BANJIR KELANTAN

PROF MOHD NORDIN ADLAN

DATA HUJAN

Tarikh	Tempat Menyukat Hujan													Jumlah
	Gua Musang		Kuala Krai	Gua Musang	Jeli	Kuala Krai			Tanah Merah	Kota Bharu	Tanah Merah	Pasir Mas	Pasir Puteh	
	Gunung Gagau	Kg. Aring	Kg. Laloh	Gua Musang	Kg. Jeli	Dabong	Tualang	Kuala Krai	Kusial	Jeti Kastam	Jenob	Rantau Panjang	Pasir Putih	
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
12/20/2014	36	19	17	13	106	24	16	38	121	84	110	58	105	747
12/21/2014	302	128	77	65	70	78	82	78	99	32	96	59	23	1189
12/22/2014	478	294	208	212	130	243	227	155	83	12	70	20	29	2161
12/23/2014	515	13	0	116	39	154	164	24	27	5	46	13	4	1120
12/24/2014	159	0	0	0	160	101	112	211	261	40	181	77	60	1362
12/25/2014	32	0	0	0	60	0	8	22	18	6	15	17	10	188
Jumlah	**1522**	**454**	**302**	**406**	**565**	**600**	**609**	**528**	**609**	**179**	**518**	**244**	**231**	**6767**

Gunung Gagau 1376m, Gua Musang 118m, Kuala Kerai 36m

Kelantan River Basin has a tropical climate receiving rainfall throughout the year. The average annual rainfall varies between 0 mm in the dry season (March-May) to 1,750 mm in the monsoon season (November – January). The average runoff for the Kelantan River basin is about five hundred (500) m^3/s. The average precipitation in the Kelantan river basin is approximately 2,500 mm/year while regional studies show that the average combined loss due to interception and evapotranspiration is about 1,200 mm/year. The resulting average runoff is therefore approximately 1300 mm/year. The average temperature is approximately 28°C at Kota Bahru. The basin is densely vegetated over the scraps and also on the valley side slopes.

Laporan Catatan Aras Air Tertinggi Mengikut Tempat

Tempoh		01-12-2014 sehingga 10-02-2015						
							Kemaskini Pada : 10-02-2015 08:37:21	
Bil	Sungai	Tempat	Aras Normal (M)	Aras Berjaga (M)	Aras Amaran (M)	Aras Bahaya (M)	Catatan Tertinggi	
							Tarikh & Waktu	Sukatan (M)
1	Sungai Galas	Dabong	28.00	32.00	35.00	38.00	12/24/2014 16:00	46.47
2	Sungai Lebir	Tualang	23.00	27.00	31.00	35.00	12/24/2014 6:00	42.17
3	Sungai Kelantan	Tangga Krai	17.00	20.00	22.50	25.00	12/25/2014 15:00	34.17
4	Sungai Kelantan	Jambatan Guillemard	10.00	12.00	14.00	16.00	12/26/2014 0:00	22.74
5	Sungai Kelantan	Tambatan DiRaja	1.00	3.00	4.00	5.00	12/26/2014 0:00	6.89
6	Sungai Golok	Jenob	19.00	21.50	22.50	23.50	1/12/2014 2:00	24.93
7	Sungai Golok	Rantau Panjang	5.00	7.00	8.00	9.00	12/18/2014 11:00	10.84
8	Sungai Semerak	Pasir Putih	0.40	2.00	2.30	3.00	12/18/2014 7:00	2.67

WATER SUPPLY

- RIVER ABSTRACTION= 20 NOS = 213,414m^3/day
- HCW = 10 NOS = 127, 570 m^3/day
- BOREHOLES = 5 NOS = 82,602 m^3/day.
- TOTAL PRODUCTION = 423,586 against designed of 461,050 m^3/day.

River basin

- The Kelantan River is only drop for 10m from the coastline to Guillermard Bridge with a distant of 60km.
- The main river comprises of seven major Subcatchments (Kota Bahru, Gullimard, Pergau, Kuala Krai, Galas, Lebir, and Nenggeri/Betis) that covers a drainage area of 13,170 km^2.
- Kuala Krai – Sg Galas + Sg Lebir
- Dabong – Sg Pergau + Sg Galas
- Kg Bertam Baru, 4 km downstream Sg Betis meets Sg Galas (Sg Betis – Cameron Highlands/Gua Musang Road)
- Gua Musang – Sg Galas + Sg Ketil
- Manik Urai – Sg Lebir + Sg Sok

List Of WTP and Intake

No	Name of Water Treatment Plant		Year of:		Supply Area (District)	2013 (June)	
		Intake	Commissioning	Upgrading		Actual Design Capacity (m^3/day)	Average Daily Production (m^3/Day)
1	Kelar	Sg Kelantan	1985	2005	Pasir Mas/Tumpat	64,000	63,894
2	Bukit Remah	Sg Kelantan	1984	2010	Tanah Merah/Machang	40,000	31,466
3	Kemahang	Sg Kelantan	1987	2013	Tanah Merah	2,700	3,314
4	Bendang Nyior	Sg Jegor	1991	2013	Tanah Merah	1,400	1,308
5	Batu Gajah	Sg Jedak	1991	0	Tanah Merah	3,500	3,295
6	Kuala Tiga	Sg Kelantan	1991	0	Tanah Merah	1,500	1,127
7	Ayer Lanas/Gemang	HCW(Sg. Lanas)	1962	2010	Jeli	4,000	3,282
8	Jeli/Pasir Dusun	HCW(Sg. Pergau)	1990	2010	Jeli	12,000	7,300
9	Kuala Balah	HCW(Sg. Terang)	1991	2010	Jeli	6,000	3,553
10	Felda Chiku	Sg Chiku	1988	0	Gua Musang	8,000	6,534
11	Bertam Baru	HCW(Sg. Galas)	1992	2013	Gua Musang	4,000	591
12	Limau Kasturi	Sg Galas	1988	2011	Gua Musang	6,000	4,152
13	Sg Ketil	Sg Ketil	1991	2013	Gua Musang	9,000	15,685

cont'd...List Of WTP and Intake

No	Name of Water Treatment Plant		Year of:		Supply Area (District)	2013 (June)	
		Intake	Commissioning	Upgrading		Actual Design Capacity (m^3/day)	Average Daily Production (m^3/Day)
14	Felda Aring	Sg Aring	1992	2013	Gua Musang	500	726
15	Kuala Betis/Panggung Lalat	Sg Kuala Betis	1992	0	Gua Musang	500	799
16	Tualang	Sg Kelantan	1986	0	Kuala Krai	8,000	8,140
17	Pahi	HCW(Sg.Lebir)	2004	2013	Kuala Krai/Machang	21,000	16,980
18	Manek Urai	Sg Lebir	2004	0	Kuala Krai	6,750	6,024
19	Nal	Sg Kelantan	2003	0	Kuala Krai	2,000	1,856
20	Stong	HCW(Sg. Stong)	1991	2010	Kuala Krai	2,000	1,170
21	Merbau Chondong	Sg Kelantan	2005	2010	Kota Bharu/Machang/ Pasir Puteh	50,000	48,655
22	Wakaf Bunut	Sg Rasau	1983	2013	Pasir Puteh	25,000	13,267
23	Jeram Pasu	Sg Jerneh	2000	0	Pasir Puteh	1,800	1,728
24	Bukit Yong	Sg Yong	2002	0	Pasir Puteh	2,500	1,444
25	Kg Puteh	Borehole	1934	2009	Kota Bharu	45,000	47,117

cont'd...List Of WTP and Intake

No	Name of Water Treatment Plant	Intake	Year of:		Supply Area (District)	2013 (June)	
			Commissioning	Upgrading		Actual Design Capacity (m^3/day)	Average Daily Production (m^3/Day)
26	Tanjung Mas	Borehole	1975	1985	Kota Bharu	10,000	12,323
27	Perol	Borehole	1998	2012	Kota Bharu	7,500	4,782
28	Pintu Geng	Borehole	1990	2013	Kota Bharu	30,000	11,692
29	Ketereh	Borehole	1990, 2003, 2009	2010	Kota Bharu	5,500	6,688
30	Chicha	Borehole (HCW)	2001	2013	Kota Bharu/Bachok	60,000	71,070
31	Kg Chap	Borehole (HCW)	1990	2013	Bachok	3,900	4,516
32	Wakaf Bharu	Borehole (HCW)	1985	2013	Tumpat	9,000	19,108
33	Lojing	Sg. Tela	2011		Gua Musang	5,000	0
34	Lebir	Sg. Lebir	2013		Gua Musang	1,000	0
35	Peralla	HCW	2013		Tanah Merah	2,000	0
	TOTAL					**461,050**	**423,586**

A 100-year maximum flood susceptibility mapping using integrated hydrological and hydrodynamic models: Kelantan River Corridor, Malaysia

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Key words
Flood susceptibility analysis; GIS; hydrological model; Malaysia; PDM model; remote sensing.

Abstract

The Kelantan River is located in the northeastern part of Peninsular Malaysia and presents a great challenge in terms of long and recurring floods. The recent floods, in the year 2005, 2006, 2007, 2008 and 2009 due to heavy monsoons rainfall have triggered these events along Kelantan River Basin. This paper summarizes the findings of the flood susceptibility analysis using hydrological and hydrodynamic models with the aid of GIS tools and remote sensing data. Terrain information such as historical flooded areas for the year 2007 was extracted from RADARSAT images. Further, digital elevation model and precipitation information were updated to enable the quantification of flood-associated attributes. For hydrological and hydrodynamic analyses, data obtained from Department of Irrigation and Drainage, Government of Malaysia, has been used corresponding to rain gauge/discharge stations along the Kelantan River. Data on daily and hourly average discharge and peak discharge are modelled for all the stations for different periods. Probability density moisture combined with rainfall simulation models was applied to determine the maximum flood susceptibility map. Results indicate that the flood-prone areas delineated on this map correspond to areas that would be inundated by significant flooding (approximately the 100-year flood).


Sg. Kelantan
@ Kota Bharu
PASIR MAS
Sg. Kelantan
BACHOK
MACHANG
TANAH
MERAH
Sg. Kelantan
@ Jamb. Kuntal
Sg. Pergau
KUALA KRAI
Sg. Kelantan
@ Kuala Krai
Sg. Pergau
@ Rt. Lembu
Sg. Galas
@ Dabong
Sg. Lebir
@ Kg. Tualang
Sg. Galas
Sg. Nenggiri
@ Jamb. Bertam
GUA MUSANG
Nenggiri
Lebir

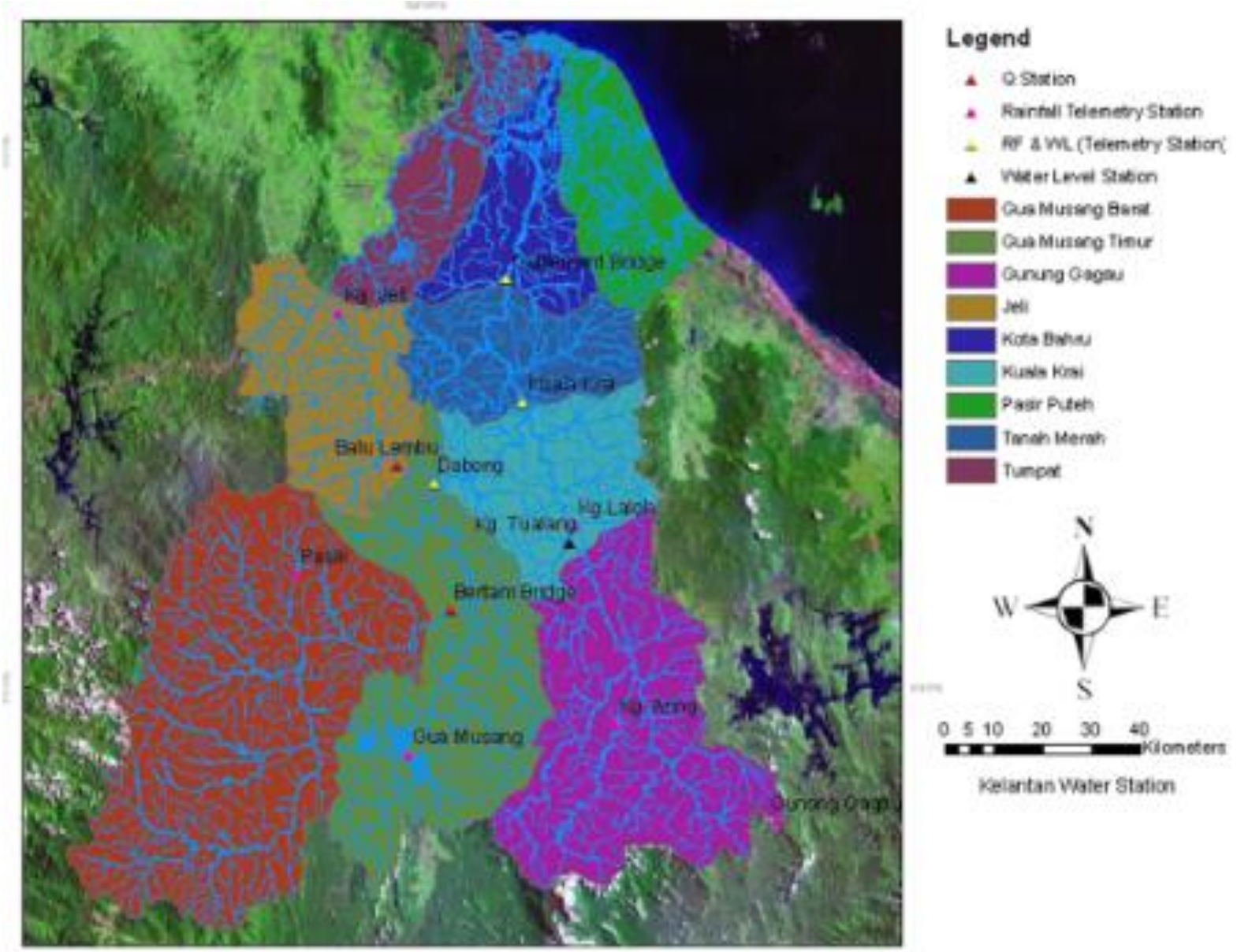

Figure 2 Catchment area and distribution of water gauging station in Kelantan River Basin.

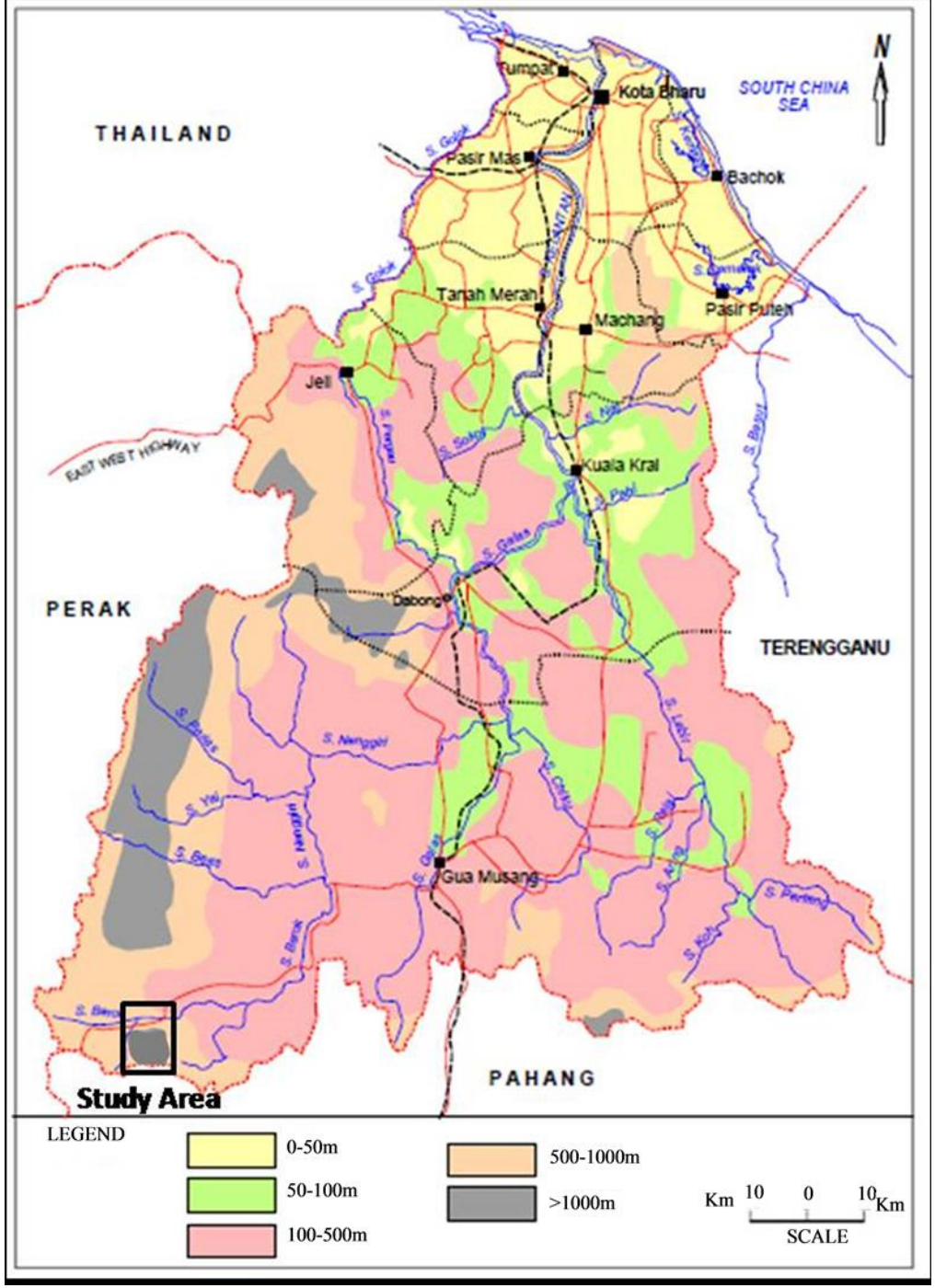
N
THAILAND
SOUTH CHINA SEA
Rumpai
Kota Bharu
Pasir Mas
Bachok
Tanah Merah
Machang
Pasir Puteh
Jeli
Kuala Krai
EAST WEST HIGHWAY
PERAK
Dabong
TERENGGANU
Gua Musang
PAHANG
Study Area
LEGEND
0-50m
50-100m
100-500m
500-1000m
>1000m
Km 10 0 10 Km
SCALE

Table 1 Characteristics of water-level stations in the Kelantan River Basin

Station no. (daily mean flow)	Station name	River Basin	Telemetry (T)/manual (M)	Year open	Data availability
5120401	Sg. Nenggiri di Jam. Bertam	Kelantan	M	April 1975	No
5222452	Sg. Lebir di Kg. Tualang	Kelantan	T	February 1973	Yes
5320443	Sg. Galas di Dabong	Kelantan	T	July 1972	Yes
5419401	Sg. Pergau di Batu Lembu	Kelantan	M	December 1978	No
5521444	Sg. Kelantan di Kuala Krai	Kelantan	T	December 1979	Yes
5721442	Sg. Kelantan di Jam. Guillemard	Kelantan	T	1949	Yes
6122441	Sg. Kelantan di Kota Bahru	Kelantan	T	December 1962	Yes

TABLE 1
Landuse Changes by Year 1984, 1997 and 2004

Landuse Types	1984 Area (ha)	1997 Area (ha)	2004 Area (ha)	Average
Forest	10454677597.83	801154.92	710073.92	3485396276
Rubber	116835.97	163510.79	142170.10	140839
Oil Palm	20656.6	65835.01	87974.12	58155.2

Source: Kementerian Pertanian Malaysia 2004

Implikasi/kesan banjir

- 21 deaths
- > RM 1 bill properties
- 2000 lost homes
- Diseases
- Intangible: Environmental damages, trauma, inconvenient, opportunity losses
- Schools + furniture + books etc were destroyed, no public water supply for cleaning works – extended opening
- WTP were damaged, some distribution pipelines were cut-off.

- We have flood every year
- But this time was so huge!

Perancangan dan pencegahan banjir

- River basin management (many studies and publication have been produced, any listeners or just among the researchers – what went wrong???
- Land use (is it too academic?? Need political will??)
- Legislation and bylaws (enforcement?? Economical aspects? Reserve water catchment?)
- Disaster Risk Reduction Program

International Strategy for Disaster Reduction

SUMMARY of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (Hyogo Framework)

Expected outcome, strategic goals and priorities for action 2005-2015

Expected Outcome
The substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries

Strategic Goals

- The integration of disaster risk reduction into sustainable development policies and planning
- Development and strengthening of institutions, mechanisms and capacities to build resilience to hazards
- The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programmes

Priorities for Action

Key Activities

1. Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

- DRR institutional mechanisms (national platforms); designated responsibilities
- DRR part of development policies and planning, sector wise and multisector
- Legislation to support DRR
- Decentralisation of responsibilities and resources
- Assessment of human resources and capacities
- Foster political commitment
- Community participation

2. Identify, assess and monitor disaster risks and enhance early warning

- Risk assessments and maps, multi-risk: elaboration and dissemination
- Indicators on DRR and vulnerability
- Data & statistical loss information
- Early warning: people centered; information systems; public policy
- Scientific and technological development; data sharing, space-based earth observation, climate modeling and forecasting; early warning
- Regional and emerging risks

3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels

- Information sharing and cooperation; Networks across disciplines and regions; dialogue
- Use of standard DRR terminology
- Inclusion of DRR into school curricula, formal and informal education
- Training and learning on DRR: community level, local authorities, targeted sectors; equal access
- Research capacity: multi-risk; socio-economic; application
- Public awareness and media

4. Reduce the underlying risk factors

- Sustainable ecosystems and environmental management
- DRR strategies integrated with climate change adaptation
- Food security for resilience
- DRR integrated into health sector and safe hospitals
- Protection of critical public facilities
- Recovery schemes and social safety- nets
- Vulnerability reduction with diversified income options
- Financial risk-sharing mechanisms
- Public-private partnership
- Land use planning and building codes
- Rural development plans and DRR

5. Strengthen disaster preparedness for effective response at all levels

- Disaster management capacities: policy, technical and institutional capacities
- Dialogue, coordination & information exchange between disaster managers and development sectors
- Regional approaches to disaster response, with risk reduction focus
- Review & and exercise preparedness and contingency plans
- Emergency funds
- Voluntarism & participation

Cross Cutting Issues

- Multi-hazard approach
- Gender perspective and cultural diversity
- Community and volunteers participation
- Capacity building & technology transfer

Contributing to the achievements of the internationally agreed development goals (including the MDGs)

Implementation and Follow-Up

In order to achieve the goals and act upon the priorities identified in this Framework, the following tasks have been identified to ensure implementation and follow-up by States, regional and international organizations in collaboration with civil society and other stakeholders. The ISDR partners, in particular the Inter-agency Task Force on Disaster Reduction and secretariat, are requested to assist in implementing this Framework for Action.

General Considerations

- Implementation by different stakeholders, multi-sectoral approach; participation of civil society (NGOs, CBOs, volunteers), scientific community & private sector is vital
- States primarily responsible; an enabling international environment is vital, incl. strengthened regional capacities
- Build multi-stakeholder partnerships
- Particular attention to:
  - Small Island developing States: Mauritius Strategy;
  - Least developed countries;
  - Africa
- States, regional and international organizations to foster coordination among themselves and a strengthened International Strategy for Disaster Reduction (ISDR)
- Follow-up integrated with other major conferences in fields relevant to DRR; reviews as appropriate

Actors

Critical tasks

States

- Designate national coordination mechanisms for the implementation and follow up, communicate to the ISDR secretariat;
- National baseline assessments of the status of DRR;
- Publish and update a summary of national programme for DRR including international cooperation;
- Develop procedure for reviewing national progress including systems for cost benefit analysis and ongoing monitoring on risk;
- Consider acceding to, approving or ratifying relevant international legal instruments and to make sure they are implemented;
- Promote the integration of DRR with climate variability and climate change into DRR strategies and adaptation to climate change; ensure management of risks to geological hazards.

Regional Organizations and Institutions

- Promote regional programmes including for technical cooperation, capacity development, the development of methodologies and standards for hazard and vulnerability monitoring and assessment, the sharing of information and effective mobilization of resources;
- Undertake and publish regional and sub-regional baseline assessments;
- Coordinate and publish reviews on progress and support needs, and assists countries in preparation of national summaries;
- Establish specialized regional collaborative centers;
- Support the development of regional mechanisms and capacities for early warning, including for tsunami

International Organizations (including UN System and IFIs)

- Engage in the implementation of the ISDR by encouraging integration of DRR into humanitarian and sustainable development fields;
- Strengthen the capacity of the UN system to assist disaster-prone developing countries in DRR and implement measures for assessment of progress;
- Identify actions to assist disaster-prone developing countries in the implementation of the Hyogo Framework, ensure their integration and that adequate funding is allocated; assist in setting up national strategies and programmes for DRR;
- Integrate actions into relevant coordination mechanisms (UNDG, IASC, RCs and UN Country Teams);
- Integrate DRR into development assistance frameworks such as CCA/UNDAF, PRSP;
- In collaboration with networks and platform support: data collection and forecasting on natural hazards and risks; early warning systems; full & open exchange of data;
- Support States with coordinated international relief assistance, to reduce vulnerability & increase capacities;
- Strengthen international mechanisms to support disaster stricken States in post-disaster recovery with DRR approach
- Adapt & strengthen inter-agency disaster management training for DRR and capacity building.

ISDR (Inter-Agency Task Force on Disaster Reduction & secretariat)

- Develop a matrix of roles and initiatives in support of follow/up to the Hyogo Framework;
- Facilitate the coordination of effective actions within the UN system and other international and regional entities to support the implementation of the Hyogo Framework, identify gaps, facilitate processes to develop guidelines and policy tools for each priority area;
- In broad consultation, develop generic, realistic and measurable indicators. These indicators could assist States in measuring progress in the implementation of the Hyogo Framework;
- Support national platforms & regional coordination;
- Register relevant partnerships with Commission on Sustainable Development;
- Stimulate the exchange, compilation, analysis and dissemination of best practices, lessons learnt;
- Prepare periodic review on progress towards achieving the objectives of the Hyogo Framework and provide reports to the UNGA & other UN bodies

Resource Mobilization: States, Regional and International Organizations

- Mobilize resources and capabilities of relevant national, regional and international bodies, including the UN system;
- Provide and support the implementation of the HFA in disaster prone developing countries, including through financial and technical assistance, addressing debt sustainability, technology transfer, public-private partnership and North-South and South-South cooperation;
- Mainstream DRR measures into multilateral and bilateral development assistance programmes;
- Provide adequate voluntary financial contribution to the UN Trust Fund for DR to support follow-up activities to Hyogo Framework; review usage and feasibility for the expansion of this fund;
- Develop partnership to implement schemes that spread out risks, reduce insurance premiums, expand insurance coverage and increase financing for post-disaster reconstruction, including through public and private partnerships. Promote an environment that encourages a culture of insurance in developing countries.

Pengurusan dan Pemulihan Banjir (Water)

- Government policy, public institution
- Community engagement, volunteers, education system
- Corp of Engineers in Waterworks (check how many have join it??)
- Hyogo Framework for Action 2005-2015

Cadangan Inovasi Pengurusan Banjir

- Water has to be available during flood (how? Where? Drinking and sanitation?)
- Potable treatment system: R & D??
- Source abstraction at certain flood return period: 1 in 50 years? 1 in 100 years?
- Boreholes in evacuated areas?? Using standby generators and pumps – need to maintain periodically