
An evaluation framework for disaster risk management in Egypt

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Abstract: Natural hazards are likely to increase in frequency and magnitude owing to climate change and urbanisation. Therefore, disaster risk management (DRM) and related issues have recently come to the fore and become an essential need. The Hyogo framework for action (HFA) noted the importance of ensuring that the disaster risk reduction (DRR) is considered a national and local priority as well through the assessment and monitoring of the DRM. This paper aims at presenting an adequate method to evaluate the DRM system to form a comprehensive view of its strengths and weaknesses. In this regard, a framework is presented to assess the national DRM through a quantitative method for evaluating its efficiency criteria. In order to do that, a set of indicators is established to evaluate these criteria. Egyptian DRM is evaluated using the proposed framework to identify the weaknesses associated with the current system and the challenges facing it.

Keywords: disaster risk management; DRM; coping capacity; natural hazards; institutional vulnerability; Egypt.

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1 Introduction

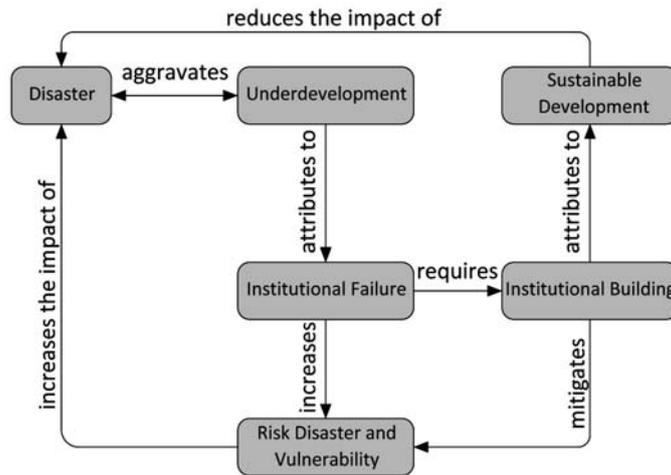
1.1 Disaster risk management

The world witnesses an alarming increase in the frequency and severity of disasters, resulting in high-risk levels in many areas (World Economic Forum, 2017). The lack of an appropriate and effective governance in the face of disaster risk is considered to be the root cause of the communities' deterioration and the aggravation of disaster impacts as illustrated in Figure 1 (Ahrens and Rudolph, 2006). Furthermore, the disaster risk reduction (DRR) became a worldwide consensus and it is considered an integral part of sustainable development, not a side issue (Timovska, 2012). Thus, improving the quality and effectiveness of disaster risk management (DRM) is essential to mitigate the adverse risk impact and achieve the sustainable development (Ahrens and Rudolph, 2006). In this regard, the Hyogo framework for action (HFA) 2005–2015 sets the priority to ensure DRR as a national and local strategy with a strong institutional basis for implementation (Dickson et al., 2012). Therefore, this paper presents a framework to evaluate the national level of the DRM and investigate relevant weaknesses and obstacles.

The primary target of DRM is to protect what human beings value, now and in the future. Therefore the DRM system needs to perform a set of functions. These functions should be applied to all such systems in the world, taking into account the variations on 'how, by whom and by what resources', from one country to another (Becker and Abrahamsson, 2012). Building and improving the coping capacity are the major functions of DRM. Coping capacity denotes the ability of people, organisations and systems, and using available skills and resources (human, financial and physical) to face and manage adverse conditions, emergencies or disasters (Dickson et al., 2012). It comprises all the strengths, attributes, and resources available within a community that can be used to achieve agreed-upon goals (Becker and Abrahamsson, 2012). In order to build and improve the coping capacity, appropriate policies and programs should be instituted to

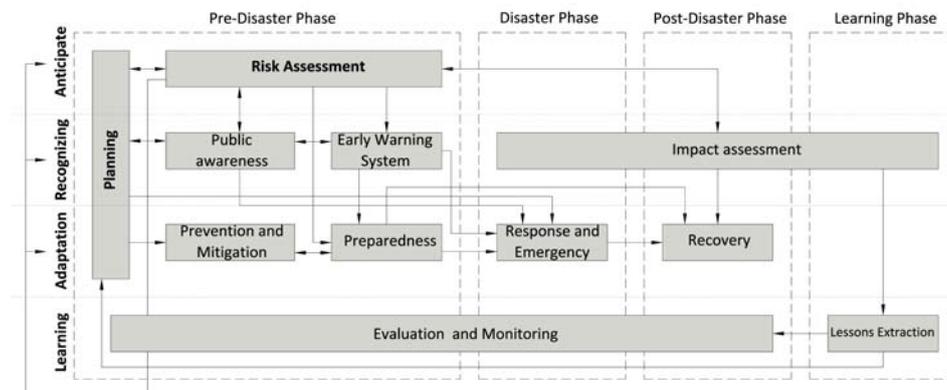
address the root causes of disasters and set in place mitigation, preparedness, and response mechanisms. Another equally important function is to enhance the awareness and practice of DRR (Baas et al., 2008).

Figure 1 The institutional role in DRM



Source: Modified from Ahrens and Rudolph (2006)

Figure 2 DRM complex system



Source: Modified from Becker and Abrahamsson (2012)

Consequently, DRM is a complex system, since it requires the integration of a variety of multi-sectoral and multidisciplinary administrative, organisational and operational planning processes and capacities, in order to mitigate and reduce the adverse impacts of the expected disasters (NDMC, 2005). Figure 2 shows DRM system diagram conducted by reviewing the previous researches and DRM systems in various countries. In this diagram, the DRM activities are divided into four categories: anticipation, recognition, adaptation, and learning. Also, these activities are sorted into four stages regarding the disaster occurrence. These stages are pre-disaster phase, disaster phase, post-disaster

phase and the learning phase. The diagram reveals the interrelations between its different elements and the complexity of DRM system.

Obviously, the complexity of DRM necessitates cooperation and integration among different institutions to build an effective management. Also, ensuring the credibility and transparency is considered a key factor for effective DRM regarding data validity, reliability, and availability which promoting a dynamic interaction among all stakeholders (Holden, 2013; Ramos, 2009). Furthermore, it is important to establish an accessible, up-to-date and comprehensible risk-information mechanism to support decision-making. However, a cohesive legislative framework of laws, regulations and public policies for DRM is required to identify the rules and responsibilities to guide the public and private sectors (UN, 2015). In brief, a number of criteria should be applied to ensure effective DRM; these include cooperation and integration, management sustainability, regulatory quality, credibility and transparency, up-to-dateness, justification and financial resources. Achieving marked progress in these criteria will increase the effectiveness of DRM system.

1.2 Evaluation of DRM

A number of global and international initiatives are developed to evaluate, monitor and improve the DRM. HFA is a global blueprint for DRR efforts. 168 countries have applied it during the period from 2005 to 2015. The main goal of HFA is to reduce disaster losses substantially with respect to lives lost, and the social, economic, and environmental assets. Also, it puts forward a comprehensive set of actions which focuses on building the capacity of local and national institutions, supporting early warning systems, spreading a culture of safety and resilience, reducing the drivers of vulnerability and strengthening disaster preparedness and response. It has, furthermore, presented a tool to monitor the progress in the implementation of DRR and recovery actions. However, progress has not been uniform across countries and action areas. Also, different challenges are identified such as developing and using assessment indicators, setting early warning systems in multi-hazard environments and enhancing the capacity of states to integrate DRR into sustainable development policies and plans (UNDP, 2014). The Sendai Framework is the successor instrument to the HFA, and its monitoring list of indicators is still under review to be agreed and disseminated (UN, 2015).

INFORM Index is a collaborative project of the Inter-Agency Standing Committee (IASC) and Joint Research Centre (JRC) (European Commission, 2015). It is an open-source risk assessment methodology and database interested in humanitarian crises and disasters. The index consists of three dimensions: hazard and exposure, vulnerability and the lack of coping capacity (IASC and JRC, 2016). In addition, United Nations University's Institute for Environment and Human Security (UNU-EHS) and the Nature Conservancy created the World Risk Index in 2012 to indicate disaster potential as a consequence of historical extreme natural events for 171 countries (Birkmann et al., 2016). The latter index consists of five main indicators: exposition, vulnerability, susceptibility, lack of coping capacities and lack of adaptive capacities (UNU-EHS, 2015).

The United Nations Food and Agriculture Organisation (FAO) has launched a program focusing on the role of local institutions in natural DRM. The program combines mutually reinforced normative, operational and field-based activities to assist countries in their efforts to shift from reactive emergency relief operations towards proactive and better-planned DRM, including prevention, reduction, and preparedness strategies. The FAO has proposed a framework for strengthening diagnostic assessments of DRM institutional systems as a first step in a capacity-building process. The framework contains various stages starting with a literature review followed by collecting data through interviews and fieldwork then assessing DRM at different levels (national, district, community) by means of indicators lists. Finally, the DRM system is analysed and reported (Baas et al., 2008). However, the literature reveals that there is no implementation of this proposed framework.

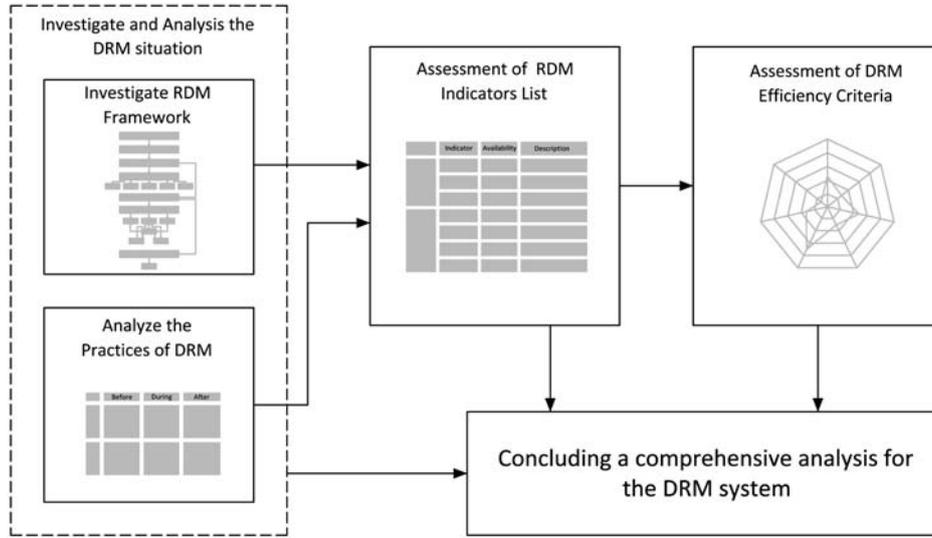
There are no specific widely accepted indicators to evaluate the performance of the DRM reflecting what needs to be measured (Carreño et al., 2007). Furthermore, there are few practical tools to analyse and evaluate the national, district and local DRM institutional framework and systems. The lack of proper analysis tools limits the ability of community-based organisations to participate effectively in the design and implementation of DRM strategies as well as the continuous management of hazard threats and disaster situations (Baas et al., 2008). In addition, there is a need for a sound understanding of existing institutional capacities, possible gaps and the comparative strengths of different actors in DRM at various levels. The proposed framework in this paper presents an adequate method to evaluate DRM system and its components to identify the strengths and weaknesses.

2 Methodology

This paper presents a new framework to evaluate the national level of DRM through testing its efficiency using a set of criteria devised from a holistic investigation of DRM. The framework aims at obtaining the influential elements and different stages by synthesising DRM indicators list which is also conducted in this paper. After that, the framework is applied to evaluate the Egyptian DRM system. The proposed framework consists of four main steps as shown in Figure 3. The first step comprises investigating DRM situation through the study and analysis of DRM institutional framework, and the practices in previous disasters to allow a broader estimation and deeper insight into national DRM. This step pinpoints all involved entities in DRM and their respective roles. It also clarifies how the existing system has dealt with the disasters in the past experiences during the different phases (before, during and after the disaster). In this step, various data are collected from governmental documents and reports along with semi-structured interviews with experts and involved parties. The second step is assessing DRM elements using the created list of indicators depending on the collected data and the extracted information through the first step. The third step focuses on evaluating efficiency criteria based on the indicators list. Finally, the results from all stages are

integrated, and then a comprehensive analysis of DRM system is concluded to identify the main problems affecting its performance and the obstacles facing the improvement of the system.

Figure 3 The proposed framework to evaluate the national DRM system



2.1 Indicators list for national DRM evaluation

In order to evaluate the DRM, it is important to adopt a list of indicators that cover all elements and processes. Some previous DRM evaluation initiatives have developed indicators lists in order to understand the existing institutional capacities and management performance. For instance, the FAO presents a list of indicators to measure institutional capacity in the different levels of DRM (national, district and community levels) (Baas et al., 2008). Also, HFA adopted a list of evaluation indicators to monitor the progress of risk reduction and the performance of the DRM. In this research, a set of assessment indicators for the national level of DRM is developed through the following steps:

- 1 Collecting and reviewing DRM assessment studies and indices for various countries in general. For example, the indicators conducted by the Egyptian Information and Decision Support Center (IDSC) in 2010 have been included in this research since Egypt is the case study.
- 2 Collecting and reviewing the international initiatives for DRM assessment: HFA, FAO, and others.
- 3 Filtering the indicators list based on the investigation of the case study and its distinctive characteristics.

Based on the above-mentioned steps, seventy-seven indicators divided into the eleven elements of DRM were established and reviewed in order to ascertain a clear

understanding of existing national institutional capacities to cope with the natural disaster risk. This list of indicators is shown in Appendix.

2.2 DRM criteria

As discussed in Section 1.1, there are some criteria that distinguish the effective DRM system. The efficiency of this system depends on the rate of success in achieving these criteria. While the DRM system includes different elements and stages these criteria attempt to reflect a holistic and comprehensive view of the DRM. As shown in Table 1, seven criteria are selected to present an evaluation of DRM system at the national level: these are cooperation and integration, management sustainability, regulatory quality, credibility and transparency, up-to-date, justification and financial resources. These criteria were derived from the literature review and the discussion with the experts and involved persons about the most effective factors in the processes of DRM, and the main obstacles that face it. The criteria evaluation has been conducted using the presented list of indicators in the Appendix, where indicators have been compiled according to the related criterion to establish an index for the criteria assessment as shown in Table 5. For example, to evaluate the cooperation and integration criterion, the indicators express the coordination between different involved institutions and mechanisms that organise the interrelatedness between them and are collected from all elements in the indicators list as well as the other criteria.

Table 1 DRM efficiency criteria

<i>Criterion</i>	<i>Description</i>
Cooperation and integration	This criterion indicates the existence of mechanisms that organise the interrelatedness between the different entities and institutions involved in DRM to reduce the waste of financials, effort, and time, which guarantee the efficiency of the processes.
Management sustainability	This criterion indicates the existence of mechanisms that ensure the continuance of DRM process, increasing its quality and considering the future conditions.
Regulatory quality	This criterion refers to the quality and completeness of institutional structure of DRM system, the quality, and experiences of institutions and members who are involved.
Credibility and transparency	Indicates the implementation of projects and programs that aimed at reducing the disaster risk impact and supporting them by advertising and awareness campaigns, and the dissemination of culture and information about the disaster risk among communities' members and institutions.
Up-to-dateness	This criterion indicates the existence of mechanisms to ensure updating information and measures, as well as to identify and monitor the probability of disaster occurrence.
Justification	This criterion relies on the existence, suitability, and empowering of laws, rules, and regulations which organise DRM processes.
Financial resources	This criterion reflects the existence of appropriate financial resources and the effective mechanisms to provide the needs in the response, emergency and recovery phases at an appropriate time and for worthy communities.

3 Case study: Egypt

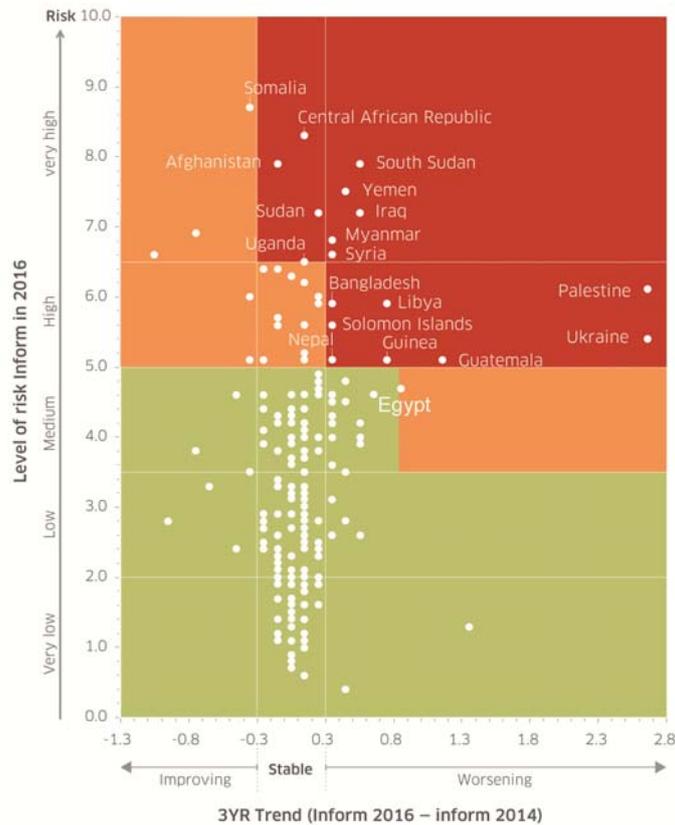
Egypt is prone to various natural and human-made disasters. Moreover, urban disasters are severe and frequent in the country and quite often result in massive destruction and loss. Different types of disasters have hit Egypt over last decades including earthquakes, droughts, insect infestations, epidemic outbreak, and other urban disasters (Abulnour, 2014). The summary of disasters in Egypt is shown in Table 2 which is adopted from the international disaster database (EM-DAT) available at (<http://www.emdat.be/>).

Table 2 Egypt disasters summary from 1950 to 2015

Disaster type	Events count	Total deaths	Total affected	Total damage (US\$)
Earthquake	4	582	92,996	$1.2 * 10^9$
Epidemic	2	15	143	N/A
Extreme temperature	3	57	105	N/A
Flood	14	777	234,551	$1.55 * 10^8$
Mass movement	2	132	997	N/A
Storm	3	52	15,100	106

Source: CRED (2009)

Figure 4 Inform index ranking 2016 (see online version for colours)



Source: INFORM (2016)

Furthermore, a number of international studies and reports present the situation of disasters in Egypt as follows. First, Index for Risk Management (INFORM, 2016) ranked Egypt as a worsening country with grade (4.6) as shown in Figure 4. The index consists of three dimensions:

- 1 hazard and exposure
- 2 vulnerability
- 3 lack of coping capacity.

The trend in the last three years showed an increase in the first and second dimensions, while the third dimension is steady. Although Egypt recorded a decline in risk index from 2014 to 2016, which could be explained due to the decrease in the hazards and exposure dimension, whereas the vulnerability and lack of capacity dimensions are increasing, this indicates the poor situation of DRM in Egypt (INFORM, 2016).

DARA¹ in 2010 reported that the future climate change condition would cause an increase in the probability of drought, floods and landslides occurrence in Egypt. Furthermore, for the year 2030, the projected increase in mortality will be ten persons per year; and the additional economic costs will be 30 million USD per person per year. The projected additional portion of the population that will be affected or need emergency assistance will be 80,000 persons per year (DARA, 2012).

Regarding HFA, there are four reports prepared for Egyptian DRM situation in 2009, 2010, 2013 and 2014. Respective reviews (CIDSC, 2009, 2011, 2013, 2015) reveal that subsequent reports are just a copy of the first original one, indicating the lack of information and the weakness of evaluation processes. The assessment does not specify the problems that face DRM in Egypt and the available solutions.

3.1 DRM in Egypt

In order to analyse DRM system in Egypt, two ways of division are done to clarify the characteristics of each part of the system. First, it is divided functionally into three levels: strategic, tactical and operational. One main leader heads each level and contains a number of other members. Table 3 illustrates these levels and the specific responsibilities.

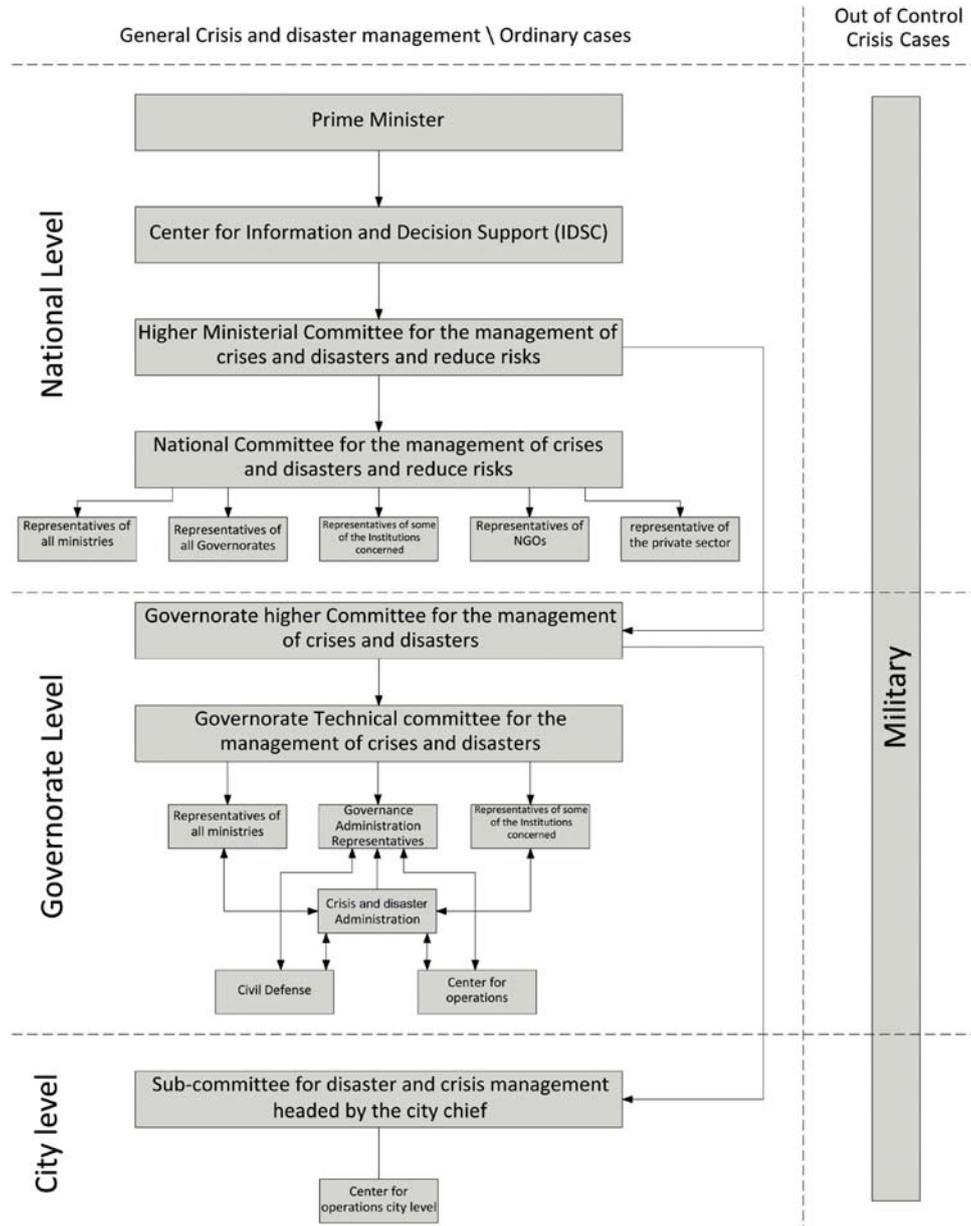
Second, the Egyptian DRM system is divided into four levels regarding scale: national, governorate, city and district levels. According to these levels, Figure 5 illustrates the framework of the institutional structure of DRM system in Egypt showing the hierarchy of management and the processes of the decision making. In addition to that, the figure refers to the role of the military in case of necessary support when the situation becomes out of control owing to the severe hazards. In that case, the military is responsible for coping with the crisis and leading all entities in order to reduce the disaster impact and recover the communities after large-scale disasters.

Table 3 The levels of DRM system in Egypt

<i>Level</i>	<i>Leader</i>	<i>Members</i>	<i>Responsibilities</i>
Strategic level	Committee for Crisis and Disaster Management (SMCDM) headed by the Prime Minister (PM)	<ul style="list-style-type: none"> • Minister of Defence and Military Production • Minister of Interior • Minister of Information • Minister of Foreign Affairs • Minister of Health and Population, • Concerned Ministers according to disaster type. • Concerned Governors according to disaster extension • Representative of National Security Council • Specialised experts. 	The main functions of SMCDM are to adopt a plan to deal with the disaster and delegate responsibilities to different entities for disaster management. They also include coordination between all stakeholders and delegating responsibilities to different entities.
Tactical level	The National Committee for Crisis and Disaster Management (NCCDM), Crisis and Disaster Management Department (CMDR) and Sectoral Ministries	<ul style="list-style-type: none"> • Representatives of the all ministries • Representatives of all Governorates • Some specialised governmental agencies such as the Suez Canal Authority, The Egyptian Environmental Affairs Agency (EEAA) and Security Agencies at the Ministry of Interior • The Information and Decision Support Centre (IDSC) • Specialised experts 	Mainly the CMDR functions are to develop contingency plans; to review national strategies and policies on the national level; and to supervise different governmental institutions and organisations in performing disaster simulation exercises.
Operational level	The Governorates Higher Committees for Crisis Management in each governorate	<ul style="list-style-type: none"> • Governor, Heads of Directorates, Head of Security Department, and representatives of districts, cities, towns, and villages. 	The role and responsibilities of the governorates are to forecast disaster-related hazards; to review the existing resources for disaster management; to formulate action plans for emergency situations; to coordinate volunteer efforts and to conduct awareness raising and formulate a communication strategy.

Source: Adapted from Arram (2009)

Figure 5 Disaster management frameworks in Egypt



3.2 *Past crises management practices in Egypt*

The most common or frequent disaster in Egypt over the last decades is flooding because of the repetition of extreme rainfall events and the presence of urban communities in flood exposure areas (IDSC, 2010). In many urban areas, the lack of a proper storm drainage system causes a number of pluvial floods produced from torrential rains. Such events that have occurred in Egypt over the last decade include:

- In August 1991 the rain continued for seven hours over Marsa Alam and left behind 370,000 m³ of water and 20,000 m³ of valley sediments (IDSC, 2010).
- In November 1994, flooding occurred in Upper Egypt governorates (Assiut, Sohag, Qena) and other areas in the country. Severe thunderstorms and heavy rains have affected some provinces in southern Egypt which cause the floods. Because of the long period between the flood occurrences, the maintenance activities were neglected, and there was a lack of proper equipment for facing the crisis. Another problem was the absence of a drainage system for flood water to transfer to the Nile basin. Also, there is no wireless communication between the villages and municipals, and there are no training programs or public awareness processes applied. The flood caused 18 deaths and 25 injuries, while approximately 2,974 houses were damaged and left 7,000 homeless families. Also, agricultural fields of 6,318 Feddans (2,653 ha) were affected. (IDSC, 2010; Youssef et al., 2005).
- In November 1996, a severe storm affected a number of Egyptian governorates including Aswan, Sohag, Asyut, Minya, Qena; this flood caused 25 deaths, and thousands of acres of land flooded. Also, 260 houses were destroyed (Dartmouth Flood Observatory, 2008; Nassar, 2001).
- In October 1997, torrential rains with a height 20 mm over Saint Catherine, Al Quseir, Ras Benas, Ras El Naqb and Aswan on the same day, led to an inundation of floods (IDSC, 2010).
- In January 2010, some Egyptian governorates including Aswan, North Sinai, South Sinai, Red Sea, Qena were exposed to strong flash floods causing 13 deaths, 49 injuries and had 12,401 victims. It also caused significant financial losses in properties as well as impacted many vital services and facilities such as electricity, water, sanitary drainage, communications, and roads, etc. (IDSC, 2010).
- In October 2015, the governorate of Alexandria and its surrounding area were the most directly affected by rainfall recorded as 3.2 million cubic metres in less than three hours; six times more than the average amount of precipitation. This flood has severely impacted the livelihoods of the approximately 5 million inhabitants of Alexandria and those living in the North Coastal areas. Furthermore, roads, tunnels, ground floors of buildings, schools, hospitals, parking lots, tramways and trains, and farmlands have been flooded. Cars were swept away, and tunnels were closed due to 1.5 metres high water levels (African Development Bank, 2015).

A number of past experiences in disasters management have been analysed where the availability of data was the primary determinant of the analysed situations. Table 4 presents the governmental activities in pre-disaster, during a disaster and post-disaster stages to cope with flood disasters in Sohag 1994, Sohag 1996 and Alexandria 2015.

Table 4 DRM past experiences analysis

	<i>Pre-disaster stage</i>	<i>During disaster</i>	<i>Post-disaster stage</i>
Sohag flood, 1994 (Nassar, 2001)	<ul style="list-style-type: none"> • Lack of warning systems. • Lack of proper maintenance and preparedness. • Lack of emergency communication system. • Lack of proper equipment. • Lack of training programs and public awareness process. • Lack of floods drainage system. 	<ul style="list-style-type: none"> • Close Ngaa-Hamady canal which caused flooding of large agriculture area. • The government try to mitigate the impact of the flood with the cooperation of NGOs and public efforts. 	<ul style="list-style-type: none"> • Rehabilitation of affected people in tents. • Reconstruct the affected villages by the cooperation between Forced Army, Construction Ministry, Municipal and private volunteers. • Lack of vulnerability analysis for the new villages. • Establishing crises management operation centre for floods in the governorate.
Sohag flood, 1996 (Nassar, 2001)	<ul style="list-style-type: none"> • Warning system alarming reports. • Wireless communication network constructed. • Preparing for the crises and providing the governorate with the needed equipment. • Linking Ngaa-Hamady canal with Nile basin. 	<ul style="list-style-type: none"> • Water flooded the buildings in Ngaa-Hamady village and affected them. • Communication between the village and municipal was ongoing throughout the disaster. • Discharge the excess water to Ngaa-Hamady canal. Also, the vacuum vehicles had been used to pull the water from the streets. 	<ul style="list-style-type: none"> • Rehabilitation of affected people in tents. • Paying subsidies to those affected the affected people. • Lack of vulnerability analysis for the new villages. • Impact assessment and inventory for losses.
Alexandria floods, 2015	<ul style="list-style-type: none"> • No suitable maintenance for rain drainage network. • Lack of warning system. • Lack of proper equipment. • The sewage and drainage systems of Alexandria and the surroundings have been reported as a poor condition. 	<ul style="list-style-type: none"> • Water pump trucks have been used yet with no significant impact due to excessive amounts of water. • The floods required the mobilisation of some 200 vacuum trucks, and so far assistance has only been provided through 84 trucks provided by the municipalities of Alexandria, Cairo, and Giza, as well as the Army and Navy. 	<ul style="list-style-type: none"> • The Ministry of Social Solidarity had announced the readiness of several centres and temporary tents to host those rendered homeless, and had distributed in-kind relief items and cash compensations in these areas. • NGOs provided food, blankets, medication and other forms of in-kind assistance. • The network of storm drains had to be maintained. • Reservoirs to divert rainwater had to be built.

The analysis of the past disaster management practice reveals a number of problems such as the following:

- the lack of early warning system in the most of the disasters
- the lack of proper preparation for the expected hazards
- the lack of public risk awareness and emergency culture
- the inconvenience of the infrastructure and the available emergency equipment
- dealing with risks is always a reaction to a disaster which reduces the efficiency of DRM.

3.3 Data collection and Egyptian DRM evaluation

Most of the collected data about disasters and hazards in Egypt are obtained from international institutions and studies, which indicates the lack of available Egyptian source about past disasters occurrences. In addition, the website of crisis and disaster management was not available during the research period. In order to collect the needed data, it was intended to use multiple sources and verification grades to ensure the validity and credibility of the results reached while the lack of information and the low credibility of some sources. However, to evaluate the national level of DRM, the following steps have been followed:

- 1 Conducting semi-structured interviews with DRM government officials from the crises and disaster management centre in the prime minister, information and decision centre, crises and disaster management managers in some governorates and other relevant stakeholders in order to gain a deeper understanding of DRM situations.
- 2 A number of national and international reports were reviewed and discussed to reach the most reliable answer for each indicator question for example:
 - national progress report on the implementation of the HFA (2013–2015) (CIDSC, 2015)
 - national plan to cope with environmental disasters (Ministry of Environment, 2006)
 - national strategy for crisis/ disaster management and DRR (IDSC, 2010)
 - Egypt's national strategy for adaptation to climate change and DRR (UNDP, 2011).
- 3 Verifying the collected data by comparing with the analysis results for a number of past experiences in natural disasters management.

Consequently, the data collected from the previous steps are used to carefully fill DRM indicators list as shown in Table 5 to present a reliable evaluation of the system situation and capabilities.

Table 5 Evaluation list for national level of DRM indicators in Egypt

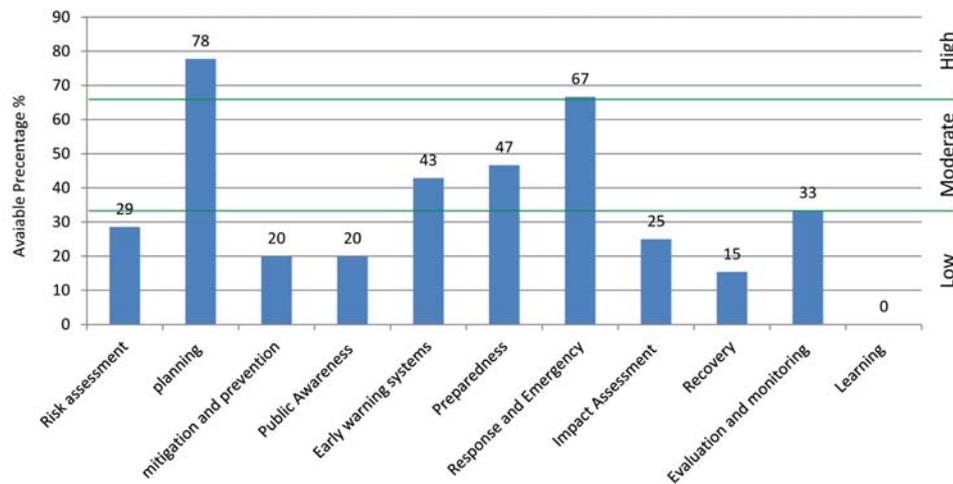
<i>Elements</i>	<i>Code</i>	<i>Availability</i>	<i>Notes</i>
Risk assessment	RA-1	0	<ul style="list-style-type: none"> Although there are some experiences for different types of disasters, there is no actual benefit from these previous experiences. IDSC is preparing a vulnerability map project for all Egyptian governorates. There are some risk assessment studies for Egypt by the international organisation, but these suffer from a shortage of data. Also, there is no adequate risk assessment by a national institution.
	RA-2	0	
	RA-3	1	
	RA-4	1	
	RA-5	0	
	RA-6	0	
	RA-7	0	
Planning	PL-1	1	<ul style="list-style-type: none"> The disasters and crises management in IDCS considers the responsible of DRM planning in Egypt on the national level. Although there are specialised institutions in crisis management, there is no coordination between them and other planning bodies in the development of future crisis management plans and sectoral action plans.
	PL-2	1	
	PL-3	0	
	PL-4	0	
	PL-5	1	
	PL-6	1	
	PL-7	1	
	PL-8	1	
	PL-9	1	
Mitigation and prevention	MP-1	0	<ul style="list-style-type: none"> Although there is some available equipment can help in different DRM activities, but the problem is the lack of information about availability.
	MP-2	0	
	MP-3	0	
	MP-4	0	
	MP-5	1	
Public awareness	PA-1	0	<ul style="list-style-type: none"> A website for the crisis management was launched, but while writing this paper, several trials are done to access it, and unfortunately, they did not work (http://www.crisismanagement.idsc.gov.eg). Although there is some educational material prepared by the UNESCO office in Cairo for different levels (available at http://www.preventionweb.net), there is no application of these in the different education stages. Human resources are available at all levels, yet they are not well trained to cope with the needs of the disaster management and risk reduction, and capacity building is to be further strengthened in all sectors and levels (CIDSC 2015).
	PA-2	0	
	PA-3	0	
	PA-4	0	
	PA-5	1	
Early warning systems	EW-1	1	<ul style="list-style-type: none"> Lack of operational coordination and cooperation between the different entities involved in the EWS sector (CIDSC 2015).
	EW-2	0	
	EW-3	0	
	EW-4	0	
	EW-5	1	
	EW-6	0	
	EW-7	0	
	EW-8	1	

Table 5 Evaluation list for national level of DRM indicators in Egypt (continued)

<i>Elements</i>	<i>Code</i>	<i>Availability</i>	<i>Notes</i>
Preparedness	PR-1	0	
	PR-2	0	
	PR-3	1	
	PR-4	1	
	PR-5	0	
	PR-6	1	
	PR-7	0	
	PR-8	0	
	PR-9	1	
	PR-10	1	
	PR-11	1	
	PR-12	0	
	PR-13	1	
	PR-14	0	
	PR-15	0	
Response and emergency	RE-1	0	
	RE-2	1	
	RE-3	1	
	RE-4	1	
	RE-5	1	
	RE-6	0	
Impact assessment	IA-1	0	<ul style="list-style-type: none"> • Although there are previous impact assessment reports for past disasters events, there is no agreed-upon and standardised reporting format. • There are some data about past disaster collected by international organisations such as EM-DAT, DARA, but there is no database established by national organisations.
	IA-2	0	
	IA-3	0	
	IA-4	1	
Recovery	RC-1	0	
	RC-2	0	
	RC-3	0	
	RC-4	0	
	RC-5	0	
	RC-6	0	
	RC-7	0	
	RC-8	0	
	RC-9	0	
	RC-10	1	
	RC-11	1	
	RC-12	0	
	RC-13	0	

Table 5 Evaluation list for national level of DRM indicators in Egypt (continued)

Elements	Code	Availability	Notes
Evaluation and monitoring	EM-1	0	<ul style="list-style-type: none"> Although these indicators list was established in 2010, there is no implementation for it. There is no a clear mechanism to monitor and evaluate the DRM, but all evaluation activities depend on the individual behaviour of municipalities.
	EM-2	1	
	EM-3	0	
Learning	LE-1	0	
	LE-2	0	

Figure 6 Evaluation of DRM elements in Egypt (see online version for colours)

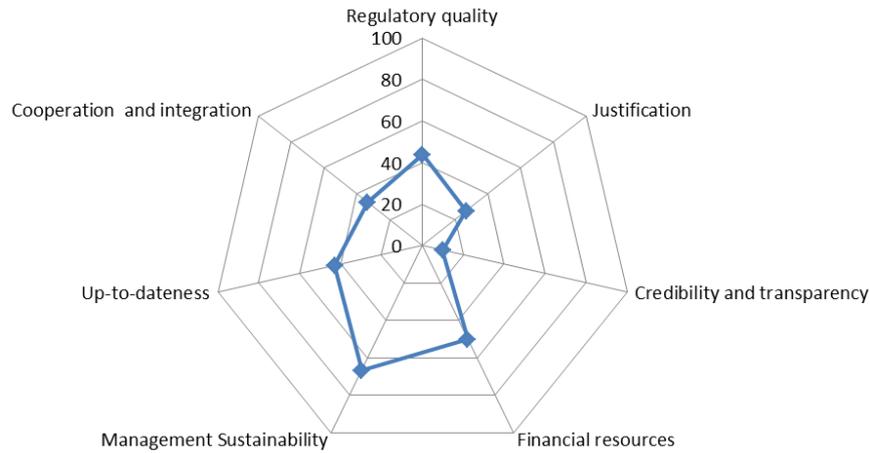
Through the above list of indicators, the chart in Figure 6 is produced by estimating the percentage of available indicators for each element of the DRM, which demonstrates a lack of a large number of indicators in Egypt for many elements. As shown in Figure 6, the ratio of most elements is low, while the planning element records a high ratio, which indicates the existence of good plans. These plans, however, are not reflected in the other element, which means that there is a need to activate and implement the plans. The figure reveals the overall weakness of DRM system in Egypt.

3.4 Assessment of DRM effectiveness criteria

As explained in Section 2.2, a number of efficiency criteria are assessed by means of a list of indicators compiled from DRM indicators list. Table 6 presents the relevant indicators for each criterion. The number of available indicators is divided by the total number of indicators for each criterion. Figure 7 illustrates the percentage of available indicators for each criterion included in a radar graph to give a quick and comprehensive impression of DRM situation.

Table 6 DRM effectiveness criteria assessment list of indicators

<i>Criteria</i>	<i>Related indicators</i>	<i>Availability</i>	<i>Criteria</i>	<i>Related indicators</i>	<i>Availability</i>
Regulatory quality	RA-4	1	Financial resources	EW-1	1
	PL-1	1		RE-15	0
	PL-3	0		RC-7	0
	MP-4	0		RC-10	1
	PA-2	0		RC-11	1
	PA-5	1		RC-13	0
	EW-1	1	Cooperation and integration	PL-3	0
	EW-6	0		MP-4	0
	PR-2	0		PA-2	0
	PR-4	1		EW-5	1
	PR-9	1		PR-8	0
	IA-2	0		PR-14	0
	RC-10	1		RE-2	1
	RC-12	0		RE-3	1
EM-3	0		RC-2	0	
LE-1	0	Up-to-datedness	RA-6	0	
RA-1	0		RA-7	1	
Justification	RA-2	0		EW-2	0
	PL-6	1		EW-3	0
	PA-1	0		EW-4	0
	PA-2	0		PR-6	1
	EW-4	0		IA-4	1
	PR-10	1	Management sustainability	RA-3	1
	RE-2	1		PL-7	1
	RE-5	1		PL-8	1
	IA-1	0		MP-5	1
	RC-4	0		RE-6	1
	RC-5	0		RC-4	0
	RC-8	0		RC-13	0
	RC-12	0		EM-2	1
	EM-1	0	EM-3	0	
Credibility and transparency	PL-3	0		LE-1	0
	PL-4	0			
	PL-6	1			
	PA-2	0			
	PA-3	0			
	PA-4	0			
	EW-4	0			
	EW-7	0			
	RC-5	0			
LE-2	0				

Figure 7 Effectiveness criteria assessment for Egyptian DRM (see online version for colours)

Evaluation chart in Figure 7 reveals that the credibility and transparency criterion has the lowest value, which indicates the lack of risk awareness dissemination among the vulnerable community. In addition, the lack of proper representation of these communities in the processes of DRM planning is an issue. While enabling the DRR projects and programs needs more cooperation with NGOs and private sectors which needs more credibility and transparency. The justification criterion also has a low record, which indicates the problem of poor laws and rules that are facing DRM system in Egypt. Establishing a cohesive and specific legislative framework is necessary to support and improve DRM structure and efficiency. Also, cooperation and integration criterion ranked low, which refers to the lack of adequate cooperation between the organisations, involved in DRM and a lack of considering disaster risk in various development activities. Up-to-date criterion has a low rank. This refers to the problem related to the available information at the national and local levels, decreasing the overall efficiency of DRM system in Egypt. The financial resources criterion is ranked as moderate; this can be explained by providing the needed resources in the past crisis situations, but the main problem is the absence of a consistent system to estimate and include the financially needed resources for DRM in national programs and policies. In addition, the criterion of regularity quality recorded a moderate value; it is evident that there is a lack of proper institutional structure needed to manage and monitor DRM activities. It is almost impossible to manage disaster risk if the government is not effective in carrying out public administration and regulatory quality is poor and where corruption control measures are absent (Lassa, 2010). Finally, sustainability criterion has the highest record, which presents an opportunity to improve DRM in Egypt. There is a national plan for DRM considering the future climate change conducted by disaster and management in IDSC (UNDP, 2011) but has not come into effect.

4 Results and recommendations

In order to reach a holistic and reliable analysis for DRM system in Egypt, integration of the results from the previous steps is done to give more insight into the criteria assessment results. Considering these previous findings, it is concluded that Egyptian DRM faces several challenges. However, implementing the proposed evaluation framework reveals the main problems and obstacles that face DRM in Egypt as follows:

- The absence of legislation and rules governing and clarifying the responsibilities for the management of crises and disasters.
- The absence of a specialised administration for disaster management through the various stages of the disaster and assignment to follow-up by supervisors and concerned authorities.
- Insufficient disaster prevention culture among government officials and vulnerable communities.
- The inadequacy of financial resources and the lack of appropriate funding mechanisms to provide for emergency and recovery phases, and to ensure the effectiveness of these deliveries.
- The lack of updated information about the disaster risk and the available technical ability to cope it.
- The absence of adequate coordination between the involved entities in the different DRM situations.

Consequently, through examination, there are some recommendations developed as priority steps which should be taken by the Egyptian government to establish a proper DRM system for coping with the likely natural disasters. These recommendations include:

- Developing the legislation and rules to control DRM system and define the different responsibilities.
- Financial resources for DRM and expected crises should be included in the national budget, and a proper mechanism to control and monitor these deliveries should be established.
- Enhancing public risk awareness and dissemination of disaster information to ensure public participation as a key to the success of the development programs.
- The evaluation and monitoring DRM mechanism should be delegated to particular institutions and support it by laws and rules that ensure its effective functioning.

5 Conclusions

Recently, the DRM has become a pressing issue, and a large number of studies are concerned with its different trajectories. The literature review revealed the importance of finding a methodology to assess the factors affecting DRM which can help to improve and develop such systems. Becker and Abrahamsson (2012) maintain that to learn and build a safe and sustainable society continuously, there is a need to utilise the functions of DRM evaluation to increase its efficiency. This paper presents an evaluation framework for DRM system focusing on the national level. The proposed framework aims at improving DRM evaluation to conclude more comprehensive results through considering the basic pillars that affect the DRM system. The evaluation is conducted through various steps starting with the investigation of the current situation, evaluation of DRM elements by indicators, and testing the efficiency criteria (cooperation and integration, sustainability, regulatory quality, credibility and transparency, up-to-dateness, justification and financial resources). Finally, the decision makers could rely on the results of all steps to analyse DRM situation and establish a holistic view to improve DRM system.

The main advantage of the proposed framework is the dealing with the complexity of DRM by considering the interaction between the different elements and involved institutions, which can help to develop solutions for the DRM problems in a comprehensive way to influence the system in a short period, whereas trying to solve the problems by studying the elements in isolation is a waste of effort and time. Accordingly, the application of the proposed framework in the Egyptian case study reveals the critical issues affecting the Egyptian DRM. As revealed, DRM in Egypt suffers from a number of problems such as the absence of DRM legislation framework and specialised administration for the DRM. In addition, there is insufficient disaster prevention culture disseminated between the vulnerable communities and involved institutions. Also, the inadequacy of financial resources along with a lack of appropriate funding mechanisms leads to the severe lack of updated information and the absence of adequate coordination between the involved entities.

Even though the proposed framework presents a preliminary and holistic evaluation for the national DRM using a quantitative methodology because of the limitation of the data, a qualitative survey for different elements could increase the reliability of the results. In addition, the application of the framework on a smaller scale (governorate and cities) should be conducted to identify the different situations in the country's regions and specify these problems. Also, the application of the framework for different countries and the comparative studies between them could improve the comprehension of the results. The comparison between countries that suffer from weak DRM system and countries have made progress in this area could help them to identify their strengths and weaknesses. Also, the countries that have made progress in this area can benefit from this evaluation by identifying factors that may affect the system in the long run, then they can avoid any problems and ensure sustainable development.

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Notes

- 1 DARA is an international independent organisation committed to improving the quality and effectiveness of aid for vulnerable people prone to conflicts, disasters and climate change. DARA was mandated by the Climate Vulnerable Forum as independent developer of the Climate Vulnerability Monitor in its first and second editions (DARA and The Climate Vulnerable Forum, 2010).

Appendix**Table A1** Proposed indicators list for DRM assessment at the national level

<i>Elements</i>	<i>Code</i>	<i>Indicator description</i>
Risk assessment	RA-1	Guidelines for undertaking a disaster risk assessment
	RA-2	Agreed national standards for risk assessments with criteria for levels of alert and common format for risk assessment
	RA-3	Assessment of past experiences learned in applying risk assessment tools available
	RA-4	Responsibilities and roles for competent organisations of risk assessment defined and operational
	RA-5	Vulnerabilities maps exist for different expected disasters
	RA-6	Multi-hazard risk assessment with classification and analysis of disaster risk by a central national repository
	RA-7	checking the accuracy of risk assessments by measures in places(Baas et al., 2008)
Planning	PL-1	Responsibilities and roles of DRM planning defined in national level
	PL-2	Mechanisms for DRM planning
	PL-3	DRM elements incorporated into on-going development programs and sectoral action plans
	PL-4	Representatives of the most at-risk groups consulted in the planning process
	PL-5	Comprehensive national DRM plan addressing specific and multiple vulnerabilities and risks
	PL-6	Existence of DRR and/or DRM projects and programs
	PL-7	DRR incorporated in developing national programs and policies
	PL-8	Incorporate climate change into national DRM plan
	PL-9	DRM specialists are involved in planning processes
Mitigation and prevention	MP-1	Mandates and responsibilities of sectoral agencies for prevention specified in existing DRM plans
	MP-2	Funding mechanisms and resources available for prevention/mitigation
	MP-3	Prevention and mitigation technologies and standards existed at the national level and applied/reinforced through sectoral line agencies
	MP-4	Knowledge within lead agencies about available prevention/mitigation technologies and where to access them
	MP-5	Risk prevention and mitigation aspects included in recovery and rehabilitation projects/plans
Public awareness	PA-1	Mandates and responsibilities of competent entities to raise the public awareness
	PA-2	Mechanisms to disseminate risk information rapidly to the public through mass media, alert systems, with support from specialised agencies and information networks
	PA-3	DRR included in the national educational curriculums in different levels of education
	PA-4	Public education campaigns to enhanced risk awareness
	PA-5	Training of local government

Table A1 Proposed indicators list for DRM assessment at the national level (continued)

<i>Elements</i>	<i>Code</i>	<i>Indicator description</i>
Early warning systems	EW-1	Country's national early warning focal points/institutions established, with adequate budgets and human resources
	EW-2	Early warnings acted effectively at the local level
	EW-3	Mechanism to link with international early warning systems.
	EW-4	Mechanisms for updating early warning data.
	EW-5	Mechanism to link risk information with relevant sectoral ministries, departments, and emergency centres.
	EW-6	Mechanism to ensure rapid dissemination of early warning information throughout the country at district and local levels exist.
	EW-7	Mechanisms for proactive access/dissemination of disaster risk information to districts (the internet, public information broadcasts - radio, TV)
	EW-8	Sector-specific impact warning systems, indicators and alert criteria, and risk/disaster management plans prepared
Preparedness	PR-1	sector-specific preparedness plans in place
	PR-2	Directory available of the names, contact addresses and phone numbers, roles and responsibilities of all key national players
	PR-3	Resources and relief assistance/technical support that can be quickly mobilised (national, international, regional, NGO agencies) identified and listed with contact points and contact details
	PR-4	Rescue organisations established and equipped with infrastructure and equipment to save lives and property
	PR-5	Shelters, high grounds, and facilities to protect lives and livelihood assets available (in collaboration with district/local level officials)
	PR-6	Preparedness plans are regularly updated
	PR-7	Basic stocks of relief materials (drinking water, foods, medicine, tents and blankets) permanently available in hazard-prone districts and functionality of warehouses in emergency case
	PR-8	Logistical arrangements planned transport, fuel, water, etc.
	PR-9	Emergency health teams defined and ready
	PR-10	Relief provision standards exist for most vulnerable people (children, elderly, disabled, women, the very poor)
	PR-11	Criteria for different levels of alert and evacuation established
	PR-12	Procedures/criteria to identify evacuation routes (in collaboration with district/local- level officials) established
	PR-13	Practice evacuation exercises carried out, and procedures agreed
	PR-14	Emergency communication systems at different levels to ensure rapid evacuation (pre- and post-disaster) and/or relief, as needed, in place
	PR-15	Hazard monitoring system installed/implemented to ensure rapid response (evacuation, relief, as needed)
Response and emergency	RE-1	Reliable alarm system in place to alert concerned officials to initiate emergency response
	RE-2	Relevant service providers and recovery operations mandated and linked through EW/information network
	RE-3	National committee/senior coordination authority nominated to form an emergency committee when needed
	RE-4	High level of government assisted in past emergency situations to solve problems, ensure adequate funding and logistical support
	RE-5	Declaration of emergency status as a basis for calling international/regional relief and technical assistance (UN, governments, INGOs)
	RE-6	Monitoring of relief/assistance operations to ensure the aid reaches those in need and prevent diversion of aid to others

Table A1 Proposed indicators list for DRM assessment at the national level (continued)

<i>Elements</i>	<i>Code</i>	<i>Indicator description</i>
Impact assessment	IA-1	Standards and processes for disaster impact assessment and the needs for food, shelter, water, medicines, hospitalisation, etc. established.
	IA-2	Sectoral and cross-sectoral teams designated and trained
	IA-3	Standardised reporting formats and analysis methods in place
	IA-4	Disaster loss databases exist and are regularly updated
Recovery	RC-1	Mechanisms exist and responsibilities defined for the design of integrated response and recovery measures/plans
	RC-2	Coordination mechanisms for national/international recovery efforts established/operational
	RC-3	Arrangements for repair/reconstruction (e.g. roads, bridges wells, schools and other key buildings) and services (e.g. health, education, agricultural extension and provision of inputs) in place
	RC-4	Guidelines exist for “building back better.”
	RC-5	Criteria for selection of people to be resettled/analysis of their skills and opportunities for gainful employment established
	RC-6	Assessments and information on transient livelihood options for those displaced temporarily or on a long-term basis available
	RC-7	National emergency and reconstruction fund exists
Evaluation and monitoring	RC-8	Standards/Criteria to decide the length of emergency assistance exist
	RC-9	Mechanism to prepare plans for rehabilitation and economic recovery exist
	RC-10	National funding mechanisms promoting rehabilitation exist
	RC-11	Role of micro-financing institutions in rehabilitation defined
	RC-12	Guidelines for local institutions and informal groups to help affected communities exist
	RC-13	Allocate adequate national budget for relief and reconstruction
	EM-1	Mandates and responsibilities of DRM monitoring and evaluation
	EM-2	Indicators defined for monitoring the implementation of DRM plan and assessing the effectiveness of the different components
	EM-3	Establishing and maintaining national DRM monitoring mechanism
	LE-1	Mechanisms for scaling up good practices and lessons learned
	LE-2	Assessments of past experiences of disaster mitigation actions disseminated