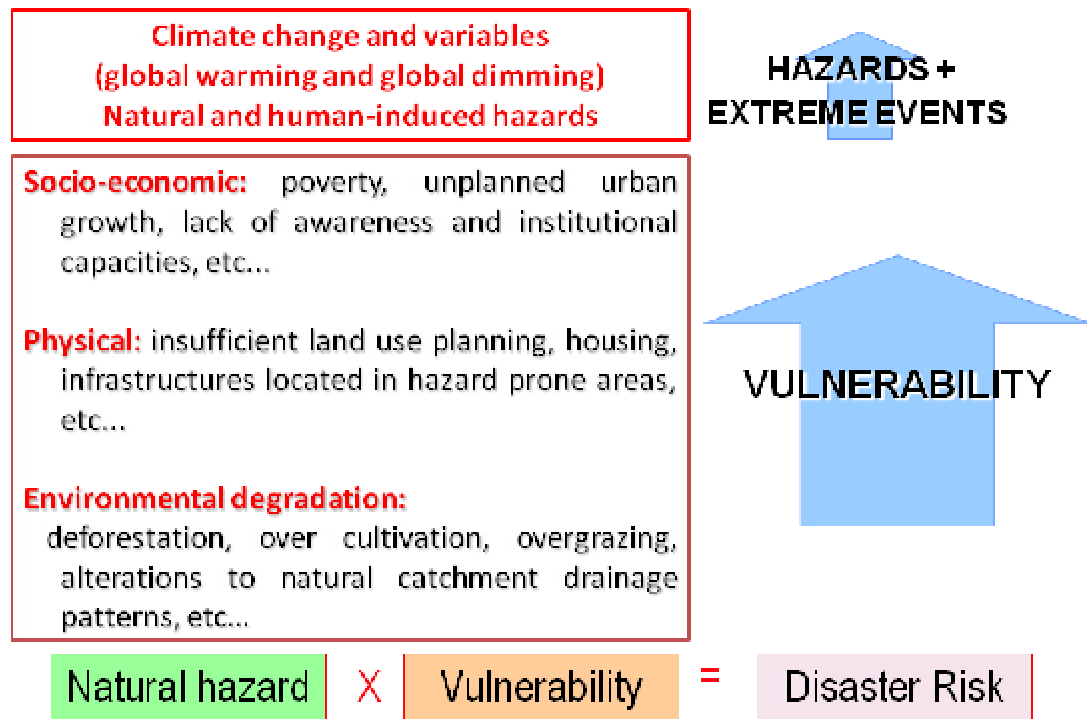


Figure 8. Anatomy of natural disasters in the Arab region

Most of the Iraq's forest consists of scattered trees, with 1,100 ha only having a tree cover of more than 40% of the land surface (UNEP, 2003). More than 35% of the initial forest cover in Lebanon has deteriorated during the last 40 years leading to a forest cover reduction from 12% (1973) to less than 7% of the Lebanese territory nowadays (METAP, 1995; Talhouk et al., 2001). It is estimated that the annual rate of change of forest areas in Lebanon between 1990 and 1995 is 7.8% (NAP, 2003). Forests cover only 0.3 per cent (267,000 hectares) of Mauritania's surface (UN, 2007a), yet the deforestation rate is high at 3.4 per cent per year (FAO, 2005). Mauritania has one of the worst rates of deforestation in Africa, costing the country about \$84 million every year in lost earnings (PAN/LCD, 2001). Forests occupy about 4,364,000 hectares or about 9.8% of the total area of Morocco (FAO, 2001). In spite of their diversity, forest ecosystems are very fragile because of pressures from population explosion and the poor livelihoods of rural inhabitants. The collection of firewood in Morocco is the first cause of the recession of forested areas, estimated at about 31,000 hectares per year (El Bagouri, 2006). Only two decades ago, almost half of Somalian earth was covered by forest (UNEP, 2005). However, today this forest is under threat by rapid deforestation caused by famine, war, overgrazing, illegal and ruthless logging and, agricultural practice which is still under the early stage of human lifestyle. At present, only 11.4% — or about 7,131,000 hectares — of Somalia is forested (Mongabay, 2005). Between 1990 and 2005, Somalia lost 13.9% of its forest cover, or around 1,151,000 hectares (Mongabay 2005). Deforestation in Sudan is estimated to be occurring at a rate of 1.87 percent per annum (UNEP, 2007). It is driven principally by energy needs and agricultural clearance. Between 1990 and 2000, Sudan lost an average of 589,000 hectares of forest per year. Pollen analyses on the sediment core from the Ghab Valley in Northwest Syria detected a large-scale

anthropogenic deforestation of deciduous oak forest as early as 9,000 year BP (Yasuda et al., 2000). Natural forest cover has decreased from ca. 30% to 2% of Syria over the last 100 years. The excessive firewood harvesting, overgrazing, land clearing, fires and urbanization are among the main reasons for the degradation of forest cover in Syria (**Figure 9**).



Figure 9. Overcutting of trees for fuel consumption in Syria

The Arab ecosystems are fragile and prone to land degradation. The fallow period for lands under intensive cropping in the Arab countries is shortened in general, that weakens the natural ability of soil to recover its fertility, leading ultimately to land degradation, lower crop productivity, and reduced incomes. The main causes of land degradation on croplands are inappropriate land use, weak capacity for sustainable water, in irrigation that may lead to salt concentration, inadequate land use planning and implementation, and inappropriate agricultural policies and incentives. These factors lead to inefficient and wasteful use of land and water resources; inappropriate crop intensification, especially under mono-cropping system; expansion of agriculture to marginal lands; and the use of farm machinery and agronomic practices that are not suitable for local soil and water conditions. The number and nature of laws, legislations and regulations to safeguard the various aspects of sustainable development vary greatly within the Arab region. However, what many countries unfortunately seem to have in common is the lack of appropriate and efficient mechanisms to enforce such important legislation. Awareness campaigns, especially among stakeholders in rural areas, are still lacking at the national Arab level, and need to be designed and prepared in layman language using all possible media facilities to ensure the progress of sustainable development.

Available statistics show also that animal resources increased in the Arab region from about 249.3 million heads in 1990 to about 373.3 million heads in 2004 (ACSAD, CAME, UNEP, 2004). High livestock density is generally coupled with the breakdown of traditional land management protocols that regulate grazing; weak policy and institutional capacity to manage rangeland sustainability; development of settlements for pastoralists and associated unplanned land and water development; and limitations on the movements of nomadic pastoralists along traditional corridors across national boundaries. For instance, the Arab countries lost about 11% of their forests during the 1980s only due to overgrazing (ACSAD, 2007). More than 28% of grazing land in Saudi Arabia is deteriorating as a result of overgrazing, gathering of woody plants and dryland farming (Abdelgawad, 1997). Degradation of the grazing lands has reached 90% in Syria and Jordan (ACSAD and GSLAS, 2000). Grazing intensities have more than doubled within the

decade 1980-1990 in Bahrain (105%), Oman (131%), and Egypt (107%), and increased by 3-79% in other Arab countries (UN-ESCWA, 1993). Dust storms, sand dunes, and various forms of wind and water erosion follow (as a result of the removal of vegetal cover coupled with soil compaction because of livestock trampling).

The fertile agricultural lands, especially around Arab cities and towns, are exposed to urban expansion resulting in the loss of vast areas of arable lands. For instance, Lebanon lost around 20 thousand hectares of its agricultural lands for urban development during the last years, and Egypt lost more than 18% of its alluvial land within the last 15 years (ACSAD and GSLAS, 2000). Most of the plant cover in Jordan has been removed during the third and second centuries B.C. mainly for land conversion to agriculture and for urban encroachment. Jordan to recent times (till fifties) was covered with large woodland areas. The area of woodlands in Jordan 100 years ago is estimated as twice as today's area (Tilawi, 1995). The area has decreased to half a million dunums (1 ha = 10 dunums) in the forties and 400 thousands during the fifties. Currently, 0.9% —or about 83,000 hectares—of Jordan is forested only (FAO, 2005).



Figure 10. Centuries of overgrazing in Tunisia removing all forest cover and making lands prone to floods, landslides and/or sand/dust storms

Some land use activities, i.e. quarries excavations (**Figure 11**) that are highly common in the Arab region, affect the intensity of floods and landslides significantly.



Figure 11. Unregulated quarrying sculpturing the landscapes and inducing landslides in Lebanon

These activities are constantly reshaping the contours of the land (topography), and thus altering the natural slope. In some instances, they can be considered as the primary cause of landslides. For example, quarries in Lebanon are sculpturing natural landscapes; their number has increased by 8% between 1987 and 1997 (Khawlie, 1999), with an amplified tendency to slope failure, landslides, and gully erosion. The problem will be aggravated since no attempt has been made to stabilize mountain slides and abandoned rock quarries in the perspectives of rehabilitation and restoration.

2.1. Floods

Flash floods and landslides, resulting from intense rainfall of a relatively short duration, are common in the Arab countries. Their incidence is increasing in frequency and magnitude during the last 40 years as a part of global climate change felt around the world. A detailed scan of the Lebanese newspapers indicates that the number of floods is rising significantly between 1971 and 2003 (**Table 1**) (Abdallah, 2007).

MONTH	1971-1981		1982-1992		1993-2003		DATES OF OCCURRING FLOODS
	F*	L**	F*	L**	F*	L**	
NOVEMBER (N)	-	-	2	-	2	2	17N (1984), 21N (1986), 16N (1993), 7N (1994)
DECEMBER (D)	1	-	3	2	3	3	1D (1971), 18D (1984), 22D (1986), 25D (1987), 5D (1994), 10D (1997), 17D (1997)
JANUARY (J)	4	1	2	1	2	2	2J (1972), 3J (1978), 9J (1979), 10J (1980), 19J (1986), 21J (1992), 1J (1994), 24J (1996)
FEBRUARY (F)	3	-	5	-	3	2	3F (1975), 11F (1980), 13F (1982), 14F (1983), 20F (1986), 6F (1992), 12F (1992), 8F (1995), 9F (1998)
MARCH (M)	2	-	3	2	6	3	8M (1978), 12M (1981), 15M (1983), 23M (1987), 27M (1989), 28M (1996), 28M (1998), 2 M (2003), 5 M (2003), 15 M (2003), 22 M (2003)

*F = NUMBER OF OCCURRING FLOODS

**L = NUMBER OF OCCURRING LANDSLIDES

Table 1. A detailed scan of the floods and accompanying landslides between 1971 and 2003 as recorded in the Lebanese newspapers (Abdallah, 2007)

Several technical reasons [e.g., mistakes in land use, bad zoning, inadequate planning, inappropriate agricultural practices (e.g., ploughing up and down a hill instead of along the contours), deforestation, etc.] connected to populations pressures (e.g., unregulated building on flood plains) are aggravating the intensity of flooding in the Arab countries becoming as such tragedies and bringing disasters in their wake. Flooding disasters have created, during the last years, widespread environmental, social and economic destruction in several Arab countries (**Table 2**). Floods cause severe degradation reshaping natural landscapes, sedimentation in reservoirs and waterways, disruption of lake ecosystems, contamination of drinking water, mudflows invading houses (**Figure 12a**), collapse of the unmaintained embankments and terraces (**Figure 12b**), deposition of eroded materials on farmland and roadways (**Figure 13a**), and damage to properties by soil-laden runoff [erosion (**Figure 13b**) which often leaves underground water (Bou Kheir et al., 2006), sewerage, power and telephone lines exposed]. Albergel et al. (2004) showed that three floods were responsible for 50% of the sedimentation that occurred in the Kamech dam (Tunisia) between the years 1994 and 2002.

Tangible impacts	Financial losses	
	Loss of house value	
	Disruption to electricity supply	
	Damage to car or van	
	Used holiday entitlement	
Intangible impacts	Immediate	Discomfort/inconvenience
		Stress of flood itself
		Having to leave home
		Dealing with insurers
		Living in temporary accommodation
		Dealing with builders
		Being stranded in/out of home
	Lasting	Time and effort to return to normal
		Worry about future flooding
		Loss of irreplaceable sentimental items
		Strains between family
		Loss of community spirit
		Deterioration to mental health
Deterioration to physical health		

Table 2. Classification of flooding disasters' impacts.

In addition to casualties (deaths and injuries), flooding disasters cause psychological, socio-economic, socio-demographic (destruction of households' dwellings), and socio-political (social activism resulting in political disruption) impacts that can develop over a long period of time, and can be difficult to assess when they occur. Psychosocial impacts include emotional signs such as anxiety, depression, and grief, as well as behavioral effects such as sleep and appetite changes, ritualistic behavior, and substance abuse. In most cases, the effects that are observed are mild and transitory. Few disaster victims require psychiatric diagnosis and most benefit more from "crisis counseling" orientation than from a "mental health treatment" orientation, especially if their normal social support networks of friends, relatives, neighbors, and coworkers remain largely intact. However, there are population segments that require special attention and active outreach. These include children, frail elderly, and people with preexisting mental illness, racial and ethnic minorities, and families of those who have died in the disaster. Emergency workers also need special attention because they often work long hours without rest, have witnessed horrific sights, and are members of organizations in which discussion of emotional issues may be regarded as a sign of weakness (Rubin et al., 1985).



(a) Public roads blocked

(b) Terraces collapsed



(c) Erosion of soil particles



(d) Sedimentation of eroded materials

Figure 12. Serious damaged by muddy flooding (Photos a&b) and erosion and sedimentation of soil materials due to flash floods (Photos c&d) (Lebanon)

The property damage caused by flooding disaster impact causes direct socio-economic losses that can be thought of as a loss in asset value (Committee on Assessing the Costs of Natural Disasters, 1999), and this can be measured by the cost of repair or replacement. Direct economic damage refers to all damage to fixed assets, capital, and inventories of finished and semi-finished goods, raw materials, and spare parts. It includes total or partial destruction of physical infrastructure, buildings, machinery, and equipment, transport and storage facilities, and furniture as well as damage to farmland and soils, irrigation and drainage works, dams, and so forth. In the particular case of agriculture, the destruction of crops ready to harvest is considered direct damage. Indirect economic damage refers to damage to the flow of goods that will not be produced and of services that will not be provided after the flooding disaster strikes. The period of time covered begins immediately after the disaster and may last several months or years, depending on the characteristics of the flooding disaster. Secondary economic effects refer to the impact of the flooding disaster on the overall economic performance of a country as measured by the most significant macroeconomic variables. The estimated changes in these variables due to the disaster complement the estimated direct and indirect damages, although they cannot be added to express the total amount of damage inflicted.

Concrete examples of the occurring floods in some Arab countries can illustrate their negative catastrophic socio-economic impacts. The November 2001 flash floods in Algeria were assessed as the most devastating

in the last 40 years. Over 712 people died, 350 injured, more than 1,600 missing; about 1,800 houses were damaged; and 56 schools and several bridges (**Figure 13a**) were destroyed. The total cost of the damage was estimated at over USD 250 million. Serious flooding occurs also during December 2001 in Morocco that killed 15 people, caused damage at \$1.75 m, and left hundreds homeless.



(a) Algiers, 10 November 2001

(b) Jeddah, 28 November 2009

Figure 13. Huge destruction of cars and accompanying victims by flooding disasters in Algeria and Saudi Arabia (Source BBC News)

The spring of 2003 (16 and 17 April 2003) saw a major flood in Muscat (the capital of Oman) that killed around 14 people, and caused extensive damage to property, cut power supplies, and uprooted vegetation. In July and August 2007, [flash floods](#) devastated many parts of [Sudan](#), including some areas in conflict-battered [Darfur](#) and war-torn [Southern Sudan](#). These floods were the worst in living memory in Sudan, and have caused the total or partial destruction of over 150,000 homes, leaving at least 750,000 homeless or in need of emergency shelter due to a destroyed home. At least 365,000 people have been directly affected, including 64 dead and 335 injured. In addition, the United Nations (UN, 2007b) reported the following highlights: (i) at least 257 schools were destroyed, leaving over 56,000 children without primary education; (ii) at least 12,000 livestock, 16,000 chicken, and 96,000 feddans of crop lost; and (iii) outbreaks of waterborne disease continue in Gedaref and Kassala, killing one person every two weeks on average.

According to IRIN news (9 August 2007), three thousands of Mauritians have been forced from their homes in the south eastern town of Titane that has been totally submerged with water levels reaching two meters in some areas. The scale and intensity of this flooding disaster is the worst in over 50 years in the region. Two people are reported to have been killed by the floods and many sustained injuries from falling walls and crossing waters. The heavy rains have also destroyed a dam and knocked over more than 1,000 date palm trees. Damages are estimated at billions, including schools, health centers, and other public infrastructure. As Mauritania tries to recover from floods occurring in early August 2007, more heavy rains on 29-31 August 2007 have affected hundreds of families in the southern regions of Gorgol and Assaba. Dozens of families have been made homeless, according to information from the World Food Programme (WFP) and the government's Commissariat Chargé de la Protection Sociale et de la Sécurité Alimentaire (CCPSSA). More recently (September 2009), flash floods have created serious population displacements in several Mauritanian cities (i.e., Rosso, Nouakchott and Kaédi). Around 3700 people have been camping in provisional shelters 7 kilometers north of Rosso on higher ground, and the response to this emergency has been slow.

Another example is Yemen, where the average annual damage from flooding in one area only (Taiz) has been estimated at US\$ 2.7 million mostly in property destruction and missing stock from households and shops (NAP, 2000). In October 2008, one of the worst rainstorms faced nearly all Yemeni provinces killing 180 people and leaving an estimated 20,000 without basic shelter. More than 2,000 houses have been

destroyed, and power lines, roads, phone lines and water supplies have been wrecked from the heavy rains. **The Yemeni government has been desperately trying to send immediate aid to the worst hit areas; however, governmental help has not been completely successful.** The impacts of such serious floods are usually long lasting, as reconstruction/rehabilitation are time consuming and depend on the celerity with which required funds are made available. In the meantime, erosive forces remain in action, as protection of fields, wadi banks, irrigation channels etc, is non-existent.

The September 2009 heavy rains and flash floods have killed 17 people in southern Tunisia. Most of the victims were killed when the roofs and walls of their homes collapsed. Others were carried away by flood waters that rose to more than six feet in some Tunisian areas. In November 2009, the number of dead in floods following Saudi Arabia's heaviest rains for years has risen to around 150 persons. Many victims were died in their vehicles, either by drowning or in car crashes (**Figure 13b**). The high cost of relief and recovery may adversely impact investment in infrastructure and other development activities, and in certain cases may cripple the frail economy of the affected areas. Ineffective response to relief operations during major flood events may lead to public discontent or loss of trust in the authorities. For that, the Saudi government has launched an unprecedented public investigation after a wave of criticism over the handling of the 2009 flash floods: at least 40 Saudi officials have been arrested into the authorities' response to devastating floods in Jeddah.

High river flows combined with torrential downpours can cause also severe flooding. For instance, throughout Lebanon, flood flows typically rise and fall in a few hours, and often contain large amounts of sediment and debris (trees, boulders, etc...) making accurate gauging of high flows a challenge. In 1955, a huge flood occurred along Abou Ali river (Lebanon) covering an area approximately 400 km². Direct damages started in the rural inner areas (Zghorta, Koura), destroying houses, bridges, killing 10-15 persons and over 2000 cattle head. In the Tripoli coastal area (the second largest city in Lebanon), where the influence of several branches of the river lie, damages covered about 100 km², more than 400 people died, 2000 families found themselves without houses, thousands of acres of citrus plantations were destroyed, 4 bridges of the city collapsed, as well as several events of failure of surficial cover (Khawlie, 1994). After the flood subsided, 1.5 m thick sediments and debris accumulated in many souks or in the houses, and a 200 000 m³ of sediments were added at the river mouth building a delta (Beydoun, 1976).

More recently, in October 2002, the strong floods from heavy rains in Libya resulted in heavy materials losses in certain areas: the mounts of water which were held in Wadi al-Njeim dam reached 7,495,600 m³, and some 5,495,000 million m³ of water in Qadi Kaam dam. According to the International Federation of Red Cross and Red Crescent Societies, the Zaizon dam located in the northwestern part of Syria collapsed on 4 June 2002. A flash flood swept away Zaizon village, and struck four additional Syrian villages: Msheek, Al-Ziyara, Quarqoor and Tal-Wast, and left 21 dead. In addition to dam destruction, 251 houses were completely destroyed and 129 sustained partial damage.

The spring 2004 (14 April 2004), torrential rains and related flash floods have killed at least 114 people on the banks of dry Ambouli river beds (Djibouti). Extremely strong winds lifted also corrugated iron roofs off houses and blew over telephone poles; and the Red Crescent and national authorities estimated that about 10,000 people have lost shelter and property. In December 2006, Somalia (one of the world's poorest countries), has been hit by the worst flooding in recent history. Up to 350,000 people along the riverine areas are reported to be displaced, inundated or otherwise seriously affected by the flooding disasters. The latter have displaced entire communities, submerged villages, destroyed granaries, cut off feeder roads, blocked or damaged irrigation and flood relief infrastructures and inundated thousands of hectares of farmland in the South/Central area covering Gedo, Juba Valley, Hiran and Shabelle Valley Regions. On 2 October 2008, a huge rainstorm flooded a seasonal river to around 8 meters in the Algerian town of

Ghardaia, a UNESCO Heritage Site. This serious flooding killed at least 29 people, injured around 84 persons, and destroyed six hundred homes.

2.2. Landslides

Incidence of landslides is very common in the hills and mountains regions of the Arab region. Topography could be the primary cause; however, in most cases landslides are triggered by torrential downpours and aggravated by human activities such as deforestation, cultivation and construction which destabilise the already fragile slopes. For instance, as a result of combined actions of natural and man-made factors, floods and landslides cost yearly around USD 10-15 millions in a small country like Lebanon with numerous fatalities and injuries (Khawlie, 2000). Some examples show clearly the occurrence of large landslide disastrous events in several Lebanese villages triggered by heavy rains (**Figure 14**): (i) in 1978, a landslide having 600 m length and a maximum width of 250 m witnessed Baalchmay village (Mount Lebanon); (ii) on 9th January 1996, a large landslide threatened several houses cutting off completely the road between Laqlouq and Tannourine; (iii) on 16th February 2000, a landslide took place in Biaqout destroying two buildings completely and one partially; and (iv) in March 2003, floods lasted for 10 days damaging large areas of the Lebanese territory with many slides and mass failure at various locations (Abdallah et al., 2005, 2007).



Figure 14. Heavy rains triggering huge landslides putting at high risk the residential population

Landslides in Jordan have caused numerous problems during the past 40 years. The most critical slides occurred during the period of 1991/1992 after exceptional heavy rain and snowfall (Abdallah et al., 1996) destroying several parts of the international highway that links Amman, Jerash and Irbid. Cracks in houses and roads, destruction of agricultural terraces, and scarps of different sizes are also found.

In mid January 1999, torrential rainstorms accompanied with huge landslides have caused 8 reported fatalities in Greater Algiers. The November 2001 mudflows (triggered by flash floods) in the Bad El-Oued quarter of Algiers were assessed as one of the worst landslides in modern history, killing more than 700 people and leaving around 1,600 missing. In October 2003, rain and hail storms bring flooding and

widespread mudslides, concentrated mainly in three western Algerian regions. In October 2008, heavy rains hit Algeria and Morocco, and dozens have been killed by flash floods (more than 40 victims in the Algerian oasis town of Ghardaia), landslides, road accidents and collapsing buildings (around 3,561). More recently (13 January 2009), the village of Chehna (360 km from Algiers, the capital of Algeria) was ravaged by floods, and a mother and her five children were killed when the landslides struck their home.

The November 2003 torrential storms dump 100 mm rain in 12 hours causing flash flooding and mudflows in Zaio town (Morocco) that destroyed around 146 houses. Artificial lakes at the Mohammed V and Machraa Hammadi dams reached maximum capacity of 331 million m³ and 180 million m³, respectively. During the same month, severe rain showers hit Mecca and surrounding villages (Saudi Arabia), and water levels reached six meters in some parts of the city. These scarce showers initiated landslides through lubricating inherently weak zones of rock and soil, and assisting in removing support along the bottom of a slope, such as running water in stream acting on the base of its banks. Another example is Tunis that has been submerged in September 2003 for several days by the heaviest rains in around 50 years. These rains induce major mudslides in several Tunisian localities (**Figure 16**).



Figure 15. Flash floods and mudslides ravaging Tunis in September 2003 (Source BBC NEWS)

In spite of the bad impacts of landslides in several Arab countries, appropriate management plans are still lacking. Moreover, lack of awareness of the community clearly reflects a misunderstanding of the risks they are facing, and uncaring of the contractors in implementing geotechnical site analysis which may raise the cost value; in addition to the lack of obligatory preventive measures by engineering firms and the legislation (**Figure 16**).



(a) Toppling of rocks triggered by heavy precipitation blocked the Mansourieh main highway partially (Mount Lebanon)



(b) Residents had evacuated and the building is for sale

Figure 16. Bad construction on a high risk area rendering the newly constructed buildings unstable

2.3. Wind storms

The semi-arid, arid and hyper-arid areas of the Arab region are affected by moderate to severe land degradation from wind erosion and there is evidence that the frequency of sand storms/dust storms is increasing during the last years due to climate change. For instance, Saharan dust storms have increased approximately 10-fold during the half-century since the 1950s, and a valuable example is Mauritania with about 80 dust storms yearly, versus two dust storms a year in the early 1960s (Middleton and Goudie, 2001). Levels of Saharan dust coming off the east coast of Africa in June (2007) were five times those observed in June 2006, and were the highest observed since at least 1999.

Human induced actions are by far the most significant factors in the alarming increase of sand and dust storms in some regions. The occurrence of wind erosion at any place is a function of weather events interacting with soil and land management through its effects on soil structure, tilth and vegetation cover. According to the Global Assessment of Human Induced Soil degradation (GLASOD), the area covered by active dune formation is quite extensive in Algeria, and encroachment of the desert onto the fertile northern section of the country is obvious. The total area of Algeria affected by sand storms and related wind erosion was estimated at 12,309,000 ha (FAO, 1992). This area is increasing gradually because of cultivation of marginal lands and movement of sand dune towards agricultural and rangelands (Harahash and Tateishi, 2000). In Morocco, the International Center for Agricultural Research in the Dry Areas (ICARDA) research revealed that seasonal hot winds not only carry away soil but also affect crop performance through excessive evapotranspiration and the direct effect of the wind (ICARDA, 2007). In the oasis regions, sand storms affect wells, palm-tree plantations and traditional irrigation systems.

All lands in the Northern Sinai are characterized by high (50 – 200 tons/ha/year) to very high (> 200 tons/ha/year) risk values of soil loss by wind erosion. The latter is particularly important because the soils are mostly dry and the vegetation cover is scattered or absent. The areas affected by wind erosion and sand storms sum up to 1,369,000 ha (FAO, 1992). Aeolian sand encroachment in Southern Egypt is known for decades. However, and due to increased bad human activities, sand storms have aggravated. For that, the amount of sand movement was identified in 26% of the total area of Egypt. The impacts of sand storms

were reported in terms of crop damage, soil productivity losses, economic losses, mass migration, health impacts, and impacts on climate.

Estimates of soil losses due to wind erosion suggest that up to 12 tons/ha/year are lost in Al Badia (ICARDA, 2007). For the whole country, 570,000 tons of soil materials are lost per day by wind erosion (ERM, 1998). Wind erosion results in sand drifting and high concentration of suspended particulates in the air. Wind storms have resulted in the decline of agricultural productivity of the irrigated lands in the Euphrates Valley, impacting about 2000 km² of land (Ministry of State for Environmental Affairs & World Bank/UNDP, 2003). In some villages in the Governate of Deir Elzzhor, sand can reach the roof level of houses. Similarly, a 40 km stretch of the railroad is severely affected by sand. Sand removal from tracks is needed every two to three days, and sometimes even daily during summer months. Virus spores in the ground are blown into the atmosphere by the storms with the minute particles then acting like urban smog or acid rain.

2.2 million km² of Saudi Arabia is dominated by extensive wind storms and sand/dust drifts, including the world's largest sand sea, the Rub al Khali, the Nafud, and Ad Dahna, all influenced by the northwesterly Shamal wind system (ASCAD, 2007). A blinding wind storm swept through Kuwait and parts of Saudi Arabia (**Figure 17**) on 10 March 2009, disrupting air traffic as well as oil exports. Billowing clouds of sand engulfed the city and surrounding areas, forcing drivers to slow to a crawl and people to stay indoors. Hospitals dispatched emergency teams to dozens of people suffering from breathing problems.



Figure 17. Wind storms and sand/dust drifts hitting Saudi Arabia in March 2009 (Source BBC NEWS)

In Kuwait, about 66 per cent of the area is considered to be wind storms prone (Al-Dousari, 2005). The severity of these storms varies in different localities being controlled by both local and regional conditions as well as land use types. As an example, dreadful sand storm took place on 30 April 2008 with a wind speed of 13 m/s. In addition, in the mentioned wind storm prone area, there are 878 grazing points, and the density of off-road vehicle tracks ranged widely from 0.46 to 4.27 km/km² with an average of 2.49 km/km² (Al-Dousari, 2005). Moreover, the off-road tracks and grazing points are highly related to each other, and both are found in higher densities around watering points. Recent mapping of areas affected by shifting sands indicates that Al Atraf-Kabd area (about 1655 km²) is severely encroached by active sands. In this area at least 11 strategic facilities including airbases, military camps and highways are threatened by shifting sands.

Vast expanses of range and arable lands in the coastal zone of Libya are steadily being invaded by fine-grained, rust-red sand consisting entirely of quartz. This constant menace has turned a large part of Jefara plain and the territory south and east of Tripoli into a complete desert. The high degree of mineralogical maturity of sand from Libyan sand seas (Muhs et al., 2003) suggests long-distance transport, repeated periods of transport and reworking over short distances, or a source in the mineralogically mature Nubian Sandstone that crops out extensively in the eastern Sahara. The fixation and reforestation of these dunes is a huge challenge to Libyan agriculture. A monitoring study on the El-Witia area (as Pilot project) conducted at the Libyan Center for Remote Sensing and Space Sciences in 1997, showed severe natural resource degradation in range lands of the Coastal Zone of Libya (52% reduction in vegetation cover and 227% increase in the formation of sand dunes during the 10 years period, from 1986 to 1996) (Marquina Barrio and Marquina, 2004).

Three-quarters of the Mauritanian territory is covered by Saharan desert, and the remaining one quarter is a Sahelian zone. Mauritania is therefore one of the countries' most vulnerable to the effects of sand and dust storms. This is the consequence of the winds activity that sweeps the country. These air masses are made up of 3 main currents blowing throughout the year: marine trade wind, continental trade wind, and the summer monsoon. Throughout Mauritania, a desolate, dune-enveloped country twice the size of France, men and women wage a daily battle against the sand. Because of human behaviour the desert is advancing from north to south more rapidly than estimated decades ago. The advancing dunes threatened to engulf wells, villages, and roads; they had even invaded Nouakchott on their march to the sea. Between 1960 and 1990, dust storms frequency has dramatically increased while the threshold wind speed declined as a result of vegetation contraction (Niang et al., 2008). Although the 2003 aerial photos show a timid return of vegetation (after 1970 and 1980 droughts) in very limited and specific areas, field surveys show that wind erosion is still very important.

The Sultanate of Oman is dominated also by extensive wind storms and sand drifts (mainly in the Rub Al Khali and the Wahiba sand area). The adverse environmental and land degradation impacts of wind storms and mobile dunes include encroachment on productive agricultural lands, leading to marked lowering of productivity and loss of top soil layers of higher fertility and soil nutrients. During dust storms, atmospheric environmental quality is significantly deteriorated and visibility is greatly reduced. This is responsible for almost unbearable outdoor living conditions, health problems and disruption of communications. Problems of sand encroachment on roads, farms, oil installations and other development establishments are commonly associated with sand storms in the Sultanate of Oman. At present, sand storms are very strong in this country and the associated sand encroachment problems present a serious environmental hazard, which adversely has its impact on the efficiency of many development activities and installations.

Wind erosion is considered the major cause of irreversible land degradation in the arid environment of United Arab Emirates (UAE) where dry, noncohesive sandy soils, poor vegetation cover, strong wind, and hyper-arid conditions prevail. 90% of the total area of UAE is covered by sand dunes (Mediaharti, 2009). The dunes are not static but constantly moving. The wind erosion indicators are formation of fall dunes, blocking of highways, dust storms, nebkha features, reduction of waterways capacity due to fallen sand, exposure of a hardpan at the surface, and gravel lag.

2.4. Forest fires

The forest area of the Arab countries accounts for only 1 percent of the world's forests. Fuel wood and charcoal are the major forest products. According to the Food and Agriculture Organization (FAO), the total forest area in these countries is 50,334 hectares (data for 1995) representing 3.7% of the total land area of the Arab States (FAO, 1999). Forests protect soil and water resources, conserve biodiversity, mitigate

climate change, provide recreation facilities, improve air quality and help alleviate poverty. However, large scale forest fires have increased at an alarming rate throughout the Arab region over the last few decades. This has come mainly as a consequence of the extreme weather events (temperature variability and wind velocity), the rapid land use changes, the socio-economic conflicts, and the competing interests characterizing the Arab region in the recent years.

The health impacts of forest fires can be serious and widespread. Forest fires can have a potential impact on global atmospheric problems, including climate change. Researchers have also realized the significant contributions of biomass burning to the global budgets of carbon dioxide, methane, nitric oxide, tropospheric ozone, methyl chloride, and elemental carbon particulates. This is accompanied with substantial economic damage in destroyed wood and non-wood forest resources, loss of biodiversity, burned housing, degraded real estate, high costs of fire suppression, and damage to other environmental, recreational and amenity values.

Several Arab countries experience dramatically the direct effects of forest fires, and some examples can illustrate clearly these sudden climate disaster events (**Table 3**). In Algeria, the average number of recorded forest fires between the years 1991 and 2000 was 1,739 and the average area affected by fire each year was estimated at 54,797 ha of the national forest cover (FAO, 2007). According to figures from the General Forests Directorate, forest fires over an area of 5,000 hectares in Batna (Algeria) were recorded in June 2007. Thousands of rare plants and trees in the forests of Bni Fdala and Larbaa Municipalities were destroyed. In addition, many rare birds and animal species died (Google Alert, 2007). Scores of forest fires were burning in northern Algeria in late August 2007 (NASA, 2009b). Several people died, dozens of families had to evacuate their homes, and the number of people seeking medical attention for respiratory and allergy problems dramatically increased as a result of these fires. Thousands of soldiers were deployed to help battle the fires.

Country	1982	1983	1984	1985	1986
Algeria	9,381	221,367	4,731	4,668	-
Jordan	130,239	223,728	78,326	189,898	86,407
Lebanon	215	319	139	38	-
Morocco	-	1	3	43	-
Syria	Average of 1,500 ha/year from 1982 to 1985				
Tunisia	1,613	4,139	1,287	396	-

Table 3. Estimated areas of forest fires in some Arab countries (hectares)

Source: ECE/FAO Agriculture and Timber Division (1986)

Forest fires are significantly mobilized by predominating climatic conditions in Tunisia, Syria and Lebanon. Between 1985 and 2000, Tunisia recorded 134 forest fires with an average impact of 1,783 ha per year, which accounts for 0.4 percent of the nation's forest cover (FAO, 2000). Similarly in Syria, the number of forest fires increased from 59 in 1990 to 320 in 1999 (FAO, 2007). Forest fires, which are practically an annual occurrence in Lebanon, have turned large areas into degraded scrubland. Forestry service reports indicate that a high number of forest fire events take place each year in Lebanon (e.g., 1413 forest fires in 1997) with resultant large burnt areas (e.g., 3000 ha during 1998). More recently, the forest fires of October 2007 claimed many lives and destroyed thousands of valuable trees and property.

In most burnt areas, when the damage of vegetation cover is followed by violent rainstorms, the unprotected topsoil is subject to severe erosion and mass movement processes (**Figure 18**). If erosion is not stopped, further increase in runoff and erosion on sloping ground may ultimately destroy the productive

value of the land (Bou kheir et al., 2008a, b). The increasing frequency and intensity of fires is a threat to the floristic species diversity in Lebanon, even those plant communities (e.g., maquis, garrigue, some pine communities) which have been adapted to naturally-occurring fires or depend on fires to maintain themselves. These plant communities can play a major role in stabilizing the terrain via their roots or acting as a direct cover against the impact of rainfall. The potential loss of life and property is considered the most harmful negative consequences of widespread forest fires.



(a) Photo taken in 1998 before fire occurrence

(b) Photo taken in 2003 showing sliding effect due to the forest cover destruction

Figure 18. Forest Fire Influence in Triggering Landslides and Sculpting Landscapes in Ramleiah Area (Mount Lebanon)

3. Climate change mitigation, environmental management and disaster risk reduction

Disaster Risk Reduction represents an important development in both disaster management and sustainable development paradigms. Whereas earlier generations of disaster managers in the Arab countries focused primary attention on the delivery of emergency relief in the aftermath of catastrophes, today increasing attention should be given to disaster preparedness. Risk may be reduced through a variety of pathways that either targets the physical hazard or the underlying socio-economic conditions that create vulnerability (**Figure 19**). Understanding the interaction of physical and social processes is fundamental to estimating future risk and the value of prevention. Risk reduction refers to activities taken to reduce both vulnerable conditions and, when possible, the source of the hazard (especially addressing floods and landslides).

Vulnerability to disasters is, to a large extent, a function of human action (or inaction) and behaviour. It describes the degree to which a socio-economic system or physical assets are either susceptible or resilient to the impact of natural hazards. It is determined by a combination of several factors, including awareness of hazards, the condition of human settlements and infrastructure, the nature and application of public policy, the resources available to a given society, and organizational abilities in all fields of disaster and risk management. For example, buildings may vary in their vulnerability and resilience based on the materials and standards used in construction. Concrete houses are less vulnerable to windstorms, and buildings reinforced with brackets are less vulnerable to earthquakes.

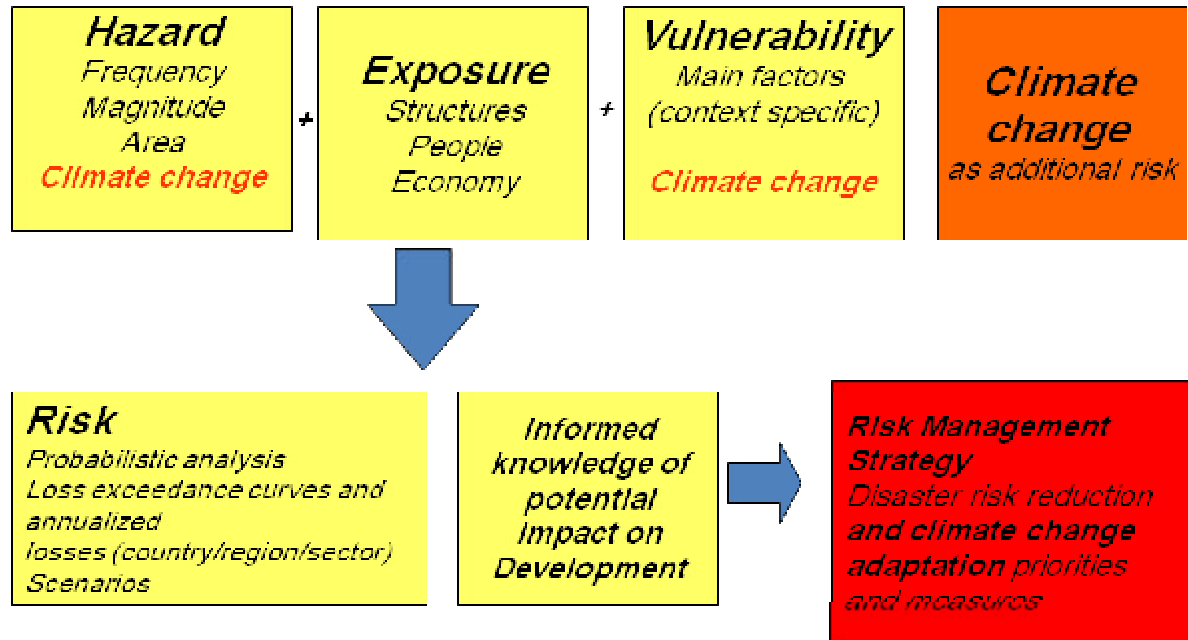


Figure 19. Combined disaster risk reduction and sustainable environmental management/ climate change mitigation (adapted from ISDR, 2001)

The choice of building materials is influenced by socio-economic and cultural factors. In human communities, the specific dimensions of social, economic and political vulnerability are also related to inequalities (**Figure 20**), gender relations, economic organizations, and ethnic or racial divisions. For instance, the poor are more vulnerable, that is less resilient and often the least able to recover from a disaster. In addition, vulnerability is largely dependent on development practices and global trends that can convert exposure to natural hazards into catastrophic disasters.

3.1. Climate changes and related natural disasters

Worldwide, countries, multilateral institutions and the private sector are recognizing that the human-induced climate change is highly related to catastrophic natural disasters. Only through global/regional/national actions with broad participation, can it be addressed. The anthropogenic stresses resulting from accelerated population growth and a higher standard of living are amplifying the impacts of climate changes (i.e., devastating natural disasters) to a wide extent. Therefore, measures to reduce these impacts are, by default, sustainable development communities' practices, whose implementation represents a potential win-win strategy.

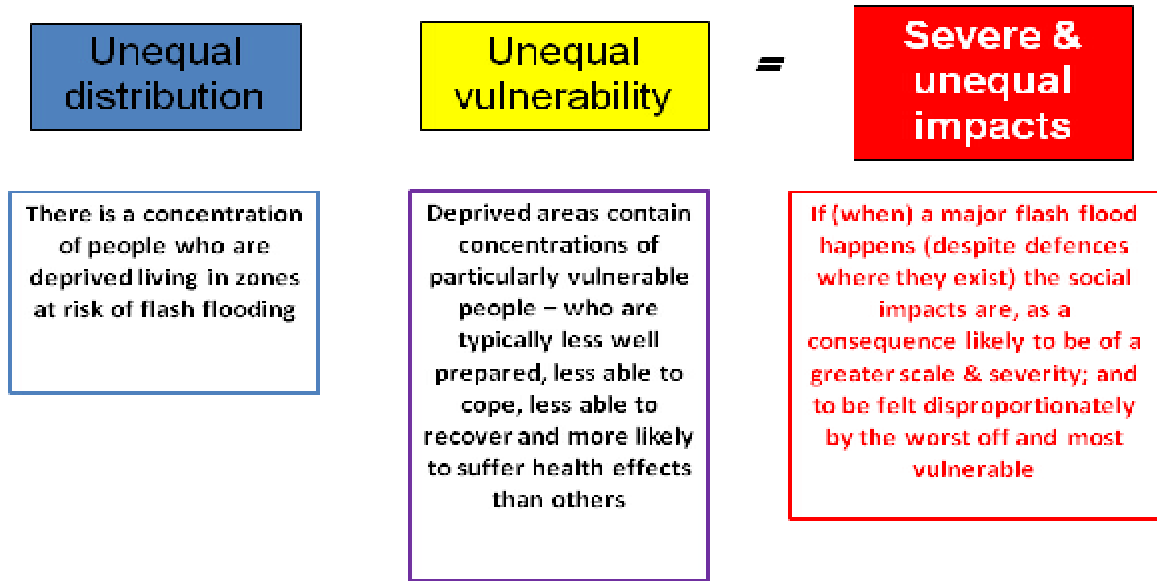


Figure 20. Vulnerability to floods as related to inequalities

The non sustainable overuse of natural resources causes pollution (particularly emissions of carbon dioxide and other greenhouses gazes) and ultimately leads to changes in the global climate (e.g., changes in temperature and related rainfall variations). These changes can affect the intensity and frequency of extreme hydro-meteorological events (e.g., floods and landslides), and increase the vulnerability of developing countries (including the Arab societies). For example, the removal of forests in the upland watersheds of major rivers leads to a decrease in evapotranspiration losses and runoff concentration times, and thereby increases annual runoff and peak discharges (Jones and Grant, 1996). Infiltration rates will decline also as a result of the deduction of the vegetation canopies, and the removal of trunks and roots. The net effect of greater water surpluses and more rapid runoff is increased flood risk and related mudslides. According to the latest UN calculation, three decades from now, around 70 per cent of the world's land will be affected by human activities and half of the people in the world will be at risk from increased flooding (cited by ISDR, 2002). By that time, there could be eight billion people on the planet; this means more fossil fuel consumption, which means more carbon dioxide emission pumped out of cars, planes, factories, power plants and homes, which means climate change and more devastating natural disasters. The UN scientists indicated in the frame of the Copenhagen Summit COP15 held between 7 and 18 December 2009 that the increase in greenhouse gases emissions need to be halted by 2020 at the latest and reduced by at least 50 percent of 2000 levels by 2050.

Apart from floods and landslides, the vulnerability to several devastating forest fires nowadays is a result of human-induced climate variability (including demographic growth and land use changes). Previously, for many fire-dependent areas, the periodic fire occurrence was an integral part of the ecological development. At present, forest fires can be prevented through local human actions that reduce the potential for occurrence, and the devastating effects of these fires can be mitigated through early warning. Mechanisms for community-based approaches and fire management activities (including monitoring, preparedness, prevention, suppression and restoration) exist in several Arab countries, but they are not widely applied. Resources to organize the transfer of technical knowledge to local communities about the latest appropriate techniques for fire control are not sufficient in these countries.

The warmer climate will most probably cause also more heat waves, more cases of heavy rainfall and also possibly an increase in the number and/or severity of sand/dust storms in several Arab countries. A rise in sea level will further exacerbate the vulnerability of societies in the low-lying coastal areas of these countries. Storm surges may already have increased coastal erosion and damage to human settlements because of the removal of or damage to natural protective elements such as mangroves, reefs and dunes. It is known that more than one third of the world population live within 100 kilometers of coastlines and many are therefore under threat.

Therefore, long-term sustainability of communities cannot be attained unless specific actions and development practices are taken against the impacts of climate change. Mitigation measures and adaptations to global warming include planting forests to absorb carbon, changing farming practices, intensified irrigation programs, integrated pest management, promotion of environmental friendly technologies and ultimately even moving populations to higher ground.

3.2. Environmental degradation and incidence of natural disasters

There is a close correlation between increased demographic pressure, growing environmental degradation, increased human vulnerability and the intensity of the impact of disasters, especially in developing countries (and most notably in the least developed countries). The countries that suffer most from disasters are the same ones in which environmental degradation is proceeding most rapidly. Similarly, poverty and vulnerability to disasters are closely linked. There is an average of some 3,000 deaths per event in low-income countries, compared with less than 400 per event in middle and high-income countries.

Rapid urban growth, particularly when it is accompanied by a large influx of poor migrants from rural areas, is contributing largely to increased vulnerability to natural hazards in several Arab countries. Other factors adding to the urban vulnerability include lowering/rising of the water table, subsidence, loss of the bearing capacity of soil foundations, instability of slopes, and the lack of appropriate drainage systems, making some Arab cities susceptible to flash floods and their populations to water-borne disease. At present, more than 62% of the total population lives in urban areas. This figure was much less than that four decades ago, where only 23.7% of the population in 1950 were urban. Urbanization has increased since then and it is predicted to increase to 66.8% and 70.9% in the years 2020 and 2030, respectively (UNEP, 1997). In some countries of the Arab region nearly the whole population is urban (e.g., Bahrain 90%, Kuwait 97%, etc.). For instance, 83 per cent of the population in Djibouti lives in towns and cities (UNESA, 2005), with a growing rate of 5.6% (World Bank, 1998). Inadequate sanitation services are common, and have left the problem of pollution unresolved, contributing to poor hygiene conditions. While the lack of access to water is one of the principal difficulties facing Djibouti cities, there is a general lack of access to basic services (including adequate drainage systems). Another example is Jordan, where 80% of the population lived in urban areas as a result of internal rural – to- urban migration, combined with the influx of refugees and migrants, mainly from Palestine and Iraq (AbaHussain et al., 2002). Libyan Arab Jamahiriya is the second most urbanized country in Africa, with ninety percent of its inhabitants residing in and around cities on the northern coast; just fourteen percent of its people live in rural areas (USDA, 2004). Continued urban expansion is anticipated to claim nearly half of the Libya's most fertile lands by 2025 (UNCCD, 1999), to cope with limited availability of arable land. As a result the vulnerability to natural disasters in the Libyan Arab Jamahiriya will increase largely in the coming years. The Syrian Arab Republic has also a relatively high urban population. In 2003, more than 67% of the total population lives in urban areas (Ministry of State for Environmental Affairs & World Bank/UNDP, 2003). The population growth rate is high as it increased from 9.046 million in 1980 to 18.138 million in 2005, which put

considerable pressures on the available natural resources, mainly in Al-Badiyah (steppe land with an area of 10.2 million hectares). These pressures are contributory factors to natural disasters.

Poverty and social and economic pressures (e.g., unemployment, illegal land tenure practices, unequal distribution of wealth, food insecurity, political instability), make also people in the Arab countries more vulnerable by forcing them to exploit environmental resources for survival, thereby increasing both the risk and exposure to disasters, in particular those triggered by floods and landslides. More and more populations are forced, through lack of choice, to expand into disaster prone areas such as flood plains, unstable landslides and deforested lands, therefore causing disproportionate setbacks to the economics and livelihoods of the affected communities and nations when disaster occurs. The ratios of rural population vary considerably throughout the countries of the Arab region and range from 4 per cent in Kuwait to more than 75.3 per cent in Yemen, with an overall average of 46.3 per cent for the entire region (ESCWA, 2007). Most of the population is living below the poverty line of one dollar per day per person. The poverty rate varies greatly among the countries. For instance, the incidence of poverty in Djibouti is high with nearly half of the total population living below the poverty level and a tenth living in extreme poverty and almost 90% of rural households are classified as poor (World Bank, 1998). Demographic pressures result in more forest loss and more land degradation. This means increased flooding, drought, or both. Poverty in Mauritania remains a predominantly rural phenomenon: the rural areas also have the highest concentration of the poor (75 percent); this is due to a great extent to the rural arid zone which is home to 57% of the nation's poor (UN, 2007a). The increase in the population in the Sultanate of Oman (2.57 million persons in 2005) with a considerable population density (slightly more than 8 inhabitants/km²) and annual demographic growth rate (2.9% between 1990 and 2000) (Hussain, 2005) has put considerable pressure on limited land and water resources of that desert country. Competition over natural resources, especially land, has become an issue of major concern as cause of conflict among the pastoral and the farming populations of Sudan. The vast majority of the population in that country is poor, with an average per capita income estimated in 2001 at us\$ 395 (UNEP, 2007). Women and children remained the main victims of environmental degradation and the consequential natural disasters, poverty and violence.

Sustainable management of natural resources, including reforestation schemes, proper land use, and ecological restoration programs will increase the resilience of communities to disasters by reversing current trends of environmental degradation. In addition to bringing the measurable successes in managing forests, wetlands and agricultural lands, water resources and air quality, the environmental initiatives should aim to influence the attitudes and behaviors of human communities in the Arab region to gender a culture of sustainability. In many ways, natural disaster management should acknowledge both the social and physical dimensions of risk and the critical role of public participation. For example, the public investment in infrastructure and human capital in Tunisia played an important role in reducing poverty (about 60 percent of Tunisia's budget is allocated to the social sectors) (World Bank, 2009). Rural roads have been particularly important in helping the rural poor connect to urban markets and services. Housing programs improved the living conditions of the poor and also freed up income and savings to spend on food and non-food items with resulting positive impacts on poverty alleviation and vulnerability to natural disasters' decrease.

Contemporary environmental management is often characterized by a diverse array of managing partners including local villagers, national, provincial and local government agencies, scientists and researchers, NGO's and the international donor community thus providing for vertical integration. Similarly, horizontal integration of management regimes incorporates the interests and dynamics of multiple sectors such as agriculture, environment, disaster management, tourism and health. Integrated approaches have become widely accepted through the development of new planning paradigms, such as integrated water resources management (IWRM) and Integrated Coastal Zone management (ICZM). Both of these approaches adopt a

regional perspective, by taking a watershed, river basin or other ecological region as the basic management unit. Integrated approaches to environmental management are, in principle, well positioned to incorporate disaster risk reduction in the framework of environmental management and development plans. In fact, the cause and impact of natural hazards often involve adjoining countries which highlights the need for a harmonized approach to the management of these hazards (e.g., transboundary river basins). For example, increasing soil erosion in the hills of Anti-Lebanon is resulting in heavy siltation of the river beds in Syria, causing more frequent flooding. Regional and subregional approaches, strategies and institutional arrangements are therefore necessary. Efficiency can be optimized through the exchange of experiences among countries and constructive dialogue between stakeholders through participatory processes. Risk assessment and monitoring, information exchange and early warning systems, enhanced preparedness and response capacities, particularly in border areas, can be facilitated by the conclusion of subregional and regional agreements.

4. Promoting adaptive strategies and development policies for disaster risk management

The relationship between disaster risk reduction and globalization will constitute a major challenge in the formulation of future disaster reduction strategies. The desire for quick economic returns and increasing deregulation often lead to increased vulnerability to disasters by encouraging unregulated construction, the inappropriate siting of important facilities, deforestation and the destabilizing of slopes for potential landslides. Losses from disasters caused by natural hazards will continue to increase in the Arab countries unless there is a shift towards proactive solutions. Sustainable development is not possible without addressing vulnerability to hazards. Disaster reduction strategies are aimed at enabling societies at risk in the Arab region to become engaged in the conscious management of risk and the reduction of vulnerability. The adoption of appropriate development policies can reduce disaster risk, and this reduction should be multi-sector and inter-disciplinary in nature (relating to the social, economic, environmental and humanitarian sectors). The adopted policies should involve the formulation of suitable regulatory and other legal measures, institutional reform, financial planning, improved analytical and methodological capacities, education and awareness. A creative partnership will need to be developed between Arab governments and the private sector in pursuing effective disaster reduction strategies. The latter should comprise a wide range of interrelated activities at the local, national, regional and international levels (as discussed below).

4.1. Enhancing public awareness for increasing sustainability of Arab communities

The importance of a clearly formulated and successfully implemented public awareness strategy within the broader disaster risk reduction (DRR) framework in the Arab region cannot be overstated. Within the context of DRR, public awareness activities entail the development of a public awareness policy, programmes and materials, and media involvement in communicating risk and awareness-raising, with the goal of changing behaviours so that communities can be more resilient to such natural disasters.

4.1.1. Mass-media coverage

Mass and community media, small/alternative media, cultural/traditional media and other community communication contexts are best integrated to achieve the goals of development (support) communication (Servaes, 2004; Singhal et al., 2004). Mass-media campaigns are among the policy tools most commonly used worldwide to attempt to influence public opinion of particular issues. However, the influence of the mass media on public opinion has been shown to be quite short-lived because media coverage jumps from issue to issue, often from day to day (Driedger, 2007). Over the long term, media attention of particular issues has been shown to vary considerably, often in identifiable cycles (Downs, 1972). Nevertheless, many

public opinion surveys in developing countries (including the Arab countries) have shown that television and radio are used as primary sources of information. Therefore, the mass media are very influential tools for widening Arab public awareness of environmental issues (including natural disasters). Coordination of media efforts with a diverse mix of other communication channels, some interpersonal and some community-based, is useful in order to extend the reach and frequency of the campaign's messages and to increase the probability that messages will successfully result in a change (Waisbord, 2005). Similarly, disaster risk reduction public awareness activities programmes should use different types of messages, locations and delivery systems to reach their various target audiences (UNISDR, 2005).

The media's primary motivation, of course, is to attract and retain audience, and there is therefore a natural inclination for the press to choose the most interesting – and often the most extreme – examples of a risk or event to feature in reports. This understandably selective use of data, especially in headlines, can distort the public's perception of the risk or event, even when a media outlet is not intentionally seeking a sensationalist approach. Developments in technology in recent years and the way the public increasingly interacts and participates in media coverage, for example by use of mobile phone cameras, can often accentuate the focus on the most dramatic aspects of a story, at the expense of more rounded coverage, exacerbating the potential for distortion. Successful emergency operations depend to a great extent on the availability and reliability of and the lead-time provided by warning systems. The longer the lead-time, the more useful the warning, since there is sufficient time to consider and carry out a number of responses. Warnings must be provided and conveyed in an unambiguous, easily understandable manner and in local language through a legally designated single authority. The role of mass media, such as radio stations, newspapers, and television, needs to be recognized and utilized properly to ensure that the warning message reaches the intended audience or vulnerable community with little or no distortion.

There have been various qualitative and quantitative analyses of mass-media coverage of climate change issues in the developed countries. Some have charted the rise and fall of media attention (e.g., Major and Atwood, 2004; Carvalho and Burgessm, 2005), whereas others have focused on the reasons behind the cyclic nature of media attention (Weingart et al., 2000; Brossard et al., 2004; O'Brien, 2006). Most of these studies have focused on how the public, as the receivers of mass media messages, understand the issue of climate change. Depth of understanding of climate-change issues depends largely on individual characteristics such as educational level, age, gender, occupation and ethnic origin (Ester et al., 2003; Aoyagi-Usui, 2008). Some studies have focused on the actual relationship between mass media coverage and public awareness of climate change. In Japan, Aoyagi-Usui (2008) compared public opinion surveys from 1997, 2002, 2006 and 2007, and reported that people's awareness of environmental issues is gradually becoming focused on global warming issues. In other developed countries (e.g., United Kingdom), the coverage of global warming has an immediate but short term influence on public concern. With such transitory high levels of media coverage in the Arab countries, for more effective communication of climate change and related natural disasters, strategies aimed at maintaining mass media coverage of natural disasters are required. Encouraging the Arab public to make their lifestyles more sustainable is necessary: public risk-avoidance actions are not only influenced by recognition of countermeasures, but also by an understanding of the context of the causes and effects of disaster risk. In addition, increasing news media coverage of environmental issues in the Arab region will have a beneficial influence on the political concern (and related public authorities) to implement treaties. This is especially true at critical junctures in the treaty making process: (i) illuminating the need for a new treaty or an amendment to an existing treaty; (ii) expediting the process of signing and ratifying the treaties; and (iii) monitoring implementation and compliance.

Implementing an efficient strategy about natural disasters in the Arab region through the utilization of media coverage should involve creative methods, e.g. celebrity spokespersons for the environmental

treaties and the problems they aim to solve, proposals for movies on the topic, and television coverage in 'soft news' formats, etc. The aforementioned three items would reach a disengaged audience, those with little to no knowledge of environmental issues. For the mass media, the ideal spokesperson would be a prominent, photogenic, non-radical, celebrity person who focuses on the importance of protecting Arab societies through proper disaster management activities.

The creation of reasonably plausible environmental crisis movies (in Arabic) is of high interest. The goal would be to tell a story that is important to the public in a respectful way, steering a path between overblown ecological disaster movies such as *The Day After Tomorrow* (inaccurate, hysterical global warming movie released May 2004) and an internationally earnest, arthouse documentary like *An Inconvenient Truth*. Proposing a movie idea would be appropriate for an NGO, with staff member developing and delivering a pitch. This includes approaching the natural disasters through an existing spokesperson or celebrities already active in the environmental; or by sponsoring a competition among aspiring screenwriters at a film school or university (grant funding would be needed in this case). The promotion of natural disasters' movie would then provide opportunities for key actors and NGOs working on the issue to raise public awareness through television, radio, and print media.

4.1.2. Public education through popular culture

Previous studies (e.g., Rogers, 2002) have indicated that broader education strategies, rather than mass communication (through media coverage), would also be useful to improve public understanding about the causes, consequences and mitigation measures of the devastating natural disasters prevailing in the Arab countries. The formulation of educational programmes including curricula revision and teacher training, as well as the development of resource centers are required. Space technologies such as remote sensing (RS) and geographical information systems (GIS) have wide applications in natural disaster assessment, monitoring and management. The development of constructivist methodologies to assist teachers in schools and universities to develop the use of RS and GIS as educational tools for disaster risk reduction in the Arab region is required. RS and GIS can be effective tools to promote change and growth for students, teachers, skill development, classroom organization, instructional methodology, curricular content, and community participation, all at the same time. They provide methods with which to explore alternative responses for specific problems and disaster situations.

The expansion of training efforts to reach all levels of society, including professionals and community-based leaders and organizations is also necessary. Strategies to support community mobilization and action for disaster reduction are also essential. Gaining the attention of the specific categories of the public is crucial, e.g. computer games about disasters, inclusion in 'Science Café' presentations around the Arab region, etc....The computer games reach the young generation with potential to engage them in the reduction of disaster risks, and the science cafes reach a more elite audience to build the knowledge base and create greater urgency.

The UN societies can feature highly popular educational computer games in which teams of players (e.g., children aged 8 to 13) compete to mitigate natural disasters in the Arab countries. Non-governmental organizations might be able to attract grant support for the creation of such games. These games might include several challenging missions, in which players learn to conduct effective assessment and management of natural disasters (before occurrence), and then plan to reduce the adverse impacts during the disaster, overcoming typical obstacles along the way. By playing the games (one game for each natural disaster), participants also learn more about the causes and consequences of natural disasters, afflicted populations, and potential solutions, including the longer term development situations.

The creation of science cafes is crucial in the Arab region as an informal, interactive way for everyday citizens to learn about climate change and natural disasters in a comfortable setting. The open meetings can take place in coffee shops, restaurants, bookstores, college campuses, clubs, and others. The main goal of UN societies' efforts would be to reach these places, and arrange speakers on environmental topics. Funding possibilities for the speakers might include local sponsors (such as universities, schools and the cafes themselves), foundation funding, or UN funding through regional NGOs. While media attention is not the goal of science cafes, their emergence can attract coverage in magazines, and various radio/television outlets in the Arab region. This kind of media coverage can expand the reach of café discussions to increase public awareness of the environmental topics under discussion. Toby Ferenczi of Cambridge University's *Varsity* newspaper commented: 'Café Scientifique is an organization which tries to take science away from the bum-numbing chairs of the classroom and into big, fluffy sofas . . . It tries to play a role in promoting public engagement in science; making it accountable, because science is no longer for the scientist alone' (Original article in Cambridge University's *Varsity* newspaper, May 2002, quoted on Café Scientifique website 2006).

The tools of electronic networking — computers, modems and Internet accounts — are becoming more and more common in the environmental NGO community, and are of high interest to raise environmental public awareness. However, many activists, although they intuitively sense the potential of this technology, are casting about for effective strategies for applying the power of electronic networking to their work. While most organizations regularly communicate via post, phone and fax, few are using e-mail and the Web effectively to communicate with the public. The number of people in the Arab countries who are online continues to grow, and a large number of environmental organizations are missing a huge opportunity to reach out electronically to their own online audience and help them become powerful and effective environmental activists. E-mail and e-mail lists are the best tools for this type of outreach, and NGO e-mail organizing efforts should be supported by a Web site that can serve as reference centre.

4.2. Spatial urban planning and land use management

The creation and implementation of comprehensive urban strategies and proper land use plans would help identify and allocate hazard-free areas for industrial and urban development. As location is the key factor, land-use plans and mapping tools should be used to determine the level of risk and to identify the most suitable use for vulnerable areas (e.g., location of buildings, roads, power plants, and storage of fuels). There is a need to incorporate soil, geological, morphological and hydrological data in both long- and short-term planning to avert or reduce the impact of natural disasters. This will have to be done on a country-specific basis, as some countries of the Arab region will still need to build or strengthen institutional capabilities to collect relevant spatial data. Others may want to concentrate more on staff training to improve interpretation and/or presentation skills (e.g. use of space science in development planning); there may also be some who have to focus more on organizational and managerial issues to ensure that crucial information reaches the authorities and is acted upon. Introduction of legal enforcement of property insurance against damage inflicted by natural, particularly flood events and related landslides, may be considered as one of the most efficient ways in the Arab countries to ensure that building codes are followed and properly allocated according to realistic criteria based on actual environmental conditions. The retrofitting of existing structures that are vulnerable is also necessary in order to "reduce the possibility of injury."

Greater emphasis should be placed on assessing and mapping different devastating disasters in the Arab countries using the most sophisticated technologies nowadays (remote sensing and GIS). The obtained thematic hazard maps will have a very high potential for reducing fatality rates. The physical impacts of natural hazards can be reduced also by preventing or modifying the occurrence of the hazard, such as in the

case of flooding. This can be done very effectively through land use planning and management, particularly in areas where structural measures would be too difficult or too expensive to implement. Spatial planning has to analyze also the interrelations between the spatial influences and natural disasters prevailing in the Arab countries. New models of spatial development have to be developed and/or adapted according to the specific environmental conditions in these countries. A spatial database has to be created also related to evacuation routes and spaces for assuring adequate emergency plans and risk management.

Apart from the institutional/organizational and managerial issues, the regional and the communal levels in the Arab countries have a great legal capacity to implement adequate spatial urban planning helping in the prevention of environmental disasters through the adoption of the following tools and strategies:

- strengthen the decentralized urban development with poly-centric structure;
- assessment framework to choose suitable location and spaces of the future settlement development apart from river valleys, natural retention areas and unstable slopes;
- priority of interior urban development (reactivation of brownfield sites, mobilization of “gap” sites, reuse of urban wasteland and vacant buildings);
- space saving development of new residential areas with mixed use and increased density;
- cooperation between urban and rural areas in the fields of settlement, infrastructure and protection of the environment;
- reduction of soil sealing;
- safeguarding and efficient realization of urban concepts;
- integrated planning strategies with social and environmental aspects in addition to town, infrastructure and traffic planning; and
- enhancement of vegetation and safeguarding the open spaces within the urban areas.

4.3. Early warning systems

Regional and national programmes on monitoring through satellite-based remote sensing and multi-level environment protection systems (early warning systems) at regional/country/ area level are needed in the Arab region. Greater emphasis should be placed on expanding observational and monitoring systems, especially in areas/regions where data is scarce. There is still a need in most Arab countries to establish and upgrade observational equipment and networks to monitor hazards properly and disseminate warnings quickly through an efficient warning system. To help improve them, reliable feedback information should be collected on warning performance, public responses and damage caused by natural disasters.

The objective of early warning is to provide individuals and communities exposed to disaster risk in the Arab region with accurate information about an impending hazard as early as possible, allowing them to act in a timely and appropriate manner to reduce the probability of suffering, personal injury, death and property losses. Increased sophistication in prediction technology, trained professionals and adequate finances are not effective if there remains poor communication amongst authorities and disaster managers. In the face of a disaster, this can lead to conflict, contradiction and confusion with bad decisions being taken. Early warning must be more than a technological instrument to detect, monitor and submit warnings and alerts. It should also include identification of hazards, risk assessments and combined efforts required by all sectors to plan ahead and build people’s capacity to respond rapidly and appropriately at the local level, and, more specifically, to identify increasing vulnerabilities in their communities. Early warning needs to become part of a management information system for decision-making in the context of national institutional frameworks for disaster management and as part of national and local strategies and programmes for disaster risk reduction. The utilization of indices and indicators is an important tool for environmental vulnerability but results must reach the appropriate decision makers. There is little point in monitoring if there are inadequate resources and support for follow-up actions.

4.4. Institutional development and mutual cooperation

Capacity building and strengthening of institutional arrangements at all levels in the Arab region is necessary to address disaster risk reduction. There is a need for free exchange of data among countries in the Arab region in standardized formats. Attempts should also be made to utilize the available data more effectively. Since urban areas for example are potentially more vulnerable to hazards such as floods, there is need for (micro) zonation maps delineating flood hazard levels. Arab countries should appoint also national inter-disciplinary committees to coordinate disaster mitigation activities of government and other agencies. These committees can collaborate with all the concerned departments and institutions to formulate and implement plans and programmes, formulate measures for natural disaster prevention and mitigation, and establish programmes of cooperation with international organizations and non-governmental organizations. Some degree of regional cooperation in disaster prevention and mitigation, particularly among neighbouring countries, is already gaining ground. The bilateral/multilateral cooperation between Arab countries is increasingly being assisted during the last years by UN organizations and multilateral agencies such as the World Bank and the Islamic Bank.

At the national level (of each Arab country), capacity building should include the development of an integrated disaster risk management plan that covers risk mapping and assessment (using remote sensing and GIS), monitoring and early warning systems, training and public awareness programmes, transfer of technical knowledge, emergency response management and recovery resources, including the strengthening of community-based organizations. This capacity building needs to take into account other primary actors in disaster risk management such as the Red Cross and Red Crescent societies and other major players at the local level. It also includes the increased capacity (environment, finance, transport, construction, agriculture, education and health), sector synergies and networking for sustainable management of forest, land, and water resources.

The design of development projects in the Arab countries should take also disaster risk assessment into account at the appraisal stage. Environmental impact assessments should systematically include a section on hazard proneness and consider disaster reduction measures where appropriate, with particular regard to the protection of lifeline infrastructure and critical facilities, such as health and education. In rural programmes and drought-prone areas, specific attention should be paid to food security and the promotion of agriculture techniques and inter-cropping that reduce hazard related agriculture losses. Vulnerability goes far beyond geographic location and thus a holistic approach is advocated. Vulnerability assessments or hazard mapping can forget or overlook the expertise of a local population. This resource, if harnessed and developed from the beginning of a project, can be a valuable asset. Gender impact analysis should also be taken into account, highlighting the need for greater integration of gender equality issues in sustainable development and risk reduction goals.

4.5. Scientific needs and design of research projects

Creating closer links between policy, research and practice is central to reducing the impact of natural disasters. Communication across these domains provides an appreciation, understanding and involvement across interrelated areas and is of high importance in reducing risk. However, for science and research to effectively influence policy development, information must be clearly communicated to government in a timely and understandable manner. This is vital in ensuring scientific research reaches its full potential and assists policy makers to make informed and relevant decisions using the best information available.

A better understanding and knowledge of the relationships between climate change, natural hazards and related socio-cultural and environmental vulnerability in the Arab region is required. The coordination application between Arab countries through the transfer and exchange of experiences and by providing greater access to relevant data and information should be supported. The design of research projects addressing the construction of spatial databases on natural disasters, the development of models for assessing and mapping natural hazards (using remote sensing and GIS) in the Arab region, the formulation of diverse climate scenarios and the study of their effects on triggering natural disasters, the adoption of suitable coping strategies for different social groups, the link between natural resources management with disaster reduction, etc. should be encouraged. The stimulation of interdisciplinary and inter-sectoral partnerships and the expansion of disaster risk reduction networking amongst Arab governments at national and local levels with a greater involvement of the private sector, academic institutions, NGOs and community-based organizations (CBOs) are necessary. The dissemination of scientific knowledge of sudden-impact disasters among Arab countries is crucial for effective risk reduction.

4.6. Long-term, apolitical policy development

Natural hazards are not confined by state or political boundaries. The actions of one local government can and do influence the potential impact of a natural hazard on neighbouring political areas. The construction of a dam or levee in one local government area, for example, may affect flood levels in other local government areas, depending on where they are located. Policy relating to the management of natural hazards needs to be holistic (Twigg, 2004), cross-jurisdictional and focused on achieving the best outcome for the whole Australian community. Arrangements, programs and policies within and between the different levels of government contribute to many effective natural disaster management relationships. The cost of natural disasters can far outweigh the cost of preventative measures, in both economic and social terms.

5. Mitigation measures before, during and after natural disasters

The systematic management of administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural disasters comprises all forms of activities, including physical, socio-economic, environmental, management/institutional and post disaster measures to avoid (prevention) or to limit (mitigation and preparedness) the adverse effects of these disasters (**Figure 21**). The level of disaster preparedness is a major factor in mitigation of natural disasters. There is a need for dissemination of information in the Arab countries on the measures to be taken before, during and after any disaster. Awareness can be raised through a number of mechanisms: mass media coverage, education, regular training, particularly in areas exposed to infrequent hazards or with new settlements. Hazard maps, depicting disaster-prone areas, evacuation routes and safe shelters, can play a critical role in awareness building. Special effort should be made to women and children and minorities and ethnic groups.

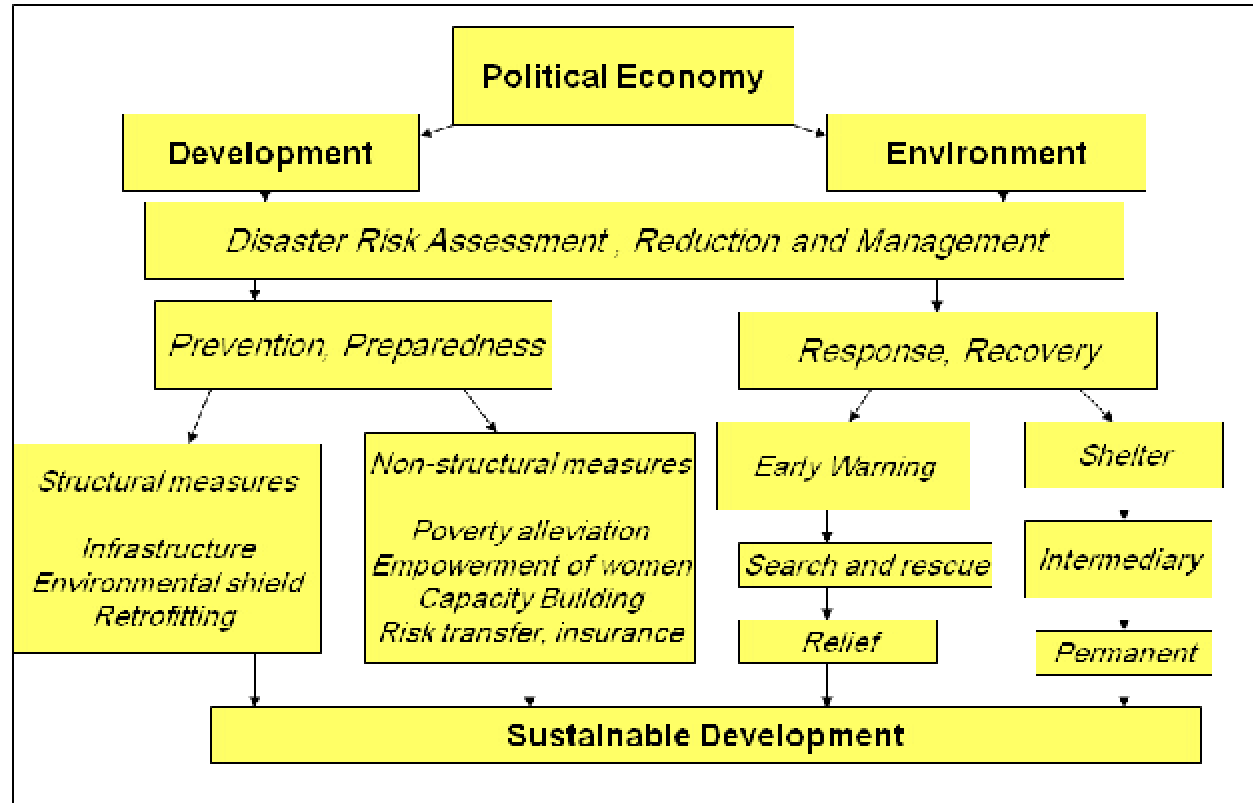


Figure 21. Natural disaster management framework

Emergency preparedness plans cover from community level to national level in various Arab countries with recognizing that preparedness begins at the community level since community members are the first responders. The local inhabitants should be facilitated and empowered to plan and implement their own disaster preparedness measures that reflect local conditions and real needs on the ground. A common platform should be established for local communities in the basin to meet and share emergency preparedness plans. This facilitates the exchange of information between the communities within the basin.

Structural and non structural physical disaster risk reduction measures have been undertaken in several Arab countries to help avoid or alleviate the damage and losses that result from natural hazards. Structural measures include construction of hazard-resistant and protective structures and infrastructure. For example, several water harvesting structures [e.g. stone contour bunds, stone walls (**Figure 22**), stone check dams, rock fill check dams, gabion check dams, gradoni terraces, hafeers, etc.] were implemented in El-Qaa watershed (Lebanon) to reduce the runoff velocity, thus increasing the time for water to infiltrate into the soil (GTZ and ACSAD, 2008).



Figure 22. Stone wall structures to reduce the adverse effects of devastating floods in El Qaa watershed (Lebanon) (GTZ and ACSAD, 2008)

However, several applied risk reduction measures do not show the requested reliable results in avoiding the losses from natural disasters. For example, terraces constructed at many localities in Lebanon and Yemen and with different support specifications, are subjected to collapse in several cases since they are badly maintained and are forsaken to further deterioration and land desertion. In addition, some retaining walls or embankments serving to prevent landslides on road cuts or unstable construction sites are badly constructed (according to engineering standards), and rarely a wet season (with torrential rainfall) goes by without a catastrophic event taking place of collapse of these measures (**Figure 23**).



Figure 23. Bad construction of retaining walls aggravating the risk of landslides

Where large-scale structural flood control measures, such as dams, dykes, reservoirs, levees, channels and floodwalls have been constructed in several Arab countries, protected communities generate a false sense

of security over a period of time. These structures are usually built to provide protection from a certain flood magnitude. If a flood larger than the designed flood occurs or certain conditions undermine the stability of the flood protection structure, protection measures are likely to fail. Therefore, it is vital for the protected community to recognize the limitations and level of the protection that these structures can offer and be aware of residual risks. Contingency plans for meeting such situations are essential to respond and prepare for such residual risks.

The implementation of effective structural measures has to be preceded by a comprehensive disaster risk mapping and assessment. The measures consist of avoiding areas with high risk, or making a non conflicting use of areas with moderate risk, or applying special engineering design and construction for correcting adverse conditions. Appropriate management plans and hazard/disaster risk maps are still lacking in several Arab countries. Moreover, lack of awareness of the community clearly reflects a misunderstanding of the risks they are facing, in addition to the lack of obligatory preventive measures by the legislation and engineering firms. Most of the earlier flood mitigation programmes adopted by individual Arab countries had been specific to a city or to a discrete agricultural area and had employed a narrow range of engineering works to provide solutions to the flooding problem. Although some projects were successful, some of them have actually exacerbated flood damage. In recent years, most countries have recognized the inadequacy of programmes based solely on structural measures. Numerous attempts had been made to employ non-structural flood loss prevention measures to assist in minimizing losses, principally through exercising control over development in flood-prone areas. These measures were usually associated with a mix of structural measures and, in some circumstances, provided a comprehensive means of coping with a flood problem. In such context, non structural measures including participatory mechanisms, public hearings and commitment, knowledge development, collaboration in decision making and the provision of information are needed in the Arab countries to reduce disaster risk and related impacts (**Figure 25**). Examples of non structural measures consist of: (i) engineering implementation such as designing for vibration, lateral loads, wind loads, load surcharges, flood resistance; (ii) physical development plans that identify land use zones that are developable and those that are hazard prone; and (iii) development regulations (design standards, building codes); etc...

The greater the extent of participation and control over decisions, the lesser the number of stakeholder representatives engaged in the process of disaster risk reduction. As shown in **Figure 24**, the lowest level

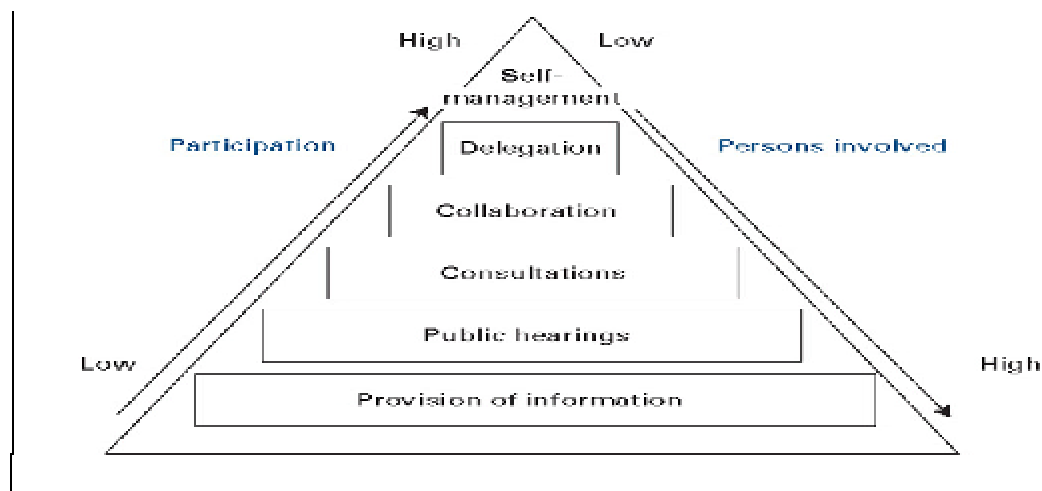


Figure 24. Participatory mechanism in disaster risk reduction: various degrees of stakeholder involvement (Source WMO/GWP Associated Programme on Flood Management (APFM) <http://www.apfm.info>)

of public participation consists of the dissemination of information on decisions taken by the decision makers on a particular issue.

The next level involves public hearings on those decisions when feedback and agreement are sought from the stakeholders. Consultations involve soliciting stakeholder views on proposed action and engaging them in a dialogue. Unlike information dissemination, consultations are characterized by a two-way information flow, from decision makers to people, and from people to decision makers. Collaboration refers to sharing, negotiating and controlling the decision-making process in project design and management between vulnerable groups (e.g., poor, women, and indigenous people) and the responsible authorities. As in consultations, collaboration is based on two-way flow of information and ideas. Delegation involves joint decision-making, with intensive stakeholder involvement but it is carried out through a representative mechanism. Under self-management, the community or individual takes its own decisions.

In recent years, people in several Arab countries have gradually acknowledged that even structural measures can contribute for the mitigation of the adverse impacts of natural disasters, inequalities and conflicts are created where inadequate attentions are paid to social/financial issues. Therefore re-orientation of socio-economic perception of natural disasters from disaster control to disaster management is inevitable. An integrated disaster management approach is needed in the Arab countries, which adopts an effective combination of structural and non structural measures and focuses on the physical, social, environmental and economic aspects of natural disasters. For instance, in the particular case of flooding (**Figures 25 and 26**), the integrated flood management requires the active participation of stakeholders and flood plain occupants are no longer viewed as hapless victims: they play an important role in helping themselves and actively participate in tackling the problem caused by floods. Socio-economic risk reduction measures are those that are designed to address gaps and weaknesses in the systems whereby communities and society as a whole prepare to respond to disaster events. Building awareness of hazards and vulnerabilities at the community level (e.g., mass media campaigns), creating community mutual assistance networks, developing employment protection programs are considered among the socio-economic measures that can be used to reduce the adverse impacts of natural disasters.

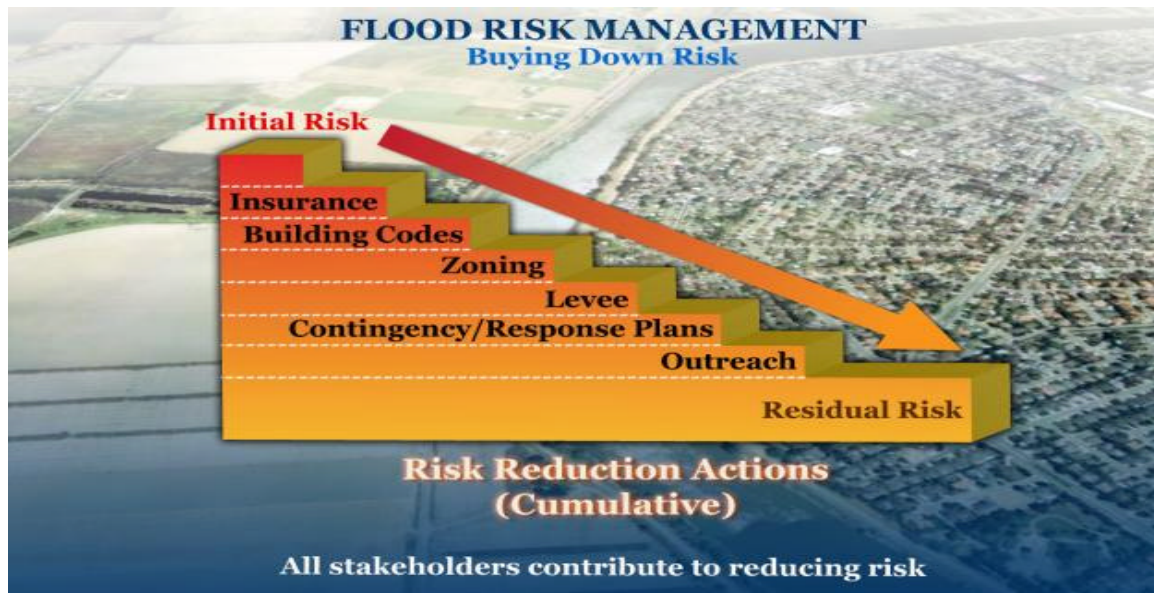


Figure 25. Buying down flood risk management (from initial risk to residual risk)

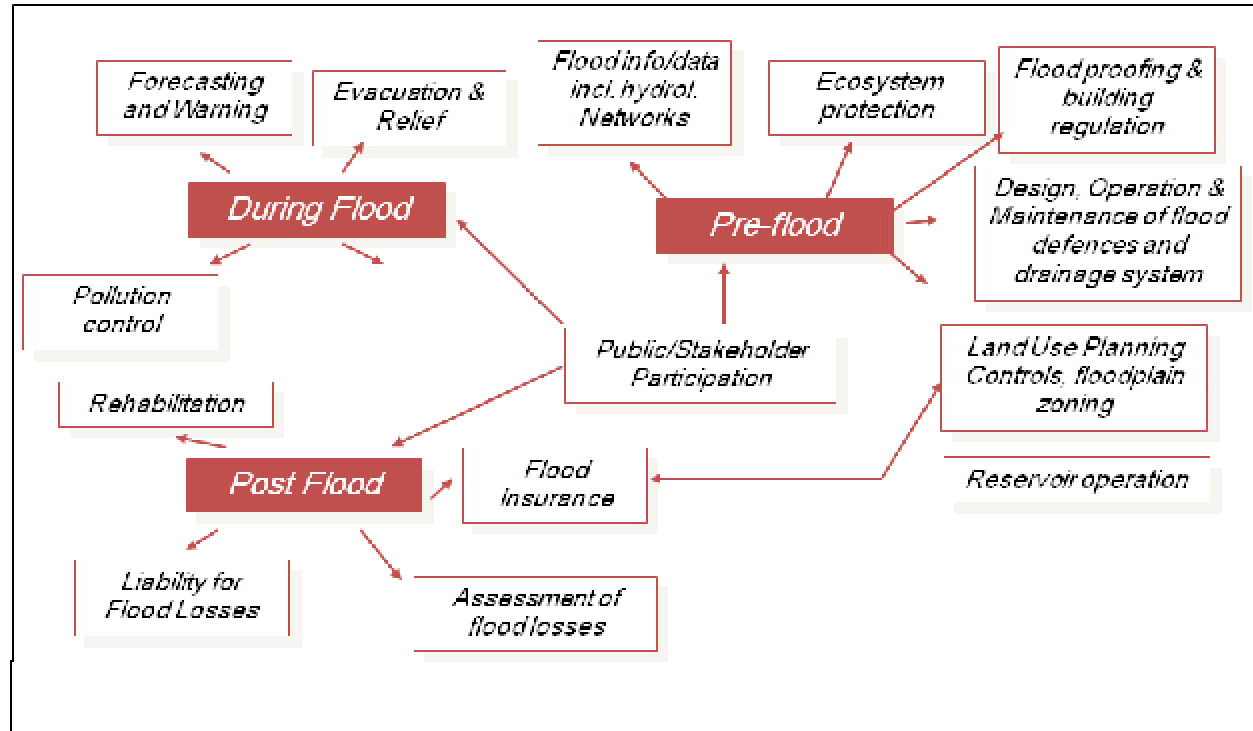


Figure 26. Overview of integrated flood management

In addition to the socio-economic risk reduction measures, environmental enhancement measures play an important role in combating natural disasters. They are needed in several Arab countries to protect existing, or rehabilitate degraded, environmental systems that have the capacity to reduce the impact of natural hazards. Environmental Impact Assessments (EIAs) can be used to: (i) identify the environmental and social impacts of proposed disaster reduction projects in order to predict environmental impacts at an early stage in project planning and design; (ii) find the ways and means to reduce adverse impacts, (iii) shape projects to suit the local environment; and (iv) present the projections and options to decision-makers. Physical measures that restore or fortify damaged environmental systems such as reforestation of critical watersheds or restoration of degraded river courses are being undertaken in several Arab countries. They can reduce to a wide extent the adverse impacts of the sudden-natural disasters such as floods and landslides. For instance, the Jordanian and Tunisian governments carry out some activities including afforestation, rangeland development, and conservation of the mountain lands and developing the major watersheds. In addition to these activities, the United Arab Emirates (UAE) is adopting environmental management policies on the agricultural lands that help to minimize the flood and related erosion problems. The government of Bahrain is issuing suitable legislations, improving farming and irrigation practices, carrying out surveys of the natural resources and drawing up a national action plan for combating desertification. A similar plan has been drawn up in Algeria. The plan is either integrated with the national programme for economic and social development, or with the national programme for environmental activities. The Algerian government is also taking specific mitigation measurements, e.g. replanting trees, bushes and protecting the watersheds. The Djibouti government has taken measures since the 1980s to rehabilitate the degraded lands. Saudi Arabia and Egypt have started a number of projects for the conservation of natural resources, flood and erosion control and development of human capacity. The governments of Sudan and Somalia are implementing integrated programmes for sustainable development, including forests, rangelands and taking institutional measures to ensure the implementation of the UN convention to combat desertification. Similarly, Syria is implementing that convention, and putting efforts

of afforestation in different parts of the country. In Iraq, water erosion is serious in the dry-land farming of the north, where few attempts at soil conservation are limited to planting trees. Oman, Libya and Yemen are rehabilitating the rangeland areas and implementing programs related to afforestation. Qatar is drawing up an integrated national action program for combating desertification, including the protection of 29 sites for forest protection, 37 sites for grazing land protection, 15 sites for the preservation of the indigenous life, rehabilitation of some pasture sites and forests, construction of earth dams, and planting 11 million trees. Likewise, Kuwait and Morocco are increasing afforestation, surveying and evaluating the range land resources, establishing protected areas and issuing proper regulations and legislations. In Morocco, the rural communities have progressively developed for centuries various strategies adapted to manage water and soil on steep hillslopes. The efforts made by the Lebanese government in combating landslides are manifested in replanting, construction of terraces, torrential water control, organized grazing and conservation of the existing forests. The strategy in Mauritania for combating flood and erosion relies on the rational management of the production capacity, on the protection of the environment and support for proper development plans. The Mauritanian government secured international help to stabilize the dune field around Nouakchott and planted 250,000 palm trees to create a barrier against the encroaching desert. To further combat desiccation, the government constructed dams on the Senegal River and its tributaries to increase the amount of cultivable land.

Moreover, measures to combat sand and dust storms including reduction of the impact of wind speed through the use of live wind breaks or shelterbelts; protection of the loose soil particles through the use of crop residues or plastic sheets or chemical adhesives; and increasing the cohesion of soil particles by mechanical tillage operations or soil mulching, were applied also in some Arab countries. For example, Kuwait has performed the management of rangelands and the establishment of protected areas (1960-2008), the restoration of degraded terrains (1991-2008), controlling shifting sands (1968-2008), and watershed management (1993-2006). Qatar developed a project for stabilizing the sand storms in Al-Asha (4500 ha). Future strategies for reducing the impacts of sand storms and dust storms must be based on community-based approaches that integrate effective crop and land management strategies as well as policy interventions to promote more effective soil conservation measures at the national and regional scales.

Management and institutional disaster risk reduction measures include education, training and professional competence, access to information and political will. The professional training of engineers, planners, economists, social scientists and other managers to include hazards and disaster risk reduction within their normal area of competence is a must. Obtaining political commitment from Arab public authorities is highly requested to reduce the devastating impacts of natural disasters. Disaster reduction should be dealt with as a primary policy issue for which public authorities should assume responsibility and should be pursued as a cross-cutting issue aimed at ensuring policy integration among various sectors and across topics such as agriculture, food security, health and education. The increased intersectoral coordination at all levels, the adoption of risk management strategies, and the allocation of appropriate resources, including the development of new funding mechanisms are needed in several Arab countries.

A well-designed disaster recovery process can help disaster-devastated Arab nations, communities and individuals regain their original socio-economic status. Vital lifeline facilities such as water supply, electricity supply, roads and telecommunications, hospitals and sewage systems have to be repaired as soon as possible. The recovery period should be viewed as an opportunity to explore ways to improve the disaster risk situation and incorporate enhanced resilience of the rebuilt assets. There is a general tendency to reconstruct the *status quo ante*, which often means that previous errors in development activities are repeated. Therefore this phase is a particular challenge to the competent local authorities since reconstruction, which should result in higher, sustainable safety levels, requires planning time in the face of the disaster victims' urgent needs. It is important that the reconstruction process use local labour and

locally available materials as far as possible in order to create jobs and help put the economy back on its feet. To improve prevention and preparedness, it is essential to learn lessons from past disasters. Hazard mapping and risk assessment needs to be done. This would delineate areas vulnerable to climate-related natural hazards and the frequency, intensity, impact, etc. of each hazard. There is need for comprehensive vulnerability analysis for disaster-prone areas.

6. Role of stakeholder analysis in disaster risk management

For an effective disaster risk management, several stakeholders have to be involved: (i) government ministries, departments and agencies, (ii) disaster-prone communities, (iii) other-basin communities, (iv) scientific institutions, (v) registered NGOs, (vi) voluntary organizations, and (vii) the private sector. Each stakeholder has a specific role to play and can be said to have an orbit of influence with respect to a particular activity (**Figure 27**). The decision-makers, who are at the centre of a orbit of influence, are the starting point in a decision-making process. The first orbit contains the stakeholders who are partners in decision-making. Final decisions must be made with their concurrence. Orbit 2 features the creators, who are deeply involved in the decision being made and in developing alternatives and are therefore constantly involved. Orbit 3 consists of the advisors, who are active but not constantly involved and are called upon periodically for advice. Orbit 4 features the reviewers, those who wish to be kept informed before a decision becomes a policy, rule, law or fait accompli. However, they do not feel the need to be active throughout the process. Orbit 5 contains the observers. These are people who do not want to be surprised. They watch and react only if an issue concerns them. However, they could be party, but not entirely involved. The outer orbit holds those who are not seen in the process, but who will react if they are suddenly surprised and feel threatened.

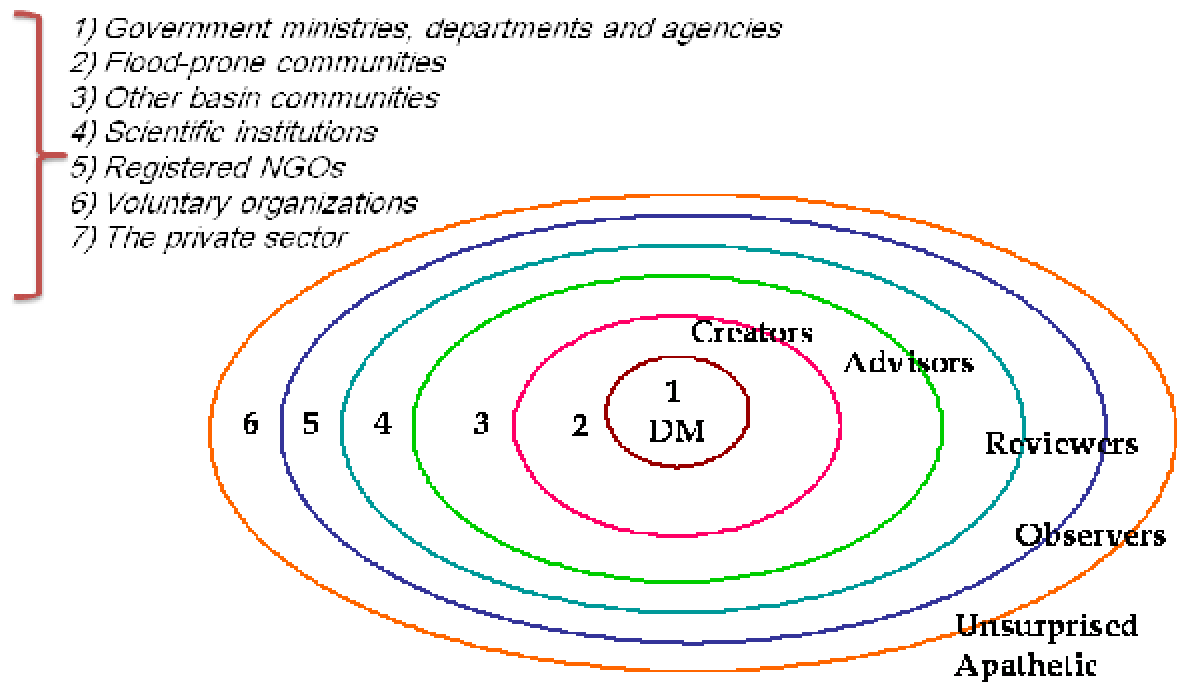


Figure 27. Orbit of influence for stakeholders involved in disaster risk management (Source WMO/GWP Associated Programme on Flood Management (APFM) <http://www.apfm.info>)

6.1. Identification of potential pitfalls and limitations of stakeholder participation

It is important to identify the pitfalls and limitations of stakeholder participation so that remedial measures can be included in the planning and implementation processes from the start. Pitfalls will differ in varying socioeconomic, cultural and political settings and include the following:

- High expectations leading to disappointment if the process is terminated prematurely or implemented unsatisfactorily;
- The complexities of involving all stakeholders may render the process unwieldy and costly;
- Insufficient involvement of the real decision makers leading to sub-optimal results;
- The process is time consuming and requires long-term commitment. A prolonged process may cause people to lose interest after a while. In such situations, more often than not the only people who remain are those who are opposed to the process;
- Lack of financial and human resources and the high costs of bringing together many stakeholders over a large geographical area may delay or prematurely terminate the process;
- People tend to discuss various options only in terms of content without addressing their economic viability.

6.2. Participatory process and planning

From the initial phase of the disaster risk management from the basin planning design to the finalized draft plan, each step involves the creation of a common level of knowledge among various stakeholders, which results in a divergence of views. After debate and discussion, convergence is reached through consensus. This process is repeated each step of the way, as illustrated in **Figure 28**. With each step of basin planning, the time spent reaching a consensus and making decisions and the time taken to resolve conflicts between stakeholders become shorter.

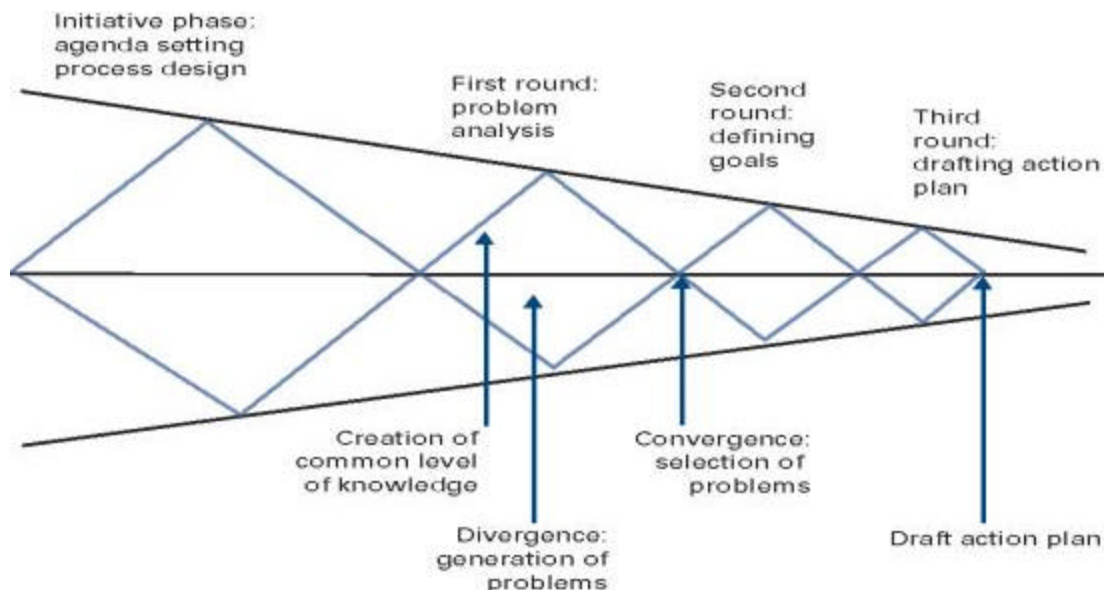


Figure 28. Divergence and convergence in a participatory process (Source WMO/GWP Associated Programme on Flood Management (APFM)) <http://www.apfm.info>

Disaster management activities should be carried out under a flexible but well defined basin disaster management plan guided by basin disaster management goals within the framework of national disaster management policy. National disaster management policy should include an overall assessment of disaster hazards and their impact on socio-economic well-being, a definition of the required degree of risk mitigation, equity principles to be followed, prioritization of pre- and post-event measures, types of incentives and disincentives to be used and a discussion on how to deal with residual risks. A basin disaster management plan starts with setting goals that are largely guided by regional development objectives and driven by the need to reduce disaster risks, secure livelihoods, sustain economic development and preserve environmental quality. Firstly the process for stakeholder participation should be designed for planning. By involving the stakeholders' ethical considerations regarding equitable development, distribution and sharing of risk and decisions as to who should finance flood risk mitigation can be made. Decisions regarding the degree of risk that people are prepared to take must be made. Institutional arrangement is required for coordination and to develop the plan. Comprehensive multi-hazard risk assessment is a key to setting goals.

6.3. Disaster risk actor groups and their influence

There are certain prerequisites for ensuring the successful and sustainable involvement of stakeholders in a given situation. The most important of all is to build trust through information sharing and repeated interaction. Commitment, accountability, transparency of action, the application of equality principles and tolerance towards dissent are factors that determine, encourage and promote public participation. When stakeholder involvement in integrated disaster management is being launched and maintained, potential hurdles and setbacks can be created by various factors. They need to be guarded against, and if possible, addressed in a systematic and persistent manner.

6.3.1. The role of ministries

Arab Governments and the public have been slow to take action on disaster risk reduction till now. Resources and efforts go mainly into relief and recovery, but very little is spent on addressing the underlying causes of disasters. For that, the Arab governments (and related ministries) should have in their approach all the ways to manage natural hazards (e.g., considered as regulatory authorities for flood and landslide hazards). They should be responsible for implementing regulatory policies and legislations relating to public risks, emergency management, disaster recovery and long term mitigation efforts. They should provide as well land-use planning and building, grading and zoning codes, and insurance coverage for flood damages including mudslides.

In disaster emergency response, local government agencies are expected to assess the immediate needs of the affected communities, conduct the evacuation of the public in high-risk areas, activate local search and rescue teams, take immediate remedial measures to repair or restore damaged infrastructure, such as bridges for transportation purposes, and seek help from state or national authorities when the scale of the disaster exceeds their capacity. Pressure to Arab governments to act may come from the public, media, lobby groups and others, and ministers will want to be seen to respond appropriately. Sometimes the 'best' course of action may be not to take substantive new measures, but this is often an unattractive choice for civil servants eager to make their mark, or for politicians, under pressure to make an announcement, to "do something". Intervention in these circumstances could be at best unnecessary and may actually be unhelpful in managing the underlying public risk. Common damage assessment and needs analysis should be undertaken by the coordinating agencies and information shared with local, state and national authorities and volunteer organizations. The most important feature of emergency response is the timely and efficient coordination between responsible government agencies, local communities and NGOs.

6.3.2. The role of research centers and universities

The research centers and universities in the Arab countries should produce inventories and maps of natural hazards and disaster risks using the most sophisticated tools nowadays (GIS and remote sensing). They should also monitor disaster-prone areas (using GPS) and support research. Some centers should provide weather forecasts and assist in emergency response activities. Faculty and researchers at Arab universities should conduct more research on flood and landslide processes, develop monitoring and mitigation techniques and advance scientific methods to understand the hazards.

6.3.3. The role of the private sector and professional societies

The private sector including hydrologists, geologists, planners, and engineers should work mainly as consultants for both government and private property owners in the Arab countries by investigating natural hazard areas and recommending hazard reduction measures. Private sector & professional societies serve as conduits of information between researchers and practitioners. They can promote also best practices, model codes, guidebooks and training for disaster risk management. Experts in specific disciplines can play a valuable role in informing responses to public risks. But they can also use the risk landscape to their own ends, taking advantage willfully or inadvertently of the high degree of trust that the public has in them. Experts can for example raise issues in the media which enhance their own reputation, or advocate standards which increase the value of their own expertise. On the other hand, common sense, local knowledge and experience are frequently undervalued in responses to community risks, in comparison with the views of specialists brought in from outside who will likely be ignorant of local factors.

6.3.4. The role of disaster-prone communities and registered NGOs

River basin organizations, disaster management committees at various levels, community-based organizations and non-governmental organizations (NGOs) are the key components of an appropriate framework aimed at facilitating dialogue and negotiations between various stakeholders for an effective disaster management. A community-based organization (CBO) is best positioned to effectively carry out activities and plans affecting the lives of the communities, socio-economic development, natural resources management, environmental conservation or disaster management. At the grass-root level, CBOs such as community flood management committees (CFMCs) can prove effective in preparing and planning community response to emergency situations. NGOs role in the field of Disaster Risk Reduction DRR is crucial, in particular activities such as mainstreaming into development, rehabilitation and recovery programmes, especially at community levels, capacity building, knowledge transfer and public awareness in communities at risks, and accumulating and sharing good DRR practices. Women play decision-making roles in disaster issues. Women and young girls play an important role in their families and communities (in health, education and childcare). Mobilizing and organizing women in separate / mixed groups or forums and strengthening leadership skills and livelihood capacities should be encouraged in the Arab countries for an effective disaster risk management.

6.3.5. The role of UN organizations

UN agencies in the Arab region need to join hands to streamline and maximize the impact of their collective efforts on Capacity Building and Awareness Raising (including training and mass media coverage) on climate change issues and related sudden natural disasters. These collaborative efforts have to be in line with the priority areas for each Arab country (e.g., floods in Yemen). UN organizations should promote bilateral and multilateral protocol on exchange of data and lesson learned between Arab countries.

They have to review and update existing legislations to reflect natural disasters issues, and create a legislative environment which enables bilateral and multi-lateral cooperation on natural disasters issues in the Arab region.

The focus on the regional and coordinating centers, with exchange of experiences and research findings, is useful also in terms of capacity building, and may place more responsibility for the UN agencies for implementation in the developing countries (including the Arab countries). UN agencies should identify also means and indicators for monitoring and evaluation of natural disasters. They should review as well the inventories of programmes and activities (including mitigation measures) being implemented in the Arab countries to reduce the adverse impacts of natural disasters. UN agencies should collaborate as well in the preparation of a vulnerability assessment to natural disasters on the economic and social development in the Arab region. They should provide simplified scientific and information material, training of media personnel and public awareness programs.

6.3.6. The role of the legal sector

The legal sector, as a risk actor group, includes judges, courts and the legal profession. With respect to public risk, they are broadly responsible for interpreting and administering the law and determining liability when applicable. The sector therefore has an important influence over those who are seen as responsible for a public risk, often exerted through insurers since the extent and nature of any likely liability is crucial in deciding the terms of insurance cover offered to a customer. Liability issues lie at the heart of perceptions of a 'compensation culture', in which people seek to assign blame for mishaps, and then make a claim against the alleged party at fault. The perception of a compensation culture is pervasive and can affect risk responses, even though actual levels of compensation claims in the courts suggest the perception might be exaggerated. With respect to flooding risk, as a natural phenomenon, the potential for unhelpful allocation of blame is less obvious, but claims against officials seen as negligent in providing a response or against those whose actions are alleged to have contributed to worsening a claimant's flooding experience are not inconceivable.

6.4. Ensuring coordination and integration

The planning and decision-making processes of a number of separate development authorities, whose decisions in any form influence the disaster response of the basin, must be coordinated to ensure that the common goal of sustainable development is achieved. Those decisions have the potential to affect disaster risks and have the potential to influence the vulnerability of the society to natural hazards. There are two aspects: first, planning at the governmental level must be integrated so that the government's strategy, implemented through different departments, is coherent and harmonized. Second, it must be applied at all levels of public planning, whether national, regional or local, and involve all relevant public agencies. At the same time, there should be some mechanism to ensure that local views and experiences are in turn communicated to national planning processes. There are horizontal and vertical interactions (**Figure 29**), thereby integrating various stakeholders and interest groups, along with the integration of disaster management into all relevant areas of government planning, as follows:

- Horizontal interactions: Between the various government departments and ministries (at all levels); and involvement of the stakeholders and interest groups in decision-making processes.
- Vertical interactions: Consistency in the policy and planning processes and implementation at different levels of government, that is, from the local level up, plans should be consistent with those produced at the next higher level.

The need for coordinated or integrated actions of various governmental institutions and stakeholders can be illustrated on the example of land use planning. Given the influence of land use on flood risk for example and water management in general, it is imperative that land use planning and water use allocation are properly coordinated. Land use in both urban and rural areas can affect flood risk elsewhere in the basin. The consequences of forestry and especially uncontrolled logging on flood risk can be significant, in particular concerning the erosion processes and to a limited extent and locally on flood peaks. The consequences of agricultural land use practices, such as topsoil compaction, may also have similar deleterious effects on downstream river regimes. Consequently, forestry policy and planning should be subject to flood risk assessment. The technical aspects of forestry and agricultural practices may also be subject to regulation but may be more difficult to enforce.

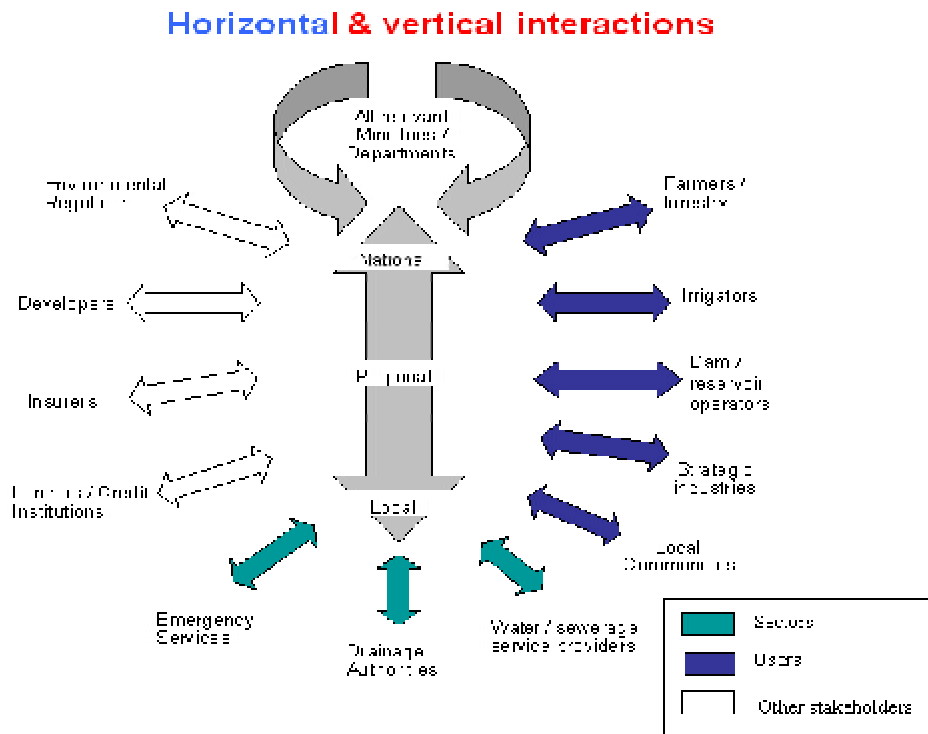


Figure 29. Integration of various stakeholders & interest groups (Source WMO/GWP Associated Programme on Flood Management (APFM)) <http://www.apfm.info>

7. Gaps, challenges and priority actions

Meeting the challenges of both environmental degradation and disaster risk remain high on the Arab agenda and, more recently, researchers, planners and policy makers have come to recognize how intricately these two factors are related. Several challenges are facing the Arab countries, and can be summarized as follows:

- a- Strategic challenges: Lack of comprehensive policy on disaster risk reduction and management and lack of strategic plan for prevention and preparedness
- b- Socio-cultural/behavior challenges: Inadequate information, education and communication, misuse of natural resources, settlement behavior, lack of environment-friendly behavior, and complacent and non-demanding society
- c- Economic challenges: poverty, lack of livelihood options rather to manipulate natural resources, and capacity of national treasury to fund adequately

d- Governance challenges: political commitment and priority, institutional readiness and capacity, systems and process, international assistance, and local self-governance persuasion

e- Legal challenges: Legal base for competent institution, limited to immediate rescue and relief, standardization, non-obligatory, participatory-national and international, functional capacity of committees, and resource base and mobilization

Environmental protection, as component of sustainable development and consistent with poverty alleviation, is imperative in the prevention and mitigation of natural disasters (**Figure 30**). A comprehensive national policy on disaster risk reduction and disaster management should be established in all Arab countries as the core need of sustainable and broad-based economic growth. This includes a conceptual clarity on disaster management, mainstreaming disaster in sectoral development plans, disaster budgeting and mobilization of international support and assistance. Strengthening the disaster prevention and preparedness is also necessary, comprising behaviour change through information-education-communication interventions, human resource development, effective enforcement of building code, and change in the settlement behavior. Providing local bodies, NGOs, community organizations and the private sectors opportunity for preparedness including rescue and relief should be performed. Making development and construction works sustainable, reliable and effective is needed in all Arab countries, and the mitigation of disasters to secure life of common people through appropriate strategies and programmes should be established in disaster affected areas.

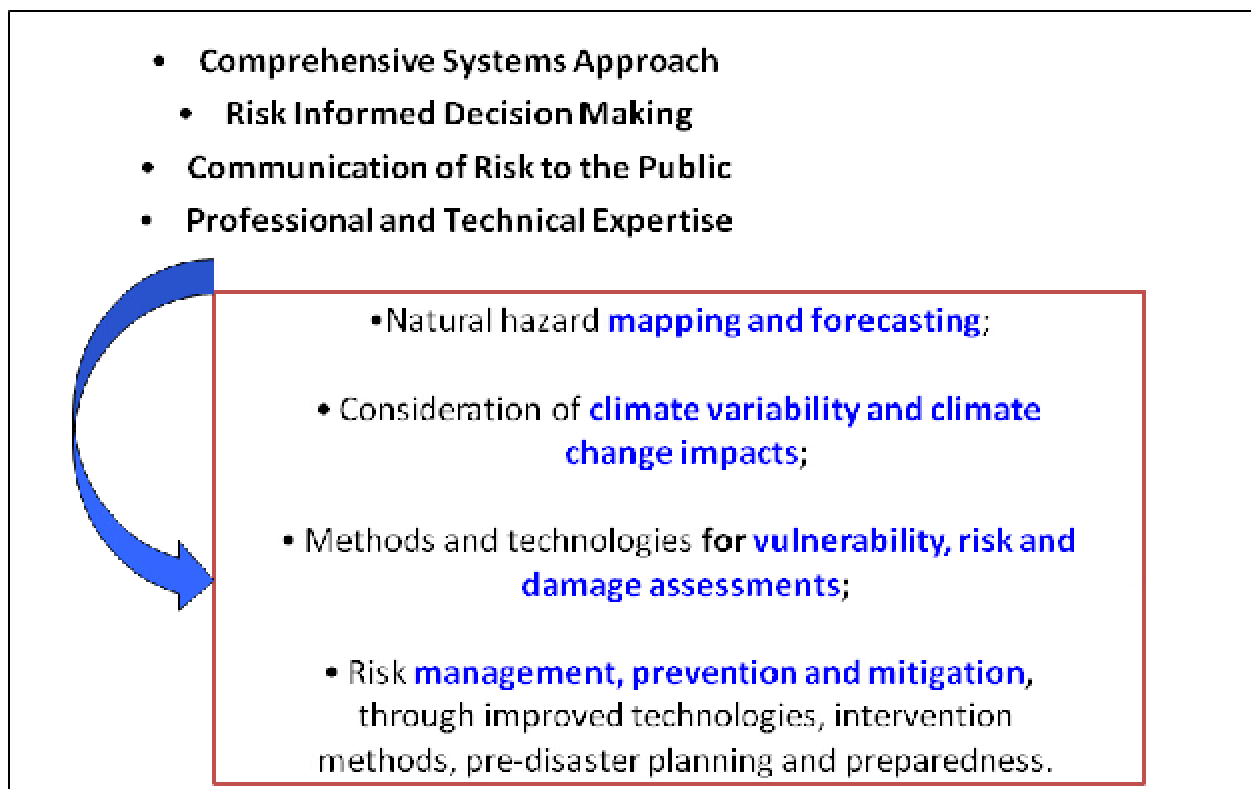


Figure 30. Actions for change in the Arab countries

Enhancing public awareness would be essential to increasing the knowledge as well as preparedness of local communities at national and community levels in dealing with most natural and environmental disasters. In the Arab region, simple raising awareness techniques similar to those used by extension specialists (demonstrative techniques) as well as information diffusion through media (radio and TV in particular) ought to be considered, especially in rural areas. On the other hand in urban areas, alternative strategies, such as workshops, conferences, as well as interactive and innovative methods like “Internet” could be more effective than classic demonstrative techniques. Even in urban areas, the role of media and particularly of TV, radio, and newspapers in passing specific messages to various partners and stakeholders in the communities cannot be overemphasized. The promotion of disaster risk education in schools and universities curricula in Arab countries vulnerable to natural hazards is required.

The formulation of amendments to enable preparedness and mobilization, and the enforcement of laws for disaster mitigation and relief operations should be encouraged in all Arab countries. Strengthening central, regional, district and community level disaster relief committees and make them capable of undertaking responsibility of carrying out preparedness activities should be performed. The vulnerability assessment and hazard mapping (using the most sophisticated tools nowadays remote sensing & GIS) of the disaster prone areas, the development of tools and methodologies for mandatory risk assessment, regulatory monitoring and evaluation are needed as well in the Arab region. Mandating relevant institutions to exchange data in necessary quality and timeliness as well as the creation of a Management Information System (MIS) for natural disaster management are required in the Arab countries. Engineers, earth scientists, and planners are interested in assessing and mapping floods/landslides due to:

- These maps identify and delineate unstable areas, so that environmental regeneration programs can be initiated to adopt suitable mitigation measures

- These maps help planners choose favorable locations for site development schemes, such as building and construction

The mobilization of internal and external resources for rehabilitation and reconstruction is considered also necessary. There is also a need of competent, professional, multidisciplinary and participatory strategies on disaster management, integrating community-center approaches and keeping track of socio-economic changes and health conditions of the vulnerable population. For example, representatives of the public, particularly owners of flood liable land, have to be actively involved in the preparation and review of floodplain management plan. In addition, management plans should be exhibited and public comment is to be considered before plan is finalised and adopted. Improvement is required in emergency response building and capacity building. Mainstreaming disaster issues into national policies, plans and programmes of all Arab countries should be performed as well. Building emergency warehouses and centers and improving the transportation and communication systems are required across the Arab countries for emergency responses – rescue and relief. Understanding the quantified scale of the disaster risks, and the differentiation between high risks from low risks can help identify the emerging sources of risk and how they change in the future. The quantification of how sudden climate-related disasters may vary under scenarios of future climate changes (2050s, 2100) and the potential effectiveness of policy alternatives for disaster risk management should be studied also. The interaction with qualitative assessment for the identification of relevant flooding processes, drivers and measures should be represented. The establishment of methods for incorporating drivers of change and disaster risk management measures should be explored.

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