Ministry of Environment, Water and Natural Resources

Water Resources Management Authority

Japan International Cooperation Agency

Republic of Kenya

Project on Capacity Development

for Effective Flood Management in Flood Prone Areas

WRMA

Technical Training Text

for Flood Management

Second edition (February 2014)

Japan International Cooperation Agency

NEWJEC Inc.

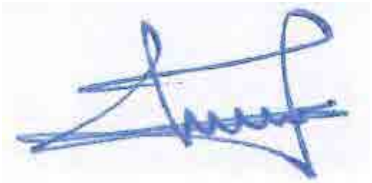
Preface

The Government of Kenya established the Water Resources Management Authority (WRMA), through the sector reform brought by Water Act 2002. WRMA is the lead agency in the management of water resources in the country through six (6) regional offices and twenty six (26) sub – regional offices of the respective water resources catchment areas.

Since its operationalization in 2005, WRMA has made significant progress in making water resources recognized as being fundamental for socio-economic and environmental sustainability. In this regard, integrated floods management is viewed as necessary component in water resources management.

Based on the request from GOK, JICA carried out the "Study on the Integrated Flood Management (IFM) for Nyando River Basin (2006 – 2009)" as the Technical Cooperation Scheme and "Programme for Community based Flood Disaster Management to Adapt to Climate Change in the Nyando River Basin (2009-2011)". This was a Grant Aid Programme with the aim of establishing a flood management system in the southern part or Lake Victoria Basin through IFM, where WRMA was the implementing agency. Through the above projects, community based flood management activities have been implemented through integrating non- structural and structural measures such as community based flood hazard mapping and construction of flood counter measure structures in prioritized flood prone areas.

Based on the achievement of Nyando project, the Project on Capacity Development for Effective Flood Management was formulated to expand IFM in other flood prone areas in Kenya. Three pilot river basins were selected namely: Isiolo, Gucha-Migori and Lumi to promote community based flood management activities. The main purpose of the project was to build institutional framework of flood management in the context of integrated water resource management for effective and sustainable implementation of community based activities. Through the project WRMA has developed strategies and guidelines in managing floods which have since been incorporated in the revised Catchment Management Strategies (CMS) and WRUA Development Cycle (WDC) manual. In order to develop capacity of WRMA officers in the field of community-based integrated flood management, a training system has been developed where the Project conducted IFM Training for WRMA officers who in turn trained the WRUAs. The Training Materials for community based flood management have been developed. These include supplemental manuals, lessons learnt and case studies.



Eng. John P. Olum, HSC
Chief Executive Officer, WRMA

Table of Contents

Module 1

1-1 Cause and Effect of Floods

FLOOD MANAGEMENT TRAINING

Module 1-1

Cause and Effect of Floods

Presented by Mr. Joseph Kimanga
Prepared Katsuro KONDO
Chief Advisor to
JICA & WRMA Flood Management Project

1

Contents

2

3

Risk, Hazard, Disaster

Risk is a function of the hazards to which a community is exposed and the vulnerabilities of that community. However, that risk is modified by the level of the local preparedness or capacity of the community at risk.
It is expressed by the following notation:

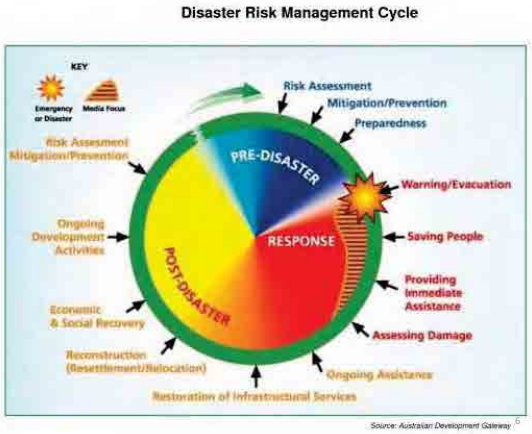
$$\text{Risk} \text{ is proportional } \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Capacity}}$$

4

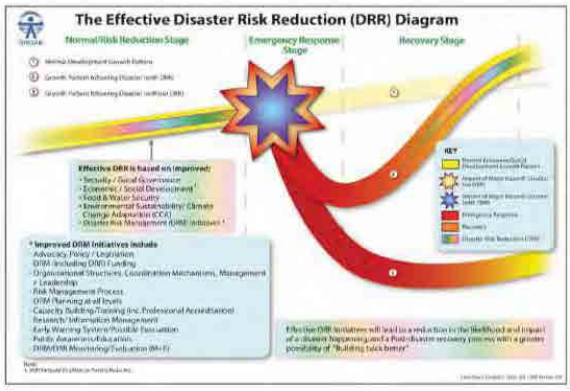
Pressure and Release model

Adapted from UN DMTP (1992) Overview of disaster management

5



6



7

Discuss Cause of Flood

- Rain to discharge

Small basin

Q= C (coefficient) x I (rainfall) x A (area)

concentration time ;tr (traveling time)

- How flood water reach to the downstream

dam, water pan, channel(wide or narrow, straight or meandering), tributary, branch, dam and bank break

- Identify the cause of vulnerability what we can handle

8

Effect of flood

- Flood Damage

A Direct Loss

human life

public asset

private asset

B In direct loss(private and business house) simulation by model

9

Conclusion

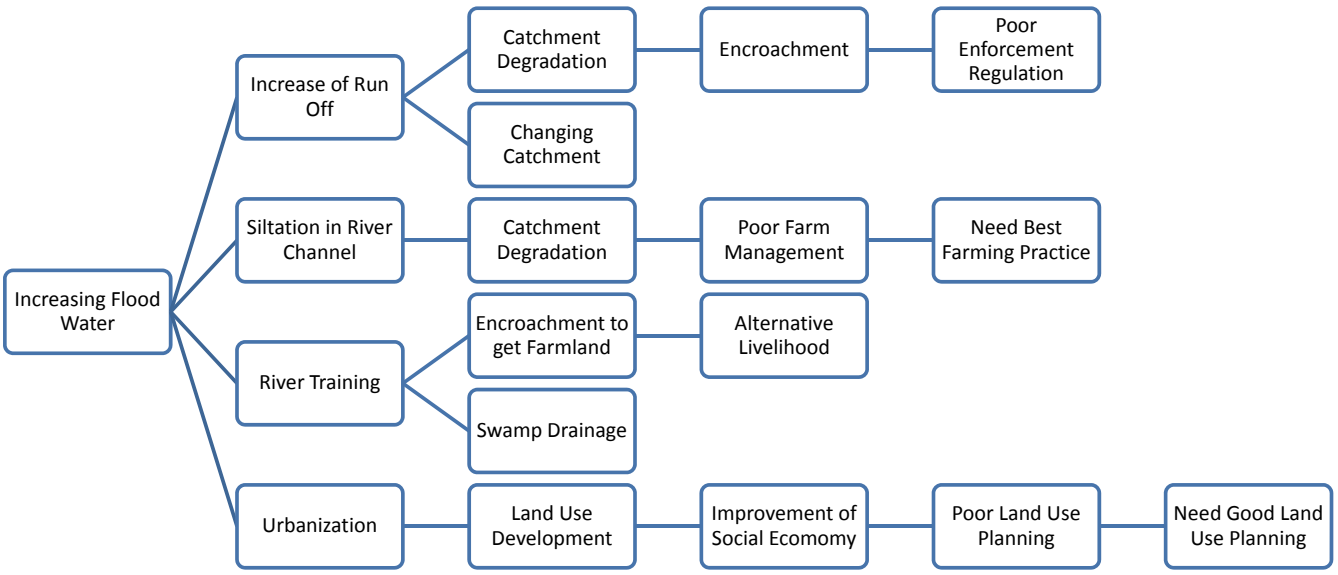
- Cause and effect of the flood is very different by the area and time and social activities
- Any activity in the river of the basin makes side effect
- It is essential the WRUA member understand how is the cause the flood and what is the relation the countermeasures activity and flood

10

Asante SANA

11

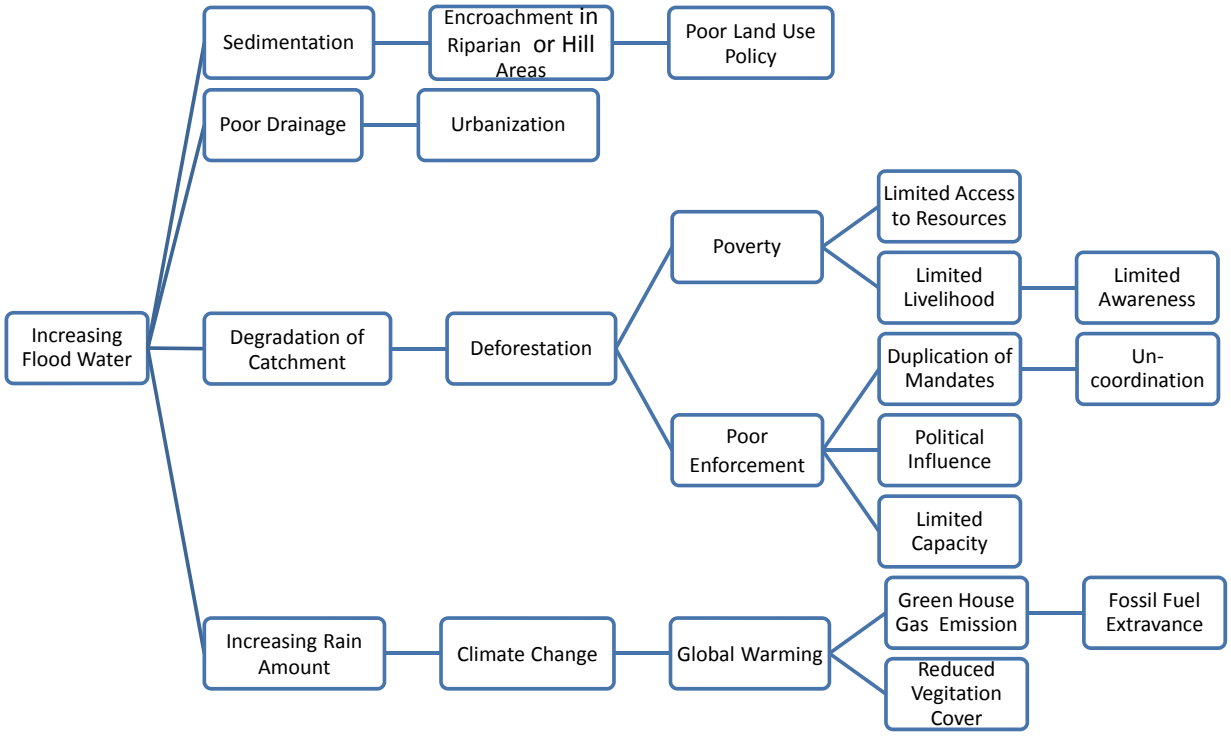
<<GROUP-1: Problem Tree>>
Why flood disaster is increasing?



1

Module 1-1B Cause and Effect of Floods--- GROUP DISCUSSION ---

<<GROUP-2 : Problem Tree>>
Why flood disaster is increasing?



2

<<GROUP-2 : Solution>>
Why flood disaster is increasing?

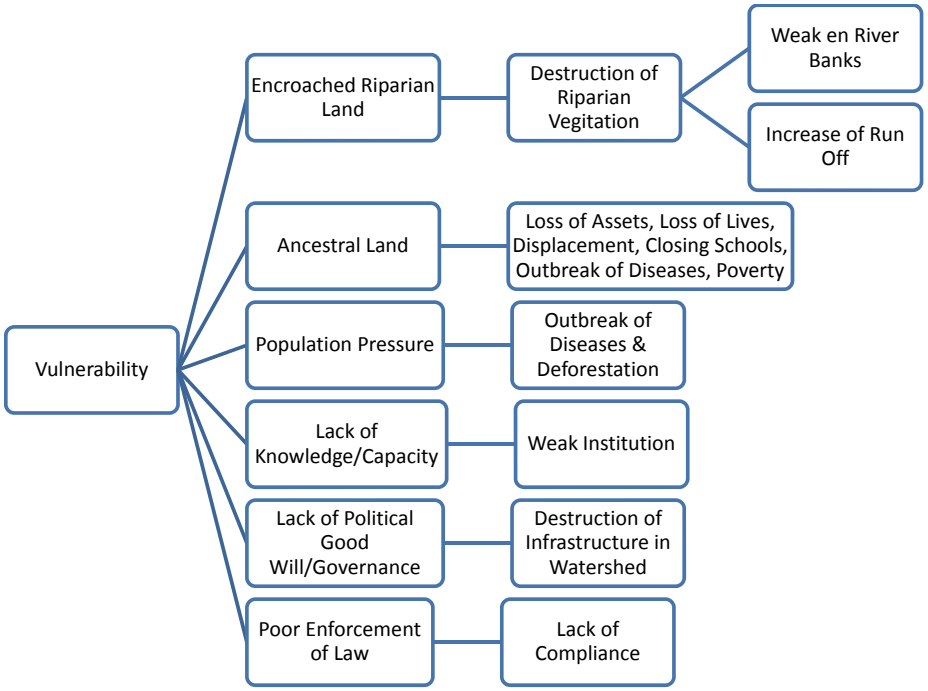
1) Harmonization of Polices/Laws

2) Advocacy and Awareness Creation
- Policy
- Sustainable Livelihood
- Leadership for politicians

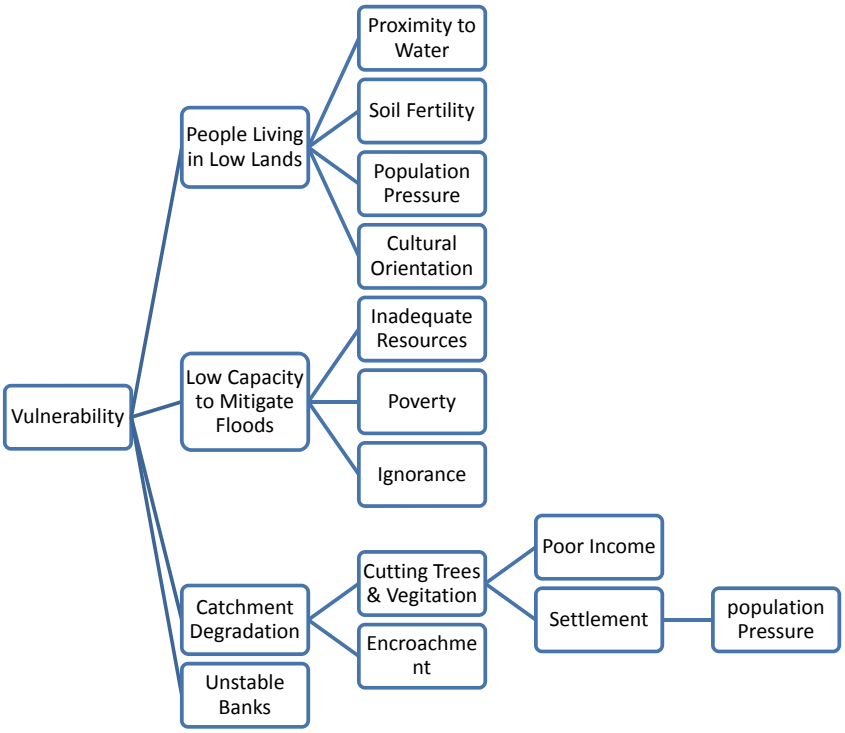
3) Enforcement
- Improvement of Capacity of Inst.

4) Capacity Building

<<GROUP-3 : Problem Tree>>
Why vulnerability is increasing?



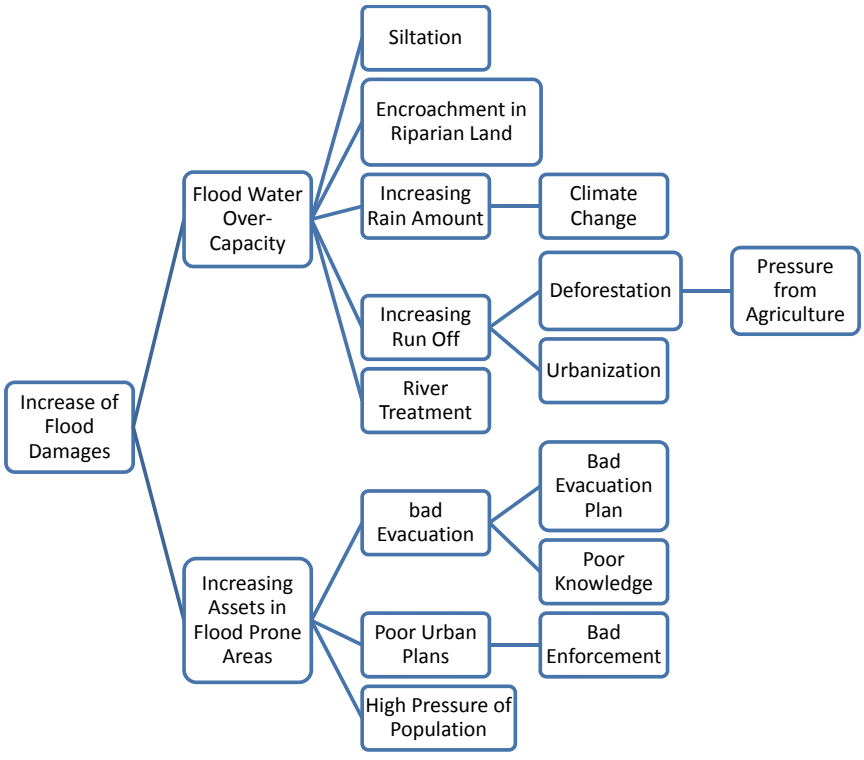
<<GROUP-4 : Problem Tree>>
Why vulnerability is increasing?



5

Module 1-1B Cause and Effect of Floods--- GROUP DISCUSSION ---

<<Eng. KONDO : Example of Problem Tree>>



6

Module 1

1-2 Understanding Flood Management

FLOOD MANAGEMENT TRAINING

Module 1-2

UNDERSTANDING FLOOD MANAGEMENT

Presented by Mr. Alexander Nzyuko
Prepared by Japheth Onyando
Professor of Soil and Water Engineering

1

LEARNING OBJECTIVE

- Understand the concept of River Basin
- Understand the meaning of flood management
- Learn the steps involved in flood management activities
- Development of Flood Management plans

2

PRESENTATION OUTLINE

A:The River basin Concept

B: Integrated River Basin Flood Management
- B1: Understanding flood managment
- B2: Steps involved in flood management

3

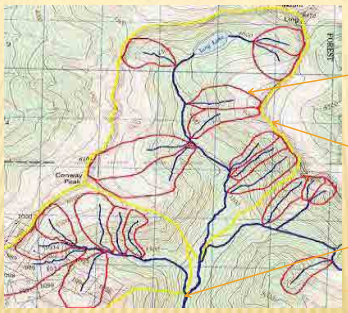
A1: THE RIVER BASIN CONCEPT

A1-1: River basin defined

- River basin is synonimous with drainage basin
- Is topographic region from which a river receives inflow
- The inflow is in the form of surface runoff, sub-surface flow and groundwater flow
- A River basin is a closed system separated from others by topographic barriers called watersheds or catchments
- A watershed or catchment contains the river and its tributaries that flow though one unique point at the downstream end of the channel
- A river basin is delineated based on the topographic information
- Quality of the river basin increases with decreasing scale

4

A1-2: Delineation of a river basin



Typical river basin showing first order and interrelationship between two basins

5

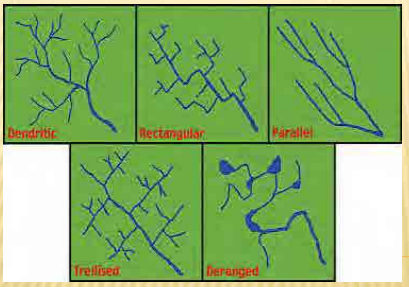
A1-3: River Basin And An Open System

- A River basin is an open system with inputs and outputs
- Inputs
  - Rainfall, snow and sedimnet
- Outputs
  - Evaporation, streamflow and deposition
- The inputs and outputs are affected by the following biophysical
  - Topography, Soil type
  - Bedrock type, Climate
  - Vegetation cover

6

A1-4: Pattern Of River Channel

- **The biophysical factors affect the pattern of river channels**

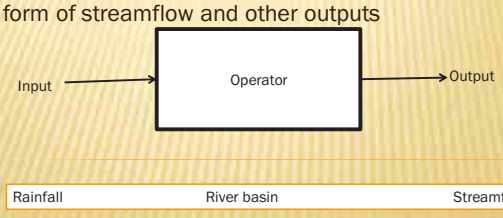


Trelised: strong structural control
Rectangular: tectonic faults or bedrock
Parallel: steep relief or flow over non-cohesive soils
Dendritic: adjusted systems on erodable sediments
Deranged: recently disturbed by glacial or volcanic deosition

7

A1-5: River Basin Systems Model

- Transforms rainfall input into streamflow
- Is a hydrologic system defined as a structure or volume in space, surrounded by a boundary, that accpets water in form of rain and other inouts, operates on them internally and produces an output in form of streamflow and other outputs



8

B1: INTEGRATED RIVER BASIN FLOOD MANAGEMENT

B1-1: What is Integrated Flood Management (IFM)

- Integrated Flood Management (IFM) is a Phenomenon that integrates land and water resources development in a river basin within the context of Integrated Water Resources Management (IWRM)

- IWRM is a process which promotes the coordinated management and development of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems

9

B1-2: DIMENSION OF IFM

- Encourage participation of users, planners and policy makers at all levels
- Open and transparent
- Inclusive and communicative
- Decentralisation of decision making
- Public consultation
- Stakeholder involvement in planning and implementation

10

B1-3: PARADIGM SHIFT IN FLOOD MANAGEMENT

- From traditional fragemented approach
- Encourages efficient use of resources of the river basin as a whole
- Employing strategies to maintain or augment the productivety of flood plains
- Prioviding protective measures against loses due to flooding

11

B1-4: APPROACHES TO IFM

Ecosystem approach

integrates land, water and living resources

promotes conservation and sustainable use in an equitable manner

implies consideration of the entire basin as a unit

accounts for the effects of economic interventions

Holistic approach

- Links social and economic development with protection of natural ecosystems
- Provide appropriate links between land and water uses
- Fosters structured information exchangeand the formation of effective organisational relationships

12

·**Adaptive Management**

·Robust but flexible in dealing with scientific uncertainties

·Decisions are made as part of an ongoing science-based process

·Involves planning, acting, monitoring and evaluating applied strategies

·Modifying management policies, strategies and practices as new knowledge becomes available

·Defines the expected outcomes

·Specifies methods to measure performnce

·Collects and analyises information sio as to compare expectations with actual outcomes

·Learns from the comparisons

·Changes actions and plans accordingly

13

B1-5: CLIMATE CHANGE AND VARIABILITY

·Effect on flood processes

·Causes sea levels to rise placing coastal communities at higher flood risk

·Increased occurrence of flash floods

·Causes riverine floods

IFM takes care of the expected effects and is therefore an autonomous adaptation strategy to climate change and variability

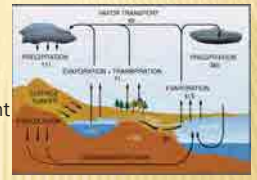
14

B1-6: THE IFM MODEL

15

B3: STEPS INVOLVED IN FLOOD MANAGEMENT ACTIVITES

B3-1: sequence of activities are outlined in IFM plan as indicated



•Manage the water cycle as a whole
•Integrate land and water management
•Manage risk and uncertainty
•Adopt a best mix of strategies
•Ensure participatory approach
•Adopt integrated hazard management approaches

Flood management plans should evaluate, adopt and implement those structural and non-structural measures appropriate to the region, and should guard against measures that create new hazards or shift problems spatially and temporally

16

B3-2: STRATEGY OPTIONS FOR FLOOD MANAGMENT

Strategy	Options
Reducing Flooding	Dams and reservoirs
	Dikes, levees and flood embankments
	High flow diversions
	Catchment management
	Channel improvements
Reducing Susceptibility to Damage	Floodplain regulation
	Development and redevelopment policies
	Design and location of facilities
	Housing and building codes
	Flood proofing
	Flood forecasting and warning
Mitigating the Impacts of Flooding	Information and education
	Disaster preparedness
	Post-flood recovery
	Flood insurance
Preserving the Natural Resources of Flood Plains	Floodplain zoning and regulation

17

FIVE ESSENTIAL ELEMENTS OF FLOOD MANAGEMENT

- Effective Use of Flood Water and Maximize Benefit
- Consistency in Planning (Land and Water Management)
- Combination of Structural and Non-structural Measures
- Participatory Approach (Community-driven Measures)
- Wider Risk Management System

18

Module 1

1-3 Flood Disaster Management

FLOOD MANAGEMENT TRAINING

Module 1-3

FLOOD DISASTER MANAGEMENT

Mr. Joseph Kimanga

1

CONTENTS

2

1. WHAT IS DISASTER

Definition

Disaster is a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.
(UNISDR)

Characteristics of a disaster.

- Is a catastrophic event, sudden or gradual
- Causes damage, loss of human life and property
- Deterioration in health and health services
- The scale is sufficient to warrant extraordinary response from outside the afflicted community

3

1.1. NUMBER OF PEOPLE AFFECTED BY FLOODS (KENYA) IN RECENT YEARS

Year	Region affected (Province)	No of people affected	
		Displaced	Fatalities
2009	Nyanza (Kisumu town)	150 families	5
2008	Nyanza, Northeastern, Rift Valley, Coast	12,000	5
2007	Western, Nyanza	20,610	9
2006	Nyanza, Western, Coast and Eastern	723,000	66
2005	Western, Nyanza, Eastern, North-Eastern	35,000 including 25,000 refugees in Daadab	20
2004	Widespread	2,500	50
2003	Western, Eastern	1,000,000	77
2002	Western, Nyanza, Eastern, Coastal	150,000	14
2001	Nairobi	Missing data	4
1997-98	Widespread	1,500,000	53

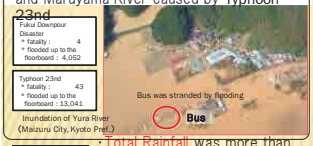
4

5

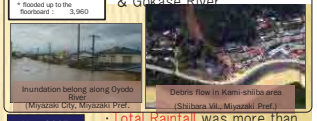
1.2.Heavy rain incidents : total rainfall more than 1000mm

Frequent water & sediment related disasters by heavy rain more than 1000mm

Year 2004
- ..., the total of which is more than 1000mm
- Dike breach and inundation along Yura River and Maruyama River caused by Typhoon 23nd



Year 2005
- Total rainfall by Typhoon 14th was more than1,000mm (southern part of Kyushu)
- Inundation along Oyodo River & Gokase River



Year 2006
- Total Rainfall was more than 1,200mm in July Flood in 2006.
- Inundations occurred along Sendai River & Yonenotsu River

Year 2007
- Total Rainfall was more than 1,000mm by Typhoon 4th.
- Inundations occurred along Midori

2. CLASSIFICATION OF DISASTER

Cause	Earthquakes, Floods, Tornadoes, Landslides, Mud flows, Drought Pest and insect infestation Chemical explosion, Oil spills Fire outbreaks, Explosions
Speed of onset	Rapid: sudden with little warning resulting in deaths and destruction
Natural or Artificial	Natural-floods, landslides, tsunami and earthquakes Human- chemical or industrial accidents, environmental pollution, traffic, political, explosions

7

3.DISASTER MANAGEMENT CYCLE

Please refer to Page 3 (handout)

8

3.1 PHASES OF DISASTER CYCLE AND ACTIVITIES

1. Normal time	•Mapping of specific location of potential disasters and associated risks conducting vulnerability analysis i.e. What makes a place to suffer the disaster •Taking inventory of resources for rapid mobilisation •Planning implementation of appropriate preventive and mitigation measures •Conducting education and training
2. Pre disaster or warning phase	•Issuance of timely warning based on the prediction of impending disaster

9

3.1 PHASES OF DISASTER CYCLE AND ACTIVITIES

3. Impact phase	•Disaster strikes and effects depend on the nature of the disaster, degree of preparedness, population density etc
4. Relief phase	•Search and rescue operation •First aid •Emergency health (services) care •Restoration of public utilities •Evacuation of victims •Public health surveillance

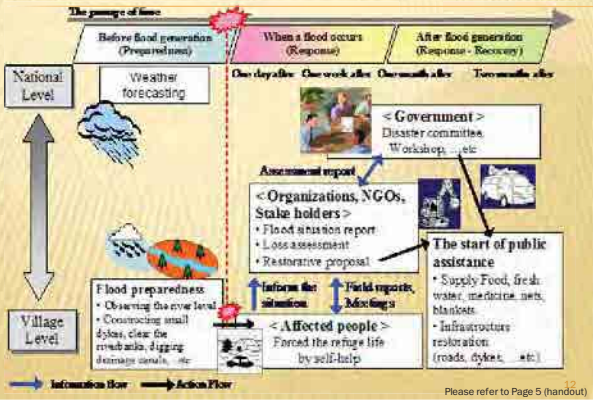
10

3.1 PHASES OF DISASTER CYCLE AND ACTIVITIES

5. Reconstruction or Rehabilitation / Recovery phase	•Measures taken to restore normalcy •Re-establishing public utilities, health services •Assessing and repairing damanged buildings, roads , schools etc •Reflection on the response to the past disaster in order to improve future disaster management by putting in place preparedness and mitigation based measures

11

PUBLIC, MUTUAL AND SELF HELPS



Please refer to Page 5 (handout)

12

Module 2

2-1A Rainfall Observation

WATER RESOUCES MANAGEMENT AUTHORITY

JAPAN INTERNATIONAL COOPERATION AGENCY

FLOOD MANAGEMENT TRAINING

Module2-1A
Rainfall Observation
Module2-1B
Rainfall Data and Statistical Processing

18th FEB 2014

Lawrence Thooko

Learning objective

To enable the participants to:

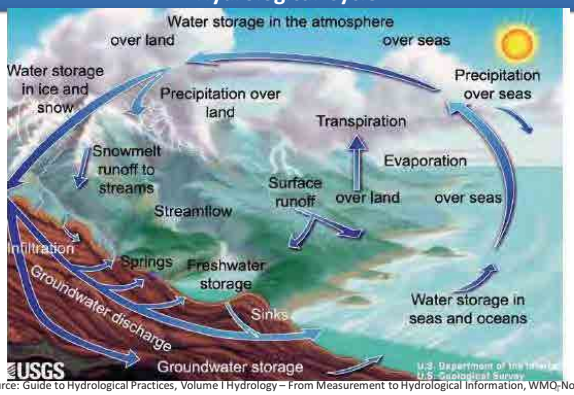
1. Lecture on methods of measuring rainfalls,
2. Lecture on how to record measured data,
3. Summarize and verify data,
4. Build a database and prepare periodical reports on measured data

Presentation outline

A. Introduction –Hydrological Cycle
B. Rainfall Observation
- B1. Purpose of rainfall observation
- B2. Methods of measuring rainfall,
- B3. How to record measured data,
- B4. Summarizing and Verifying data
- B5. Building a database and prepare periodical reports on measured data

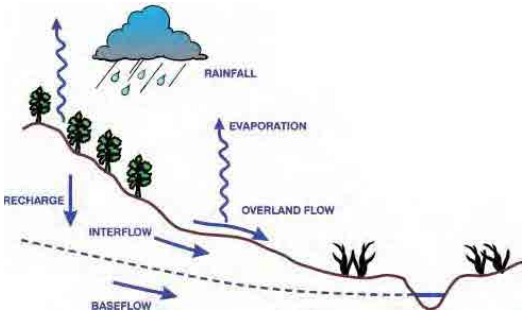
C. Rainfall Data and Statistical Processing (Rainfall Analysis)
- C1. Average Rainfall in the objective basin
- C2. Annual maximum average rainfall
- C3. Average rainfall by the return period

A. Introduction - Hydrological Cycle -



Source: Guide to Hydrological Practices, Volume I Hydrology – From Measurement to Hydrological Information, WMO No. 168

The Hydrologic Cycle



B1. Purpose of rainfall observation

1. Daily rainfall data of all gauging stations within and around the catchment area throughout the recording period from KMD and other related agencies.

2. Hourly rainfall data of all gauging stations within and around the catchment area during the duration of the flood.

3. Hyetographs of past typical floods on all synoptic rainfall gauging stations from KMD and other related agencies.

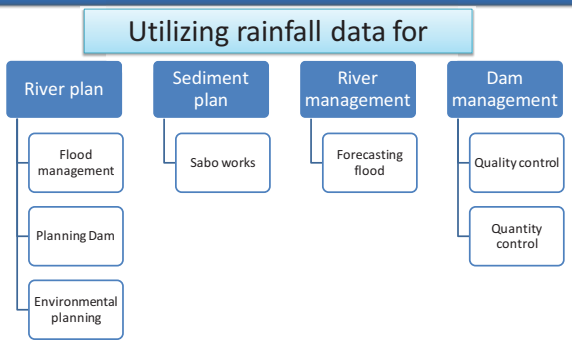
4. Data on the maximum **water levels** during peak floods at all water level gauging station. (For rainfall and runoff analysis).

5. Discharge measurement record for all water level gauging stations.

6. H-Q (Height-Discharge relationship) rating curve for all water level gauging stations (with location, cross-section and flow velocity during flooding time).

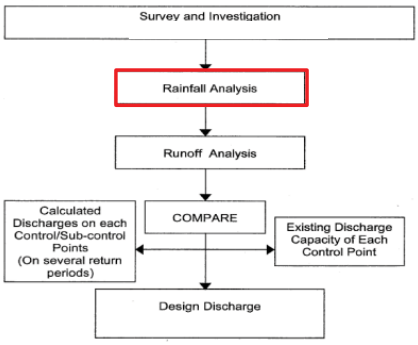
Source: **Technical Standards and Guidelines for Planning and Design DRAFT VOLUME I: FLOOD CONTROL** MARCH 2002 Project for the Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH

B1. Purpose of rainfall observation



7

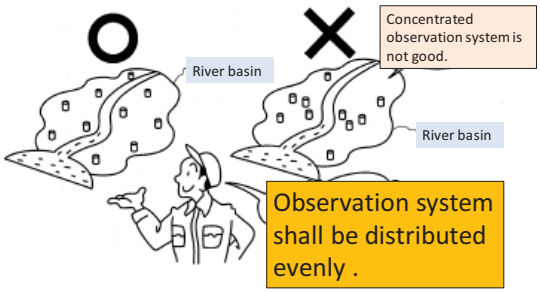
B1. Purpose of rainfall observation
Flow diagram in determining design discharge



Source: **Technical Standards and Guidelines for Planning and Design DRAFT VOLUME I: FLOOD CONTROL** MARCH 2002 Project for the Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH

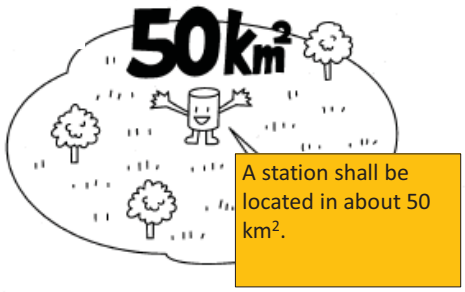
8

B2. Methods of measuring rainfalls
B2-1.Location of observation stations



9

B2. Methods of measuring rainfalls,
B2-1.Location of observation stations



10

B2. Methods of measuring rainfalls,
B2-1.Location of observation stations

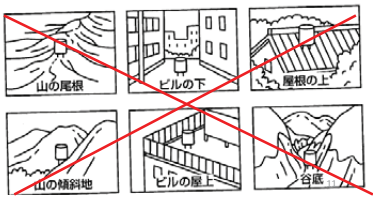
(1) Location of observation stations

a) Best Location for a rain gage

- Easy to access for observers
- Flat topography where wind blows parallel to the ground

b) The following locations must be avoided

- Where sheltered by objects or trees
- Mountain and hill tops
- Hillside
- Cliff edges



11

B2. Methods of measuring rainfall,
B2-2. Observation equipment

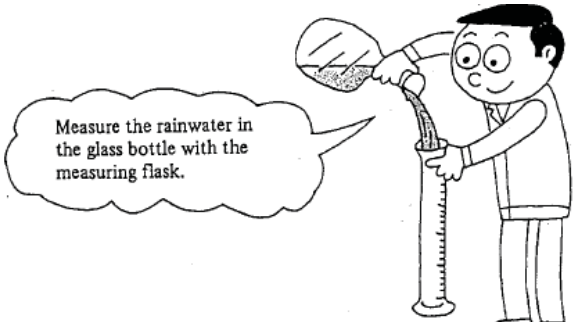
Source: MLIT, Japan, Hydrological Observation Explained in pictures (2001)

12

B2. Methods of measuring rainfall, B2-3. Ordinary observation

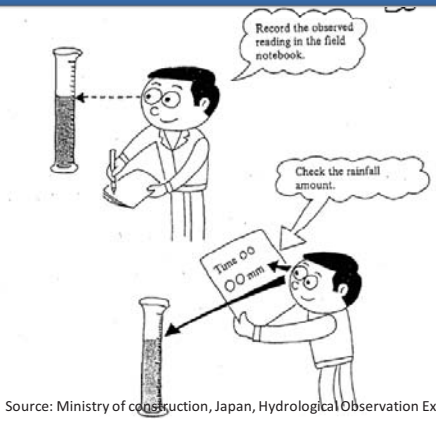
Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures 13

B2. Methods of measuring rainfall, B2-3. Ordinary observation



Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures 14

B2. Methods of measuring rainfall, B2-3. Ordinary observation

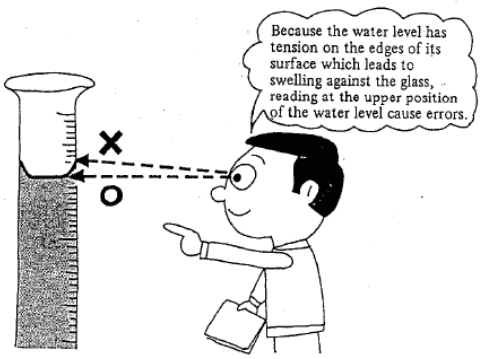


Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures 15

B2. Methods of measuring rainfalls, B2-3. Ordinary observation

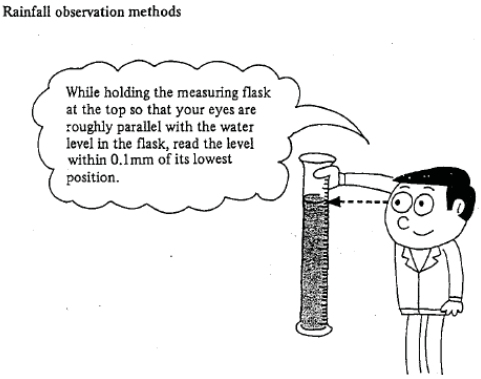
Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures 16

B2. Methods of measuring rainfall, B2-3. Ordinary observation



Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures 17

B2. Methods of measuring rainfall, B2-3. Ordinary observation

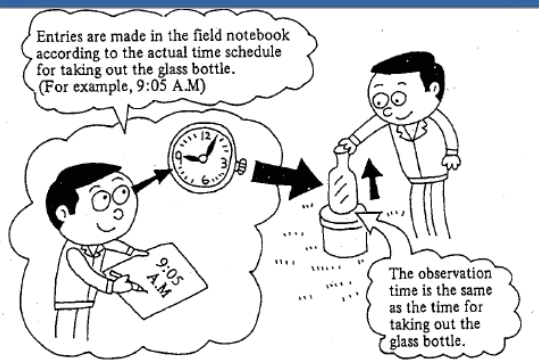


Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures 18

B2. Methods of measuring rainfall, B2-3.Caution of Ordinary observation

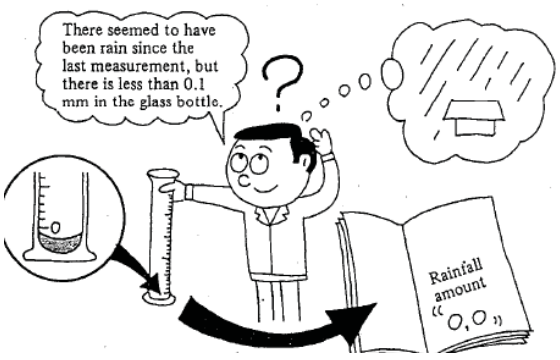
Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures

B3. How to record measured data



Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures

B3. How to record measured data



Source: Ministry of construction, Japan, Hydrological Observation Explained in pictures

B4. Summarizing and Verifying data

Summarize precipitation data in the specified format.

Make a yearly table of daily precipitation, a monthly table of hourly precipitation and table of storms. Follow the formats provided in the Regulations on Hydrological Observation Service.

Data must be verified thoroughly at every stage of the data summary process in order to eliminate any errors before publication.

Source: River bureau, Ministry of construction, Japan, Manual for River Works in Japan

B5. Building a database and Preparing periodical reports on measured data

If any question arises as the results of verification, investigate it thoroughly. If any error is found , correct it by the specified procedure.

Store field notes, recording papers and summary materials securely. Define storage responsibilities clearly in advance and designate secure delivery method.

Source: River bureau, Ministry of construction, Japan, Manual for River Works in Japan

C. Rainfall Data and Statistical Processing (Rainfall Analysis) C-1. Average Rainfall in the objective basin

From the observed rainfall values obtained at rainfall gauges set up in the basin, the areal rainfall of the basin is estimated.

There are 3 methods for estimating Average Rainfall;

a) Arithmetic Mean

b) Thiessen Method

c) Isohyetal Method

C. Rainfall Data and Statistical Processing (Rainfall Analysis)
C-1. Average Rainfall in the objective basin

a) Arithmetic Mean

- The arithmetic mean of the rainfall observed at the station in a objective basin is the simplest method to estimate the average rainfall over the basin
- This method is suitable for basins with a large number of rainfall stations which are spaced uniformly or in some other way adequately sample the rainfall distribution over the basin
- The arithmetic mean rainfall is calculated by the following equation;

$$P_d = \frac{\sum_1^n P_i}{n}$$

where,
R_d : Rainfall over the dam basin,
RS_i : Rainfall at the satiation No.i
N : Number of the stations

Station	Rainfall (cm)
A	3.2
B	3.0
C	2.6
D	2.4
E	2.5
F	2.0
G	1.8
Total	17.5

Average = (17.5/7) = 2.50cm

25

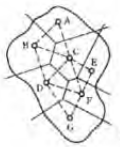
C. Rainfall Data and Statistical Processing (Rainfall Analysis)
C-1. Average Rainfall in the objective basin

b) Thiessen Method

- This method is used with non-uniform station spacing, and gives weights to rainfall data in proportion to the space between station
- In this procedure, lines are drawn between adjacent stations on a map
- The perpendicular bisectors of these lines form a pattern of polygons with one station in each polygon
- The area which each station is taken to represent is the area of its polygon, and this area is used as a factor for weighting the station rainfall
- The calculation method of Thissen method is shown below;

$$P_d = \sum_1^n \left(\frac{A_i}{A_d} \times P_i \right)$$

where,
P_d : Rainfall over the dam basin
P_i : Rainfall at the satiation No.i
A_d : Catchment area of the dam basin
A_i : Effective area of the station No.i in dam basin
n : Number of the stations



Station	Rainfall P (cm)	Catchment area A (km²)
A	3.2	4.29
B	3.0	5.26
C	2.6	4.01
D	2.4	4.54
E	2.5	3.15
F	2.0	3.71
G	1.8	4.64
Total		29.60

Average = Σ(PA)/ΣA = 71.27/29.6 = 2.49cm

26

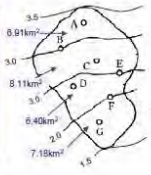
C. Rainfall Data and Statistical Processing (Rainfall Analysis)
C-1. Average Rainfall in the objective basin

c) Isohyetal Method

- This method is used the areas encompassed between isohyetal contours
- These areas may be determined by planimetering within each contour interval
- It is important and difficult to prepare the isohyetal map than to estimate the rainfall
- The isohyetal method fits to estimate the annual total rainfall and peak
- rainfall, but it is rare case to apply estimation of the daily rainfall
- Example for calculation of the isohyetal method is shown below;

$$P_d = \sum_{i=1}^{n-1} \left(\frac{P_i + P_{i+1}}{2} \cdot A_i \right) / A_d$$

where,
P_d : Rainfall over the dam basin
P_i : Rainfall of isohyetal map
A_d : Catchment area of the dam basin
A_i : Effective area in the dam basin
n : Number of the stations



Rainfall (Isohyet)			area average P(cm)	Catchment area A (km²)
1.5 -	2.0		1.75	7.18
2.0 -	2.5		2.25	6.40
2.5 -	3.0		2.75	8.11
3.0 -	3.5		3.25	6.91
		Total		28.60

Average = [Σ(PA)/ΣA] = 71.725/28.6 = 2.51 cm
Dam basin area = 28.6 km²

27

C. Rainfall Data and Statistical Processing (Rainfall Analysis)
C-2. Annual maximum average rainfall

- In order to determine the annual maximum average rainfall (2-day, 3- day, etc.), rainfall data records shall be collected.
- Preferably, the data should be for a period of fifteen (15) years or more.
- Design rainfall duration should be determined based on the observed lag-time between the peak rainfall and peak flood.
- If the lag-time is within one (1) day, hourly rainfall distribution should be developed based on annual maximum one (1) day rainfall.
- If lag-time is more than four (4) days, design rainfall duration should be more than four (4) days.
- Lag-time between peak rainfall and peak flood reflects the basin capacity for floodwater storage.

Year	Dates of Occurrence	Maximum Annual 2-day Rainfall Amount (mm)
1985	September 2 & 3	510
1986	August 14 & 15	315
1987	October 4 & 6	200
-	-	-
2000	September 16&17	283

Source: **Technical Standards and Guidelines for Planning and Design DRAFT VOLUME I: FLOOD CONTROL**
MARCH 2002 Project for the Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH

28

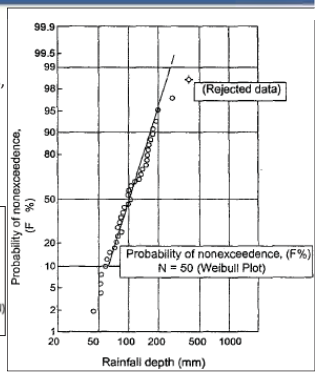
C. Rainfall Data and Statistical Processing (Rainfall Analysis)
C-3. Average rainfall by the return period

Return-period of rainfall depends on the available amount of data for a period of years.
Rough estimation of hydrological quantities, such as average rainfall by return period may be done using probability paper.

The Weibull

$$F(x_n) = \frac{n}{(N+1)}$$

where : $F(x_n)$: probability of non-exceedance
N : number of data
n : order from the highest value (1, 2, 3 .... N)
x_n : rainfall of order n



Source: **Technical Standards and Guidelines for Planning and Design DRAFT VOLUME I: FLOOD CONTROL**
MARCH 2002 Project for the Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH

29

C. Rainfall Data and Statistical Processing (Rainfall Analysis)
C-3. Average rainfall by the return period

- In order to determine the amount of rainfall for a higher return period than the available years of data, it is necessary to plot a particular number of available annual maximum rainfall data which is at least one-half the target return period (e.g., to get the design rainfall for a100yr. return period, there should be at least available annual maximum rainfall data for 50 years).
- To approximate the value of the return-period, a line is manually drawn based on the plotted points and extended to the upper range of the distribution, as shown in the Figure. Thus, a relationship between the probability of non-exceedance return period and the approximate design rainfall could be established.

30

Module 2

2-1B Rainfall Data and Statistical Processing

Statistical Processing

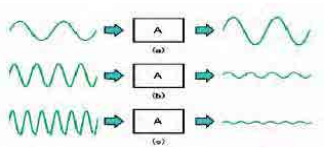
Module 2-1B

18th FEB, 2014

Lawrence Thooko

1

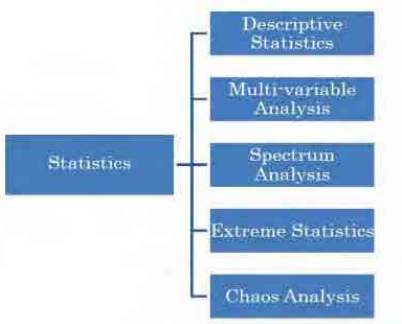
Physical Model for Input and Output



- Cause ----------【Mechanism】----------Effect
- Hazard----------【Society】----------Disaster
- Earthquake---------【Sea Water】----------Tsunami
- Rainfall Data----【Run-Off Model】----------Discharge Data
- Rainfall Data----【Extreme Statistics】-----Return Period
- Input ----------【Transfer Function】-------Output

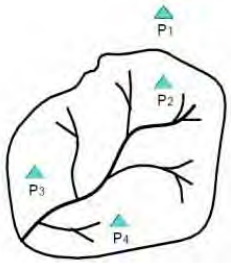
2

Statistics



3

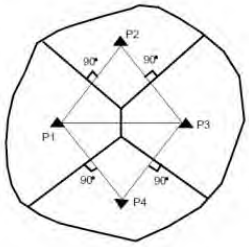
Average Rainfall in Catchment Area
1) Arithmetic-Mean Method



Station	Observed rainfall within the catchment area (mm)
P2	30.0
P3	40.0
P4	50.0
Average Rainfall = 120.0 / 3 = 40.0 mm	

4

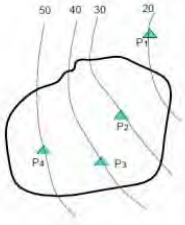
Average Rainfall in Catchment Area
2) Thiessen Method



Station	Observed Rainfall (mm)	Area (km^2)	Weighted Rainfall (mm)
P1	20.0	8.0	160.0
P2	30.0	5.0	150.0
P3	40.0	8.0	320.0
P4	50.0	7.0	350.0
Total		28.0	940.0
Ave Rainfall = 980.0/28.0 = 35 mm			

5

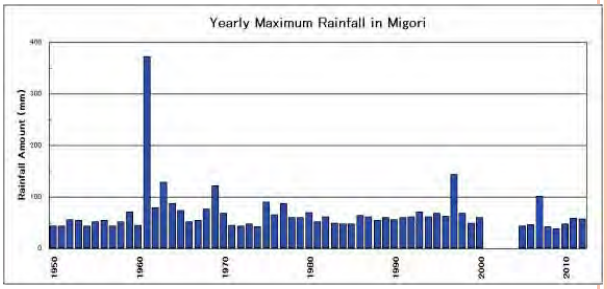
Average Rainfall in Catchment Area
3) Isohyetal (Contour) Method



Station	Observed Rainfall (mm)	Area Enclosed (km^2)	Average Rainfall (mm)	
P1		0.5	15.0	7.5
	20.0			
		3.5	25.0	87.5
P2	30.0			
		6.5	35.0	227.7
P3	40.0			
		6.0	45.0	270.0
P4	50.0			
		4.5	55.0	247.5
Total		21.0		840.0
Average Rainfall = 840.0 / 21.0 = 40.0 mm				

6

Design Total Rainfall Amount by Return Period
1) Annual Maximum Daily Rainfall Amount at Migori



7

Design Total Rainfall Amount by Return Period
1) Annual Maximum Daily Rainfall Amount

Year	Yearly Maximum rain (mm)
1961	372.7
1997	144.1
1963	129.1
1969	122.1
2007	102.0
1975	91.1
1977	88.2
1964	87.7
1962	80.7
1968	77.3
1963	74.5
1993	72.2
1959	72.1
1980	71.2
1998	69.5
1970	68.8
1995	66.6
1976	66.0
1986	65.7
1996	64.3
1992	63.0
1994	62.3
1982	62.1
1987	62.0
1991	61.5
1989	61.0
1978	60.9
1979	60.8
2000	60.5
2011	59.4
2012	58.2
1952	57.4
1990	57.4
1988	56.7
1953	54.9
1956	54.9
1967	54.9
1981	53.3
1955	52.1
1958	52.1
1966	52.1
1999	50.4
1983	50.3
1973	48.6
1985	48.6
1984	48.0
2010	48.0

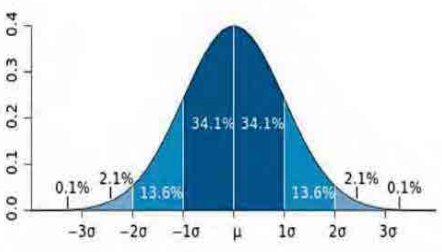
8

Daily Rainfall Amount in Descending Order

No.	DDMMYY	Rainfall Amount
1	27 Nov, 1961	372.7mm
2	10 Nov, 1961	209.2mm
3	4 Aug, 1997	144.1mm
4	17 Nov,1963	129.1mm
5	9 May, 1963	127.2mm
6	12 May, 1969	122.1mm
7	8 Nov, 1961	111.4mm
8	11 Feb, 1963	103.5mm
9	9 May, 1969	102.2mm
10	23 Mar, 1969	91.1mm

9

Probability DENSITY Function



10

Design Total Rainfall Amount by Return Period
2) Weibull (Thomas) Plot

Weibull Plot::

$$F(X_n) = \frac{n}{N+1} \qquad \text{Eq. 5.2.2a}$$

Where,

$F(x_n)$:	Probability of non-exceedance
N:	Number of data
n:	Order from the highest value (1, 2, 3 …. N)
x_n:	Rainfall amount of order n

To estimate the value of the return-period, a line is manually drawn based on the plotted points and extended to the upper range of the distribution, as shown in Fig. 5.2.1. Thus, a relationship between the probability of non-exceedance/the return period and the design total rainfall amount could be established.

The return period is calculated as:

$$Return\ Period = 1 / (1 - F(x)) \qquad \text{Eq. 5.2.2b}$$

For example, if $F(x) = 0.95$, then the Return Period is 20 years and the rainfall amount is corresponded to 200 mm in Fig. 5.2.1

11

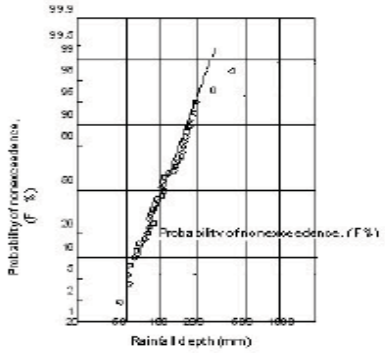
Yearly Maximum Rainfall Amount

n=59 (59 year rainfall data in Migori)

i	Xm	Non-Exceedance Probability (%) F=i/(n+1)*100 (Thomas Plot)	i	Xm	Exceedance Probability (%) P=100-i/(n+1)*100 P=100-F' (Thomas Plot)
1	372.7	1.7	1	372.7	98.3
2	144.1	3.3	2	144.1	96.7
3	129.1	5.0	3	129.1	95.0
4	122.1	6.7	4	122.1	93.3
5	102.0	8.3	5	102.0	91.7
6	91.1	10.0	6	91.1	90.0
7	88.2	11.7	7	88.2	88.3
8	87.7	13.3	8	87.7	86.7
9	80.7	15.0	9	80.7	85.0
10	77.3	16.7	10	77.3	83.3
11	74.5	18.3	11	74.5	81.7
12	72.2	20.0	12	72.2	80.0
13	72.1	21.7	13	72.1	78.3
14	71.2	23.3	14	71.2	76.7
15	69.5	25.0	15	69.5	75.0
16	68.8	26.7	16	68.8	73.3
17	66.6	28.3	17	66.6	71.7
18	66.0	30.0	18	66.0	70.0
19	65.7	31.7	19	65.7	68.3
20	64.3	33.3	20	64.3	66.7

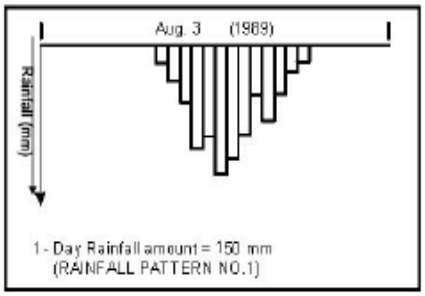
12

Design Total Rainfall Amount by Return Period
3) Weibull (Thomas) Plot



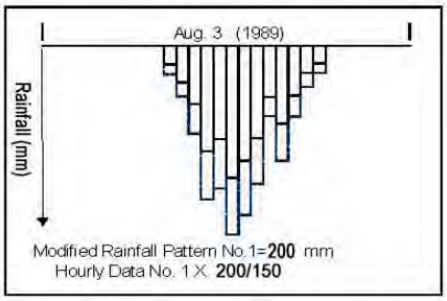
13

Design Total Rainfall Amount by Return Period
4) Typical Hyetograph of Past Major Floods



14

Design Total Rainfall Amount by Return Period
5) Modification of Hyetograph based on Return Period



15

Thank you for Listening!

16

Module 2

2-2 Flood Discharge Observation

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

FLOOD MANAGEMENT TRAINING
Module2-2

Flood Discharge Observation

Presented by: Reuben Ngessa
Snr. Surface Water Officer

10th December 2013

Objectives

To enable participants to:

- Measure flood water level and flood discharge
- Understand the concept of discharge observation using modern hydrometric equipment

Hydrological Observation

1. Rainfall Observation
   1) Ordinary observation (manual observation)
   2) Recording observation (automatic observation)
2. Water Level Observation
   1) Ordinary observation (manual observation)
   2) Recording observation (automatic observation)
3. Flood Discharge Observation
   1) Observation with current meter (from the bridge/using boat)
   2) Observation with floats
   3) Observation using Acoustic Doppler Current Profiler

Principles of ADCP Operation



(**How do these things work?**)

What is an ADCP?

Acoustic	Sound Waves and the
Doppler	Doppler Shift are used to measure
Current	Water Velocity
Profiler	Profiles

ADCP History

- The predecessor of ADCPs was the **Doppler speed log**, an instrument that measures the speed of ships through the water or over the sea bottom.
- The first commercial ADCP, produced in the mid-1970's, was an adaptation of a commercial speed log (Rowe and Young, 1979) redesigned to measure water velocity more accurately and to allow measurement in range cells over a depth profile.
- Thus, the first vessel-mounted ADCP was born.

ADCP History-cont

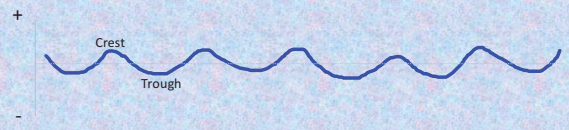
- In 1982, RDI produced its first ADCP, a self-contained instrument designed for use in long-term, battery-powered deployments.
- In 1983, RDI produced its first vessel-mounted ADCP.
- By 1986, RDI had five different frequencies (75-1200 kHz) and three (3) different ADCP models (**self-contained, vessel-mounted, and direct-reading**).

DOPPLER PRINCIPLE

The Doppler effect is a change in the observed sound pitch that results from relative motion.

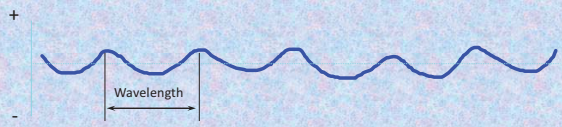
Sound/Wave Terminology

Waves – Water wave crests and troughs are high and low water elevations. Sound wave "crests" and "troughs" consist of bands of high and low air or water pressure.



Sound/Wave Terminology

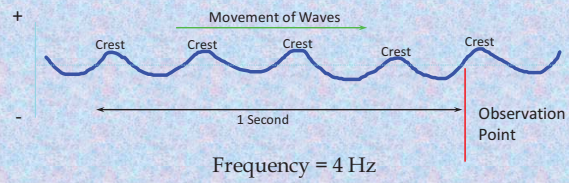
Wavelength (λ) – The distance between successive wave crests. (units: meters)



Wavelength = 1 m

Sound/Wave Terminology

Frequency (f) – The number of wave crests that pass an observation point per unit time. (units: Hertz [Hz] which means "per second")



Frequency = 4 Hz

Doppler Principle

- <u>In General</u>- the change in frequency from a sound (or light) source to an observer is proportional to the speed at which the distance between the source and observer is increasing or decreasing
- *An example of the Doppler effect is the sound made by a train as it passes . The whistle has a higher pitch as the train approaches, and a lower pitch as it moves away from you. This change in pitch is directly proportional to how fast the train is moving. Therefore, if you measure the pitch and how much it changes, you can calculate the speed of the train.*

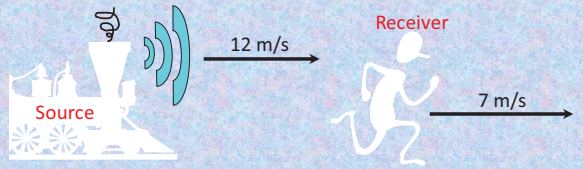
<u>Applied to ADCPs</u>- The change in frequency of a sound wave transmitted from a transducer and reflected back off particles in the water, is proportional to the speed at which the distance between the transducer and particles is increasing or decreasing

Doppler Terminology

Doppler Shift (F_D) – the change in frequency from a sound source to an observer due to the distance between the source and observer increasing or decreasing

Doppler Terminology

Relative Velocity (V) – relative velocity between the sound source and the sound wave receiver (the speed at which the receiver is moving **toward** the sound source; units: m/s)



V= 5 m/s

Doppler Terminology

Source Frequency (F_s) – the transmitted frequency of waves from a sound source (units: Hz)

Examples:

Trumpet  F_s= 300 - 1,000 Hz

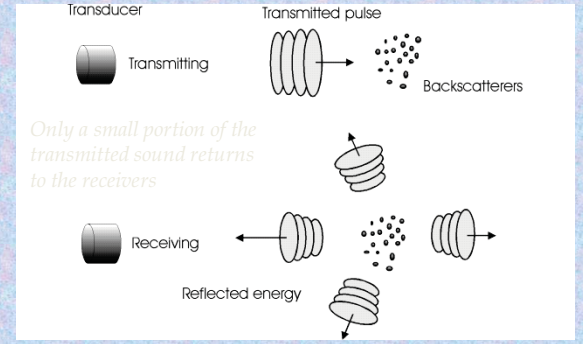
ADCP Transducer  F_s= 300,000 – 5,000,000 Hz

Doppler Principle

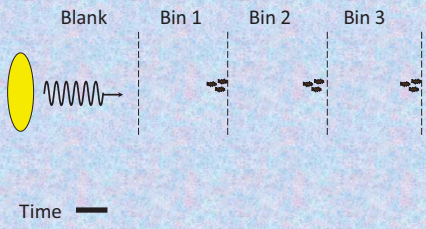
$$F_D = F_S * V/C$$

F_D = Doppler Shift Frequency (change in frequency)
F_S = Source Frequency
V = Velocity at which objects are moving together
C = Speed of Sound

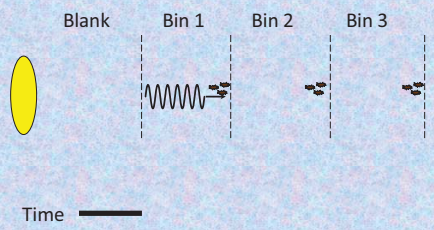
Sound Sources/Observers



Doppler Principle in Action

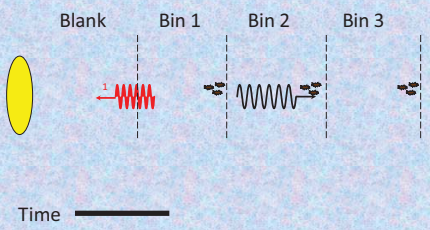


Doppler Principle in Action



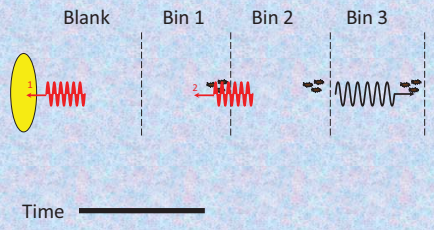
Time

Doppler Principle in Action



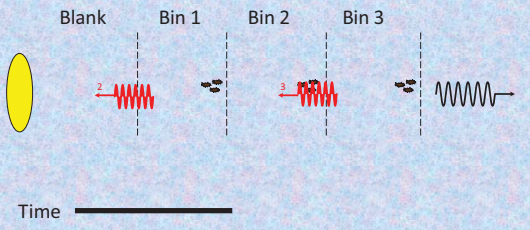
Time

Doppler Principle in Action



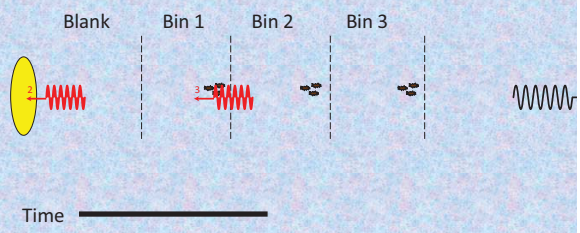
Time

Doppler Principle in Action



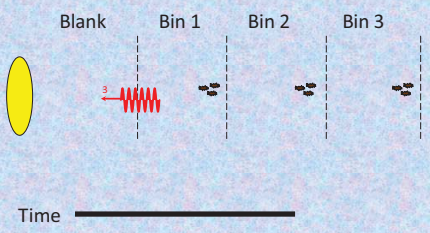
Time

Doppler Principle in Action



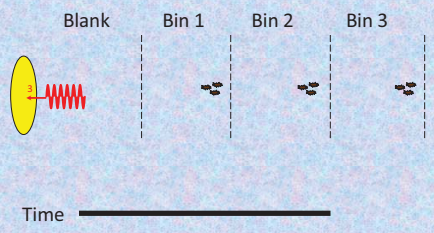
Time

Doppler Principle in Action

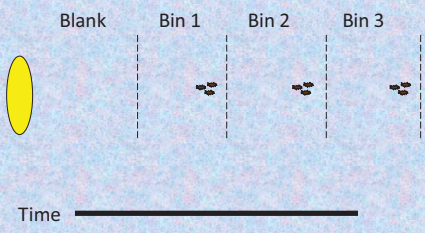


Time

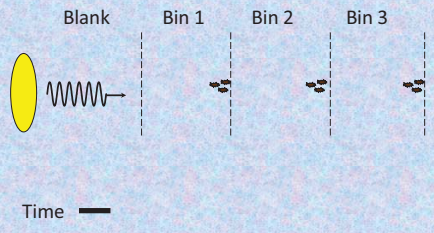
Doppler Principle in Action



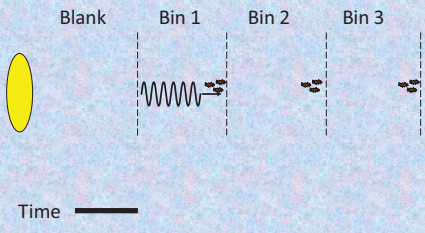
Doppler Principle in Action



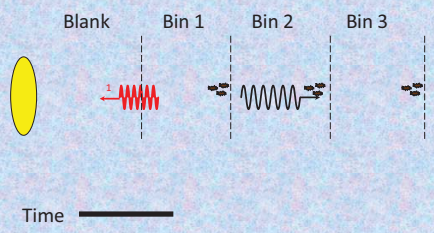
Doppler Principle in Action



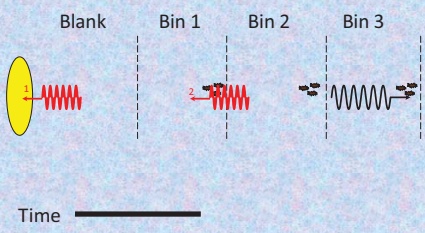
Doppler Principle in Action

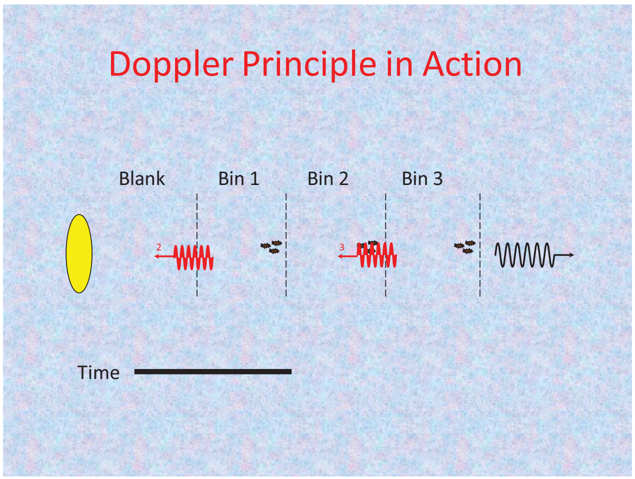


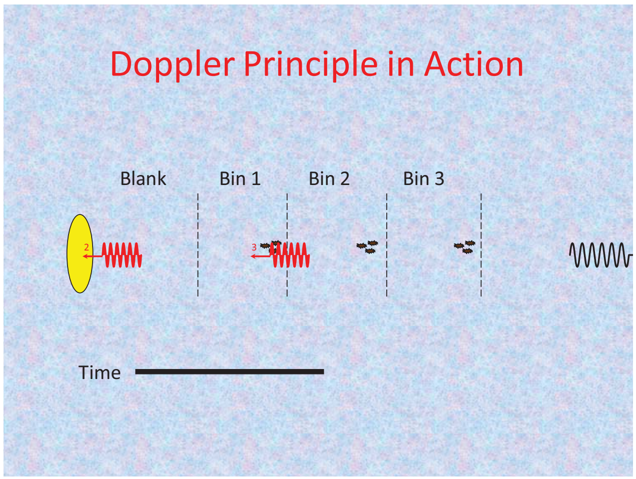
Doppler Principle in Action

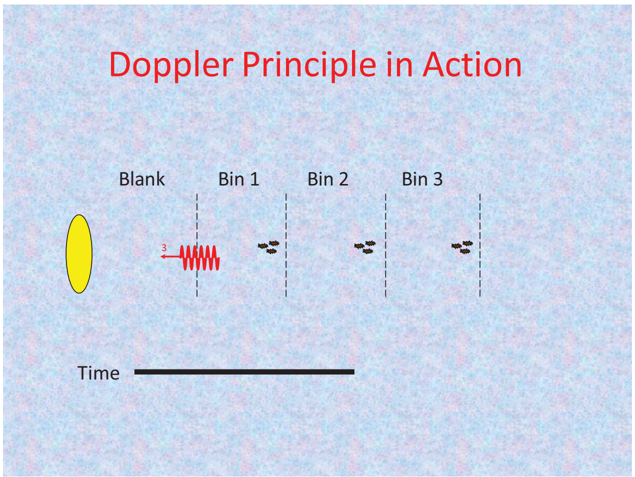


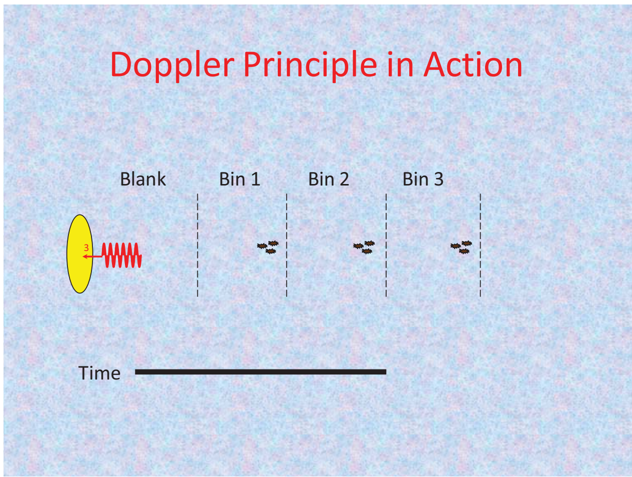
Doppler Principle in Action

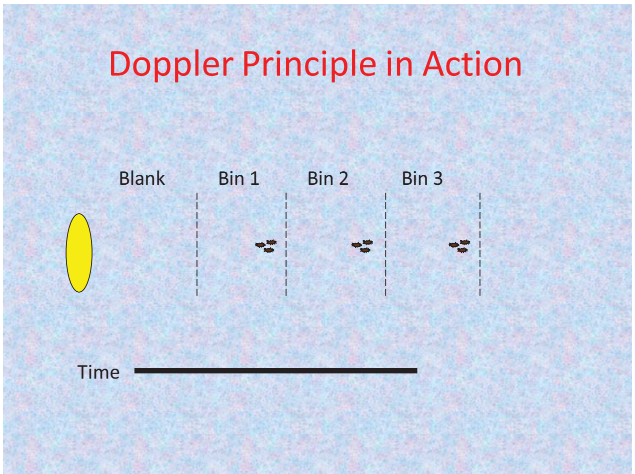


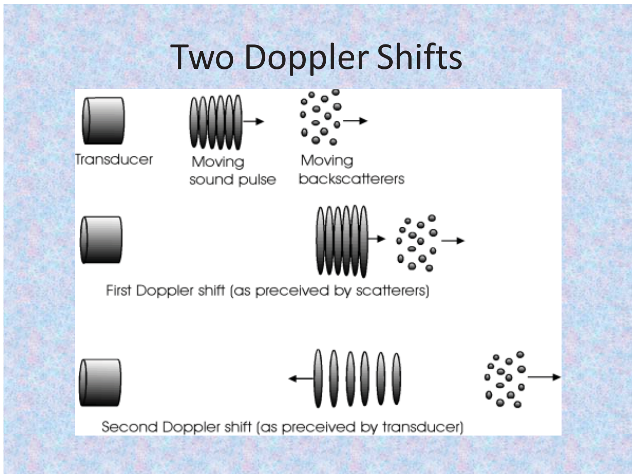

Doppler Principle in Action
Blank
Bin 1
Bin 2
Bin 3
Time


Doppler Principle in Action
Blank
Bin 1
Bin 2
Bin 3
Time


Doppler Principle in Action
Blank
Bin 1
Bin 2
Bin 3
Time


Doppler Principle in Action
Blank
Bin 1
Bin 2
Bin 3
Time

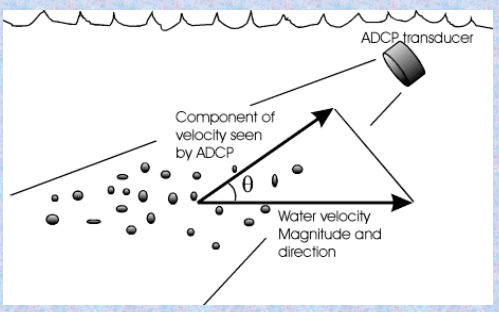

Doppler Principle in Action
Blank
Bin 1
Bin 2
Bin 3
Time


Two Doppler Shifts
Transducer
Moving
sound pulse
Moving
backscatterers
First Doppler shift (as preceived by scatterers)
Second Doppler shift (as preceived by transducer)

Corrected Doppler Shift Equation

$$F_D = 2F_S * V/C$$

Radial Velocity and Horizontal Currents

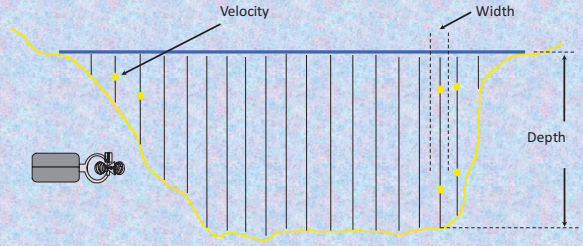


ADCPs Measure Water Velocity with SOUND

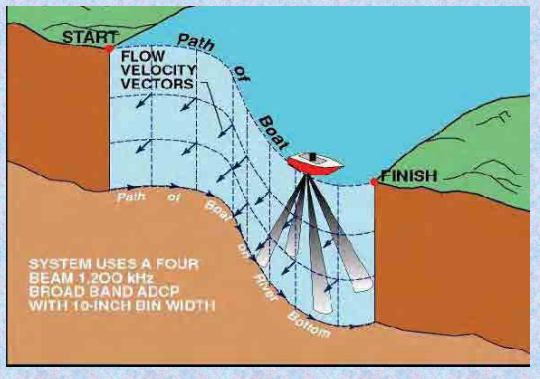
- Sounds are simply pressure waves that travel through gasses, liquids, or solids
- Sound waves have crests and troughs that correspond to bands of high and low pressure
- We perceive sounds by these pressure waves vibrating our eardrums, which with the inner ear convert the mechanical energy of pressure waves to electrical signals interpreted by our brains
- Humans can hear sounds in the range 40-24,000 Hz
- Common ADCP range is 300,000-3,000,000 Hz

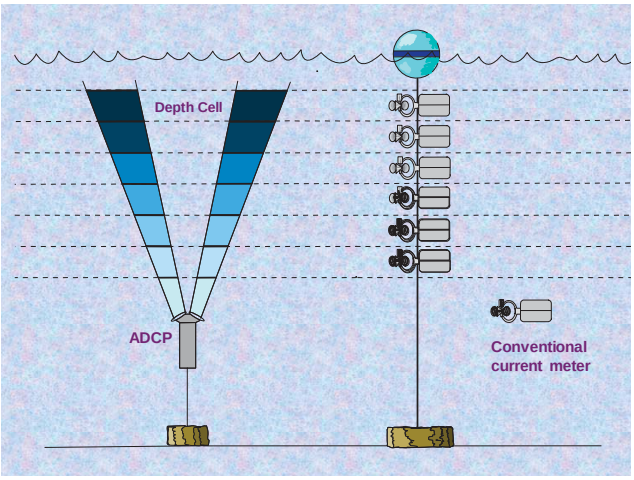
Theory of ADCP Discharge Measurement

Conventional Discharge Measurement

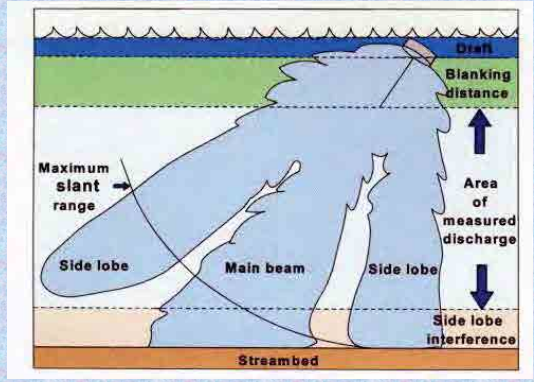


ADCP Discharge Measurement

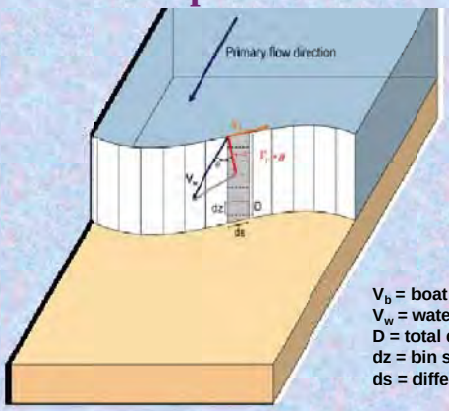




Unmeasured Top and Bottom



Explanation of Terms



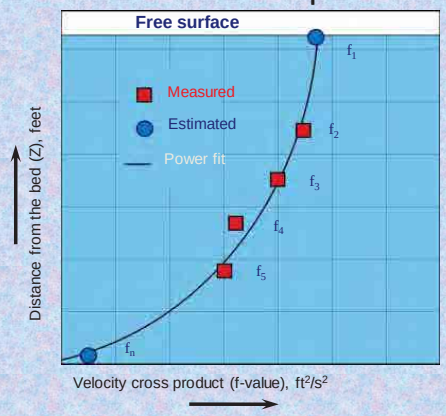
V_b = boat velocity vector
V_w = water velocity vector
D = total depth profiled
dz = bin size
ds = differential area

- The drawing is an illustration of an imaginary slice of water measured using an ADCP in one transect.
- It shows the primary flow direction is here
- The blue vector – **V_w** - is the water velocity vector at a given depth
- The green vector - **V_b** - is velocity of the boat for that ensemble
- The red vector is the cross product of the water velocity vector **(V_w)** and the boat velocity **(V_b)**
- D is the total depth profiled
- **dz** is the depth cell size
- **ds** is the area of the depth cell
- **Theta** is the angle between the water velocity vector and a vector normal to the boat velocity vector

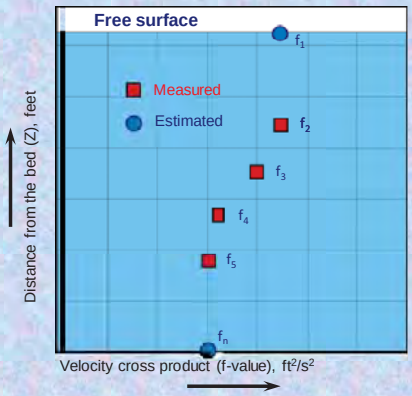
- The general equation for discharge through an arbitrary surface is
- Q = ! *ds
- Q=total discharge, V_f= mean water velocity vector, n = a unit vector normal to ds, and ds= differential area. Ds for a moving vessel is the vertical surface beneath the transect path.
- The dot product simply projects one vector on to another vector. So in this case $V_f \cdot n$, we are projecting the component of V_f to n, thus $V_f \cdot n$ is the velocity perpendicular to ds.

- The discharge for one ensemble is computed from the depth and velocities measured by the ping AFTER that ensemble and the distance travelled between the ping before and the ping after that ensemble that ensemble:
- - no discharge is computed until the second ping of a transect is made

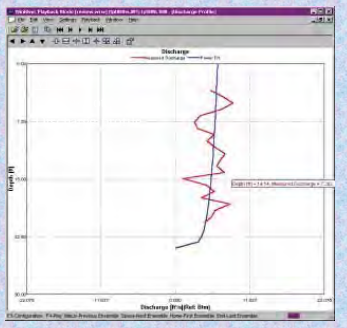
Power Curve Extrapolation



Constant Extrapolation



Evaluate Extrapolation Method Using Discharge Profile Plots

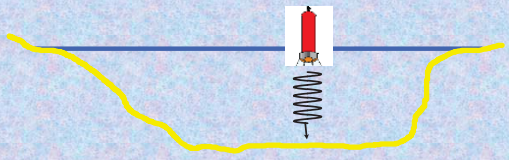


Bottom Tracking

- All of the measurements of water velocity made by an ADCP are absolute velocities which include both:
  - the natural movements of the water in the stream
  - the apparent movement of water due to the boat (ADCP) moving
- Boat (ADCP) velocities must be measured and subtracted from the water velocities measured by the ADCP to get the actual water velocity

Bottom Tracking

- Bed velocity or bottom-tracking measurements are similar to the water-velocity measurements
- Bottom-tracking pulses are sent separate from the water measurement pulses
- Bottom-tracking pulses are longer than water pulses
- Also measures water depths for discharge computations



Summary of ADCP Operation

- Water velocity measurement
- Boat velocity measurement
- Interaction of ADCP with software

Water Velocity Measurement

- Velocity measured from reflections from particles in the water column
- Includes both water and boat velocity
- Side lobes can contaminate data near the bed
- Phase measurement is accurate but can result in ambiguity errors

Boat Velocity Measurement

- Reference velocity for water measurements
- Bottom tracking
  - Velocity of boat (ADCP) determined by using the Doppler principle to measure the "streambed velocity"
  - It is assumed that the streambed is stationary, so the measurement is actually the velocity of the boat in the opposite direction
- GPS
  - Must be used to measure boat velocity if the streambed is not stationary

Interaction of ADCP with Processing Software

- **ADCP** measures water and boat velocity
- **Software**
  - communicates with the ADCP
  - is the users interface with the ADCP
  - allows for adjustment of ADCP configuration parameters
  - processes ADCP data, computing discharge
  - displays ADCP measurement results
- Correct setup of ADCP parameters is critical to collecting good data

Discharge Measurement Using ADCP

ADCP Measurement from moving boat

Use of Tethered ADCP

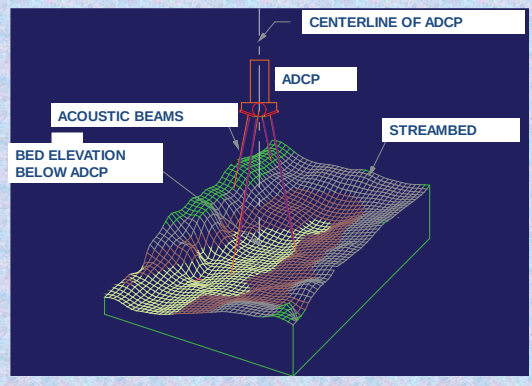
Tethered Platform and Cableway Rover

ADCP Boat

Remote-Control Deployment

- Safety considerations
- Boat ramp access
- Developed for bridge scour research
- Applicable to other situations including routine discharge measurements

Measuring Bathymetry



Fixed Deployments of Profilers

- Horizontal profilers (single or multi-bin)
  - Index velocity measurements
  - Navigation information and aids
- Vertical profilers
  - Index velocity measurements (Bi-directional)
  - Research interests

Fixed Horizontal Profilers (ADCPs)

SonTek Argonaut SL

500 kHz SonTek ADP-SL

Nortek EZ-Q

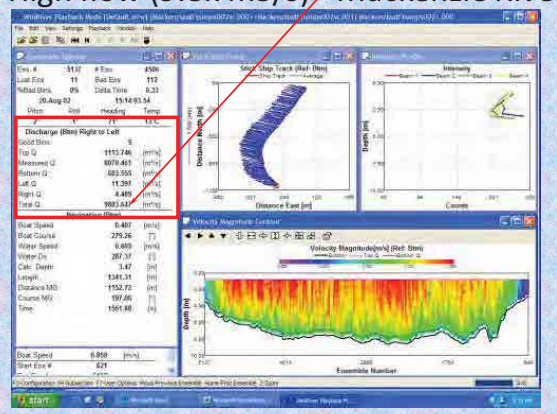
Bottom-mounted ADCP

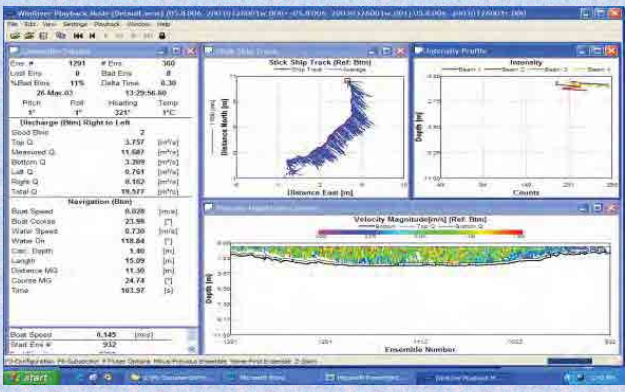
Summary

- ADCP can be deployed permanently in a stream or from several type of boats
- Can be used to measure
  - Stream Discharge
  - Velocity fields
  - Bathymetry
  - Sediment concentration?

Review of ADCP Data

High flow (9.8k m3/s) - Mackenzie River





END

Thank you for your attention

Module 3

3-1 Integrated River Basin Flood Management (IRBFM)

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

FLOOD MANAGEMENT TRAINING

Module3-1
Integrated River Basin Flood Management (IRBFM)

17 February 2014

Mr. Joseph Kimanga

Objective

The objectives are to enable the participants to understand:

1. "river basin" and "target river basin"
2. meaning of flood management; and
3. steps involved in flood management activities.

Presentation outline

A. The concept of river basin
B. Meaning of flood management
C. Steps involved in flood management activities
D. Case example of Integrated River Basin Flood Management Plan (IRBFMP)

A. The concept of river basin

Question:

What is the meaning of river basin (watershed) in scientifically?

A. The concept of river basin

A river basin (watershed) is an area of land that collects water from rain or snow.

The water collected in the watershed seeps into the ground or flows downstream into rivers, streams, and lakes.

Source:
http://www.blueseaonline.net/proofs/ugrwc/about-watershed.php

A. The concept of river basin

The boundary of the river basin (watershed) is divided based on the elevation .

Water moves from upstream to down stream.

7

A. The concept of river basin

A watershed functions as an interconnected system, so that natural changes or human activities in one part of a watershed affect other areas downstream.

As watersheds change due to natural processes and human activities, these changes can alter water quality, runoff rates, habitat values and erosion processes along the creek and, eventually, have impacts throughout the watershed.

8

Terms

- Catchment
- Catchment Area
- Drainage
- River Basin
- Watershed
- River System

9

Catchment Area (in the Water Act 2002)

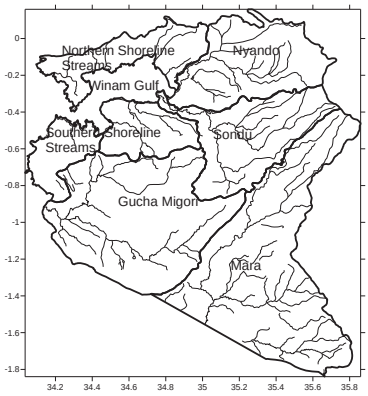
14. Catchment areas.

14. (1) In accordance with the national water resources management strategy, the Authority may by notice published in the Gazette designate a defined area from which rainwater flows into a watercourse to be a catchment area for the purposes of this Act.

(2) A catchment area designated under this section may lie wholly or partly within another catchment area.

10

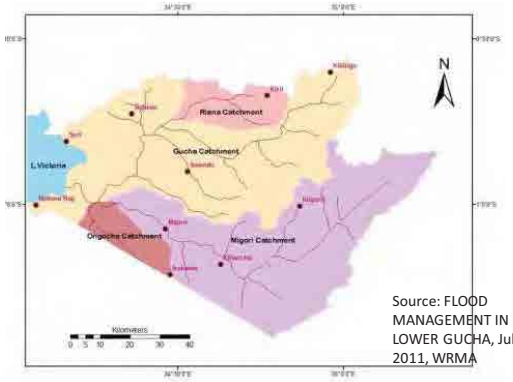
Lake Victoria South Catchment Area



Source: Lake Victoria South Catchment Area CATCHMENT MANAGEMENT STRATEGY, June 2009, WRMA

11

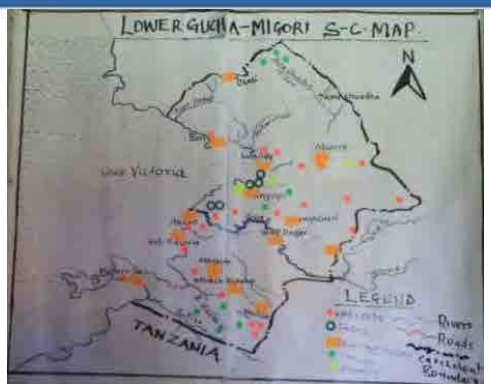
Gucha Migori River Basin



Source: FLOOD MANAGEMENT IN LOWER GUCHA, July 2011, WRMA

12

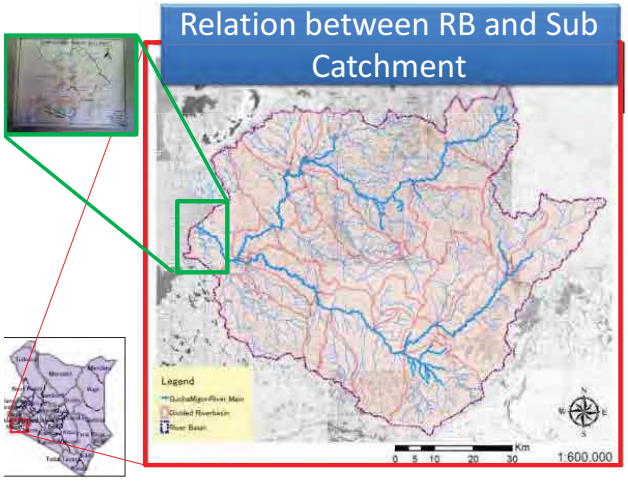
Sub Catchment



Source: Lower Gucha Migori WRUA

13

Relation between RB and Sub Catchment

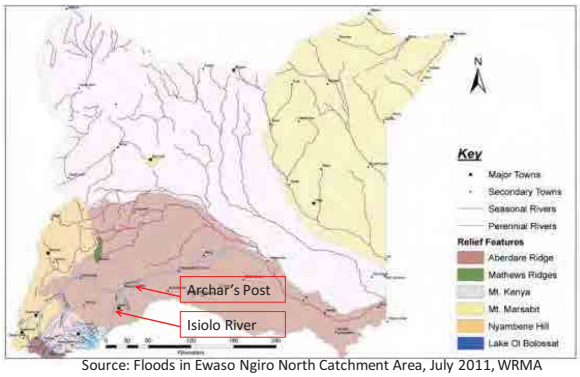


ENNCA Catchment and Location of Isiolo River Basin

Source : Ewaso Ngi'ro North Catchment Area Catchment Management Strategy (June 2009)

15

ENN Catchment Area and Isiolo River Basin



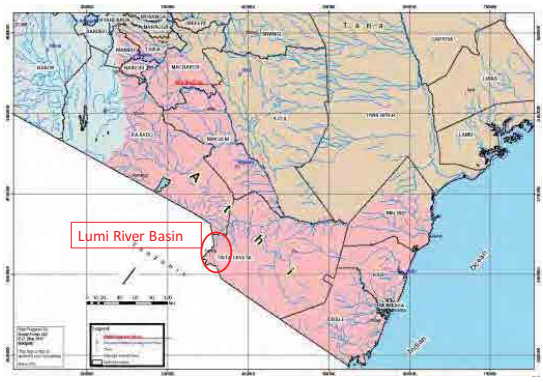
Source: Floods in Ewaso Ngiro North Catchment Area, July 2011, WRMA

Isiolo River Basin

Source: ISIOLO RIVER BASIN INTEGRATED FLOOD MANAGEMENT PLAN - DRAFT -, August 2013

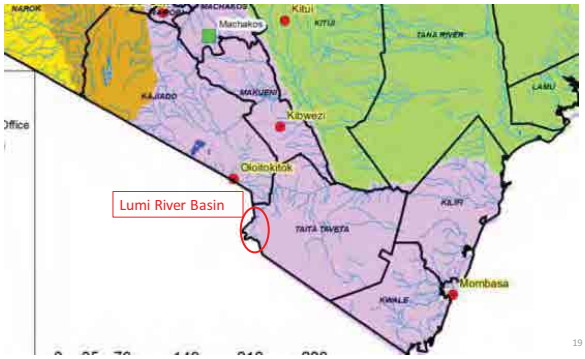
17

Athi Catchment Area



SOCIO-ECONOMIC CONDITIONS

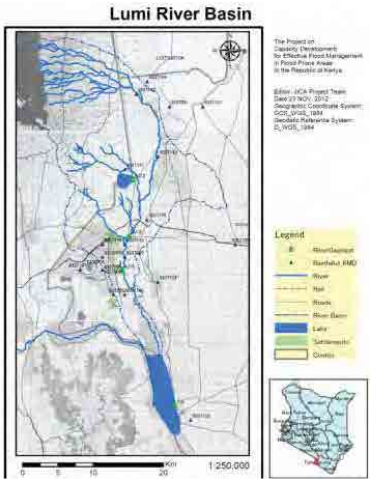
2.2.1 Local Administration: Taita Taveta County



19

LUMI RIVER BASIN

- Two WRUAs (Sub Catchments)
- Internationally trans-boundary river (Tanzania is located in the upstream and the downstream)



Why we should consider River Basin in Flood Management?

- To consider flood discharge at certain flood affected area (Runoff Analysis)
- Upstream activities may affect downstream flood discharge
- Upstream change of condition may affect downstream river channel and flood
- Upstream change of condition may affect downstream flood discharge

21

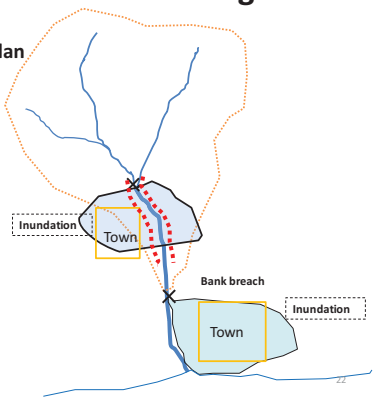
Upstream activities may affect downstream flood discharge

Current situation (1)
→ No river basin-based plan

In the middle reach, bank breached and flood inundation occurred.

If dyke will be constructed to protect a town without basin-wide plan.

Flood water shall go downstream and it might breach bank downstream and cause inundation in another town .



22

Upstream change of condition may affect downstream river channel and flood

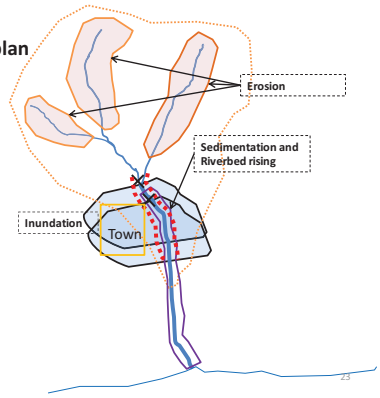
Current situation (2)
→ No river basin-based plan

In the middle reach, bank was breached and flood inundation occurred.

If dyke will be constructed to protect a town without basin-wide plan.

Erosion in the upstream will cause sedimentation and riverbed rising.

Flow capacity of river channel will be reduced and bank might be breached again.



23

Upstream change of condition may affect downstream flood discharge

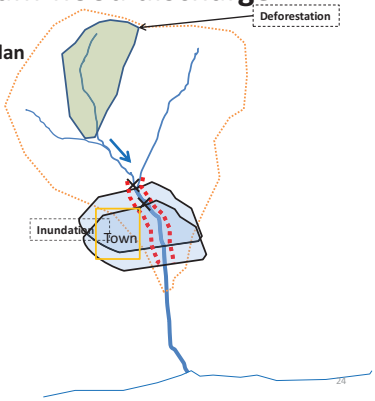
Current situation (3)
→ No river basin-based plan

In the middle reach, bank was breached and flood inundation occurred.

If dyke will be constructed to protect a town without basin-wide plan.

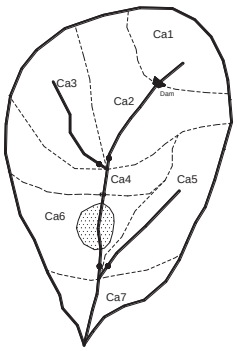
Expansion of deforestation in the upstream will increase flood discharge in the downstream.

Flow capacity of river channel will be not enough and bank might be breached again.



24

Technical Term: Catchment Area



The catchment area is derived by delineating the basin boundary (in polygon) in a contour map. A perpendicular curve to the contour lines is drawn using the latest topographic map with a scale of 1:50,000 or better from the **Survey of Kenya** may be used. The catchment area is then computed using the following:

- planimeter
- triangulation
- cross-section mm paper
- AutoCAD / GIS software

In runoff analysis, divide the catchment areas into several smaller areas (100 to 200 km^2) depending on the control points, sub-control points, tributary, expected dam location, etc.

25

Let' try to delineate a river basin

10 min exercise

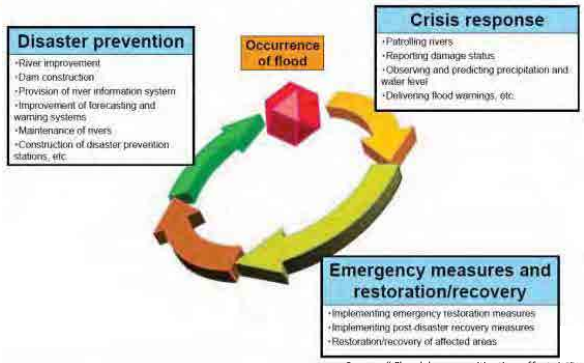
26

B. Meaning of flood management
Mechanism of Flood Damage

Social and Economic	Vulnerability/ Exposure	Disaster Damage	Hazards	Natural Condition
-Population growth -Urbanization -Environmental degradation -Poverty, etc.	-Dangerous building -Unsafe area -Precarious livelihood -Low income -Inadequate health service		-High-velocity flow -Overflow stream, dyke break -Inundation -Sediment discharge -Bank erosion, etc	-gradient of river -width, elevation of river bed -geology -precipitation, etc

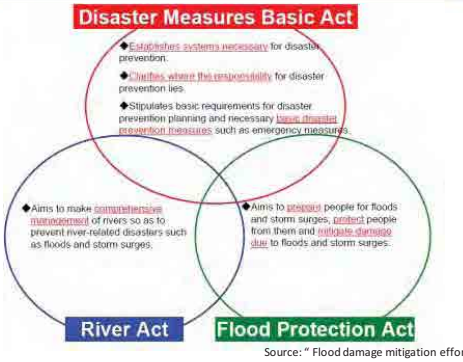
Source: Revised by JICA Project Team, based on material of "Community and Development assistant of Disaster Prevention", Mr. Mikio Ishiwatari (1997)

C. Steps involved in flood management activities
C1 MLIT(Japan)'s disaster prevention efforts



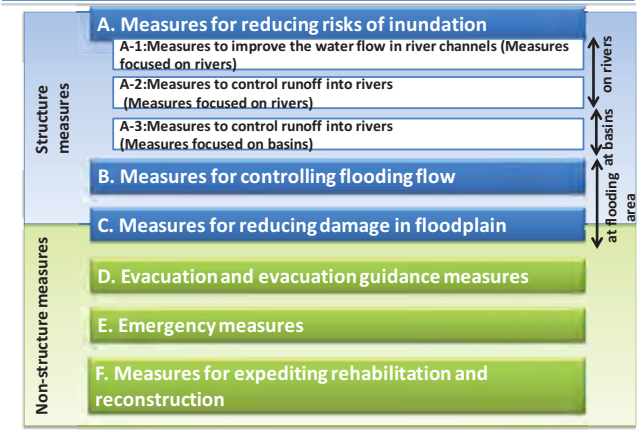
Source: " Flood damage mitigation efforts in Japan", Toshiyuki Adachi ,Water and Disaster Management Bureau, MLIT, Japan (2009)

C. Steps involved in flood management activities
C2 Disaster response laws related to MLIT



Source: " Flood damage mitigation efforts in Japan", Toshiyuki Adachi ,Water and Disaster Management Bureau, MLIT, Japan (2009)

Flood Management Measures categorized by Types



A. Measures for reducing risks of inundation

A-1:Measures to improve the water flow in river channels (Measures focused on rivers)

- Excavation of river channels
- Levee setting back and embankment
- Discharge channels and cut-off channels
- Floodgate
- Inland water drainage

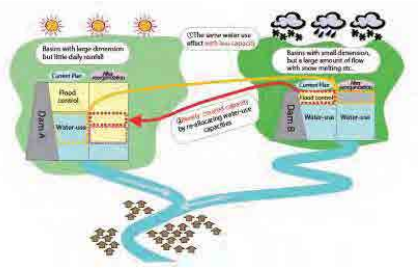
Excavation and widening of river channels

Source; MLIT Japan, Japan Practical Guidelines on Strategic Climate Change Adaptation Planning -flood disaster-

A. Measures for reducing risks of inundation

A-2:Measures to control runoff into rivers (Measures focused on rivers)

- Dam
- Flood control facilities
- Effective utilization of existing facilities



Source; MLIT Japan, Japan Practical Guidelines on Strategic Climate Change Adaptation Planning -flood disaster-

A. Measures for reducing risks of inundation

A-3:Measures to control runoff into rivers (Measures focused on basins)

- Storage and infiltration facilities

Rainwater storage and infiltration facility

Infiltration pit and trench

Source; MLIT Japan, Japan Practical Guidelines on Strategic Climate Change Adaptation Planning -flood disaster-

B. Measures for controlling flooding flow

- Secondary levees
- Open levees
- Ring levees

Secondary levees

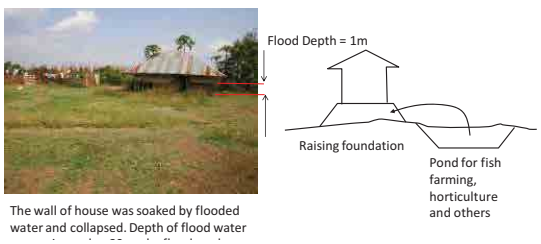
Open levees

Ring levees

Source; MLIT Japan, Japan Practical Guidelines on Strategic Climate Change Adaptation Planning -flood disaster-

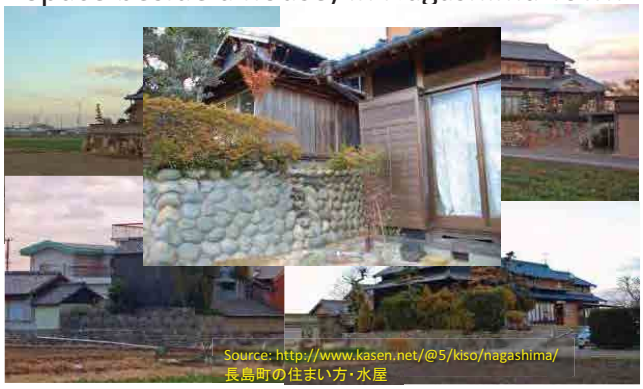
C. Measures for reducing damage in floodplain

- Raising floors of buildings
- Installing electric and machinery equipment at higher places
- Regulation of land-use

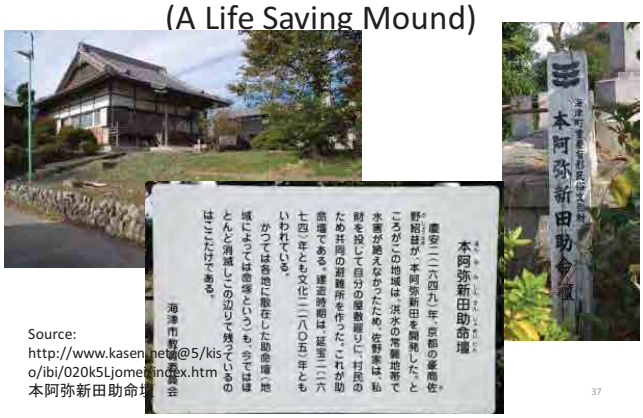


Raising floors of buildings

Mizuya (Temporary Raised Evacuation Space beside a house) in Nagashima Town



Jomei-dan/Inochi-duka in Kaizu City (A Life Saving Mound)

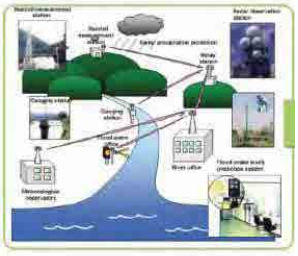


Source:
http://www.kasen.net/@5/kiso/ibi/020k5Ljomeiindex.htm
本阿弥新田助命壇

D. Evacuation and evacuation guidance measures

- Evacuation and evacuation guidance
- Forecast and warning
- Evacuation facilities

Community flood hazard map



Forecast and warning

Source; MLIT Japan, Japan Practical Guidelines on Strategic Climate Change Adaptation Planning -flood disaster-

E. Emergency measures

- Flood fighting
- Cofferdam
- Drainage measures
- Training
- Education

Flood fighting

Source; MLIT Japan, Japan Practical Guidelines on Strategic Climate Change Adaptation Planning -flood disaster-

F. Measures for expediting rehabilitation and reconstruction

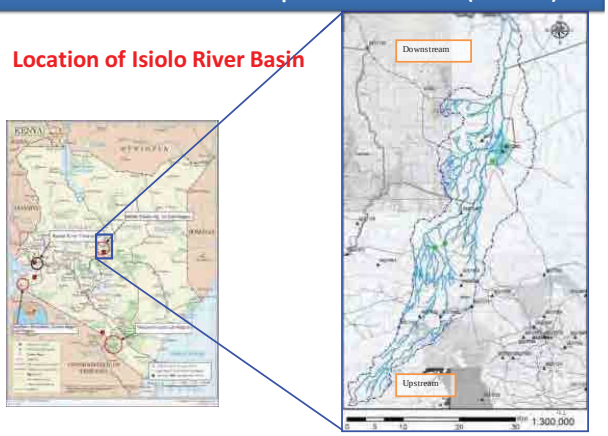
- Disaster prevention facilities
- Transportation network
- Disaster prevention operation plan
- Business continuity plan
- Disposal of flood-generated waste, etc.

Long List of Flood Control Measures

Structure measures	A. Measures for reducing risks of inundation	
	A-1:Measures to improve the water flow in river channels (Measures focused on rivers)	•Excavation of river channels •Levee setting back and embankment •Discharge channels and cut-off channels •Floodgate •Inland water drainage •Riverbank protection •Spur dike, etc.
	A-2:Measures to control runoff into rivers (Measures focused on basins)	•Dam •Flood control facilities •Effective utilization of existing facilities, etc.
	A-3:Measures to control runoff into rivers (Measures focused on rivers)	•Storage and infiltration facilities, etc.
	B. Measures for controlling flooding flow	
		•Secondary levees •Open levees •Ring levees , etc.
	C. Measures for reducing damage in floodplain	
		•Raising floors of buildings •Installing electric and machinery equipment at higher places •Regulation of land-use , etc.
Non-structure measures	D. Evacuation and evacuation guidance measures	
		•Evacuation and evacuation guidance •Forecast and warning •Evacuation facilities, etc.
	E. Emergency measures	
		•Flood fighting •Cofferdam •Drainage measures •Training •Education , etc.
	F. Measures for expediting rehabilitation and reconstruction	
		•Disaster prevention facilities •Transportation network •Disaster prevention operation plan •Business continuity plan •Disposal of flood-generated waste, etc.

D1. Case example of IRBFM(Isiolo)

Location of Isiolo River Basin



D1-1. Long list/candidates of Countermeasures to the Flood

No.	Countermeasure Method to be considered	Remarks	Target Area
1	Flood Early Warning	Collect and analyze information on flood such as rainfall and water level in the upstream of Isiolo River and transmit it to the urban area of Isiolo.	Isiolo Town
2	Flood Hazard Map	Flood hazard map is a tool for communicating the impact of a specific flood event in a particular community.	Isiolo Town
3	Communication and collaboration between up/down stream	Information sharing such as rainfall, water level, focal community members in both the upstream and downstream areas in the river basin allows for damage mitigation, evacuation, response and rescue operation	Isiolo Town
4	Flood evacuation programme	Establish evacuation programme including evacuation plan, safe evacuation places, route and evacuation drill	Isiolo Town
5	Education on disaster management	Educate the residents on how to reduce by themselves the present flood damage	Isiolo Town
6	Drainage network	Development in the whole urban area of Isiolo	Isiolo Town
7	Sand bag	Guidance on sand bag production and provision of materials	Isiolo Town
8	Forestation activity	Activity to promote plantation and forestation	Isiolo Town
9	Excavation of Merire River	Excavation of river bed of Merire River	Isiolo Town
10	Widening of Merire River	Widening of river width	Isiolo Town
11	Restriction on land use	Legislation on land use restriction	Isiolo Town
12	Cleaning River campaign	Carrying out of cleaning campaign near Merire River	Isiolo Town
13	Dams/ Check Dams	Construction of dams and check dams in the upstream	Isiolo Town
14	Drainage canal	Development of drainage canal in the airport area	Isiolo Town
15	Culvert under the road	Development of culvert in the airport area	Isiolo Town
16	Retarding basin/pond	Development of retarding basin/pond in the airport area	Isiolo Town
17	Contingency Plan	Contingency planning aims to prepare an organization to respond well to an emergency and its potential humanitarian impact.	Isiolo Town
18	Reconstruction and recovery including funds	A process of long-term reconstruction and economic recovery should begin while post-emergency actions aimed at restoring normality for the displaced populations returning home or settling in new places are being undertaken.	Isiolo Town
19	Check Dam	Construction of check dam at Isiolo River	Upstream
20	Riverbank protection and spur dike	Construction of riverbank protection works at Isiolo River	Entire basin
21	Improvement of river course	Improvement of river course of Isiolo River	Midstream and tributary stream
22	Improvement of bridge	Improvement of bridge of Isiolo River	Midstream and tributary stream

D1-2. Bank Erosion in the Entire Basin

(1) Natural Conditions and Hazards

Natural Conditions	Hazards
Most of basin is arid zone and streamflow is small normally, sometimes heavy rain occurs in a local area	Aggradation of river bed by runoff soil, short river width
Loss of forest	Soil erosion, Soil runoff

(2) Conditions on Socio-economic and Vulnerability/ Exposure

Socio-economic conditions	Vulnerability/ Exposure
Villages are not concentrated in the same area, besides a part. (Number of houses and population is small.)	Number of houses and population is small. Affected people and houses are few.
The region has been prosperous in agriculture	Agricultural damages are occurred. Lose/ threaten former's livelihood
Highway and trunk road are developed	A temporary halt and/or stagnation in logistics due to inundation
Development of sightseeing resources	Delay of development suspension of service and due to debris (A part of the area includes resort area. Assumed damage is medium scale.)

D1-2. Bank Erosion in the Entire Basin

(3) Mechanism of the bank of river erosion damage in whole area

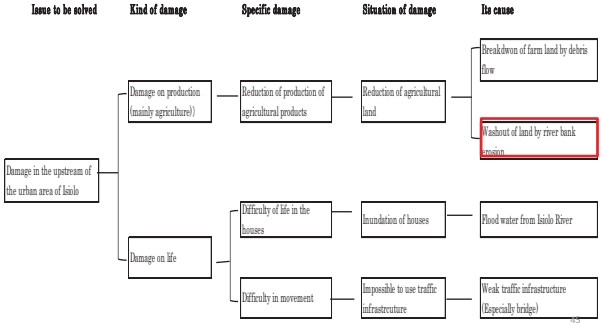
- Isiolo river bank tends to be eroded.
- National Highway A2 is the highway not only important to communities and economic activities in and around Isiolo, but also important to the northern part of Kenya.
- Therefore it is inferred that economic negative impact by the bridge being damaged and traffic suspended at the time of flood is very serious to large population.

Bank erosion near urban area

Bank erosion at the Eastern Marania River

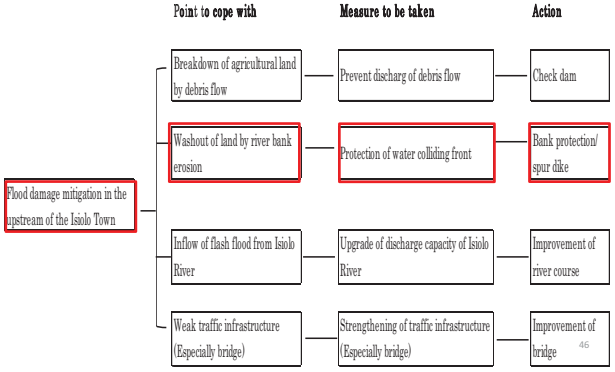
D1-3. Analysis on Flood Damage and Countermeasure in the Outskirt excluding the Urban Area

(1) Flood Damage and its Couse



D1-3. Analysis on Flood Damage and Countermeasure in the Outskirt excluding the Urban Area

(2) Countermeasures



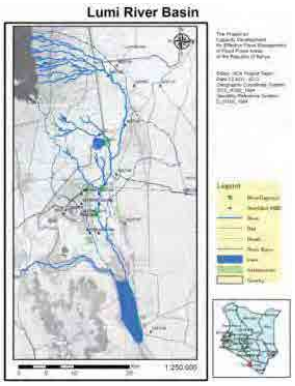
D1-4. Countermeasure (Riverbank erosion) Riverbank protection

No.		19	
Target Area		Upstream of Isiolo River	
Countermeasure		Riverbank Protection	
Outline		It is a structure to prevent riverbank erosion.	
Evaluation by Five Criteria	Relevance	Population and number of houses are few at upstream. However, damage to farmland and plantation is extensive. There is a main highway near by upstream of Isiolo River. Prevention for road erosion is necessary. Stakeholder has strong request.	A
	Effectiveness	It also functions as protection of highway. In addition, it contributes to reduce flood damage to physical distribution and human movement. However, the effect of one construction is limited.	B
	Efficiency	Both cost and effectiveness are medium scale.	B
	Impact	If it is simple design, application in other area is not difficult.	B
	Sustainability	Continuous maintenance is inevitable. However, if it is simple design, maintenance is not difficult.	B

D1-4. Countermeasure (Riverbank erosion) Riverbank protection

Merit	Expectation for prevention of bank erosion.
Demerit	It is necessary to consider the influences to upstream, downstream and the opposite bank.
Negative Impact to Environment	Positive
Necessity of EIA	Necessary when bank scale is large.
Necessity of Residents contribution	According to WDC manual, 15% contribution in cash, labor or material is required.
Main Actor	WRUA
Organization to be concerned	<Approval>WRMA/ County/ District/ KeNHA <Technical Assistance>MWI/ WRMA
Public assistance/ Mutual support / Self-help	Mutual Support, Public assistance

D2. Case example of IRBFM(Lumi)



49

D2-1. Long list/candidates of Countermeasures to the Flood

No.	Countermeasure	
L-U1	Check dam / Earth and Soil Flown Out Area in the Upstream of Lumi River Basin	S
L-U2	Restriction on logging / Earth and Soil Flown Out Area in the Upstream of Lumi River Basin	N
L-U3	Forestation activities / Earth and Soil Flown Out Area in the Upstream of Lumi River Basin	N
L-W1	Channel Improvement of Lumi River / Long term inundation area	S
L-W2	Drainage Channel Improvement / Long term inundation area	S
L-W3	Repair of existing embankment / Long term inundation area	S
L-W4	Dredging of Lake Jipe / Long term inundation area	S
L-W5	Small check dam	S
L-W6	Forestation Activity (upstream) / Long term inundation area	N
L-W7	Education on Disaster Prevention / Long term inundation area	N
L-W8	Early Warning System (IFAS/GFAS) / Long term inundation area	S
L-W9	Environmental Improvement of Evacuation Camp / Long term inundation area	S
L-W10	Rain water harvesting	S
L-W11	Development of Community Road/ Long term inundation area	S
L-W12	Raised-up Toilet / Long term inundation area	N
L-W13	Spring protection (gabion)	N
L-E1	Riverbank Protection / Tributary Stream Area	S
L-E2	Restriction on land use	N
L-E3	Forestation Activity / Tributary Stream Area	N
L-E4	Education on Disaster Prevention / Tributary Stream Area	N
L-E5	Early Warning System / Tributary Stream Area	S
L-E6	Development of Community Road / Tributary Stream Area	S
L-E7	Raised-up Toilet / Tributary Stream Area	N

50

D2-2. Flood Characteristics of Low-lying Area in the Lower Lumi River Basin

(1) Flood Characteristics from Natural Conditions

Natural Conditions	Hazards
Gentle river bed slope and flat landscape	hinders the water flow downstream
Discharge large amounts of sediment In narrow rivers	Deposit on river bed, leading to threat of levee breach. Small capacity of river flow

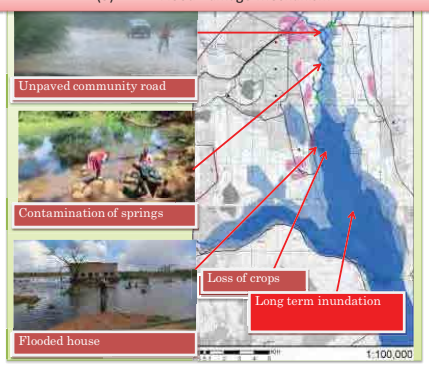
(2) Characteristics of Flood Damage from Socio-economic conditions

Socio-economic conditions	Vulnerability/ Exposure
Highly-populated residential areas (population density of 600 people per square kilometer)	A number of people affected by flood
Agriculture and stockbreeding have been prosperous in this area	Agricultural production stoppage, necessary protection of livestock, difficulty of breeding, affect the residents' livelihood
Part of river bank has been intentionally broken to take agricultural water.	Creation of adverse impacts on surrounding area
Unpaved community road	Roads are severed by floods
Tourist facilities located near the Lake Jipe	Due to inundation and severed roads, stoppage of a service for tourists

51

D2-2. Flood Characteristics of Low-lying Area in the Lower Lumi River Basin

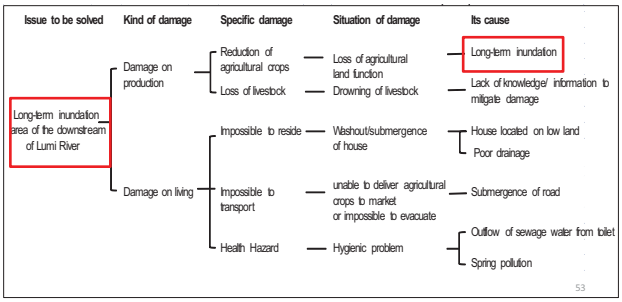
(3) Flood Damage Mechanism



52

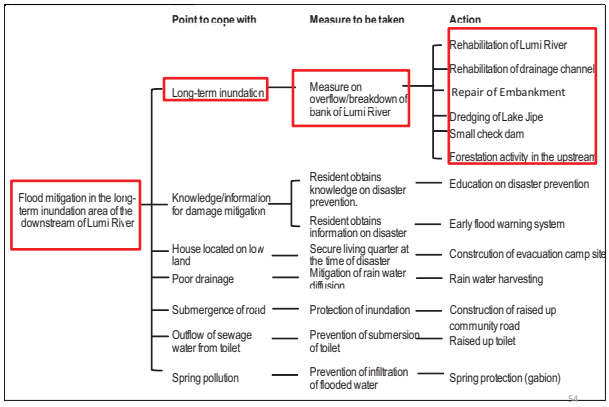
D2-3. Analysis on Flood Damage and Countermeasure in the Long-term Inundated area of the Downstream of Lumi River

(1) Flood damage and cause



53

(2) Countermeasures



54

D2-4.Counteemeasure1(Long term inundation) Channel Improvement of Lumi River

No.		L-W1		
Target Area		Downstream of Lumi River		
Countermeasure		Channel Improvement of Lumi River		
Outline		It is a work to widen of the river and to dredge raised river bed.		
Evaluation by Five Criteria	Relevance	Flood damage is huge in this area. Residents and stakeholder highly desire to improve the actual situation. Lack of flow capacity of Lumi river is the main factor. Excavation and widening of the river channel is effective and necessary.	A	
	Effectiveness	It contributes considerably to reduction of long term inundation from Lumi River.	A	
	Efficiency	Both cost and effectiveness are medium scale.	B	
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	
	Sustainability	Continuous maintenance is necessary. If WRUA implements this project with WSTF fund, additional maintenance cost should be considered.	C	

55

D2-4.Counteemeasure1(Long term inundation) Channel Improvement of Lumi River

Merit	Easy appearance of effects
Demerit	Relevance with PCDEFM project is low. Each stage such as planning, design, and construction need long term. Continuous maintenance, High costs.
Negative Impact to Environment	Silting at downstream, Bio diversity
Necessity of EIA	Necessary
Contribution by the residents	Soil carriage
Main Actor	Taveta County/MWI/NWCPC
Organization to be concerned	<Approval>County / District, <Technical Assistance>MWI, WRMA
Public assistance/ Mutual support / Self-help	Public Assistance

56

D2-4.Counteemeasure2(Long term inundation) Drainage Channel Improvement

No.		L-W2		
Target Area		West side of downstream of Lumi River (Canal A/B/C)		
Countermeasure		Drainage Channel Improvement		
Outline		Removing sediment on river bed to increase flow capacity		
Evaluation by Five Criteria	Relevance	Flood damage is huge in this area. Residents and stakeholder highly request to improve the actual situation. Sediment deposition is one of main factors. To recover flow capacity of the drainage channel is effective and necessary.	A	
	Effectiveness	It contributes considerably to reduction of long term inundation from Lumi River.	A	
	Efficiency	Cost is very large, and damage reduction is also large.	A	
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	
	Sustainability	Continuous maintenance is necessary. If WRUA implements this project with WSTF fund, additional maintenance cost should be considered.	C	

57

D2-4.Counteemeasure2(Long term inundation) Drainage Channel Improvement

Merit	Impacts can be very large.
Demerit	Huge construction cost necessary to improve all three canals. Also continued maintenance of channels will be required.
Negative Impact to Environment	Influence to biodiversity in downstream, if the flow changes.
Necessity of EIA	Necessary
Contribution by the residents	According to WDC manual, 15% contribution in cash, labor or material is required
Responsible Institution/Agency	MWI, WRMA
Main Actor	NWCPC, County
Organization to be concerned	<Approval>County / District, <Technical Assistance>MWI, WRMA
Public assistance/Mutual support /Self-help	Public Assistance, Mutual support

58

D2-4.Counteemeasure3(Long term inundation) Repair of existing embankment along Canal C

No.		L-W3		
Target Area		West side of downstream of Lumi River (Canal C)		
Countermeasure		Repair of existing embankment		
Outline		To Repair the broken segment of Canal-C to prevent outflow of flood water from Lumi River		
Evaluation by Five Criteria	Relevance	Flood damage is huge in this area. Residents and stakeholder highly request to improve the actual situation. To bank up overflow from Lumi river and to lead to Canal C is effective and necessary.	A	
	Effectiveness	It contributes considerably to reduction of long term inundation from Lumi River.	A	
	Efficiency	Both cost and effectiveness are medium scale.	B	
	Impact	It is difficult to spread structural works itself. However, maintenance system that is already operated by WRUA in this community can be spread.	B	
	Sustainability	Continuous maintenance is necessary. Fortunately, WRUA members at this community already operate maintenance system of irrigation facilities voluntary. Sustainability is highly expected.	B	

59

D2-4.Counteemeasure3(Long term inundation) Repair of existing embankment along Canal C

Merit	Relatively easy to confirm the effects, and easy to implement, if the problem indeed results from the said broken segment of Canal-C
Demerit	It takes certain costs and time for planning, design and construction.
Negative Impact to Environment	Nil
Necessity of EIA	Unnecessary
Contribution by the residents	According to WDC manual, 15% contribution in cash, labor or material is required
Main Actor	NWCPC, County
Organization to be concerned	<Approval>County / District <Technical Assistance>MWI, WRMA
Public assistance/ Mutual support/ Self-help	Public Assistance, Mutual support

60


Thank you for your attention!!
Asante Sana

Module 3

3-2 Community-managed Flood Disaster Risk Reduction (DRR)

FLOOD MANAGEMENT TRAINING

Module 3-2

COMMUNITY MANAGED FLOOD DISASTER RISK MANAGEMENT (CMDRR)

Joseph Boit, LVS RO

1

CONTENTS

- What is CMDRR?
- Factors Influencing adoption of CMDRR
- Main Stakeholders in CMDRR process
- Roles of stakeholders in assessing Risks in Communities

2

WHAT IS CMDRR?

- Is a process of bringing together people within same community to enable them collectively address a common disaster and collectively pursue a common disaster risk reduction measures
- Involves mobilising a group of people in a systematic way towards achieving a safer and resilient individual/community which takes place in a geographically-defined living area (0r) in sector groups not necessarily living in the same location

3

WHAT IS CMDRR?

- the end result is
  - an empowered dynamic community
  - Cohesive in decision making
  - Handles conflicts effectively
  - Capable of resolving issues
  - Manages tasks individually and collectively in an effective way
  - Capable of recovering from hazard event

4

Why disaster is community managed

- It is localised and occurs in a community
- People in the community and they are the first respondents
- Adaptation occurs locally at community level
- Communities are the foundation of humanity

5

Why disaster is community managed Cont.

Philosophy and principles of Communities in hazard reduction

- Knowledge accumulation in addressing hazard events
- Communities are survivors not victims
- Basic rights are the foundation of human safety
- Community organisation enhances disaster risk reduction
- Community support to disaster disadvantaged members

6

Disaster Risk Reduction formula

Offers an algorithm on how to reduce the risk
•DR (Disaster Risk)=H(Hazard)x V (Vulnerability) x C (Capacity)
- •H-Prevention and mitigation of hazards
- •V-Reduce vulnerability
- •C-strengthening capacities to cope and regain after the hazards

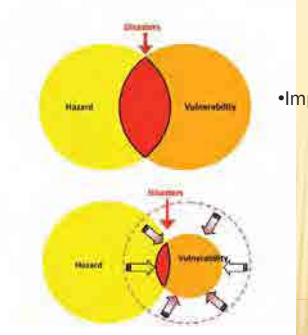
7

Disaster Risk Reduction formula Cont.

- •Fundamental of DRR
  - •If a disaster risk is reduced then the probability of the hazard becoming a disaster is less
- •High risk level
  - •Occurs when hazards, coupled with vulnerability and lack of capacity to cope translates into communities with high levels of risks

8

Correlation between Vulnerability and disaster



- •Implication of disaster algorithm
  - •Proper assessment of disaster
  - •Necessary disaster prevention measures
  - •Reduce vulnerability of community
    - •Less disaster or impact reduction

9

DISASTER RISK MANAGEMENT CYCLE

- Explains general outline of disaster reduction
- Has four phases
  - Response /Recovery
  - Rehabilitation/Reconstruction
  - Prevention/Mitigation
  - preparedness

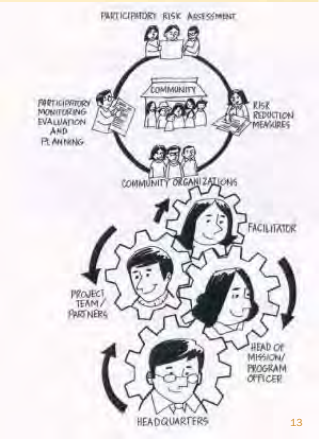
10

11

Response: combined action of coordination and quick and appropriate relief
Rehabilitation and Reconstruction : well planned for the next event
Prevention/Mitigation: structural and non-structural measures to reduce impacts magnitude
Preparedness: Activities and measures taken in advance to ensure effective response to impact of disasters

12

OPERATIONALISING CMDRR



13

REQUIREMENTS FOR MAKING CMDRR OPERATIONAL

Participatory Community Disaster Risk Assessment and Analysis

- **Hazard assessment:** Identifies and analyses the hazard or threat
- **Vulnerability assessment:** elements at risk and susceptibility to the risk
- **Capacity assessment:** knowledge gaps for effective coping (prevention, mitigation, ability to survive and readiness)
- **Disaster risk analysis:** Analysis of threats and packaging of reduction measures

14

Disaster Risk Reduction (DRR) Measures

- Is a process whereby a community plans to solve its disaster risk by translating the result of risk assessment to development abs contingency plan
  - Development plans: actions taken for long term solutions and implemented before the hazard comes
  - Contingency plans: actions taken during the hazard events
  - Risk reduction: measures aimed to answer the gaps to prevent, mitigate hazards, reduce vulnerability and increase the capacity of elements at risk

15

Organisation of risk reduction groups

Is a process of identifying and strengthening the role and responsibility of each member vis-à-vis the community disaster risk reduction measures *(Please see attachment 9 Implementation of DRR Community Action Plans)*. This is known as the "functional" organization. It is aimed at forming a cohesive decision-making group to ensure ownership by the community of its disaster risk reduction processes, project, challenges and benefits.

16

Participatory planning, Monitoring, Evaluation and Learning (PPMEL)

- Is a process of building a system of community, where
  - learning is drawn in terms of keeping track of their disaster reduction measures and development of their organisation
  - Identifying strenths and weaknesses
  - External threats and opportunities
  - Determining achievemnets
- It involves relevance, efficiency and effectiveness of their DRR work and organisation
- Recognises success and errors
- Draws lessons to guide future disaster risk reduction development and contingency plans
- Ensure growth and sustainability of the community organisation

17

IMPLEMENTATION OF CMDRR AND ROLE OF STAKEHOLDERS

The facilitator

- Link between community and development organisation and facilitates the dynamics of CMDDR

Partner organisation

- Provides enabling support for effective and efficient implementation of CMDRR

Head Mission

- Advisory on CMDRR implemenation in accordance with national policies, strategies and programmes

The Headquarters

- Resources mobilisation and creation of enabling environment

18

INSTITUTIONALISATION OF CMDRR

Essential Mainstreaming tools and guidelines

Partner Proposal Guidelines

•Entails standards for mainstreaming CMDRR

Partners reporting Guidelines

•Instructions on different levels of operation

Partners Learning Agenda

•Guides practitioners to use tools and processes in generating knowledge, experiences and drawing lessons

Measures to sustain CMDRR

•Knowledge generation, advocacy and resource mobilisation

19

INSTITUTIONALISATION OF CMDRR CONT.

Documentation and sharing

•Continuous documentation and sharing of experiences and lessons

Resource Mobilisation

•Elaborate strategies for mobilisation of financial and related resources from stakeholders

Advocacy and Networking

•Essential for influencing public policies, resource mobilisation, awareness and visibility

Capacity building

•Strengthens internal mechanisms and human resource

20

Module 3

3-3 Vulnerability Assessment

FLOOD MANAGEMENT TRAINING

Module 3-3

VULNERABILITY ASSESSMENT

Prepared by Japheth Onyando
Professor of Soil and Water Engineering and Presented by Simon Mwangi ATCM(SW)

CONTENTS

WHAT IS VULNERABILITY?

- Is the degree of loss suffered whenever a hazard of given severity occurs

Two types of vulnerability exist

- **Structural/Physical:** is the extent to which a structure is likely to be damaged or disrupted by a hazard event
- **Human Vulnerability:** Is the relative lack of capacity of a person or community to anticipate, cope with resist and recover from impact of a hazard

VULNERABILITY CONT.

- **Risk:** is the probability that a disaster will occur
- **Hazard:** is the trigger event which sets off the disaster
- **Disaster:** in an event or occurrence which may be sudden or gradual causing damage to human life, livestock, crops and physical facilities
- Risk is determined from
  - The hazard occurrence probability
  - The elements at risk
  - The vulnerability of the elements

VULNERABILITY CONT.

- Hazard, vulnerability and risk information is used for
  - Formulation of disaster plans
  - Formulation of relevant programmes for disaster training and public awareness
  - Definition and application of measures to reduce vulnerability
  - Formation and application of measures to reduce vulnerability
  - Formulation and utilization of long term programmes for comprehensive disaster management
- Hazard X Vulnerability = Risk

VULNERABILITY CONT.

- **Factors affecting human vulnerability:**
  - **Poverty:** increases vulnerability to floods by making people live in flood prone areas including riparian land
  - Increased population density: increase over exploitation of resources leading to degradation
  - Rapid urbanisation: Enhances flash floods
  - Changes in way of life:
  - Environmental degradation:
  - Lack of awareness and information
  - War and civil strife

EXTENT AND DISTRIBUTION OF FLOODS

- **The concept of flood disaster map:**
  - Is a tool for communicating the impact of specific event in a particular community
  - Provides information on spatial distribution of inundation areas and its associated depth during the heaviest and annual average flooding

7

EXTENT AND DISTRIBUTION OF FLOODS

- **Preparation of Flood Disaster map:**
- Data and information needed
  - Water depth during flooding
  - Duration flooded
  - Flow direction and velocity
  - Status of evacuation facility (location of evacuation centres, routes, dangerous spots) and other infrastructure (e.g. Schools, Hospitals, Churches).

8

PURPOSE OF FLOOD DISASTER MAP

To define areas likely to be inundated by flooding and their hydrological behaviour

To understand the past flood incidence

To provide basic information on evacuation planning

To assist in land use planning

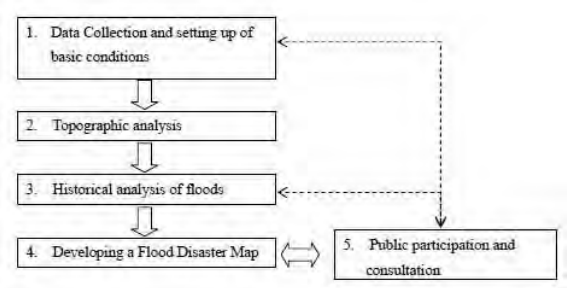
To simulate emergency drills

To assist in developing disaster prevention and preparedness countermeasures

To provide basic inputs to developing a flood hazard map

9

KEY STEPS TOWARDS DEVELOPING A FLOOD DISASTER MAP



10

DATA COLLECTION AND SETTING-UP BASIC CONDITIONS

(1) Data collection

- Information on inundation:
  - Previous study results
  - Flood damage survey results
- Information on evacuation facilities
  - Areas to be evacuated
  - Number of residents to be evacuated
  - Evacuation refuges
  - Dangerous spots on evacuation routes
  - Communication channels
  - Evacuation criteria
  - Facilities for those vulnerable in the event of emergency

11

DATA COLLECTION AND SETTING-UP BASIC CONDITIONS CONTD

Other information to be collected:

- Bodies and agencies concerned
- Disaster prevention facilities and equipment
- Medical facilities
- Lifelines
- Social welfare

12

DATA COLLECTION AND SETTING-UP BASIC CONDITIONS - CONTD

2. Setting up basic conditions

(i) Magnitude of target flood
- Design flood
- Largest flood previously recorded
- Largest flood occurring once in several years

(ii) Extent of areas to be mapped
- Entire areas subject to flooding
- Neighbouring areas with high potential of flooding

(iii) Scale and size of base maps
- 1/10 000 to 1/15 0000
- Possible to identify individual houses, evacuation routes and extent of inundation

13

TOPOGRAPHIC ANALYSIS

1. Required data

•Variuous maps, air photos, satellite imageries
•Relief orientaion of the area
•Elevations
•1/50 000 topomap with 20 m contour interval
•1/10 000 topomap with 2 m interval

14

TOPOGRAPHIC ANALYSIS CONT.

2. Topographic Analysis

•Based on collect topo and other related maps
•Topographic features of flood areas to be classified to estimate the flood conditions
- •Extent of inundation area, area to be submerged, direction of flood flows, change in river course etc

15

TOPOGRAPHIC ANALYSIS CONT.

Geomorphic elements	State of flooding
Terrace	Remains unsubmerged during floods
Valley plain	When submerged, high velocity of current. Good drainage
Fan	When submerged, erosion, deposition and change in water course occurs. Good drainage
Natural levee	Submerged during extraordnary floods. Good drainage
Back-marsh	Remains submerged for long period. Deep water
Delta	Submerged for very long period
Former river course	Water flows along it during periods of extraordinary flooding

16

TOPOGRAPHIC ANALYSIS CONT.

Geomorphic elements	State of flooding
Sand spit	Submerged during extraordinary flooding. Good drainage
Sand dune	Remains unsubmerged
Lowland between sand dunes	Submerged during torrential rainfall
Reclaimed land	Submerged for very long period. Experiences frequent tidal waves
Artificial filled field in shallow sea	Experiences tidal waves and tsunami but water drains off well

17

TOPOGRAPHIC ANALYSIS CONT.

Geomorphological classification map

18

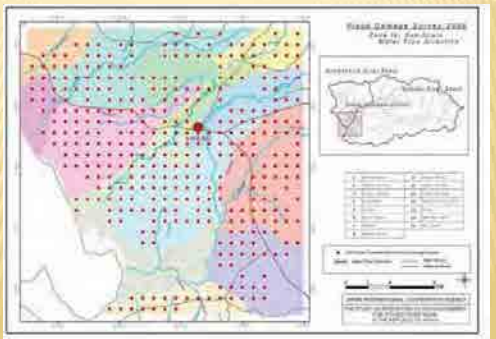
HISTORICAL ANALYSIS OF FLOODS

- Determination of flood history of the area
  - Flood maps
  - News
  - Reports
  - Personal experiences
- Undertaking of flood damage survey
  - Actual flood surveys during flooding event
  - Administering flood survey questionnaires
  - Interviews with communities

19

HISTORICAL ANALYSIS OF FLOODS CONTD

Example of survey area and interview sites in the flood damage survey



20

PREPARING FLOOD DISASTER MAP

1. Data input in map form
   - Reference map
   - Existing survey results on flooded area
   - Flood water depth
   - Duration of floods
   - Flow direction and velocities
   - Evacuation facility
- The maps are overlaid in a GIS environment through spatial analysis

21

PREPARING FLOOD DISASTER MAP CONT.

2. Developing a flood disaster map
   - Done using spatial data
   - Undertaken through spatial anaysis in a GIS environment
   - Flood, water depth, ununddation duration, flood flow direction etc are overlaid
   - Continuous structures, micro-topographic features (sources and sinks) are considered

22

PUBLIC PARTICIPATION

1. Implementation of public hearing
- Sample issues raised
  - Naming of local ditches
  - Clarification of boundaries (location and sub-location)
  - Local flow direction
  - Brief history of floods in the past
  - Lack of drainage channles

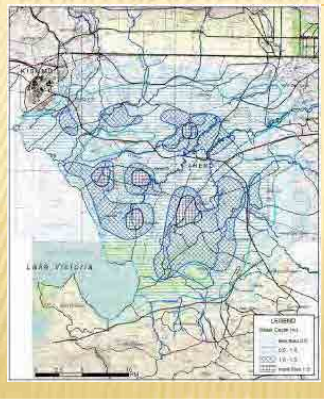
23

PREPARING FLOOD DISASTER MAP

2. Reflecting results from public consultation
   - Leads to finalisation of the map
     - Map flood water level in the past
     - Annual flood water level

24

FLOOD DISASTER MAP



Interview Survey at 350 points

Public Hearing (November 2006)

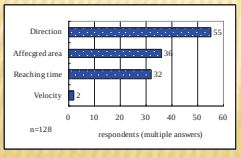
25

Please refer to Page 2 (handout)

ASSESSMENT OF VULNERABILITY: PARTICIPATORY APPROACH

Assessment of Community Vulnerability

Awareness Creation of Flood Hazard



Collection of Baseline Data

Consensus Building

26

THE END

27

Module 3

3-4 Developing Community-based Flood Hazard Maps

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

Module 3-4
Community Based Flood Hazard Map
15th October, 2013

Joseph Boit, LVS RO

Project on Capacity Development For Effective Flood Management In Flood Prone Areas In the Republic of Kenya

Objectives

To enable the participants to:
1. Arrange flood related information on paper,
2. Understand the use of flood hazard map in a community.
3. Understand the importance of community's participation as a source of local information on past floods.

Background

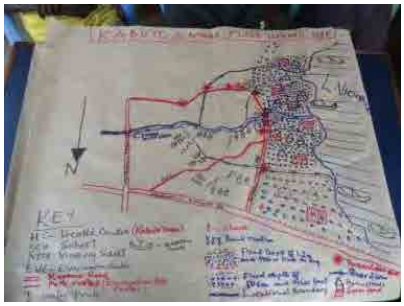
Hazard maps have been recognized as an instrument for disaster management in many countries in recent years. However, most of them are literally only maps indicating dangerous spots and no useful for practical applications of disaster reduction.
In March 2003, the Ministry of Land, Infrastructure &Transport in Japan developed a "Flood Hazard Map Manual for technology transfer".
Utilizing the manual, the Asian Disaster Reduction Center (ADRC), with the cooperation with Fuji Tokoha University, developed an exercise for "Community Based Flood Hazard Mapping".

Background Contd'

The exercise is a simple and cost effective tool used to raise public awareness while fostering the active participation of the community. The tool was also developed bearing in mind that in order to raise public awareness and to ensure smooth evacuation when a flood or another disaster is imminent, maps must be user-friendly and easily understandable for the community. According to a survey recently conducted in Japan, among the residents who evacuated, those who had seen such hazard maps were 1.5 times greater in number, and they evacuated one hour earlier than their counterparts who had not seen a map.

What is the Flood Hazard Map

Flood hazard map is a tool for communicating the impact of a specific flood event in a particular community.



Flood hazard map provides information on spatial distribution of inundation areas and its associated depth during the heaviest and annual average flooding.

Point to note when developing Flood Hazard map

In the case of a flood,hazard maps need to include not only inundation areas and depth but also information such as evacuation centres & routes, disaster management centres, dangerous spots, communication channels and systems, evacuation criteria, tips for evacuation including emergency kits and other items needed in evacuation, and mechanisms and symptoms of hazards.

The community must be provided with relevant information regarding hazard maps and how to utilize them. Most importantly, how effectively hazard maps are used depends on the level of community awareness. The members of the community must be taught how to understand potential disasters in their area from the map to take appropriate countermeasures.

ADRC Approach in developing CFHM

the following steps are advocated by ADRC when developing Community Flood Hazard Map :

1) Members of the community along with experts and local government officials walk around the town or village to find out about, among others aspects, 'inundation areas', 'evacuation centres & routes', 'expected problems in disaster management activities', 'disaster related facilities' and communication channels'.

2) They then transfer the field observations and information onto a map using different colours to facilitate visual understanding.

3) Participants should discuss the 'possible disasters', problems to be expected in disasters' and 'possible countermeasures'.

7

What constitutes a Flood Hazard Map

Flood hazard map, in general, is a tool for the presentation and dissemination of information on flood hazard (intensity, spatial range, inundation depth, duration time, frequency, etc.) and evacuation options (location of evacuation centers, evacuation routes, dangerous spots, etc.) in aid of quick and safe evacuation in the event of flooding.

Generally the following items should be included on the map

Basic Information		Other Information
Flood Hazard Information - Flood inundation area - Flood inundation depth - Flood Duration time	**Evacuation Information** - Evacuation centers, - Evacuation path routes - Dangerous spots, - Healthcare center, etc.	- Addition of the information on the building used as residents' land mark - Setting to the scale range which can have a common view - Consider of gender and old man, children, etc.

8

Methodology for developing Flood Hazard Map

To develop the Flood Hazard Map the following should be considered:

- Gender representation which considers women, aged, children, etc;
- Community members identify key flood related landmarks ;
- Setting up of an open ground the process of developing flood hazard map which takes into consideration the views of the community;
- Consensus building on the language, symbols , signs, legend, colours etc to be used on the flood hazard map

WRMA staff explains the purpose to community members

A community member identified leads in drawing the map on the ground

9

Methodology for developing Flood Hazard Map

- For village based flood hazard map it is advisable for a transect walk to carried out to verify the various points and locations indicated on the draft community flood hazard map.
- Explanation of the purpose and objective of flood hazard map to the community
- Identify one member of the community to lead in drawing the community flood hazard map; and last but not least
- Transfer the sketch from the ground to the manilla paper as the first draft and after discussion the draft is adopted as it is or they review as per community consensus.

Community members transfer to paper map drawn on the ground

10

Importance of Local Knowledge

It is important to utilize local knowledge when developing the community flood hazard map. Why use local knowledge?

- ✓ Community members that live in that geographical location know their area better than the outsiders. They know their surrounding environment and the areas that are prone to disasters;
- ✓ Local knowledge also allow the planners to rapidly survey needs and opportunities for mitigation needs; and
- ✓ Local knowledge also contribute different view points and concerns that helps in mapping out hazardous conditions.

11

Importance of the community based flood hazard map

to WRMA

Flood Hazard Map can be utilized for **formulation of regional planning,** which includes; Road improvement planning for evacuation, drainage improvement, selection of sites for new evacuation facilities, prioritization of communities to be strengthened against and prepared for flooding, etc.

to Community (WRUA)

Flood Hazard Map can be utilized for **evacuation information at the flooding** and as **disaster prevention learning information at the usual.**

12

WRMA's role in developing community based flood hazard map ①

1. Preparatory Work by WRMA

1-1. Mobilization of Community Members

1-2. Identification of the venue for the exercise

1-3. Provision of Stationary and other logistics

1-4. Develop the flood hazard mapping Program

13

Merits of the community based flood hazard map

✓Makes the community know the flood characteristics in their area,

✓It assists the affected to know the important points like Evacuation Routes, Evacuation Centres and other hotspot areas,

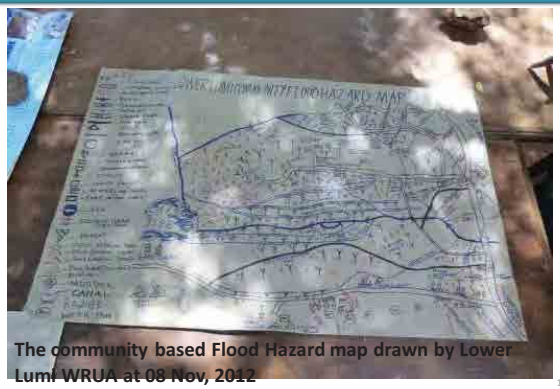
✓Assists the WRUA to interpret the real flood features on the ground and opens up discussion among the community members thereby enhancing flood awareness and sensitization within the community,

✓Assists the Government, KRCS, JICA and other donors to access the affected communities with ease and

✓It also facilitate the transfer of historical flood incidences both past and current to the younger generation .

14

Example of the community flood hazard map



The community based Flood Hazard map drawn by Lower Lumi WRUA at 08 Nov, 2012

15

Key point to note in community based flood hazard map ⑥

It is imperative to note that the success of community flood hazard map does not only lie in just developing the map but continuous review and updating such maps marks its success.

Before

After

16

Flood Hazard Map Signboard

17

How to use community flood hazard map in updating topographical map

Transfer the information on Community flood hazard map to a topographical map

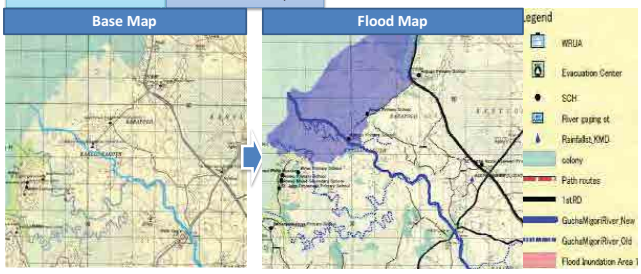
18

Using GIS software to develop efficient data management system

Basic Information

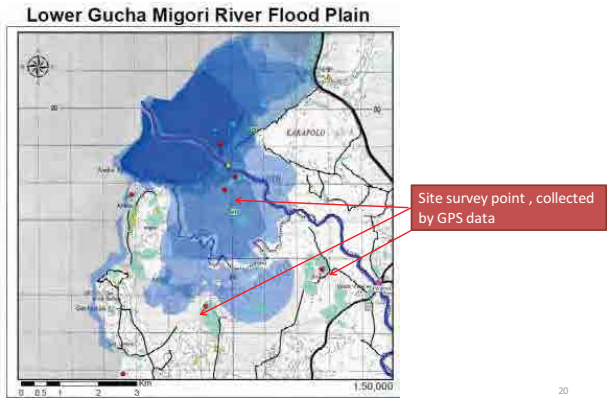
Flood Risk Information	Evacuation Information
- Flood inundation area - Flood inundation depth - Flood Duration time	- Evacuation center, - Evacuation path route - Dangerous point, - Water points, - Healthcare center, etc.

Adding Flood Risk Information and Evacuation Information to the Base map



19

Using GIS software to develop efficient data management system



20

Integrating the past flood hazard information and data collected during the site survey

Recording flood information on the map
Collecting of various floods damage information

Integration of the various flood damage information

It's possible to figure out characteristic features of flood pattern in each area

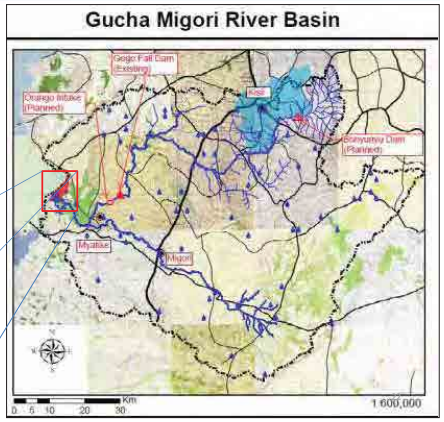
21

Integrating Flood Information on the River Basin Map

Integrating flood information including flood damage information and facilities planning, etc., on each area.

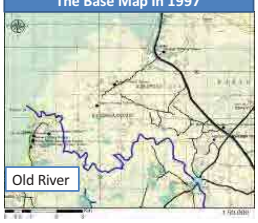
Analyze flood and its damage and Reviewing flood management plan in the river basin

Consistency in river management in the basin that takes into consideration the balance of the upstream and downstream issues

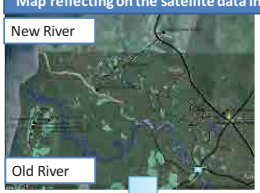


Step6: Updating base map and information by using satellite data

The Base Map In 1997



Map reflecting on the satellite data in 2003



The Updated Base Map

Building data base on river information,
- R. Gucha Migori has since changed its course, therefore there is a need to update base map.
- Documenting such information is important and more so if it this new data information can be digitalized.

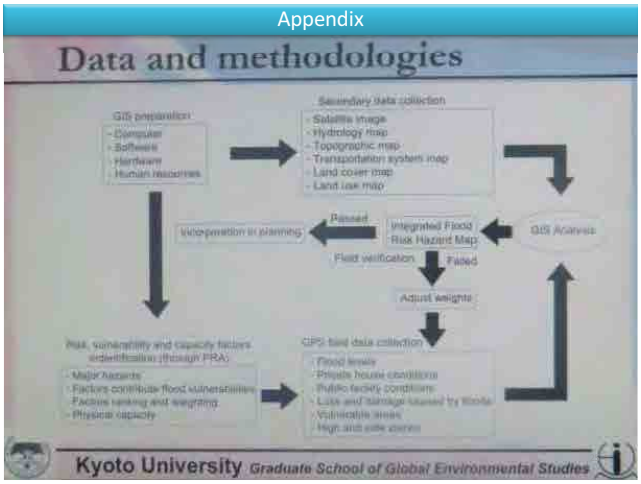
23

Conclusion

- Collection of Flood information not only hydrological data(water gauging, flow volume etc.) and flood damage data during the flooding period but also geographical information should be collected.
- If various data collected including the above data and are properly stored, it is possible therefore to analyze physical features of flood phenomenon and social and economic features of flood damage.
- The Flood Analysis can therefore be useful for planning structural (e.g. river structures) and non-structural (e.g. evacuation plan) measures.

24

Appendix



Thank you for giving me your attention

26

Module 4

4-1 Flood Early Warning System

Project on Capacity Development for Effective Flood Management in Flood Prone Areas (PCDEFM)

Module 4-1

Flood Early Warning System (FEWS)

18 FEB 2014
Prepared by Hideki Sawa
Team Leader, JICA Project Team and Presented by Simon Mwangi ATCM

1

MODULE 4: FLOOD EARLY WARNING

Sessions:

- 4-1 Flood Early Warning System (FEWS)
- 4-2 Community based Flood Early Warning
- 4-3 Introduction to IFAS and GFAS

Introduction

- Early Warning System developed along Nzoia river basin by World Bank and KMD.
- Rainfall gauge at a primary school, as community based action for early warning system.

Objective

- To understand **elements** of an early warning system
- To understand **importance** of early warning system in flood disaster mitigation

2

Step I: Elements of Early Warning System

- **Rainfall observation and/or forecast**
- **Travel time** from where the rain if falling to where participants are settled
- **Rate of river water level rise**
- **River flood discharge/ water level observation or forecast**
- Community flood early warning system is based on their experience in many cases.

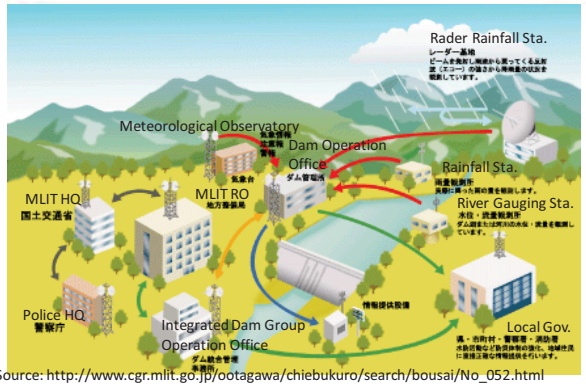
3

Step II: Importance of flood early warning system

- Allows for transmission of real time information of flood risks
- Allows the flood mitigation managers to plan in advance on responses required, evacuation and evacuation routes (if needed), healthcare centres, identification of hot points, evacuation centres etc
- Timely dissemination of forecast and warning information to relevant stakeholders and communities.

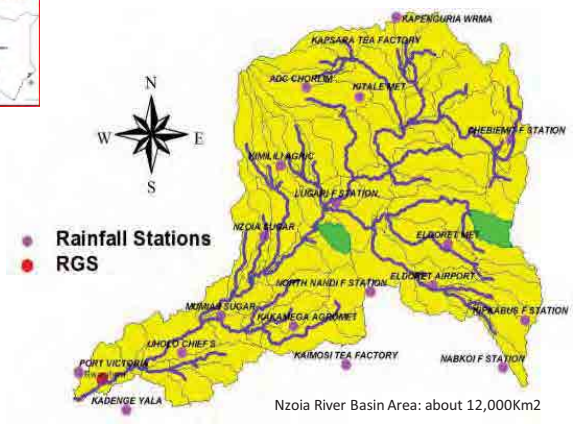
4

FEWS in Japan



Source: http://www.cgr.mlit.go.jp/ootagawa/chiebukuro/search/bousai/No_052.html

NZOIA RIVER BASIN



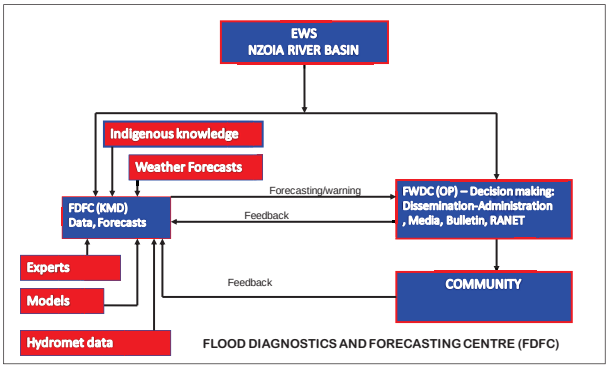
Nzoia River Basin Area: about 12,000Km2

Components of flood forecasting & Warning System

- ✓ **Hydro-met network:**
- ✓ **Data acquisition and processing:**
  a rapid communication system and data base system for data collection, processing, and storage/retrieval
- ✓ **Forecasting Centre - models:** Software, hardware, expertise
- ✓ **Forecast dissemination** ; press, TV, Radio, wireless or telephone, Internet,
- ✓ **Forecast review and development:**

7

NZOIA RIVER BASIN EWS

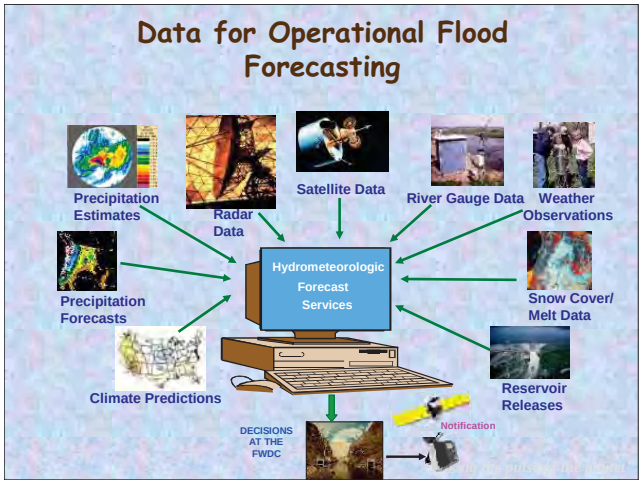


8

MONITORING SYSTEMS

9

Data for Operational Flood Forecasting

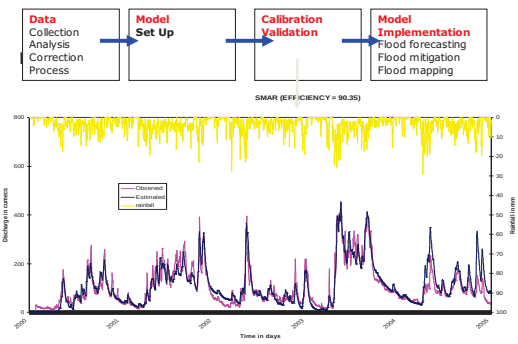


Data acquisition-Hydromet Network

- ✓ 20 rainfall stations were initially identified in the basin and are sending data daily.
- ✓ 4 RGs Rwambwa Bridge, Lusumu, Yala, and Webuye are also sending river levels daily.
- ✓ Warning levels, Danger levels and Highest Flood Levels were surveyed
- ✓ Upgrading to automatic and telemetric network
- ✓ KMD has procured:
  - ❖ 6 hydromet stns which are automatic and telemetric installed in Kapsara, Lugari, Mumias, Kaimosi, P. Victoria and Londiani
  - ❖ 4 Synoptic Automatic Weather stns in Kisumu, Kakagema, Kitale and Eldoret
  - ❖ RANET FM Radio at P. Victoria (Bunyala West Chief's office) set up to broadcast in Kinyala by the local people
- ✓ Project to procured:
  - ❖ 7 hydromet stns – Installed in Cheptongei, Chorlim, Kapenguria, Mukuyuni, Kipkabus, Nabkoi, and Uholo
  - ❖ 3 radar RGs with rainfall sensors installed at Rwambwa, Sigomre and Webuye

11

Modeling



12

Outputs

- The team has come up with two main products:
- a monthly Flood Diagnostic Bulletin and
- a daily Flood Watch up-date.

The content and structure of the bulletins has already been discussed and agreed on.

13

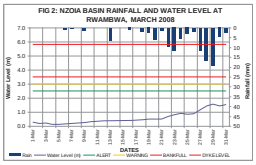
Monthly Flood Diagnostic Bulletin

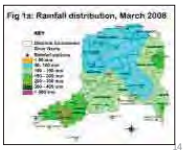
Bulletin Summary

The Nzoia River Basin received slightly above average rainfall during March 2008. The first and second weeks of the month were mainly dry while much of the rainfall occurred during the rest of the month. In response the Nzoia river level at Rwambwa Bridge rose from a low level of 0.125m to1.5m at the end of the month. In general the river levels were below the flood alert level of 2.5m. The Nzoia basin is expected to receive rainfall which is above the long term average in April 2008. In view of this, river levels are expected to continue rising and may reach the flood alert level during the month.
The table below gives the situation in February, March and the forecast for April 2008.

MONTH	COLOUR CODE	SITUATION
February		No flooding
March		No flooding
April		River levels rising

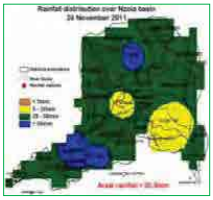
Colour Code : Red – Flooding (above 3 m), Amber/Yellow – Alert(2.5 to 3 m), Green – below alert level (below 2.5m)

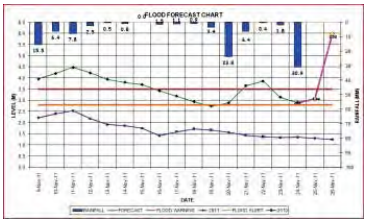




14

Daily flood watch update





Water levels at Rwambwa Bridge RG5

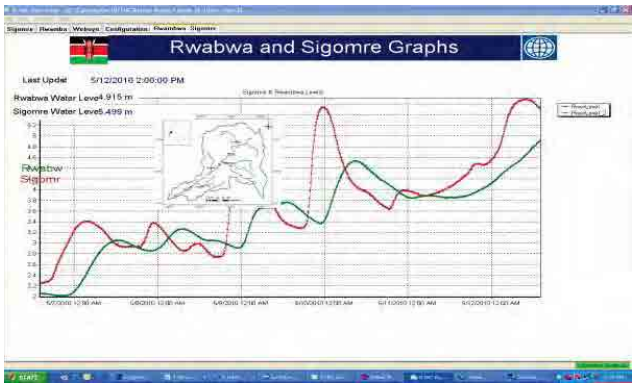
Date		Level (m)	Trend	Flood Risk Category
Yesterday's Max. Level		3.00	–	
Today's 'Morning water level' - 8am		3.84	–	
Forecast	25th November 2011	3.96	Rising	
average water levels	26th November 2011	3.98	Rising	

KEY
High flood risk
Moderate flood risk
No flood risk

15

Products of Flood Early Warning System

Routing flow from Sigomere to Rwambwa: Flood prone area



Stream flow Measurement with Acoustic Doppler Current Profile (ADCP) and Rainfall Measurements

17

Radar Telemetric Real Time Water Level Observation Stations at Sigomere and Rwambwa Bridge in the Nzoia River Basin

18

Preventing Vandalism is Challenging
(A Solar Panel at Webuye Radar Observation Station Vandalized)

19

Despite its Location below a Railway Bridge, the Webuye Radar Observation's Solar Panel was vandalized!

20

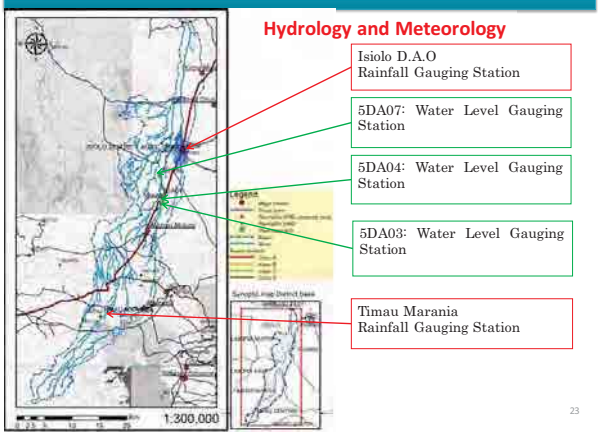
NEEDS OF COMMUNITY BASED FLOOD EARLY WARNING IN ISIOLO

21

Situation of inundation

22

Hydrological Observation in Isiolo



23

Water Level Gauging Station

Water Level Gauging Station No.:5DA07
Observation River : Eastern Marania River

Same as left.

24

Water Level Gauging Station

Water Level Gauging Station No.:5DA04
Observation River : Eastern Marania River
Special Note : Water level gauge is broken off and damaged.

Water Level Gauging Station No.:5DA03
Observation River : Eastern Marania River

25

List of Water Level Gauging Station in Isiolo River Basin

No.	ID	Name	River Name	Manual/ Auto/ Both	National/ MU/IMU/ Special	Daily/ Hourly/ Both	Operational	Start Year	End Year	SRO in charge
1	5DA07	Isiolo	Isiolo	Manual	MU	Daily	Yes	1976/1/1	N/A	MEN
2	5DA03	Kithima	Kithima	Manual	Intra-MU	Daily	Yes	2010/9/1	N/A	MEN
3	5DA04	Rugusu	Rugusu	Manual	Intra-MU	Daily	Yes	2010/10/1	N/A	MEN

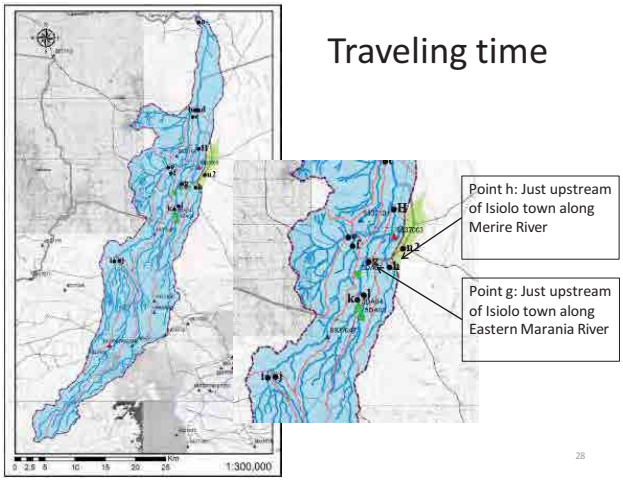
26

List of KMD Rainfall Gauging Station within Isiolo River Basin and its Vicinity

STATION_NUMBER	stationname	Year_Opened	Year_Closed	Obtain
8937002	TIMAU_MARANIA	1925		obtain
8937003	ISIOLO_DISTRICT_AGRIC_OFFICE	1930		obtain
8937004	NGARE_UNGA_FARM	1930	1941	
8937046	MARANIA_FOREST__NANYUKI	1951	1953	
8937047	BIRDS_HILL_RANCH_ISIOLO	1951	1963	
8937078	MUCHENE_FOREST_STATION	1973		
8937083	NTUMBURI_PRIMARY_SCHOOL	1974		
8937100	MARURU_PRIMARY_SCHOOL	1979		
8937101	ISIOLO_L_M_D_HEADQUARTERS	1980		
9037155	SIRIMON_GATE__MT_KENYA_PARK	1970		

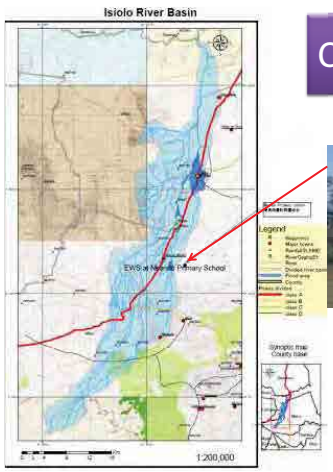
27

Traveling time



28

Point	Traveling Time t_c (min)	Catchment Area A(km^2)	1/50 : r24=125m m/day Peak discharge Qp(m^3/s)	1/30 : r24=116m m/day Peak discharge Qp(m^3/s)	1/20 : r24=108m m/day Peak discharge Qp(m^3/s)	1/10 : r24=96m m/day Peak discharge Qp(m^3/s)	1/5 : r24=82m m/day Peak discharge Qp(m^3/s)	River	Name of the point
l	96	45.0	238	221	206	183	156	-	
j	218	64.1	196	182	169	151	129	Western.M.R	
k	275	90.1	236	219	204	181	155	Eastern.M.R	
l	131	46.3	199	184	172	153	130	-	
e	71	40.4	260	242	225	200	171	-	
f	333	150.6	347	322	300	267	228	Western.M.R	
g	297	145.6	362	336	313	278	237	Eastern.M.R	Just upstream of Isiolo town
h	76	17.6	109	101	94	83	71	Merire.R	Just upstream of Isiolo town
b	76	11.4	70	65	61	54	46	-	
c	400	229.6	468	435	405	360	307	Western.M.R	
d	368	184.3	397	369	343	305	260	Eastern.M.R	Conjunction to Western.M.R
H	104	27.1	136	126	117	104	89	Merire.R	Conjunction to Eastern.M.R
a	489	473.6	844	783	729	648	554	Isiolo.R	Conjunction to Ewaso Ng'iro North R.
n2	31	2.4	21	19	18	16	13	-	Runoff from neighboring catchment



CBFEWS in Isiolo

Nkando Primary School

30

Nkando Primary School

Broken Meteorological Observation Equipment

Broken Rain Gauge

31

Installation of rain gauge

Mr. Arakida explains the system to teacher.

WRUA chairman and Mr. Jared measure length of wire to need.

32

Construction

Cutting timber for pole

Materials for installation

33

Construction contd

WRUA member digs the ground for pillar.

WRUA member place the pillar.

The alarm system and battery was placed at the side wall of the storage with a wooden box. The rain gauge was set up on the wooden stand and wire is connected in pipe.

34

Construction contd

The team set up battery and alarm system in the wooden box.

35

Construction contd

Wire between gauge and battery

Mr. Jared connects wire and pipe

36

Construction contd

Mr. Arakida explain its operation to teacher

Rain gauge

37

Happy smile

38

Role of the Community in EWS

- ✓ **Observers**: Observe rainfall and water level gauges
- ✓ **Communication Network**: Relays data and information to FEWT
- ✓ **Indigenous Knowledge**: to be integrated to forecasting and early warning.
- ✓ Provide **flood information/data**
- ✓ Provide **impacts information** during floods

41

Reference

- NZOIA FLOOD EARLY WARNING SYSTEM (Mr. Andrew Njogu, Kenya Meteorological Department (KMD), Workshop on Effective Flood Management, 7 August 2012)
- Community Participation in the Operation of the Nzoia River Flood Early Warning and Flood Mitigation (Mr. Eugen Mwandoe Mnyamwezi, Western Kenya Community Driven Development & Flood Mitigation Project (WKCDD&FMP), Ministry of State for Special Programs (MSSP) with Inter-Ministerial support from relevant government ministries, Workshop on Effective Flood Management, 7 August 2012)

Module 4

4-2 Community-based Flood Early Warning

Module 4-2

From Early Warning to Evacuation

- Community early warning systems with focus on hydrological equipment
  (Please refer to "Development of Hydrological Monitoring Equipment for Community Early Warning Systems")

FEB 19, 2014

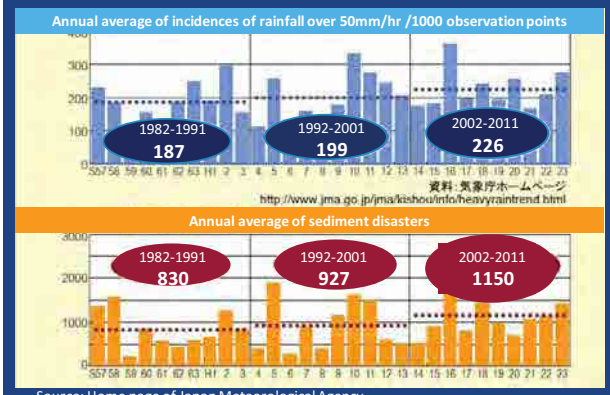
BY JOSEPH MAINA-FMO ,NOLTURESH-LUMI SUB REGION

1

Community operated early warning with focus on hydrological equipment

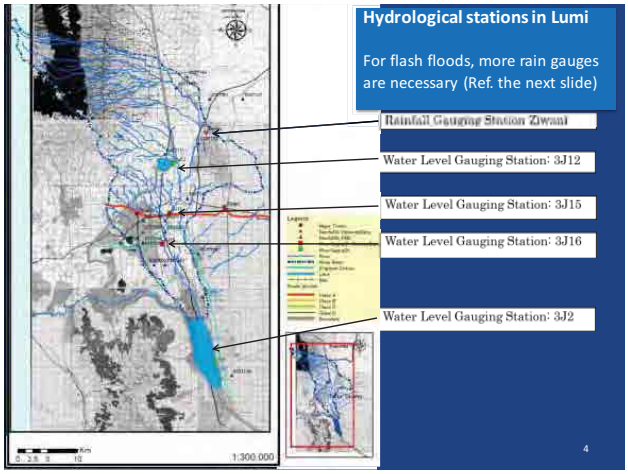
2

Increase in intensive rainfall and sediment disasters



Source: Home page of Japan Meteorological Agency
Home page of Sabo Department of MLIT

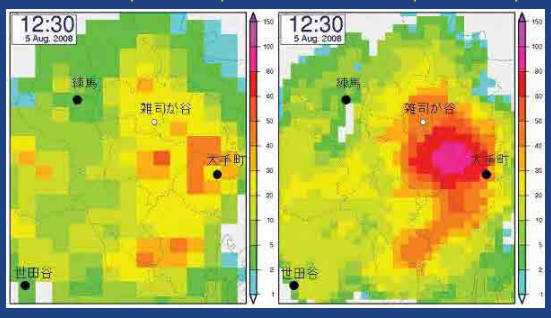
3



4

Rains concentrate in narrow areas, therefore rains should be monitored for as narrow areas as possible preferably at each community or at each small river basin.

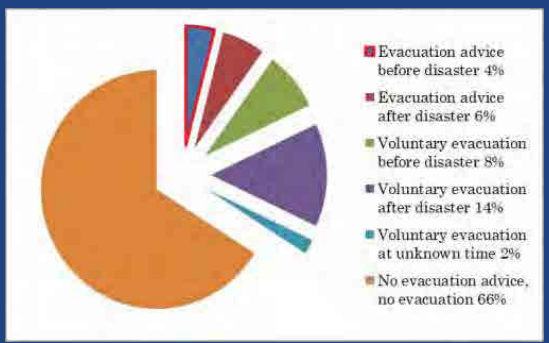
C-band radar (1km mesh) X-band radar (500m mesh)



The picture shows how rains will be concentrated, different from place to place even between the near places. The difference will be much more in mountainous areas.

5

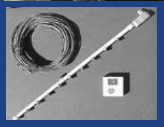
Government instruction is not always timely, therefore community early warning is necessary for evacuation on their own judgement/responsibility.

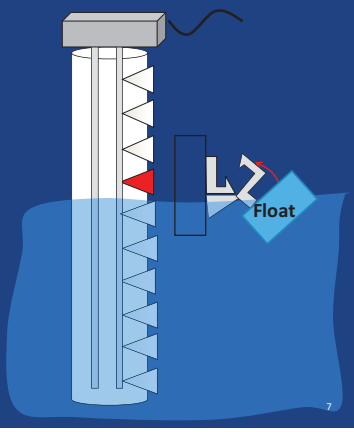


Source : Survey of 84 disasters in 2007 which caused human loss and/or damage to houses, MLIT

6

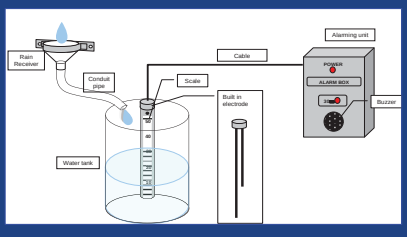
Water level gauge developed in Central America





7

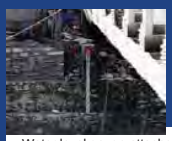
Rain-gauge developed in the Caribbean



8

Workshops in Nepal (2010) and in Fiji (2011)

Workshop inviting staff of government and ICIMOD



Water level gauge attached to the gabion revetment

Rain gauge installed on the veranda

Workshop inviting staff of government organizations

Installation of water level gauge

Rain gauge installed in the yard of the observer

9

Installation of rain-gauges

Japan : One cup for 100 mm, Rain-gauge on the veranda, Bamboo of different length with a bell

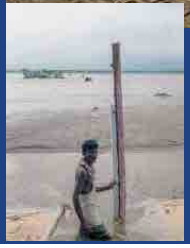
← Taiwan ↑ Sri Lanka

10

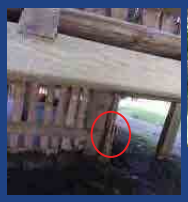
Installation of water level gauge

11

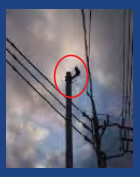
Assam in India by ICIMOD



12



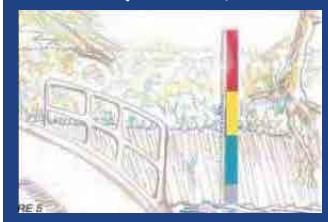

Mindanao, Philippines
Two stainless steel rods beneath the floor of a house near a river. When over flowed water reaches the bottom of the shorter rod, the siren starts sounding.

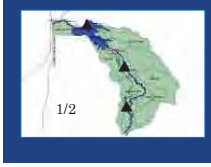
Okazaki City, Japan
Two stainless steel rods of different length are inside a cover pipe. when the inundation water level reaches the bottom of the shorter rod, the siren starts sounding. The same mechanism as that of Mindanao. The elevation of the bottom of the shorter rod is the same as that of a house, which is located at the lowest place of the community

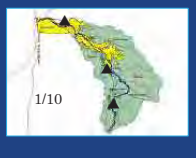
13

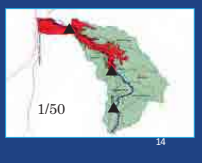
Caparo River, Trinidad Tobago



There are three water level gages in the river: upstream, middle and lower reaches. The three colors correspond to the possible inundation in the downstream areas by two years, 10 years and 50 years return period floods.







14




Costa Rica

A dedicated and reliable observer is a key to sustainable operation.

Debris flows from Mt. Iraz destroyed Cartago city in 1964. Dykes were constructed thereafter surrounding the flooded area. Poor people continue to come to settle in areas once affected. She said "I am happy to work for other people" She works devotedly without remuneration.

15

END
THANK YOU FOR PAYING ATTENTION

16

Module 4

4-3 Introduction to Integraed Flood Analysis System (IFAS) and Global Flood Alert System (GFAS)

2013 Capacity Development for Flood Risk Management with IFAS
Oct 17, 2013

Integrated Flood Analysis System

IFAS

... an introduction

Simon Mwangi
E-mail: simonmwenja@yahoo.com

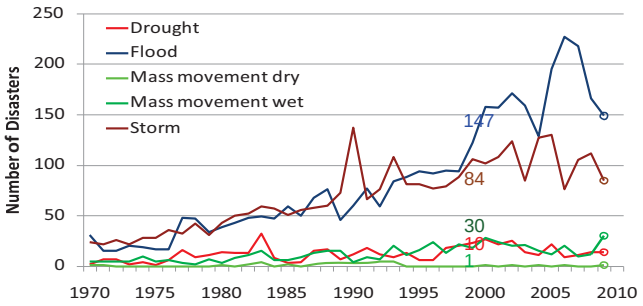
1

Lecture Outline

1. Flood forecasting
   - Benefits of early warning
   - Role of hydrologic models
2. Hydrologic modeling – the basics
   - Hydrologic prediction for flood forecasting
   - Uncertainty in hydrologic modeling
3. Flood related information available in the internet
4. IFAS

2

Increase in water-related disasters



Made by ICHARM based on CRED EM-DAT


May 2008 Myanmar


Sep 2009 Philippines


Jul 2010 Pakistan

3

Flood Forecasting for Early Warning

Two critical components:

1. **Forecast accuracy** 2. **Forecast lead time**

HOURS DAYS WEEKS

Increasing forecast lead time, increasing potential response and loss reduction

4

Flood Forecasting for Early Warning

Economic benefit- damage/loss reduction

Table 14: Quantifying benefits: July- August 2007 floods

No.	Sector	Damage elements	Damage cost (million BDT)	(%)	Avoidable Damage (million BDT)	Remarks
Food and Agriculture						
1	Agriculture (crop)	Crop (Transplanting *Aman* seedlings, jute, vegetables, *T. Aman*, *B. Aman* and oilseed crops)	42,165.44	30	12,649.63	For crops at harvest stage only - 30%
2	Livestock	Cattle, bullocks, sheep, goats, chicken, ducks, forages and straw	608.55	70	425.99	For livestock, forages/ straw moved to safe grounds/shelters only - 70%
3	Fisheries	Fish fingerlings, freshwater fishes, shrimps/prawns, pond embankments	1,964.95	50	982.48	For fish, shrimp prawns harvested only - 50%
4	Deep and shallow tube well	Pump house and Deep tube-well machineries and installations	509.40	-	-	Unavoidable
5	Seeds & irrigation	Pump house, underground pipe line, water pump, control structure and connecting road"	10.00	-	-	Unavoidable
6	Forest	Forests, nursery, roads and buildings in forest"	37.80	5	1.89	For nurseries only - 5%
Total damage cost - Food & Agriculture (million BDT)			45,296.14		14,059.99	Avoidable damage (million BDT) (31% of total damage in sector)

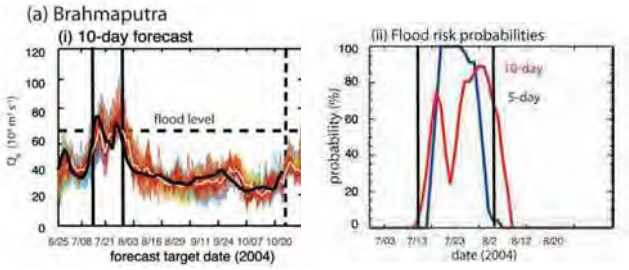
"In **other words, for every USD 1 invested in this EWS, there is a return of USD 558.87 in benefits."** Subbiah and Bilden, 2008, World Bank Report

5

Flood Forecasting for Early Warning

Two critical components:

1. **Forecast accuracy** 2. **Forecast lead time**



Accuracy of forecast with 10 days lead time

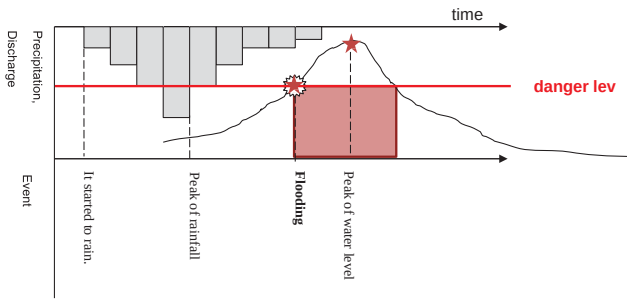
Webster et al., 2010

6

Flood Forecasting for Early Warning

Important to accurately predict:

1. Onset of flooding
2. Peak discharge
3. Duration of flood



7

Hydrologic modeling – the basics

Key hydrologic modeling vocabulary

- **Calibration**
  - The process of adjusting parameter values of a model to obtain a better fit between observed and predicted variables.
- **Validation**
  - A process of evaluation of models to confirm that they are acceptable representations of a system.
- **State Variables**
  - A variable in the model that is part of the solution of the model equations and which varies with time during a simulation but which is not a flux or exchange of mass.
- **Boundary conditions**
  - Constraints and values of variables required to run a model for a particular flow domain and time period. May include input variables.
- **Initial conditions**
  - Values of storage or pressure variables to initialize a model at the start of a simulation period.

8

Understanding uncertainty:
All models are wrong; some are useful.

UNCERTAINTY IN:

MODEL STRUCTURE
Are key processes represented sufficiently?

PARAMETERIZATION
Are parameter values estimated correctly?

INPUT DATA
Are input data of sufficient accuracy and resolution?

OBSERVED DATA
Confidence in observed data used in calibration and validation?

9

…and now on to IFAS!

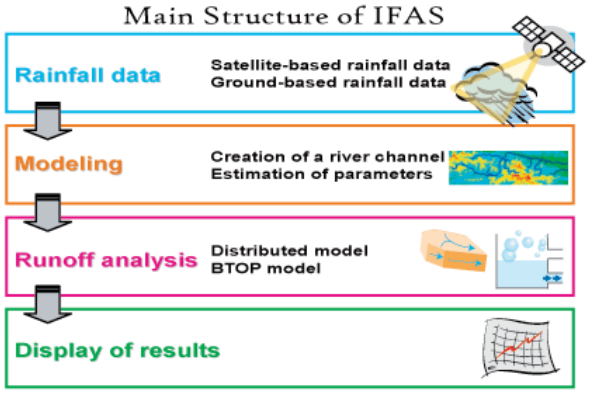
13

IFAS version 1 development

IFAS is software to calculate river discharge using satellite based rainfall and ground based rainfall data. Topography, Land Use and satellite-based data can be obtained free of charge. This makes it possible to predict and analyse the time and the scale of flood events in insufficiently gauged basins.

14

Flood forecasting in poorly gauged basins



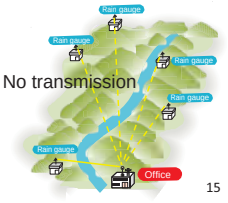
Flood forecasting in poorly gauged basins

Challenges:

- Insufficient implementation and maintenance of ground-based, real-time hydrologic observation
- Lack of data required for creation of a flood forecasting model
- High cost associated with flood forecasting system installation
- Insufficient of framework to enhance technical capabilities

Rainfall observation manually

Dwelling along the river



No transmission

15

Objective of IFAS development

Concise hydrologic analysis software for insufficiently gauged basins

- GIS and GUI functions for creation of runoff network, model parameterization, and flow simulation
- Links to global datasets for model building and parameterization
- Flexible system to accommodate both ground-gauged and satellite rainfall data
- Streamlined calculation processes
- Interfaces to display output results
- **Free distribution** (Download from ICHARM website)

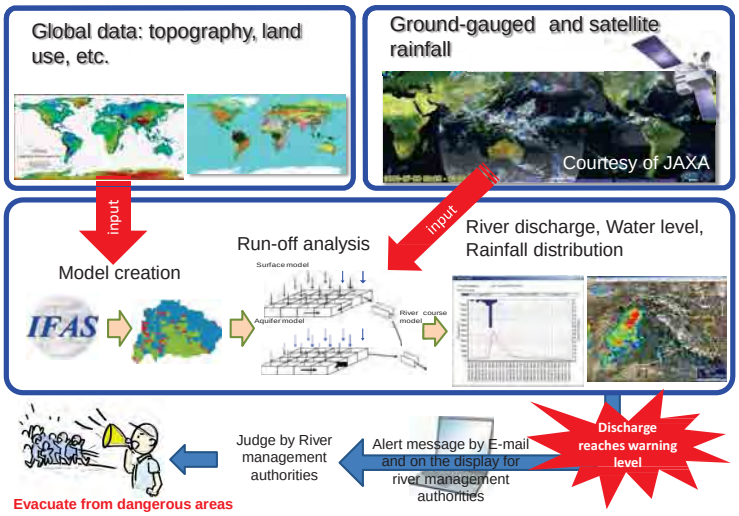
16

Download HP (IFAS ver 1.3β)

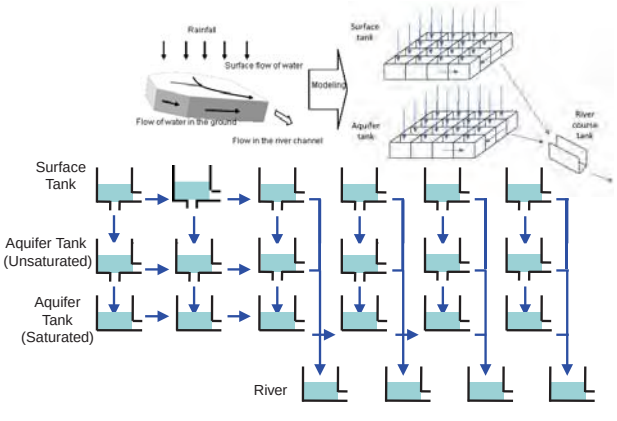
http://www.icharm.pwri.go.jp/index.html
http://www.icharm.pwri.go.jp/research/ifas/ifas_1.3beta_top.html

17

IFAS for flood forecasting

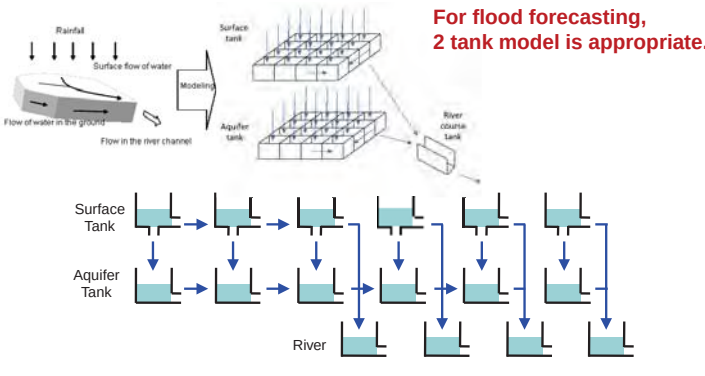


IFAS model structure



19

IFAS model structure



For flood forecasting, 2 tank model is appropriate.

20

IFAS – creating river channel network

Type	Product	Provider
Elevation	Global Map(Elevation data)	ISCGM
	GTOPO30	USGS
	Hydro1k	USGS
	GLCC	USGS
Land use	Global Map(Land cover)	ISCGM
	Global Map(Land use)	ISCGM
Geology	Geology	CGWM
	Soil Texture	UNEP
Soil type	Soil Water Holding Capacity	UNEP
	Soil Depth	GES

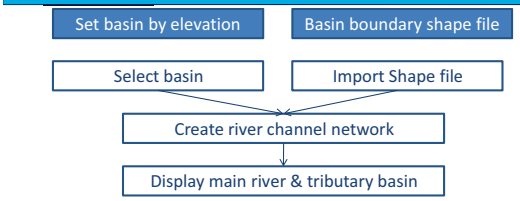
Example of elevation data of a each cell and creation of river channel network

116.5	116.4	181.8	198.7
114.2	95.6	110.5	114.8
123.0	91.2 →94.2	98.5	97.3
164.0	93.5	93.2	94.5

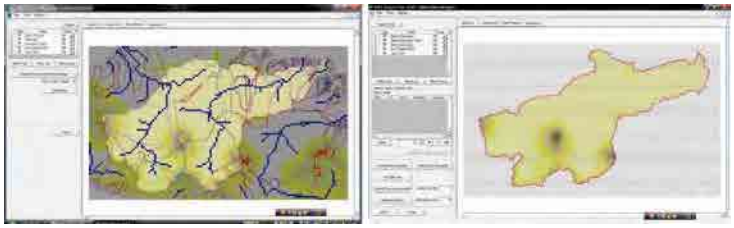
Sink filling- IFAS modifies elevation to remove sinks

Creation of River channel net work and basin shape based on elevation data

IFAS – creating river channel network



Global river basin Boundary shape files available from USGS HydroSHEDS



Basin boundary made from elevation

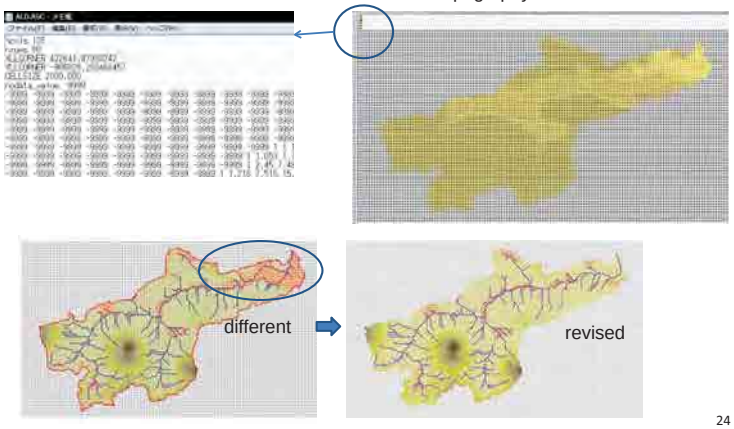
Basin boundary from shapefile

Solo river basin, Indonesia

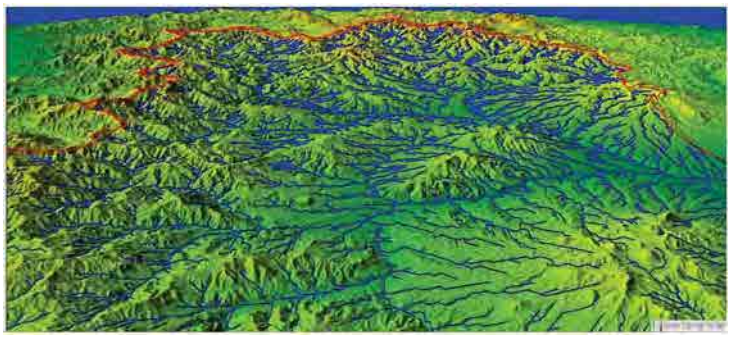
IFAS – creating river channel network

ESRI/ASCII format

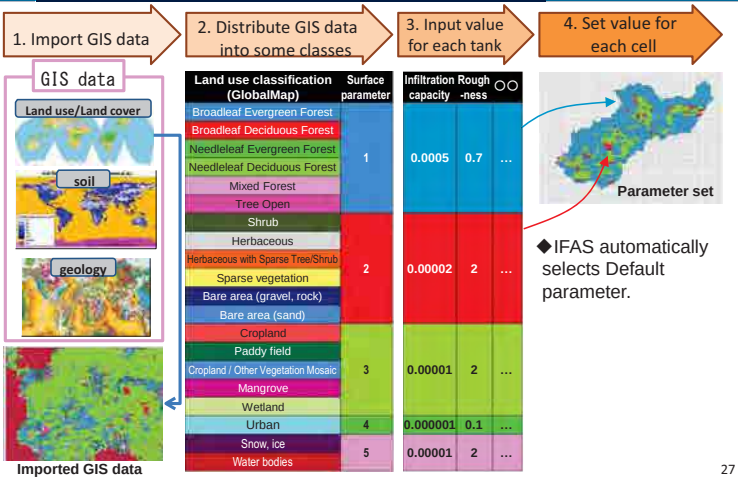
Revised topography



IFAS – creating river channel network



IFAS – setting parameter values



◆IFAS automatically selects Default parameter.

IFAS – Satellite rainfall data

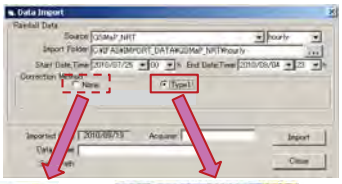
- Several datasets have global coverage.
- Resolution (time and space) and observation accuracy are low compared with ground observation rainfall.

Product name	3B42RT	CMORPH	QMORPH	GSMaP
Builder	NASA/GSFC	NOAA/CPC	NOAA/CPC	JAXA/EORC
Coverage	50N～50S	60N～60S	60N～60S	60N～60S
Spatial resolution	0.25°	0.073°	0.073°	0.1°
Time resolution	3 hours	30 minutes	30 minutes	1 hour
Delay of delivery	6 hours	18 hours	3 hours	4 hours
Coordinate system	WGS			
Data archive	Dec. 1997～	Recent 1week	Recent 1week	Dec.2007～
Data source (sensor)	Aqua/AMSR-E, AMSU-B, DMSP/SSM/I and TRMM/TMI and IR	TRMM/TMI, Aqua/AMSR-E, AMSU-B, DMSP/SSM/I and IR		TRMM/TMI, Aqua/AMSR-E, DMSP-F13-15/SSM/I, DMSP-F16-17/SSMIS, IR data

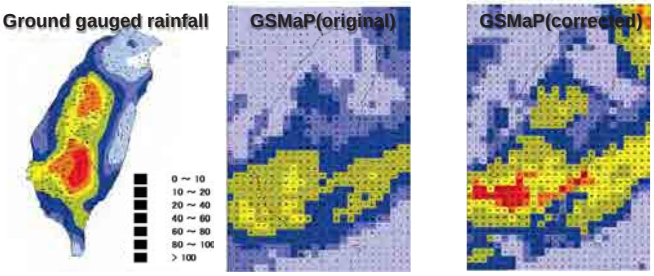
SATELLITE RAINFALL IS NOT A SUBSTITUTE FOR AN OBSERVATION NETWORK!

Correction method of satellite rainfall

- Corrected GSMaP is more accurate than raw GSMaP data.
- **This correction equation is already set in IFAS- correction method Type 1**



Ground gauged rainfall | **GSMaP(original)** | **GSMaP(corrected)**



3 hourly rainfall in Taiwan on typhoon Morakot, 2009 Aug.08 20-23(UTC)

IFAS – simulation

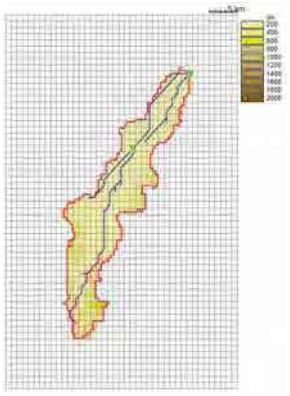
Simulation time depends on spatial and temporal setup:

1) **grid size** and 2) **timestep**

Estimation of mesh size

****TIP:** IFAS runs smoothly at around 100 X 100 grid. It is also easily viewable on screen.
Thus, if:
Basin area ~10,000 km^2 → grid size 1 km
Basin area ~40,000 km^2 → grid size 2-4 km
Basin area ~100,000 km^2 → grid size 4-8 km

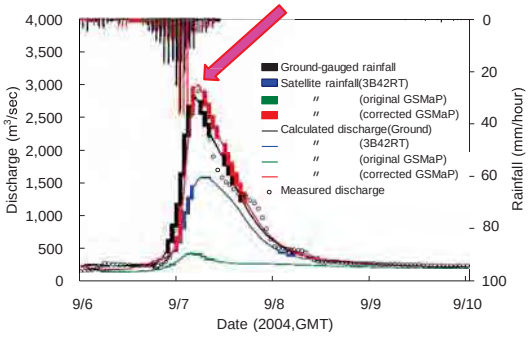
Caution: *If the basin is large or a long-term analysis is run with a short time interval, it will take time to import rainfall data and to run the calculations.*



Calculation results : Sendaigawa River, Japan

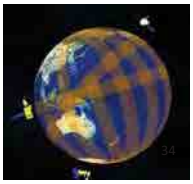
Sendaigawa
River length =137km
Basin Area =1,600km²

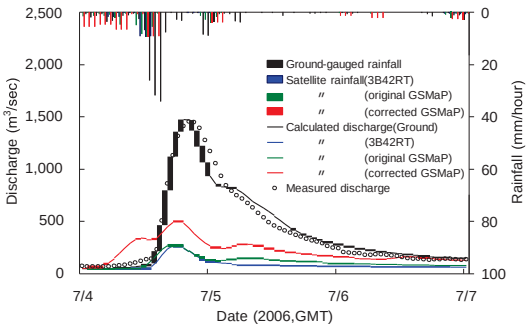
Correction of satellite data is successful



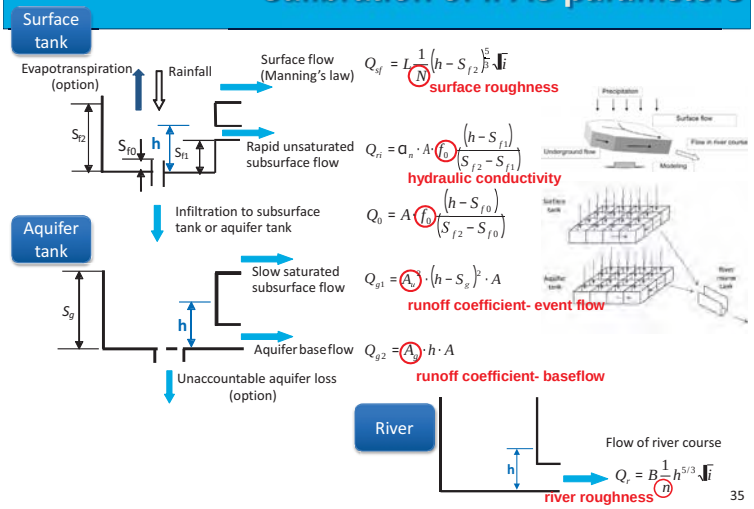
Simulation results : Kikuchigawa River, Japan

Kikuchigawa
River Length =71 km
Basin Area =996 km²





Calibration of IFAS parameters

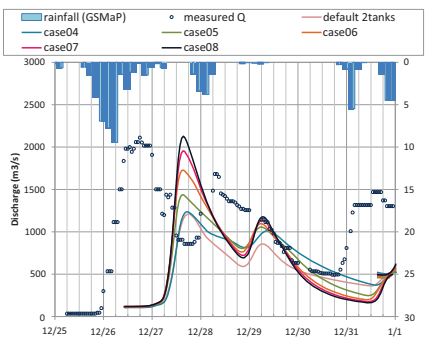


Calibration of IFAS parameters

AUD- Runoff coefficient of unconfined groundwater

Parameter values

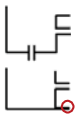
	Default	Case 05	Case 06	Case 07	Case 08
AUD	0.1	0.2	0.3	0.4	0.5



Solo River basin, Indonesia, Jurug station

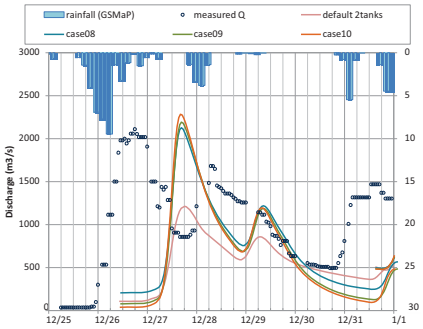
Calibration of IFAS parameters

AGD- Runoff coefficient of baseflow



Parameter values

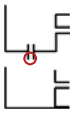
	Default	Case 08	Case 09	Case 10
AGD	0.003	0.003	0.002	0.001



Solo River basin, Indonesia, Jurug station

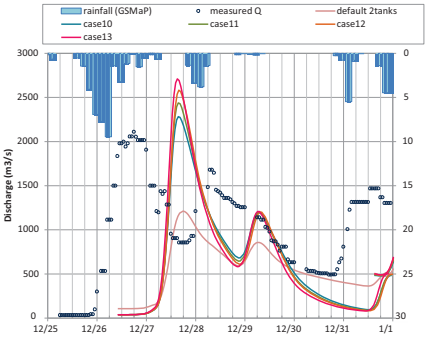
Calibration of IFAS parameters

SKF- Hydraulic conductivity



Parameter values

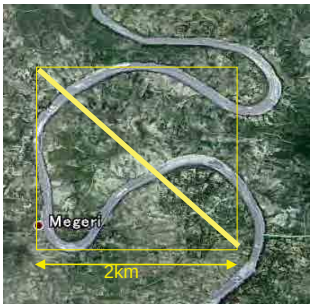
		Default	Case 10	Case 11	Case 12	Case 13
SKF	Land1	0.0005	0.0025	0.003	0.0035	0.0040
	Land2	0.00002	0.0001	0.00012	0.00014	0.00016
	Land3	0.00001	0.00005	0.00006	0.00007	0.00008

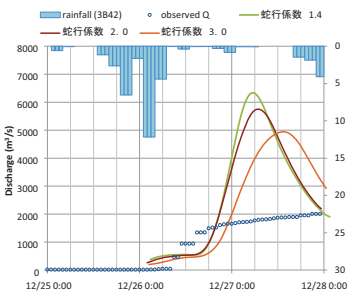


Solo River basin, Indonesia, Jurug station

Calibration of IFAS parameters

RLCOF- Meander coefficient

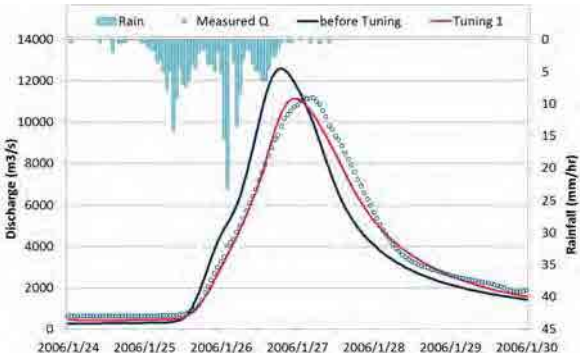




Solo River basin, Indonesia

Calibration of IFAS parameters

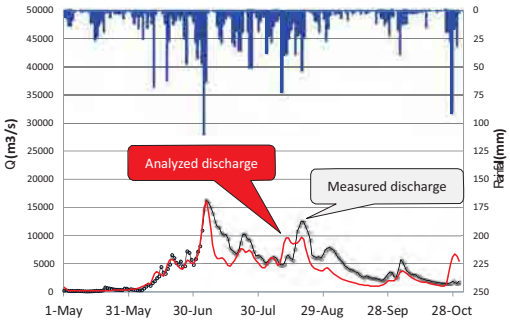
Simulated discharge before and after model calibration



Cagayan River basin, Philippines

IFAS

****Must use data observed over an event that was not used to calibrate the model!**



By visual inspection

****Must use data observed over an event that was not used to calibrate the model!**

Nash-Sutcliff model efficiency coefficient

$$E = 1 - \frac{\sum_{t=1}^{T}\left[Q_o^t - Q_p^t\right]^2}{\sum_{t=1}^{T}\left[Q_o^t - \overline{Q_o}\right]^2}$$

Where:

E = Nash − Sutcliff model efficiency coefficient

Q_p^t = discharge predicted at time t

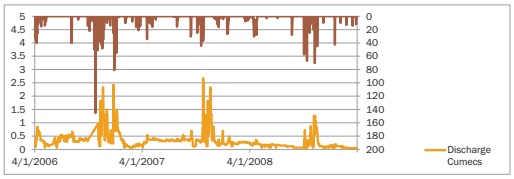
Q_o^t = discharge observed at time t

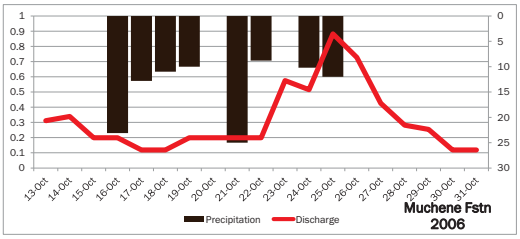
$\overline{Q_o}$ = mean discharge observed throughout simulation time

T = time at simulation end

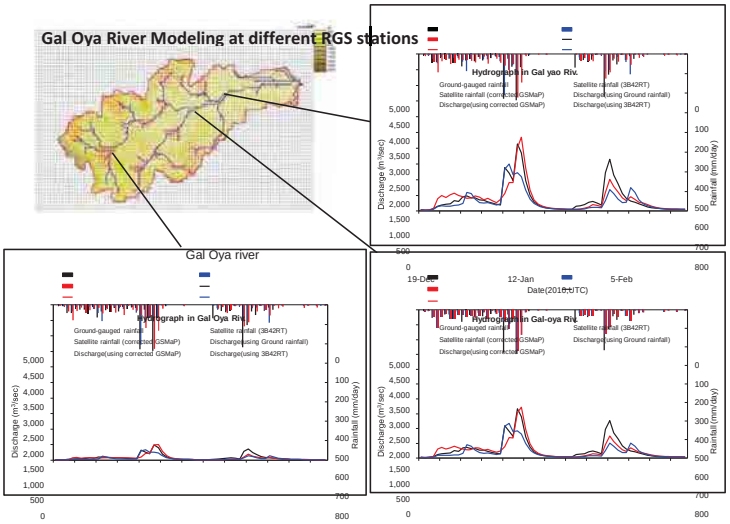
Validation by quantitative method is less subjective than by visual inspection.

Importance of selection of a flood peak – Isiolo River

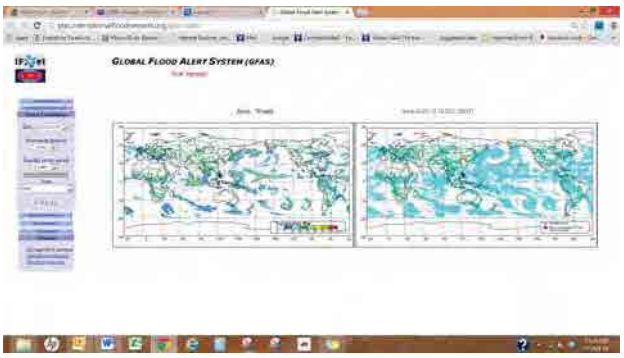




Gal Oya River Modeling at different RGS stations



19-Dec 12-Jan 5-Feb
Date(2010,UTC)



Conclusion

- The combination of satellite-based data rainfall information, global GIS data and IFAS as a practical toolkit for users, especially in poorly-gauged river – very high potential to promptly & efficiently implement flood analysis & forecasting system
- Even though accuracy is limited because of the lack of observed data – key valuable information can be acquired through satellite –based and global-GIS-based IFAS simulations.
- ESSENTIAL to have OBSERVED DATA for calibration and validation
- ESSENTIAL to have LOCAL OWNERSHIP for the system to be an efficient flood forecasting system

WAY FORWARD

- UPGRADING THE RGS MONITORING NETWORK TO REAL TIME DATA COLLECTION FOR PRIORITIZED FLOOD MONITORING STATIONS
- 3 DAY RAINFALL PREDICTION DURING THE LONG AND SHORT RAINS FROM KMD
- OBTAINING THE IFAS (FREE) & OTHER RELATED MODELS
- OBTAINING RAINFALL FROM SATELLITE DATA SOURCES AS INDICATED ABOVE

IFAS version 1 development

- ICHARM
- Infrastructure Development Institute
- CTI engineering Co. Ltd
- Pacific Consultants Co Ltd
- Nippon Koei Co Ltd
- NEWJEC Inc
- CTI engineering Co Ltd
- Yachiyo Engineering Co Ltd
- IDEA consultants INC
- TOKYO KENSETSU CONSULTANTS Co Ltd
- KOKUSAI KOGYO CO LTD

Module 5

5-1 Evacuation Planning

Module 5-1
Evacuation Planning

FEB 19, 2014
BY JOSEPH MAINA-FMO,NOLTURESH-LUMI SUBREGION

1

Interviews with people affected by floods in 1993 in Nepal

- ***The rain in Bhandhara was not as heavy as to result in a flood. As usual, the radio broad cast was sending sorrowful folk songs and ended at 23:00 without any information on the impending danger. "We knew later that at that time it had been raining heavily already for hours in the upstream especially in Makwanpur District. If the radio had sent such information about rainfall beforehand, we could have evacuated timely • • •***

  The rain concentrated in upstream area and caused immense damage in the downstream area where rain was much less.
- ***Whether to stay in the house or to evacuate? If the latter be the choice, then where to evacuate?*** was the question that put Mr. Lok Raj in dilemma. His family and the three neighbors were waiting for his decision, but he had no information based on which he should make a decision. While he was deferring his decision, the rain was further intensified.

  Many people died while hesitating to make the final decision as to whether to stay or evacuate. Many were engulfed by flood while trying to evacuate with no particular destination in mind. If evacuation places had been designated in advance , people could go there without any skepticism and without losing time.

2

Example of evacuation planning: Ikusaka Village, Japan

A series of community meetings were held by community by community.

First: To know omens(symptoms) and disaster areas/places. People put those information on the hazard map based on their own memory and those of aged people about past disasters.

Second: To identify places appropriate for evacuation.

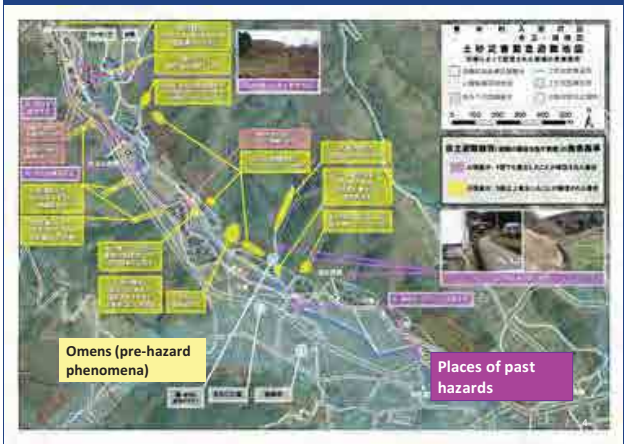
Third: Evacuation planning.

- Where to evacuate (evacuation places)
- When to evacuate (evacuation timing)

Forth : Evacuation rule summarizing the results of the previous three meetings.

Evacuation drill

3



Evacuation Rule of Ikusaka village

- When rains begin, community people start measurement of rainfall and inform the community chief when the rainfall reach the followings:
- Rainfall intensity exceeds 2cm/hour, or,
- Total rainfall exceeds 10 cm (rainwater overflows the cup)
- Community chief informs community people of such information through information telephone
- Community people should be stand-by for evacuation any time.
- Community people inform the community chief when they perceive any omens.
- The chief of the communities will issue "Let us evacuate" to community people and inform to the mayor when any of the followings happens:
  - Water begins to spout from the slopes
  - water begins to overflow from the torrents
  - Three omens out of 12 omens have been reported;
  - Total rainfall in the upstream observation station has exceeded 10 cm;
  - City/Town/Village office has issued evacuation instruction

5

Omens for warning of Sediment hazards

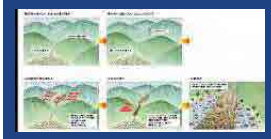
- Omens had long been used for warning on sediment hazards (debris flows slope failures, landslides).
- Such an indigenous method became obsolescent as technology advanced.
- Recent survey revealed that majority of people were reluctant in taking action in response to warnings by local governments; however they took immediate action if omens were perceived.
- Re-recognizing such effectiveness of omens, government encourages communities/local governments to incorporate omens in their respective disaster management plan. Government (Min. of Land, Infrastructure and Transport) conducted a survey on omens perceived during 71 disaster cases for 2004-2005 for reference of communities/local governments.
- Communities/local governments incorporate omens in the warning systems based on their own local experiences and in reference to the government survey.

6

Progress of hazardous phenomena and omens perceived

SLOPE FAILURES

1. Cracks, Falling of cobbles, Swelling of slopes
2. Spout of water from slope; Springs become muddy.
3. Tilting of trees, Trembling of trees
4. Ground rumbling



DEBRIS FLOWS

1. Slope failures in mountain slopes, Falling of cobbles
2. Decrease in river water while rains continue.
3. Ground rumbling, Sounds of trees being split
4. Smell of "decay"

LANDSLIDES

1. Deformation of ground; Cracks in slopes, foot path, pavement, walls
2. Water of wells, streams becomes turbulent.
3. Sudden decrease in water level (ponds etc.)
4. Sounds of trees being split

Example of survey (for Debris Flows)

Takeda City, Oita Prefecture on 6 September 2005

Omens and time

September 6

1:00 Smell of decay, smell of something burning.

2:00 Sound of stones rolling in the river.

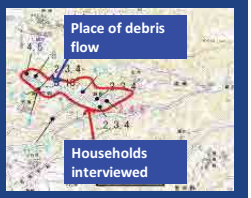
6:30 River water became muddy.

8:00 Falling down of pebbles on the slope.

8:50 Drifting of trees in the river.

11:00 Spring out of water from the slope. Sounds of ground rumbling. Spring of water became stable and less muddy.

12:10 Debris flow broke out.



Advance Evacuation and Urgent Evacuation

Evacuation should be considered on both cases of in advance and in urgency.

"Advance Evacuation" is a principle. A cording to the situation ,evacuation further away to more safer places will be possible.

When the timing for advance Evacuation" is missed, "Urgent Evacuation" is necessary. However evacuation in a flooded situation as in the above picture is dangerous.

Warning/ Alert Level	Level 1 Alert, Standby "Ready"	Level 2 Preparation "Get set"	Level 3 Evacuation "Go"
Precondition	Heavy up-stream rainfall (threshold value may vary as per location and watershed) warning level 1,	Water level in river increased by X (according to calculated threshold) meter	Water level in river increased by XX (according to calculated threshold) meter
Warning Messages	High possibility of flood	Flood is inevitable within X hours (according to calculated lead time)	Flood coming any time
TO DO LIST	• Upstream observer will inform the EWS management committee and then they will inform the community. • Upstream observer will inform concerned organizations/ persons in accordance with agreed communication channel. (refer to communication channel on page 5.4)	• Upstream observer will inform the EWS management committee and then they will inform the community. • Upstream observer will inform concerned organizations/ persons in accordance with agreed communication channel. (refer to communication channel on page 5.4)	• Upstream observer will inform the EWS management committee and then they will inform the community. • Search and rescue and first aid teams will be activated for immediate evacuation as per the contingency plan. • Inform nearest police station, Red Cross Chapter and others for external assistance

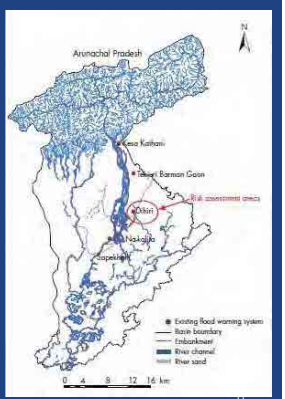
Warning/Alert Levels to be agreed among community people

Source: Practitioner's Hand book, DIPECHO/Red Cross

Success stories

Assam, India

Early warning systems were established for 5 villages along Jiadhal river in August 2010 following the training workshop by VCEW in July 2010 in Nepal. Floods occurred on 21 August (midnight, two villages), 25 August (at night, 3 villages), 4 September (at night, 3 villages), 4 July 2011 (morning, 4 villages), 17 July 2011 (midnight, 4 villages),15 August 2011 (early morning 3 villages). In each event, the alarms woke villagers during night or early in the morning. Information was communicated to downstream villages one by one, as a result, down stream communities had lead time of one to 1.5 hours. Ex. during the flood of 25 August, livestock (mainly pigs and poultry) worth USD 3,500 and other valuables were saved in Dihiri village.



Solomon

SOLOMON LOCAL NEWS (24 Feb. 2013) reports successful operation of VCEW equipment for floods at the end of January 2013.

Example of Success Story of Community Early Warning System
Toda community, Fukuchiyama city, Kyoto prefecture, Japan

Toda community has "Rule for evacuation" based on experience of flood disaster in 2004: To evacuate when the water level of the river reaches "evacuation level".

On 19 September 2013, community people started evacuation early in the morning according to this rule, and all people had successfully evacuated when "Special Warning" was issued at 5:07 in the morning from JMA (Japan Meteorological Agency) .

"Toda area" was a flood prone area and has been developed for a housing plot as the construction of the embankment progressed.

13

END
THANK YOU FOR LISTENING

14

Module 5

5-2 Evacuation Centre Management

WATER RESOUCES MANAGEMENT AUTHORITY

JAPAN INTERNATIONAL COOPERATION AGENCY

JICA

Module 5-2

EVACUATION CENTRE MANAGEMENT

19th Februrary, 2014

Sunset Hotel, Kisumu.

Willis MEMO
(Assistant Technical Coordination Manager - Community Development

1

A. Objectives

To enable the participants to understand:

1. What is an evacuation centre
2. What is required in an evacuation centre
3. Resources needed in O&M
4. Rules in the management of an evacuation centre.

2

B. Background: Images of Evacuation Centres

Evacuation centre in Aceh Indonesia

Storage at Kowiti

Evacuation centre in Kanyango in Nyando River Basin

Boreholes

2 and 10 Compartment toilets - Kowiti

Source: Disaster Management Report in Meuraxa Sub-district Kota Banda Aceh by JICA Experts Team 2008

Source: Project Outline for the Programme of for community- based flood disaster management to adapt to climate change in the Nyando River basin

3

C. What is an Evacuation Centre?

- **Evacuation Centre**
  - Building constructed based on a plan
  - a shelter that will accommodate a specific number of people displaced from their homes as a result of catastrophic event.
- **Evacuation Place**
  - A designated place that displaced community members
  - seek refuge in a particular place.
  - Examples schools, churches, market place, raised grounds etc

4

Evacuation Route

- This is the path or road
- identified by community members
- Safe place where they can easily access and use for purposes of moving from the affected area
- Place of shelter and refuge.

5

D. What is to be done, how it is to be done and why it should be done!

Knowledge that is required for effective management of an Evacuation Centre:

- Determine resource needed, mobilise and secure them;
- Maintaining the evacuation centre structure and equipment;
- Preparing the evacuation centre for use;

6

Knowledge requirements Cont./

- Operate the evacuation centre with available resources;
- Establish and maintain effective channels of communication with relevant agencies and support groups;
- Completing all tasks at closure.

E. REQUISITE EQUIPMENT AT AN EVACUATION CENTRE

- **Emergency Equipment**

I. The equipment used at the time of the occurrence of unforeseen disasters and very soon needed, such as earthquakes, fires and others.

II. Examples of first aid, Emergency equipment: Walkie Talkie (HT), megaphone, Radio, mobile phone etc

- **Rescue Equipment**

I. The equipment used to save lives or property (ladder, spade etc).

II. Example: Rescue Stretcher equipment, Life Jacket, Siren and etc.

III. Equipment for survival (jiko, penknive, matchbox or lighter, touch etc)

IV. Examples of equipment: tents, stoves, blankets and more.

F. What is required at evacuation centre during pre-flood phase

In the pre-flood phase is characterized by planning and mainly consists of preparedness activities.

- **The List of items required at the evacuation centre include:**
  - Stationary which must include a registration form list to register evacuees whenever they evacuate to the centre;
  - Stock piling of food, clothing, mat and medicine;
  - Firewood;
  - First aid kit;
  - Cleaning gadgets including soaps;
  - Stretchers ;
  - Spade, wheelbarrow, jembe.
  - Flood Hazard Map
  - Life saving jackets

G. WHAT IS REQUIRED AT EVACUATION CENTRE DURING FLOODING PHASE

Flood phase is characterized by evacuation and mainly consists of response activities.

- **The List of items required at the evacuation centre include:**
  - Registration form;
  - Check list for what to be done and the person responsible
  - First aid kit;
  - Stored food;
  - Emergency cooking unit;
  - Mobile phone;
  - Stretchers;
  - Gumboots;
  - Medical referral chart;
  - Communication channel chart;
  - Flood Hazard Map

H. WHAT IS REQUIRED AT EVACUATION CENTRE DURING POST-FLOODS PHASE

Post flood phase is characterized by evacuees moving back to their homes and mainly consists of recovery and rehabilitation activities.

- **The List of items required at the evacuation centre include:**
  - Check list for what to be done and the person responsible;
  - Evacuation centre assessment forms
  - A departure list that indicates the persons leaving evacuation centre
  - Mobile phone;
  - Cleaning gadgets including soaps, broom, bucket, brush mopper etc
  - Brush and paint;
  - Gumboots;
  - Flood Hazard Map;
  - Communication channel chart;

I. OPERATION AND MAINTENANCE OF EVACUATION CENTRE

Reference material: O&M manual developed under the Nyando Project

Effective operation and ongoing maintenance are critical to the long term viability of any public building. It is imperative therefore that operation and maintenance manual(OMM) that is easy to understand especially in outlining what to do when to do and who is responsible. OMM can ensure that the public building is efficiently operated and well maintained long into the future.

Public building operation and maintenance manual for architectural and structural parts should cover the system components and should be explicit. O&MM should be developed to supplement drawings, equipment and other manuals. O&MM should describe why and how the public building functions and what will happen if it is not operated as intended.

An O&MM should describe the key components and systems within the public buildings and explains how they should be operated & maintained to ensure that building's potential is realized for occupants& community.

Operation and Maintenance of Evacuation Centre Contd.

Exits: All exterior and exit doors should be kept in operable conditions at all times. All doors and particularly fire exits doors should be kept free.

Roofs and Drains: The roofs function is to protect the building from the sun, rain and the wind. It should also prevent water from getting into the building. Roofs and drains should be kept clean and clear of debris at all times to prevent water ponding on the roof. All debris (such as cans, bottles, pieces of wood, paper, rope broken glass) should be removed from the roofs and periodic examinations should be performed .Non essential foot traffic should be prohibited.

13

Operation and Maintenance of Evacuation Centre Contd.

Water Supply System: The water supply system for the evacuation centre should be properly maintained. The water storage tank should be inspected every year and cleaned if necessary. The access cover should fit properly, be in good condition and easy to remove for cleaning. In the case of the mechanical foot pump periodical checks must be done.

Structural Operation and Maintenance

Paint and protective coatings. Protective coatings such as paints and rust inhibitors should be maintained to prevent structural deterioration and other adverse effects

Check all drainage around the evacuation centre and clear any stagnant water around the building.

Clean the building regularly and provide insecticide treatment at least once every month.

14

Operation and Maintenance of Evacuation Centre Contd.

Provide peripheral fence compound around the building.

Plant some light trees and flowers to add to beauty of the building.

Collect waste around the building and put this in rubbish pit.

Replace unserviceable parts of the building including broken window glasses, door handles etc should promptly be attended to.

Regular painting of the wall should be given priority.

Overhead water storage should be regularly cleaned where such tanks are situated within evacuation centers.

Identify key design elements and materials that are critical to long term performance of the structures e.g. exterior wall and roof materials, windows, exterior doors and scrapping.

Develop a checklist file for regularly monitoring

15

Operation and Maintenance of Evacuation Centre Contd.

Typical O&M checklist for evacuation center.

Date _____

Village _____

Building components (Materials / Equipment)	Type of information collected
Roof	_____
Windows	_____
Interior doors	_____
Exterior doors	_____
Land scapping	_____
Glass-window	_____
Gutters	_____
Hinges	_____
Wires	_____
Paint (colour, style, replacement floor)	_____
Cleaning information	_____

16

Operation and Maintenance of Evacuation Centre Contd.

There are various ways how buildings are operated but the major one is occupation of these buildings by human beings. The following safety measures should be considered:

Occupational safety: This includes safety considerations when moving to the building. It is important to note this proverb that says "better be a living dog than a dead lion". During disaster human safety is paramount and therefore all should strive towards safe evacuation and occupying of evacuation centre. It is important to note that no matter the reason evacuate to the nearest evacuation centre settle in and organize how evacuees will spend their nights at the evacuation places.

Sanitary Arrangements and general cleaning of buildings: Proper sanitation is prerequisite in all buildings. The compound should be kept clean and ensure that there are no overgrown grasses and shrubs around the compound. All stagnant water around the compound should be drained away. The kitchen should be kept clean with minimal human traffic to and fro the kitchen.

17

Operation and Maintenance of Evacuation Centre Contd.

Storage and Handling of Fuel: Storing of fuel at the respective building should be done with a lot of care. Kerosene is a popular fuel that lights up the lamp and is also used on the stoves for cooking. In the building where there are many people the use of lamps should be properly managed by the CFMO to avoid fire breakouts. Match-boxes also should be handling with care to avoid children playing with them that can lead to unnecessary fires and panic around the building. Smoking should be prohibited at the public building to avoid health concerns and unnecessary fire breakouts.

Security at the buildings: The CFMO should arrange for security at the building especially when there are people occupying the building. The CFMO should link with the Provincial Administration to ensure the security of the evacuees is assured. Young and energetic men should be organized to maintain security at these buildings.

18

Operation and Maintenance of Evacuation Centre Contd.

Protection of the Environment: The buildings are constructed purposefully to meet the need of the communities residing in the respective villages. The evacuation centre is designed to host evacuees, toilets to be used by evacuees, storage to keep valuable properties of evacuees. This in essence implies that environmental concerns should be of paramount importance to the communities. The CFMO therefore should ensure that around the buildings there is no environmental degradation or improper dumping of garbage around the building compound

J. Rules of Managing Evacuation Centre the dos and don'ts

- Keys must be kept properly and in places that they could easily be accessed;
- Keys should be clearly labelled e.g. front door keys, kitchen keys etc;
- The evacuation centre should remain open at all times there is a disaster i.e. do not use the evacuation centre for any other purpose other than hosting evacuees during disaster;
- Personal differences should not be the reason of turning away individuals from the evacuation centre;
- Special consideration should be accorded to the evacuees that use or take regular medication as a result of life threatening conditions: Diabetes, high blood pressure, HIV-AIDS etc; and
- Drug and alcohol abuse should be prohibited at the evacuation centre;

Conclusion

It is important to note that often than not grace is always abused by lack of knowledge or indolent character. Therefore the most difficult thing for a human being is to keep the dos and don'ts especially when there is no element of punishment for breaching the established rules and regulations. It is therefore prudent to ensure that community members mutually agree and come to a consensus for punitive consequences for those who breach the agreed upon by-laws that govern evacuation centres.

Appendix Logistics checklist

Duties	Description	Completed (*)a			Person responsible (*)b	Comments (*)c
		Yes	No	Partial		
Manage the health supply chain	Supply chain and personnel contracted for or assigned to logistics					
Purchase	Selection, purchase, outsourcing					
Storage and inventory	Manage warehouses					
	Transfer of inventory					
IT, radios, communications	Functional networks					
	Communications center					
	Field offices					
Transport	Merchandise					
	Means of transport					
	Manage transport contractors					
	Manage transportation fleet					
Maintenance	Communications equipment					
	Medical equipment					
	Vehicles					
Imports and donations	Manage documentation and procedures for imports and donations					
Implement SUMA/LSS (other systems)	Management system for donations and supplies					
Basic operational needs for Disaster	Housing, food, security, transport					

Please remember that community are dynamic and the above dos or don'ts are not universal but should be coined to fit the idiosyncratic characteristics of the target community.

THANK YOU VERY MUCH FOR LISTENING

Module 6

6-1 Capacity for Transmitting and Communication Skills

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

Module 6-1
CAPACITY FOR TRANSMITING AND COMMUNICATION SKILLS

18th February, 2014, Sunset Hotel, Kisumu

Willis MEMO
(Assistant Technical Coordination Manager Community Development)

WRMA
Project on Capacity Development For Effective Flood Management In Flood Prone Areas In the Republic of Kenya

1

CONTENTS

- What is Communication?
- Importance of communication in flood risk
- Roles involved in communication in flood risk
- Parties involved in communication
- Communication channels in flood risk
- Important Information in communication in flood risk

2

What is communication?

3

WHAT IS COMMUNICATION?

❑The word "communicate" can be used to imply conveying of thoughts, ideas, warnings., instructions, orders, command, knowledge and information.

❑is simply the act of transferring information from one place to another.

The Fairfax Dictionary defines:

❑ The exchange of thoughts, messages, or information, as by speech, signals, writing, or behavior.

❑ The art and technique of using words effectively to impart information or ideas

4

Two distinct facets in communication:

1) Physical one

❑ where we use a variety of means using ever progressing technology [use technology such as satellite phones, TV, Radio and even print media].

1) The conceptual one.

5

CONCEPT OF COMMUNICATION

❑It is necessary to ensure that recipient of communication understands the contents of the message being conveyed and that s/he responds to it in the desired manner.

❑This therefore demands thorough knowledge, clarity and conciseness.

❑The originator must realize the capacity and capability of the receiver to appreciate the message and to react correctly.

❑Thus, content and clarity have to be the essential features of the message being communicated.

6

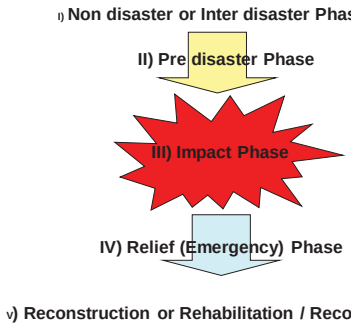
CONCEPT OF COMMUNICATION cont./

- The content has to be specific, to the point, brief and couched in simple, understandable and clear language with no ambiguity.
- Thus in its modern concept "communication" transcends its traditional meaning of transmission of message but includes the quality of the message itself especially the content, conciseness and comprehensibility.

…. So what is importance of communication in flood risk?

IMPORTANCE OF COMMUNICATION IN FLOOD RISK

Phases of Disaster



Source: Trainers training manual developed under Nyando Project

IMPORTANCE OF COMMUNICATION .. CONT./

In the aftermath of a disaster, time counts and efficient communication at all levels decides the success of all efforts.

The role - and need - of communication.

i) Non-disaster phase: Is a period where all communication are geared towards assessing and studying the previous disasters. Collection of primary and secondary data, interviews with community members characterize this phase;

IMPORTANCE OF COMMUNICATION CONT./

ii) **Pre-disaster phase:**

- **This is the most important phase. The state of Preparedness is to be reached for maximum efficiency to be effective.**
- **In this phase, all resources -their types and strength - are worked out, identified and are placed "on call" whenever situation so warrants**

IMPORTANCE OF COMMUNICATION CONT./

- Pre-disaster Phase requires high degree of dedication and cooperation of all parties i.e.
  - Flood fighting corps,
  - WRUA members,
  - WRMA,
  - DMC, KRCS,
  - Medical personnel, transporters, volunteers and above all a sound communication system must be put in place.

IMPORTANCE OF COMMUNICATION CONT./

iii) Disaster Impact and response:
Communication, in all its forms, plays a most vital role in this phase.

❑The prime requirement of this phase is to convey facts without creating any panic.

❑Also, time element is of utmost importance. Even a minor delay caused due to incomplete or incorrect communications will add to the problem.

13

IMPORTANCE OF COMMUNICATION CONT./

❑The intimation of the occurrence of a disaster is to be given, in the laid down priority, to government officials, affected population and news media of all types. This becomes effective only when there are "Check Lists" at all levels and personnel are trained to act strictly yet timely according to their respective check lists. In the absence of check lists, chaos will prevail disrupting the smooth responses at required levels

14

Example of a checklist

FIELD LEVEL HAZARD ASSESSMENT — Company Name:

Work to be done: — Date:

Task location: — Emergency meeting location: — Permit Job #

Identify and Prioritize the tasks and hazards below, then identify the plans to eliminate/control the hazards.

TASKS	HAZARDS	PLANS TO ELIMINATE/CONTROL

Require Gloves to be Removed: Yes ☐ No ☐ — Warning ribbon needed? Yes ☐ No ☐

Is the worker working alone? Yes ☐ No ☐ — If Yes, explain:

Job Completion

All Permit(s) closed out? Yes ☐ No ☐ — Are there Hazards remaining? Yes ☐ No ☐ (If Yes, explain)

Was the area cleaned up at end of job / shift? Yes ☐ No ☐

Were there any incident / injuries? Yes ☐ No ☐ — If Yes, explain:

Please print and sign below (All members of the crew) prior to commencing work and initial when task is completed or at the end of the shift

Worker Name and Signature: (below) — Foreperson's Name & Signature: (sign upon reviewing completed card)

All Names and Signatures should be legible — Reviewed by Name & Signature:

SAMPLE

15

IMPORTANCE OF COMMUNICATION CONT./

iv) Post flooding Phase:

The authorities, after normal life is restored, carry ruthless audit of all events, critically analyze faults, weaknesses, lapses, and shortcomings together with impediments, if any is experienced, and introduce measures to overcome/remove them.

16

IMPORTANCE OF COMMUNICATION CONT./

It is therefore implied that efficient communication can:-

❑ Prevent occurrence of a disaster or reduce its impact,

❑ Reduce vital delays in aftermath and

❑in general decide the success of disaster management efforts

17

TECHNIQUES OF COMMUNICATION:

❑Efficient communication needs hardware and software systems of considerable sophistication. It is obvious, therefore, that their use needs skills and techniques of high order.

❑In the various phases of Disaster Management, where every minute and every effort are precious, it is the efficient and flawless communication which ensures the success of the operation.

18

TECHNIQUES OF COMMUNICATION:

Following are the broad areas where skilled communication is required:

❑Mass Education and Public Awareness.

❑Appraisal of Government Authorities

❑Information to Media

❑Use of Wireless set, and amateur radio (Ham)

19

TECHNIQUES OF COMMUNICATION:

- Use of Telephones, Cell phones and satellite phones
- Use of INTERNET including e-mail
- Use of social media networks

20

TECHNIQUES OF COMMUNICATION:

❑Participatory video approach

A concerted effort is required to train every originator and each recipient in order to make the communication effective, so as to achieve the intended objectives.

21

WAYS TO ENSURE EFFECTIVE COMMUNICATION DURING DISASTER

- **Plan the Total Requirements of Today and Tomorrow :**
  - ❑determine numbers of key parties involved in disaster management.
  - ❑Engage them in identifying each role that each party will play in case of a disaster.
  - ❑Also provide for the futuristic increased requirements.
- **Disaster Management Directory :**

Develop a flood disaster management telephone directory. During disaster day to day interactions are important. Therefore, a group wise Telephone Directory is also necessary

22

- **Skilled Personnel:**

❑Developing an operation centre that coordinates and interact with various key stakeholders is of paramount importance.

❑The centre should therefore be equipped with basic and essential technological apt equipment that will require skilled personnel.

❑Therefore there is need for this skilled personnel to be inducted to handle it. Every instrument has to be kept in daily use by scheduled "checking". The equipment needs to be maintained and always kept in serviceable condition.

23

- **Vigorous and Regular Training :**

❑It must be an integral activity so as to maintain and improve the skill level.

❑For example use of wireless set has a specific pattern, not familiar to even educated. This has to be attended to.

❑ Also, duty personnel must be taught the use of telephone in an economical yet clear manner.

❑The duty personnel must be trained on how to use social network like Facebook and Tweeter to convey information.

24

Who are the parties involved in communication in flood risk

25

Parties involved in Flood Disaster Management

- WRMA is the leading agency in flood management in Kenya and it therefore plays a pivotal role which include coordination of various stakeholders, assessment of flood damage and data collection, analysis and management;
- WRUA is a voluntary community based organization that works directly with WRMA and therefore plays a pivotal role in flood management at grassroots;
- Community members are the actual people who suffer from flood impact and the basic unit that they are organized in is at the village level;
- KRCS is a leading humanitarian organization that responds to disasters in Kenya

26

- Disaster Management Committee (DMC) is organized from the sub-location level to the district level and are coordinated under the office of the President. The most active DMC is the District Disaster Management Committee that comprises of various line ministries district department heads and is chaired by District Commissioner. It plays the key role of coordinating disaster management activities at district level in Kenya; and
- Other stakeholders includes NGOs like World Vision etc, religious organizations, schools etc. Schools play an important role because most evacuees move to the nearby schools for shelter.

27

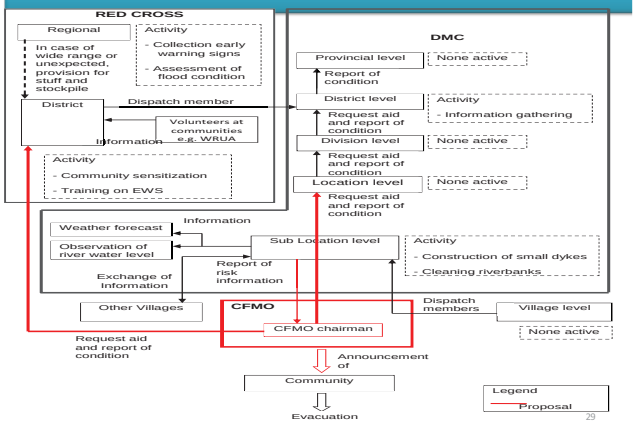
Communication channels in Flood Disaster Management

During the implementation of the Nyando Project 2006-2008 the following communication channels were envisaged as ideal:

- Communication channels before floods (pre-floods phase);
- Communication channels during floods (response phase) and
- Communication channels after floods (post-floods phase)

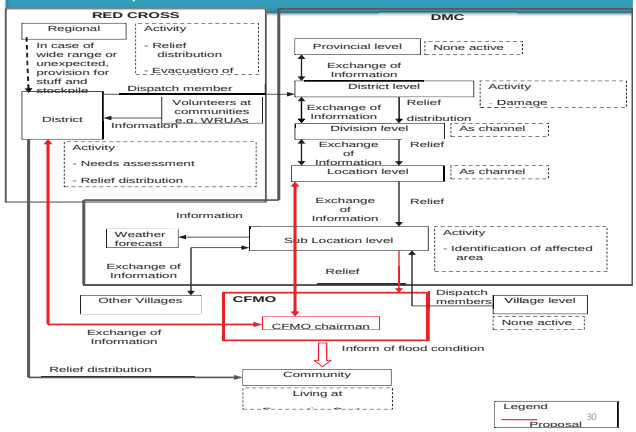
28

Pre-Floods Communication Channels



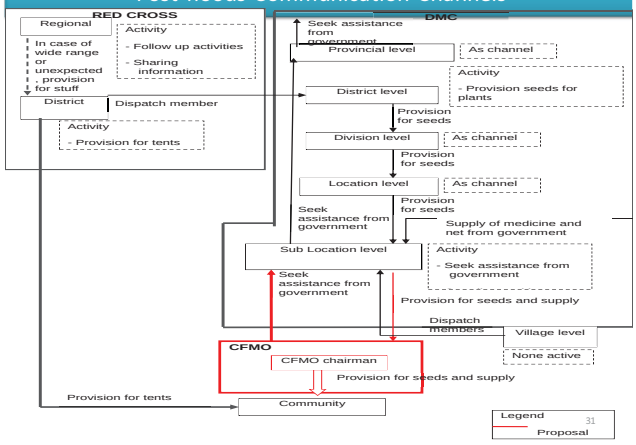
29

Response to Floods Communication Channels



30

Post-floods Communication Channels



31

WHAT INFORMATION SHOULD BE COMMUNICATED DURING FLOODS

Floods disaster cause untold suffering to the affected and the concerned in the country. It is important that right information is relayed accordingly to respective stakeholders. Information that needs to be communicated include:

- ❑How many people are affected;
- ❑How many people are injured and require medical attention;
- ❑Properties lost during the flood disaster;
- ❑Location of the vulnerable persons in the affected areas;

32

WHAT INFORMATION SHOULD BE COMMUNICATED DURING FLOODS CONTD.

- ❑Condition of vulnerable but basic infrastructure within the affected areas for example a link bridge, dispensary, school;
- ❑Condition of the evacuation places i.e. hygiene & sanitation and food security;
- ❑Status of clean and safe water;
- ❑Condition of evacuation routes and accessibility to evacuation places i.e. accessibility;
- ❑Medical referral system; and last but not least
- ❑Lead organization in the response to floods i.e. the role of each responding organization.

33

Analogy

Communication is not one sided but it involves both the originator and the recipient(s). Communication is only complete when the originator successful pass information that the recipient receives and understands. A story is told where a husband was angry with his wife and after that quarrel the wife laid down on bed to cool off her temper and the husband wrote a note and left it on the bed side, the note read “please wake me up at 5:30 am I have an important meeting with the board,” The following morning the man woke up when the sun rays struck his face and angrily asked his wife “why did you not wake me up at 5:30 am as I had requested.” The wife calmly answered “I did, I wrote the note and placed it besides the one you wrote!” Messages were conveyed between two parties yet there was no communication!!!

34

Wish you merry Christmas!

35

Module 6

6-2 Communication on Desired Information to Schools

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

Module 6-2

Communication on Desired Information to Schools

18th February, 2014

Willis MEMO

(Assistant Technical Coordination Manager-Community Development)

Project on Capacity Development For Effective Flood Management In Flood Prone Areas In the Republic of Kenya

1

Objectives

To enable the participants to understand:

- ❑Role of schools as centres for relaying messages on disasters; and
- ❑use of school curriculum to disseminate information on floods within their WRUAs and communities.

2

Some vital Quotes

- Only take heed to thyself and keep thy soul diligently lest thou forget the things which thine eyes have seen and lest they depart from thy heart all the days of thy life, but teach them thy sons, and thy son's sons. Deut. 4:9
- Train up a child in the way he should go: and when s/he is old s/he will not depart from it. Prov. 22:6

3

Background

- ❑Education and public awareness are the cornerstone of approaches aimed at reducing vulnerabilities to natural hazards.
- ❑The Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, adopted at the World Conference on Disaster Reduction, highlights knowledge and education as one of the five main priorities of action.

4

Background Cont./

Attention should be accorded, and support given to efforts targeting school children and youth with the aim of;

- ❑ making people more aware of the threat of hazards and
- ❑the need and possibility to become better prepared before disasters strike

5

Background Contd'

Both the Hyogo Framework and the United Nations Decade of Education for Sustainable Development (DESD, 2005-2014), observes;

- ❑ What international community, national academic institutions and educational establishments concerned with disaster risk reduction are giving to education is based on evidence that education contributes towards the knowledge and skills essential for disaster preparedness.

Badaoui Rouhban, Chief, Section for Disaster Reduction, UNESCO, Paris

6

Background Cont./

❑It is increasingly acknowledged that disasters are the result of natural and social processes.

❑Unlike the natural conditions that have potential of hazards, social dimension of the disaster risk is much to do with what human being interacts with nature.

❑Hence, human behavior is the crucial factor in the degree of vulnerability and the likelihood of disasters taking place.

7

Background Contd'

❑ Education (knowledge) plays a significant role in society. Since disasters are infrequent in nature and memories are short in terms of passing knowledge from one generation to another, there is a need to promote culture of prevention.

❑The misconception about disasters as nature's curse or divine's force till recent time is also a barrier in changing mindset of people towards safety culture.

❑ Here, only the educational reform can change this status quo and promote the disaster prevention practice.

8

Background Cont./

❑The necessity of integration of the disaster safety concept in all forms of daily life is an obvious condition to achieve the goal of disaster reduction.

❑ It requires that the disaster risk reduction knowledge should be as a built-in component of knowledge block.

❑Disaster awareness needs to be part of every individual's cultural heritage and the development of such attitudes should be encouraged in early childhood.

9

Background Contd'

❑ Schools give this opportunity to implant that culture to entire future citizens.

❑ A new culture of disaster prevention will have to be created in the home, in school, in the workplace and in society in general.

❑The goal of education efforts is to change people's behavior.

❑Disaster education attempts to increase protective actions by people by presenting information about the hazard and the risk it poses. If planned effectively and well implemented, it will make, in long run, people habituate safety practice in all forms of their action.

2007, Kenji Okazaki Professor, GRIPS

Reference material: **Disaster Education ,Building Research Institute (BRI)National Graduate Institute for Policy Studies (GRI PS)**2007

10

ROLE OF SCHOOLS AS CENTRES FOR RELAYING MESSAGES ON DISASTERS

❑an avenue where information in terms of knowledge are relayed from teachers to pupils for purposes of empowering these pupils.

❑medium of socialization and inculcation of values.

❑Schools as centres of learning therefore become pivotal in relaying knowledge including the subject of disaster.

❑ Majority of persons in schools are school pupils who come from different homes, villages and even locations. The school pupils are always eager to share new information with their friends, relatives and parents.

11

ROLE OF SCHOOLS AS CENTRES FOR RELAYING MESSAGES ON DISASTERS

❑Building the capacity of teachers on the subject of disaster is important because the pupils often than not trust their teachers and what the teacher tells them is the absolute truth and therefore when the teachers relay messages of disaster to the pupils it becomes the truth that the pupils will share with others.

12

WHAT KIND OF DISASTER MESSAGE SHOULD BE RELAYED?

- ❑Case of Kenya:
  Nyando River Basin
- ❑Case of India
- ❑Case of Japan

13

CASE OF KENYA

Package 3 Education program – Teachers Training

Review Text book

Lesson for std 4-classes

Assessment of education program

Participants attentively listen to a lecture during the teachers training workshop in flo disaster management.

Selected Teachers to review the Flood Management Textbook for pupils engage in group discussions.

A teacher infuses a flood disaster management topic during a class 7 English lesson in Rae Kanyaika Primary.

A teacher presents his lesson plan scheme to the Assessor (an official from Ministry of Education) during assessment.

WHAT KIND OF DISASTER MESSAGE SHOULD BE RELAYED?

CHAPTER 1 INTRODUCTION TO DISASTER

- ✓ **DEFINITION OF DISASTER**
- ✓ **CLASSIFICATION OF DISASTER**
  - ❑ Disaster According to causes
  - ❑ Disaster According to speed at which they occur
  - ❑ Disaster According to acts of humans
- ✓ **MAJOR VOCABULARIES THAT ARE USED IN DISASTER MANAGEMENT**
  - (1) Hazard
  - (2) Capacity
  - (3) Vulnerability and Emergency
  - (4) Risk

15

WHAT KIND OF DISASTER MESSAGE SHOULD BE RELAYED? CONTD.

CHAPTER 2 FLOOD DISASTER

- ✓ **USE OF ARTISTIC TECHNIQUE eg THE NARRATIVE: KODH UHURU**
- ✓ **WHAT IS FLOOD?**
- ✓ **FLOOD AS A DISASTER**
- ✓ **HOW NATURE GIVES US EARLY WARNING SIGNS CONCERNING FLOODS**
- ✓ **TYPES OF FLOODS**
- ✓ **CAUSES OF FLOODS**
  - ❑ Natural Causes
  - ❑ Man-Made Causes

16

WHAT KIND OF DISASTER MESSAGE SHOULD BE RELAYED? CONTD.

- ✓ **CHAPTER 3 FLOOD IN KENYA AND ITS EFFECT**
- ✓ **AREAS AFFECTED BY FLOODS IN KENYA**
- ✓ **CASE EXAMPLE: NYANDO RIVER BASIN**
- ✓ **EFFECTS OF FLOODS**
  - ❑ GOOD EFFECTS OF FLOOD (ADVANTAGES)
  - ❑ BAD EFFECTS OF FLOOD (DISADVANTAGES)

17

What kind of disaster message should be relayed? Contd.

CHAPTER 4 FLOOD DISASTER MANAGEMENT

- –flood disaster management
- –flood preparedness
- –flood mitigation
- –flood response management

18

What kind of disaster message should be relayed? Contd.

CHAPTER 5 EXPERIENCES OF FLOOD DISASTER MANAGEMENT WITHIN A RIVER BASIN

- ✓ FLOOD DISASTER PREPAREDNESS
- ✓ FLOOD MITIGATION
- ✓ FLOOD RESPONSE
- ✓ FLOOD RECOVERY

19

What kind of disaster message should be relayed? Contd.

CHAPTER 6 THE ROLE OF COMMUNITY IN FLOOD DISASTER MANAGEMENT WITHIN A RIVER BASIN

- WATER RESOURCES USERS ASSOCIATION
- COMMUNITY FLOOD MANAGEMENT ORGANIZATION
- CFMO OBJECTIVES
- ACTIVITIES

20

Case Example: India

India experiences a large number of disasters every year

❑earthquakes, cyclones, tsunamis, floods, droughts, landslides and industrial accidents resulting in the loss of a large number of lives and injuries to countless others.

❑Bhuj Earthquake of 2001: large number of schools were destroyed and students and teachers were affected

❑Decision made to focus on disaster education in schools in order to inculcate a culture of safety among the students and teachers.

21

Source: Disaster Education: BRI, GRIPS

Example of India

❑The CBSE has introduced disaster management as a part of Social Sciences course in class VIII, IX and X since 2004 for all students.

❑These courses cover a wide range of hazards, their consequences and mitigation and preparedness measures.

22

Case Example: India

DISASTER MANAGEMENT CURRICULUM IN CLASS V

The disaster management curriculum in Class V introduces the basic concepts of the most commonly occurring disasters in India, viz. earthquake, flood and draught. The main objectives of the Class V curriculum on disaster management (as a part of Environmental Studies subject) are:

1. Acquaint students about some major disasters that have occurred recently, such as earthquakes, floods and drought.
   - The emphasis is on understanding the consequences of these disasters, their mitigation measures and communicating that these are due to naturally occurring physical processes.
2. Introduce the students to the role of governmental, international and local organizations after a natural calamity. In addition, the important role of local people is also emphasized.

23

Source: Disaster Education: BRI, GRIPS

Disaster management class v cont./

On Floods

The topics included for floods include:

- Causes of floods - Cyclones and Typhoons are also included as one of the causes of floods;
- Effect of floods on normal life of the people;
- Methods to control floods;
- Means to reduce the effect of floods (mitigation); and
- Simple Do's and Don'ts.

24

Case Example: India Contd.

DISASTER MANAGEMENT CURRICULUM IN CLASS VIII

❑ introduces the concepts of hazard, vulnerability, risk and disaster management.

❑The main objectives of the Class VIII curriculum are:

❑ 1. Acquaint students about various disasters that India is vulnerable to, and the hazard maps that enable them to visualize their vulnerabilities. (Emphasis would be on the effects rather than causes, since the geographical reasons for the occurrence of natural hazard dealt with in geography).

Source: Disaster Education: BRI, GRIPS

25

Case example: India Cont./

❑2. Introduce a few key concepts in disaster management, in simple terms, to orient them to these words that are used in media, discussions, analysis, etc, when a disaster strikes.

❑The questions at the end of each lesson would provide a guide to teachers on what the learning expectations are from students, and in setting examination papers.

26

OBJECTIVES CONT./

❑3. Introduce the concepts of being prepared for disasters through simple do's and don'ts that school children can imbibe and spread to families and community and leading to reduce vulnerability and possible reduction in impact of the disaster on lives, livelihoods and property.

❑4. Develop an interest in the subject through interactive activities in the classroom, so that students seek more information on disasters.

On Floods topics included include:• Causes and effects;• Flood-prone areas in India; and • Preparing for floods.

27

Case Example: India Contd.

DISASTER MANAGEMENT CURRICULUM IN CLASS IX

❑is the second level formal introduction to disaster management studies.

❑The main objectives are to teach about mitigating disasters such that their impact reduced, and possibility of preventing hazards from becoming disasters. Introduction to the community based disaster management, disaster management plans for schools are taught.

❑The contents of the curriculum are as follows:

1. Part I - Getting Acquainted with Disaster Management –
- Chapter 1:Becoming a disaster manager, understanding key terms and
- Chapter 2: Components of disaster management

Source: Disaster Education: BRI, GRIPS

28

CURRICULUM IN CLASS IX

Part II - Disaster Risk Reduction-

Chapter 3: Introduction to disaster risk management - Understanding the disaster mitigation and –

Chapter 4: Specific hazards & management

Part III - Some Common Manmade Disaster-

Chapter 5: Preventing common man-made disasters

29

DISASTER MANAGEMENT CURRICULUM IN CLASS IX

Part IV - Community Based Disaster Management-

Chapter 6: Community-based disaster management, & - Chapter 7: School planning for disasters

On Floods: • Onset-type; • Warning; • Elements at risk; • Typical effects; • Main mitigation strategies and • Student exercises: Find further information.

30

Case Example: India Contd.

DISASTER MANAGEMENT CURRICULUM IN CLASS X

The curriculum of Class X appears to have been developed after the Great Indian Ocean tsunami in December 2004. The curriculum therefore provides special focus on tsunami, alternate communication system and the importance of advance planning for disaster management. The content of the curriculum is under the following broad headings:

Chapter 1- Introduction
Chapter 2- Tsunami- the killer sea waves
Chapter 3- Survival skills
Chapter 4- Alternative communication systems during disaster
Chapter 5- Safe construction practices
Chapter 6- Sharing responsibilities
Chapter 7- Planning ahead

31

Source: Disaster Education: BRI, GRIPS

④ Safe Construction - Floods

✓ Most vulnerable homes,
✓ Effects on buildings,
✓ Protection measures from damage to buildings.

⑥ Survival Skills

• Search and Rescue Skills, Defining Search and Rescue, Community as Local Rescuers, Outside Community Resources, Objectives of Search and Rescue Team, Team Composition, Duties of a Rescuer. • Plan - Manpower/Equipment/Method.
• Precautions before, while entering and while moving inside damaged buildings.

⑦ Sharing Responsibility - Role of Local and State Bodies

• Managing disasters/ How disaster is managed.
• Response from the Centre/State/District/Block/Village bodies.
• Activity and planning as an example government official.
• Functions of some organizations - UN Disaster Management Team (UNDMT)-India, Indian Armed Forces, National Cadet Corps (NCC), Civil Defence, National Service Scheme (NSS), Nehru Yuva Kendras and Home Guard.

32

Source: Disaster Education: BRI, GRIPS

Case Example: India Contd.

DISASTER MANAGEMENT CURRICULUM IN CLASS XI

The disaster management curriculum in Class XI has been introduced as a unit of Geography subject. The curriculum of this course is at a high level, and discussions the technical aspects of various hazards and disaster management concepts. The disaster management cycle is also discussed in detail in this course. The main objectives of the Class XI curriculum are:

- To acquaint students about the concepts of disaster management and the various terminologies used in this field.
- To describe the various natural hazards that occur and their consequences and mitigation measures. The curriculum discusses the concepts in disaster management in much more detail than in the earlier classes, and includes the technical aspects of the various natural hazards. The curriculum also describes the occurrence of major natural disasters in India, their consequences and mitigation/preparedness measures.

④ Floods

The topics included for floods include:

• Causes.
• Adverse effects.
• Flood-prone areas in India.
• Risk reduction measures.

33

Source: Disaster Education: BRI, GRIPS

Case Example: Japan

(1) Elementary schools

In addition to evacuation drills, practical programs have been organized as people realize the importance of disaster-prevention education at elementary schools.

Some main reasons why an earlier start of disaster-prevention education is beneficial are as follows.

• By taking an interest in disaster prevention at an early age, children can pick up the habit of thinking about disaster prevention.

34

Source: Disaster Education: BRI, GRIPS

Elementary schools: Japan

•Children tend to talk about what they have learnt to their parents. It could, in turn, raise the awareness of disaster prevention of local community.

• Because people usually learn about places with danger in their childhood, it is effective to give them disaster-prevention education to enable them to make quick and appropriate judgment in an event of disaster or emergency. People never easily forget what they learnt at their early ages, and therefore, it is meaningful for children to gain various experiences through disaster-prevention

35

Elementary schools: Japan Cont./

❑Schools have started not only programs within schools, but also initiatives promoted in cooperation with local administrative organizations and universities and other education institutions.

❑At elementary schools, disaster-prevention education has begun in recent years, for integrated study or as an optional subject.

❑Inventive drills and workshops have also been implemented. In many cases, disaster-prevention workshops are incorporated in the integrated study

36

Case Example: Japan Contd.

① Disaster-prevention education conducted within the framework of existing school subject Education Teaching materials and teacher training

To pass down the lessons from the Great Hanshin Awaji Earthquake Disaster 1995 and learn about disasters, the Hyogo Prefectural Board of Education prepared supplementary reading materials for students for classroom use. Different reading materials have been prepared for lower grades and higher grades of elementary schools, junior high school students and for senior high school students, respectively.

The supplementary reading materials for elementary school students feature local residents' experiences of previous disasters in Hyogo Prefecture. It also provides a detailed account of earthquakes and basic disaster prevention measures. The materials for junior and senior high school students explain mechanisms of earthquakes, earthquake damage such as liquefaction, specific disaster prevention measures including emergency lifesaving techniques and simple anti-seismic reinforcement.

Reading materials about natural disaster and disaster management in elementally school

Source: Disaster Education: BRI, GRIPS

Teaching materials and teacher training program
Objective: To pass down lessons from the Great Hanshin-Awaji Earthquake Disaster and learn about Disaster Main Target: students of elementary school, junior and senior high school
Main Activities:
· Disaster education in school
Development of educational material Learning Disaster
· teachers' training
· Development of manual for emergency management
Organizers: Hyogo Prefecture Board of Education

37

Case Example: Japan Contd.

(2)Drills and workshops

Activities at an elementary school

With the collaboration of residents' associations and Ichikawa Municipal Government, 135 sixth-grade students at Gyotoku Elementary School in Chiba Prefecture take part in a disaster drill, develop a disaster prevention map and participate in an experience-based class provided by Chiba Prefecture West Disaster Control Center.

These activities not only raise the students' awareness of disaster prevention, but also increase the awareness of the local community.

During the disaster drill, participants conduct a drill of handing over students to their parents (a drill to perform a procedure of handing over children from school to their parents in an event of a warning declaration), concurrently with an evacuation drill. Safety along school routes is also checked with the parents.

Drills and making disaster prevention map within community
Objective: Raising students and local residents awareness in disaster preparedness
Main Target: 135 sixth-grade students and parents at Gyotoku Elementary School in Chiba Prefecture
Main Activities:
· disaster drill
· disaster prevention map
Organizers: Gyotoku Elementary School, Chiba Pfecture West Disaster Control Center
Partners: residents' associations and the Ichikawa municipal government sis & Environment Management Policy Institute

38

Source: Disaster Education: BRI, GRIPS

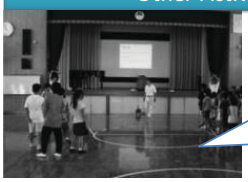
Case Example: Japan Contd.

During the workshop, the students charted their own disaster prevention maps with assistance of *Gyotokukko Mamoritai*, which is a kind of squad protecting kids in the Gyotoku area, established in March 2004 within the Gyotoku area of Ichikawa City senior citizens' club. The team is dealing with suspicious individuals and engages in traffic safety and crime prevention activities. The students checked the complete maps later with graduate school students.

In addition, they reach out to residents within the school district to draw up "my family's disaster-prevention plan," issue disaster-prevention newspapers and put up posters to raise disaster-prevention awareness.

Gyotoku Elementary School evaluate that the programs are effective, because many students state that they have less fear of disaster than they used to do after they underwent the disaster prevention programs.

Other Activities that can be engaged.



Disaster-prevention "ultra" quiz (True-or false questions are asked. Only those who give a correct answer can answer the next question. Several quiz questions are asked and a person who could continue to give a correct answer to the last wins the quiz

39

Panel Discussion

DISASTER MANAGEMENT CURRICULUM IN SCHOOLS OF KENYA

Attempts have been made to incorporate elements on disaster, at the lower level primary school children are inculcated with a sense of preserving the environment, they are taught about the risks of environmental degradation and importance of planting trees and grass to avoid soil erosion. At secondary school level the environmental education components are integrated in to syllabus and covered in a variety of subjects. At tertiary and university level the students take on the subjects of their interest and those who end up in subjects covering risk reduction may end up as professionals in that field. Detailed information on curriculum is not available.

1) In your own opinion on the above captioned statement does it qualify Kenya as one of the country that have disaster management in their curriculum?
2) How can we mainstream disaster (flood) management into the school syllabus?
3) What role should WRUA play in enhancing public awareness on floods in schools?
4) Should flood management education programmes be adopted in schools within the flood prone areas only?

HAPPY CHRISTMASS AND A BLESSED NEW YEAR

41

Module 6

6-3 Effective Public Awareness Raising on Floods

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

Module 6-3
EFFECTIVE PUBLIC AWARENESS RAISING ON FLOODS

10th December 2013

Mrs Elizabeth Diego-Lusimba
Assistant Technical Coordination Manager, Community Development
WRMA

Project on Capacity Development
For Effective Flood Management
In Flood Prone Areas
In the Republic of Kenya

1

2

Background

- "Tell me & I will forget. Show me & I may remember. Involve me & I will understand." Confucius Circa 450 BC

Consider the following preposition:

- We learn through our senses: taste, touch, smell, hear, and 80% through sight
- We remember through what we read, hear, see, 50% what we see and hear, 80% what we say and 90% what we say and do.

3

Background Cont'd

Therefore when approaching Public Awareness Raising the following issues should be considered:

- ✓ Know your purpose
- ✓ Let your purpose guide and inform your message
- ✓ Know your audience
- ✓ Anticipate problems and find solutions or manage the risk
- ✓ Ensure credibility with your audience: Trust is vital component
- ✓ Communicate a little at a time i.e. aim for quality rather than quantity
- ✓ Look for ways of getting feedback from your audience

Source: Principle of Awareness Raising by Richard Sayers

4

What is Public Awareness Raising

- Public awareness raising implies the act of drawing the attention of people in a society to know something of interest to them. In our case that something is flood management.
- Awareness raising is to raise awareness of something whether good or bad i.e. to promote that thing visibility and credibility within a community.
- Public awareness is therefore a promotion of a concept or a campaign of the concept to take centre stage in the way of life of the society in dealing with a particular issue, problem or challenge

5

What is Public Awareness Raising Cont'd.

The purpose of flood public awareness raising therefore is an opportunity for information exchange that aims at improving and developing competencies in the public on flood management that will enhance effective flood management within communities that live in flood prone areas.

It is important to note that public awareness raising does not immediately translate to behavior or belief change but it is a major step towards behavior or belief change and thus it is continous

6

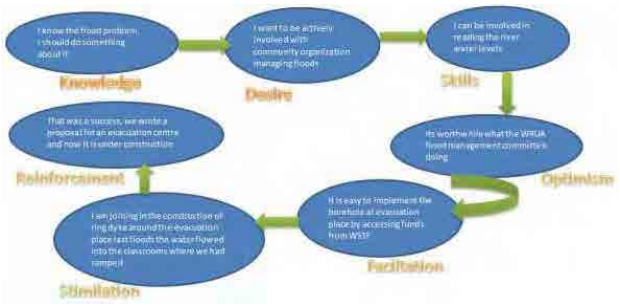
What makes a good public awareness raising for floods?

To develop a good public awareness raising campaign the following should be considered:

- ✓ Research on the subject matter e.g. effective evacuation during floods this should be done uniquely to sub catchment ;
- ✓ Mobilize support by WRUA e.g. carryout evacuation drills
- ✓ Informing the public on flood mangement e.g. carryout community sensitization
- ✓ Lobbying decision and policy makers

7

Steps towards developing a good Public Awareness Raising Cont'd



8

Steps towards developing a good Public Awareness Raising

Public awareness should also communicate one central message or a suite of closely related subsidiary messages and not exceeding five and should be linked with common theme (Flood management).

7steps towards a good public awareness raising by Social marketing consultant Mr. Les Robinson. The steps are as follows:

- Knowledge i.e. Knowing there is a problem in our case ?affects communities leading to mass suffering
- Desire i.e. Imagining a different future in our case effective management of floods
- Skills i.e. Knowing what to do to achieve the desired future in our case effective early warning and improved evacuation

9

Steps towards developing a good Public Awareness Raising Cont'd

- Optimism i.e. confidence or beliefs in success in our case example of Nyando basin where currently registers zero casualty during floods as a result of flood management system in place
- Facilitation i.e. resource and support infrastructure in our case proactive community based organizations like WRUAs
- Stimulation i.e. a compelling stimulus that triggers action in our case effective coordination amongst stakeholders as the case of Gucha Migori where DDMC coordinated the activities and assigned roles to al stakeholders leading to effective response to floods in April May floods that led to reduced human suffering
- Reinforcement i.e. regular communications that reinforces the original messages and messages in our case sensitization through the Chief baraza leading to establishment of eight CFMO in LOGUMI

10

Components of effective public awareness raising

✓ Message
✓ Audience
✓ Strategy
✓ Timing

Message Audience Strategy Timing (MAST) i.e. what is the message e.g. quick tips for effective evacuation who are the target audience i.e. communities & stakeholders in flood prone areas what is the strategy of reaching them e.g. posters or community meeting and getting it done at the right timing i.e. the right time for tips of safe evacuation on radio should be broadcasted in the month of February to April because the floods occur in April to June bwill be during.

11

Approaches of public awareness raising

Approaches of public awareness raising include:

- Personal communication with community members through public meeting, presentation, workshop and informal social events e.g. community flood sensitization meetings;
- Structured education and training programmes in schools eg the education programme on flood management
- Printed materials: Newsletter, brochures, posters eg PCDEFM IFM Newsletter
- Audio-visuals resources like CDs DVDs, Tapes etc;
- Websites, Email discussion lists, Web Log (blog)
- Mass media: Interviews with radio, print media or TV eg radio programmes (WRUA interviews in Ramogi radio)
- Songs and dances even drama eg school pupils have dramatized a narrative on floods in Nyando;, Lower Lumi , kaeru caravan

12

Importance of Public Awareness Raising

- Public awareness raising leads to behavioral change for example in Nyando sharing of toilets between mother in law and son in law customarily is prohibited but through public awareness raising the community members have accepted and acknowledged that security and preservation of human life is important than the dos and don'ts of traditions
- Community participation and engagement in flood management activities thus cooperation from the community towards achieving the desired purpose establishing effective flood management systems; public consultation meeting in Isiolo and Lower Lumi led to successful community contribution

13

Importance of Public Awareness Raising Cont'd

- Knowledge is power therefore empowerment of community through sharing of information and community members thereafter understand that there is something that they can do on their own rather than wait for government relief assistance;
- Reduced human suffering: Public awareness raising destroys misconceptions and negative stereotypes that eventually reduces human suffering for example in floods early evacuation in some communities is considered as an act of cowardice and those who evacuate early

14

Best ways of transmitting the messages

1) Personal Communication: Through community meetings like chief's baraza, WRUA workshops, social events like weddings and funerals
2) Mass Communication: Through radio for example in Nyando there were radio programmes on floods short spot (advertisement like) productions and long spot (interviews) productions. Use of posters
3) Education: Community training programmes, flood management subject in schools
4) Public Relation: use of brochures, newsletters, social media networks
5) Advocacy: Reaching out to elected members of parliament, county representatives, governors and other officers in policy making

15

Appendix-one

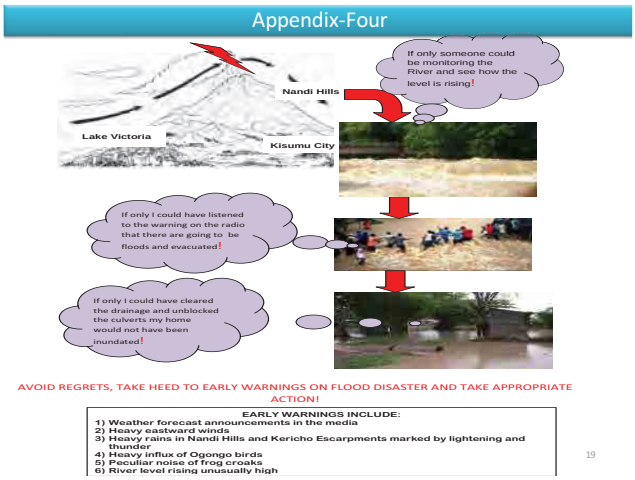
16

Appendix-two

17

Appendix-three

18

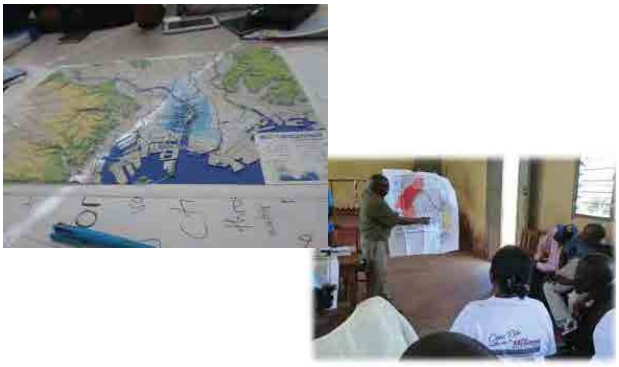


19

Awareness creation – flood hazard map by Isiolo WRUA

20

3D flood hazard map presented to community



Awareness creation on flood depth

22

- A fully aware well informed and properly trained population is the guarantee of safety and of successful response to disaster" Richard Sayers

23

Lets publicize Flood management activities to build flood resilient communities

24

Module 7

7-1 Planning and Design of Flood Damage Mitigation Measures

Project on Capacity Development for Effective Flood Management in Flood Prone Areas (PCDEFM)

WRMA Flood Management Training

7-1 Planning and Design of Flood Damage Mitigation Measures

19TH. February 2014

Eng. Matagaro, W.O

WRMA

MODULE 7: PLANNING, DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF FLOOD DAMAGE MITIGATION FACILITIES

Sessions:

- 7-1 Planning and Design of flood mitigation measures
- 7-2 Flood damage mitigation non-structural measures including community based measures
- 7-3 Flood damage mitigation structural measures including community based measures
- 7-4 Operation and maintenance of flood damage mitigation structural measures

Overview

This module presents the participants with the overall planning, designing operation and maintenance of flood damage mitigation measures. It also seeks to impart skills to the WRUA leaders and the community members on the best practices to plan, design, maintain and operate simple flood damage mitigation facilities within their respective sub-catchments.

2

Objective

The objective of this session is to enable the participants understand:

- The types of flood damage mitigation measures
- Use of flood damage mitigation measures

NECESSITY OF FLOOD MANAGEMENT PLAN

The formulation of a Flood Management Plan for a target river basin is necessary, and must be undertaken in a "basin-wide" approach, considering the influence/effect of flood and the future related plans such as:

- Irrigation development plan,
- Road network/bridge plan,
- Forestation plan,
- Environmental management plan
- Resettlement plan

Some effects/influences of other development plans in the formulation of flood control plan may include examples, such as height of levee affecting the design height of bridge; the design riverbed profile affecting the design of irrigation intake/canal and other related facilities.

Classification of Flood Management Plan

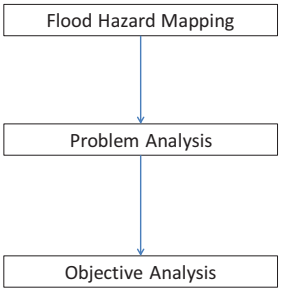
- Master Plan (MP)

  The Master Plan incorporates flood management policy, strategy, target flood magnitude and main works, etc. in the river system. Extensive survey, investigation and analysis to formulate the flood management master plan are necessary. Each identified project in the Master Plan shall be formulated for a long-term to have optimum benefits and in consideration of the effect in the implementation in other areas of the river basin.
- Feasibility Study

  From the list of project proposed in the Master Plan, implementation for medium term are selected and prioritized based on the urgency to mitigate flood damages within the framework of socio-economic importance. The affected core areas should be given higher attention. The study includes technical, economic, implementation schedule, operation and maintenance.
- Project Implementation Plan (PIP)

  The Project Implementation Plan specifies the works selected from the Feasibility Study including the funds and benefits to be derived from the project. Implementation period is usually 5 to 10 years. Economic analysis shall be conducted to determine the scope of the Project Implementation Plan.

Community Participatory Approach

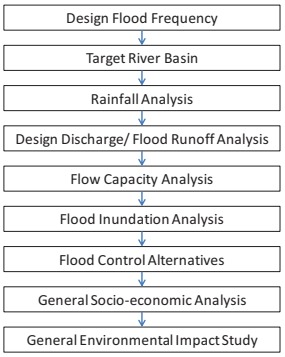


- To grasp the flood damage extent, seriousness
- To understand the most vulnerable people in the area
- To understand the relation between problems and causes
- To prioritize problems and cause
- To understand the relation between cause of damage and intervention

Flood Mitigation/Control Master Plan

- **Project area**: The project area shall describe, among others the natural condition, topography and/or historical background (flooding history).
- **Safety level** described by return period.
- **Flood control main objective**: This takes into consideration which appropriate improvement has to be undertaken (i.e., widening the river, excavating the river mouth, embankment, etc). The structures shall be decided based on the entire river basin flood management.
- **Basin-wide rainfall-runoff model**: A simulation model for the estimation of the probable flood discharge at all the control points is necessary to be developed.
- **Diagram of design discharge**: A diagram at the control points to determine the critical areas affected by high water stages is necessary for improvement plan.
- **Main works**: What are the main works to be undertaken (i.e., dike, dredging, etc.).
- **Survey works**
  - Longitudinal Profile
  - Typical cross section of the river.
  - Etc.
- **Typical structure design** (i.e., embankment/revetment, etc.).
- **Location map of main works**
- **General Socio-Economic Analysis**
- **General Environmental Impact Study**
- **Proposed Flood Control Projects** and Main Works with Typical Design

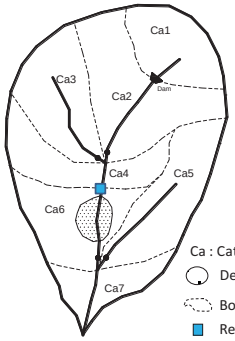
Procedure for the Formulation of Master Plan (MP)



Design Flood Frequency (Safety Level)

- Basically, all flood management projects must have a flood management plan. It is necessary to make a flood management plan based on the forecasted river phenomena which is likely to occur as a result of the discharges corresponding to the design flood frequencies.
- Design Flood Frequency is expressed by return period, i.e., the probability (expressed in years) where a flood of a target size/magnitude is likely to occur.
- The return period shall be determined based on the size of catchment area, the degree of importance of the proposed project area and the economic viability of the project.
- Thus, it is necessary to determine the design flood discharge corresponding to the design flood frequency of the river. It is also necessary to consider the funds needed for the implementation of the proposed improvement works and the expected benefits.

IDENTIFICATION OF TARGET RIVER BASIN



1. **Catchment Area**
2. **Establishment of Reference/ Sub-reference Points**

Reference/Control points are usually where the design discharges are set, strategically accessible for data collection (e.g., observer's nearby house, bridge, etc.) and adjacent to or in significant areas. Reference/control points are established to provide sufficient hydraulic data as bases for hydraulic and hydrologic analyses.

Ca : Catchment Area
Densely Inhabited area
Boundary of Catchment Area
Reference point
Sub-reference point

DESIGN DISCHARGE

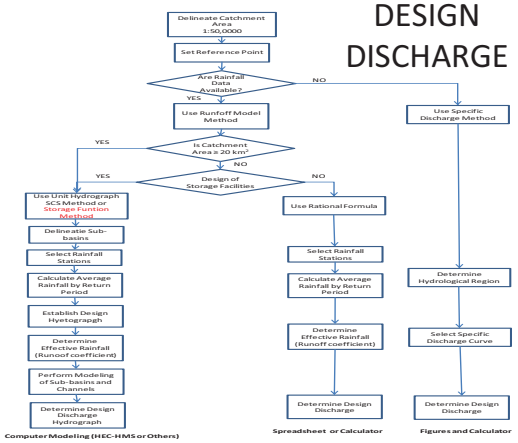
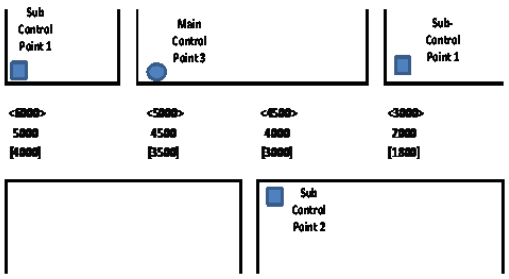
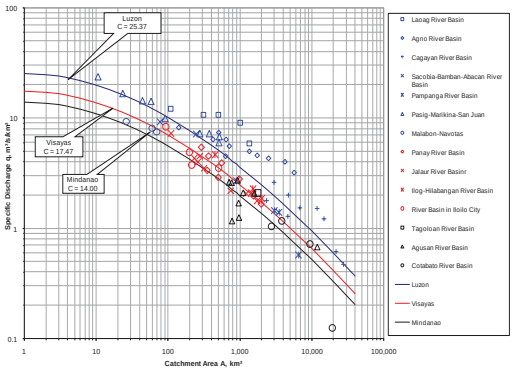


Diagram of Discharges



<Q> = Long-term target discharge (Master Plan)
Q = Design discharge (Implementation Plan)
[Q] = Existing discharge capacity

Specific Discharge Curve



Rainfall Analysis

The return-period of the flood is determined through the rainfall data available. These are the only readily available data to calculate the discharge of probable flood .

The following procedure shall be followed:

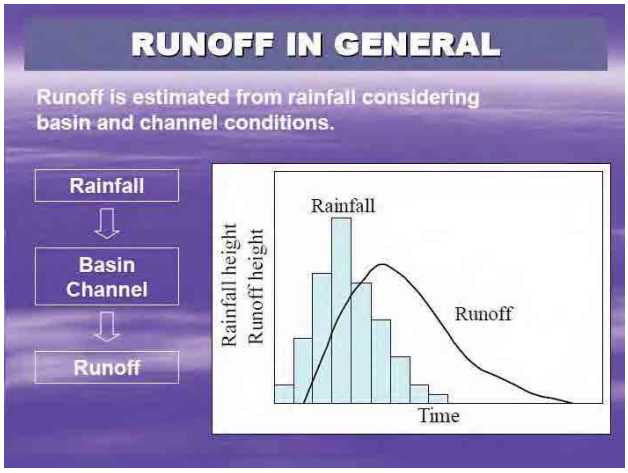
- Calculate average rainfall in catchment area
- Calculate design total rainfall amount by return periods
- Collect typical rainfall patterns (hyetographs) of past major floods
- Modify typical rainfall patterns based on return period

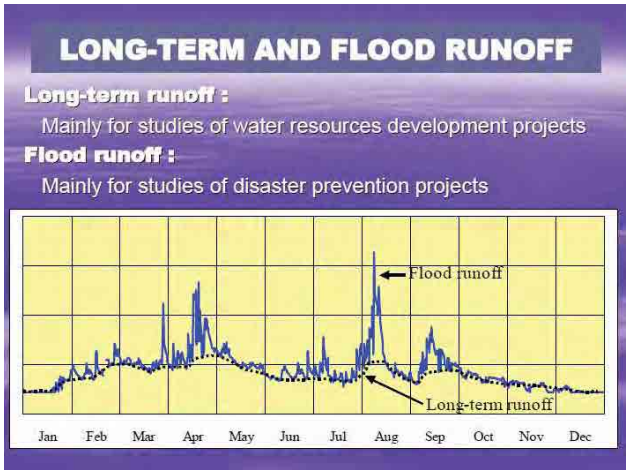
Runoff Analysis

Runoff analysis is required for planning of flood control facilities/structures and discharge control, particularly for the construction of dams and retarding basins. It aims to establish the relationship between the amount of rainfall and the river discharges.

There are many methods for runoff analysis; however, introduced in this Volume are the following:

1. Rational Formula
2. Unit Hydrograph Method
3. Storage Function Method





FLOOD RUNOFF is used in determining/deciding the:

- Height of Dike/Levee
- Scale of River Widening
- Scale of Dredging/Excavation
- Capacity of Pumps
- Size of Drainage Facilities
- Bridge Design

CASES OF RUNOFF ANALYSIS

1) Sufficient past annual maximum flood discharge/water level data are available.
2) Hourly rainfall and flood discharge/ level data are available.
3) Only rainfall data are available.
4) No rainfall or flood data are available.

CASE # 1 "Sufficient past annual maximum flood discharge/ level data are available."

a. Collect data.
b. Arrange the data from the lowest to highest value.
c. Order of discharges/water level corresponds to its return period.

a. Collect data (For example: 25 years).

Year	Max. Q (m^3/s)	Year	Max. Q (m^3/s)
1981	2,502	1996	2,900
1982	1,532	1997	1,759
1983	1,850	1998	1,200
1984	800	1999	1,800
1985	2,058	2000	2,465
1986	2,950	2001	1,957
1987	2,300	2002	3,000
1988	1,050	2003	1,275
1989	950	2004	2,852
1990	3,200	2005	2,600
1991	600		
1992	1,000		
1993	1,220		
1994	2,028		
1995	1,508		

b. Arrange the data from the lowest to highest value.

Order	Discharge (m^3/s)	Order	Discharge (m^3/s)
1	600	16	2,058
2	800	17	2,300
3	950	18	2,465
4	1,000	19	2,502
5	1,050	20	2,600
6	1,200	21	2,852
7	1,220	22	2,900
8	1,275	23	2,950
9	1,508	24	3,000
10	1,532	25	3,200
11	1,759		
12	1,800		
13	1,850		
14	1,957		
15	2,028		

c. **Order of discharges/water level corresponds to its return-period.**

Return Period (yr.)	Discharge (m^3/s)
2	800
5	1,050
10	1,532
25	3,200

CASE # 2 **"Hourly rainfall and flood discharge/ level data are available."**

Calculation Methods

1) Unit Hydrograph
2) Storage Function

UNIT HYDROGRAPH

Assumptions:

- Base length of hydrograph is constant.
- Volume of direct runoff is in direct proportion to the rainfall intensity.
- Volume of runoff is to be determined by adding together the runoff components of each rainfall.

STORAGE FUNCTION

Assumption:

- Existing relation between the volume of storage and runoff.

CASE # 3 **"Only rainfall data are available."**

Calculation Method

1) Rational Formula*

** For catchment areas less than 20 km^2.*

RATIONAL FORMULA

Assumptions:

- The computed peak rate of runoff at the outlet point is a function of the average rainfall rate during t_c.
- The time of concentration is the time for the runoff to become established.
- Rainfall intensity is constant throughout the rainfall duration.

1. Rational Formula

- $Q = c.i.A / 3.6$
- Where : Q : maximum flood discharge (m^3/s)
  c : runoff coefficient
  i : rainfall intensity w/in t_c (mm/hr)
  A : catchment area (km^2)

FLOW OF ANALYSIS

RAINFALL

- Rainfall Intensity (i) during t_c

RIVER BASIN/CATCHMENT

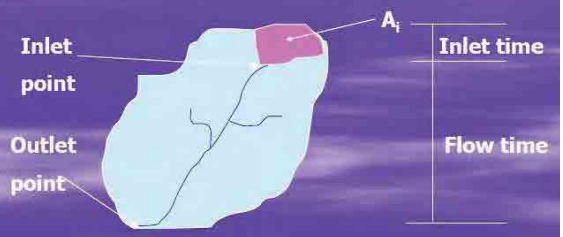
- Catchment/Basin Area (A)
- Runoff Coefficient (c)

RUNOFF/DISCHARGE

- Calculation using Rational Formula Method

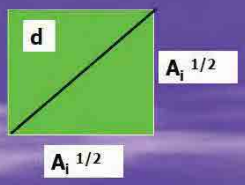
TIME OF CONCENTRATION

- t_c = inlet time + flow time



INLET TIME (t_i)

Estimate catchment area of inlet point (A_i).



- $d = (2.A_i)^{1/2}$
- When d = 2 km. ; t_i = 30 min.

FLOW TIME (t_f)

- $t_f = L/(60.V)$, in min.
- L : Length of river course from inlet point to outlet point (m)
- V : Average flow velocity (m/s)

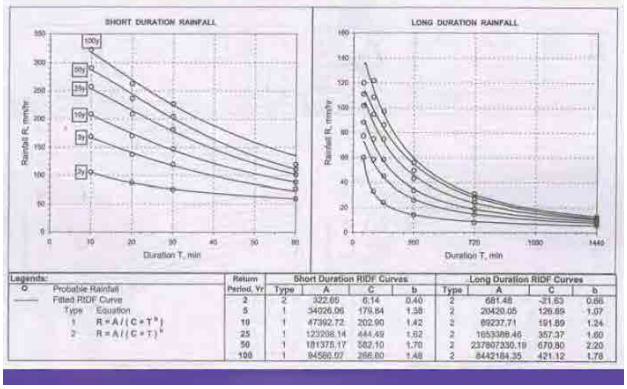
Average riverbed gradient (I)

- I = (Elev. Inlet – Elev. Outlet)/L

Table

I	I > 1/100	1/100 > I > 1 /200	I < 1/200
Velocity (V)	3.5m/s	3.0m/s	2.1m/s

Rainfall Intensity Duration Frequency Curve (RIDF)



Legends:	Return Period, Yr	Short Duration RIDF Curves Type	A	C	b	Long Duration RIDF Curves Type	A	C	b
Probable Rainfall	2	2	322.65	6.14	0.40	2	681.48	-21.63	0.66
Fitted RIDF Curve	5	1	34026.06	179.84	1.38	2	20428.05	126.89	1.07
Type Equation	10	1	47392.72	202.90	1.42	2	89237.71	191.89	1.24
1 $R=A/(C+T^b)$	25	1	123208.14	444.49	1.62	2	1653388.46	357.37	1.60
2 $R=A/(C+T)^b$	50	1	191375.17	582.10	1.70	2	237807330.19	670.80	2.20
	100	1	84586.07	266.80	1.48	2	8442184.35	421.12	1.78

Formula
(Conversion Formula from Design Daily Rainfall to Rainfall Intensity)

$$Rt = \frac{347.1}{t^{1.35} + 1{,}502} \cdot R_{24}$$

Rt : Average Rainfall Intensity during traveling time (mm/h)

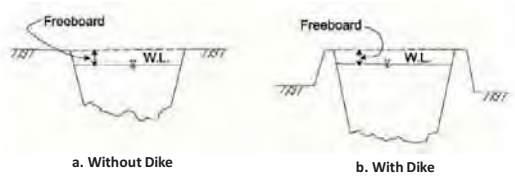
t : Traveling Time (min)

R_{24} : Design Daily Rainfall (mm)

FLOW CAPACITY

Flow capacity of the existing river channel should be estimated to identify the reaches with insufficient capacity in order to consider the possible alternatives to accommodate the design discharge. Flow capacity of the existing river channel shall be basically estimated by non-uniform flow method except for the channel with uniform shape and slope, for which uniform flow method is applied.
The water level used to estimate flow capacity shall be as explained below.

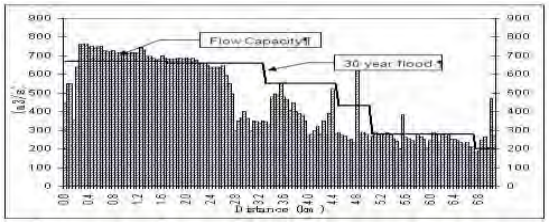
1) Reaches without dike : Ground elevation minus freeboard
2) Reaches with dike : Dike elevation minus freeboard



a. Without Dike b. With Dike

Flow Capacity Computation

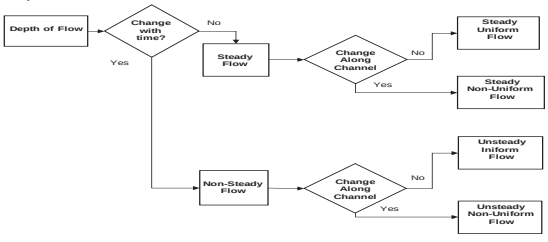
Uniform Flow Calculation and Non-uniform Flow Calculation are used in calculating the existing discharge capacity according to the types of flow and river condition.
The succeeding sections discuss the principles.
Estimated flow capacity shall be indicated in separate figures for left and right banks as follows with design flood or floods with several return periods.



Water Level Computation

After the determination of the river channel route, the alignment, longitudinal profile and cross section shall be a part in the formulation of the optimum plan by applying the water level computation using the uniform (e.g., cut-off channel or irrigation canal) or the non-uniform flow method. Water level of river channel is basically computed by non-uniform flow computation method. For rough estimate of discharge, uniform flow may be used for planning.

1) Flow Classification



Uniform Flow Calculation

Uniform flow computation may be used to estimate water level of rivers under the following conditions.

1. River of steep slope with supercritical flow in all reaches under consideration
2. River of mild slope with uniform shape and slope along channel

Uniform flow calculation is applicable for rivers with the following conditions:

1. When there are no points of abrupt change of riverbed gradients.
2. When there is no structures/obstruction that impedes the flow discharge.
3. When the cross sectional area of the river is almost the same longitudinally.
4. When there is relatively long straight river reach.

There are many velocity formulas, but generally, Manning's Equation, is the most commonly used as it includes river hydraulic elements.

Manning's Equation

There are many velocity formulas, but generally, Manning's Equation, is the most commonly used as it includes river hydraulic elements.

Manning's Equation

$$V = \frac{1}{n} R^{2/3} \cdot S^{1/2} \quad (m/s)$$

Where:

V : Average river velocity (m/s)
R : Hydraulic radius (m)

Where: $R = A/P$

P : wetted perimeter (m)
A : Average river cross-sectional area (m^2)
R : *h, if the river width is extremely larger than depth*
h : *flow depth*
S : Riverbed gradient
n : Manning's coefficient of roughness

Manning's Coefficient of Roughness

Manning's coefficient of roughness (n) shall be determined based on the analysis of experienced floods; however, when the data of experienced floods are few or not so accurate, use the recommended values of (n) as shown in Table 6.3.

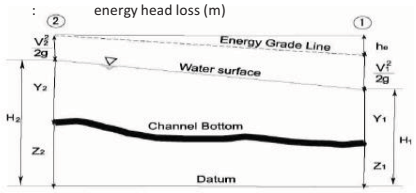
Channel Conditions	Coefficient of Roughness
General waterway	0.030 – 0.035
Rapid river of wide and shallow river	0.040 – 0.050
Temporary waterway excavated without timbering	0.035
Three-sided lined channel	0.025
River tunnel	0.023

Non-uniform Flow Calculation

$$Y_2 + Z_2 + \frac{V_2^2}{2g} = Y_1 + Z_1 + \frac{V_1^2}{2g} + h_e$$

Where:

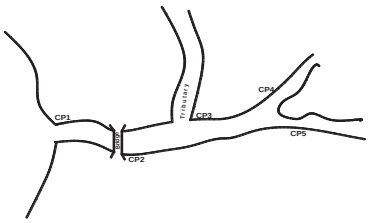
Y_1, Y_2 : depth of water at cross section (m)
Z_1, Z_2 : elevation of the main channel bed (invert) (m)
H_1,H_2 : water level (=Y_1+Z_1 and Y_2+Z_2, respectively)(m)
V_1, V_2 : average velocity (m/s)
g : gravitational acceleration (m/s^2)
h_e : energy head loss (m)



DESIGN DISCHARGE DISTRIBUTION AND FLOOD CONTROL MEASURES

Design Discharge Allocation

The design discharge or the probable discharge is generally computed at the reference point and other important points of the target river such as the junctions of tributaries and sites of proposed flood control facilities. The design discharge along the river reaches is then allocated for the various flood control measures and their corresponding costs determined and evaluated for the most optimum plan.



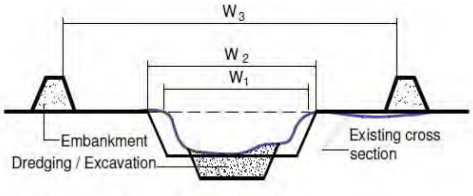
Flood Control Measures

There are various river engineering works, either individually or in combination, which provide flood protection and reduce flood damages along river reaches. These measures result to design discharge allocation appropriate for the specific purpose as listed below.

No	Category	Facility/Measure
1	Increase of river flow capacity	- Dike/Levee - Widening of waterway/river - Dredging/Excavation - Combination of above - Cut-off channel
2	Reduction/control of the peak discharge of flood	- Dam - Retarding basin - Floodway
3	Prevention of bank collapse	- Revetment - Spur dike - Change of waterway/cut-off channel - Pilot channel (small channel)
4	Prevention of riverbed degradation	- Groundsill - Regulated quarrying
5	Prevention of riverbed aggradation and, obstruction/interruption against river flow	- Sabo works (for sediment control) - Regular maintenance (channel excavation/dredging) - Vegetation/Reforestation - Jetties / estuary training dikes

RIVER IMPROVEMENT

One of the functions of river improvement is to increase the flow capacity of the existing river channel, which may include widening, dredging/excavation, and dike construction as illustrated below.



W_1 = Existing river width
W_2 = Improved river width by widening
W_3 = Improved river width by diking

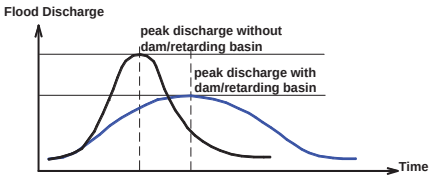
Reduction of Flood Peak Discharge by Dam/Retarding Basin

a) Dam

A dam is a hydraulic structure constructed across a river to control and/or conserve water in a mountainous area. The flood peak discharge is reduced and stored in the reservoir and later released so as to reduce the peak discharge in the downstream. The dam should be situated in a place where large quantity of water will be possibly stored. However, such area is constrained by the topographical and geological conditions of the area.

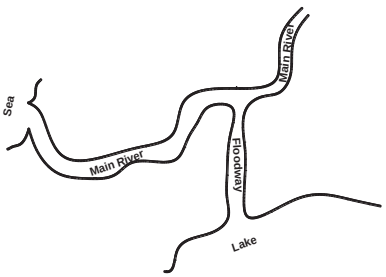
b) Retarding Basin

A retarding basin has the same function as a dam (Figure 7.1.1b). In general, a retarding basin is generally constructed in the middle reach to reduce flood discharge at the downstream reaches.



Floodway

Floodway is constructed to divert floodwater to the sea, lake or another main river from the existing river by excavating a new manmade waterway, in order to avoid the excessive widening of the existing river or to shorten the extension of improvement



Allocation Procedure in Flood Control Planning

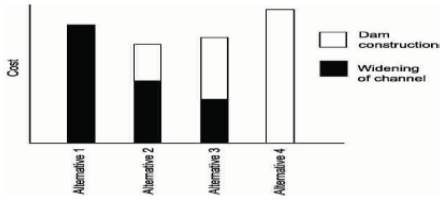
In the formulation of a flood control plan, all possible flood control measures/facilities should be explored and evaluated from the engineering, socio-economic and environmental viewpoints to select the optimum plan. The design discharge allocated to the optimum flood control facilities/measures is termed as the design discharge distribution.

The procedures to evaluate flood control alternatives are described below.

1. Allocate the discharge to the river channel by increasing the flow capacity in consideration of the existing flow capacity and the land use of riverine area
2. If the discharge cannot be accommodated in Item 1, allocate the design discharge to alternative flood control facilities of item 2 such as ; dam, retarding basin, and floodway.
3. Determine the appropriate flood control facilities to accommodate the allocated discharge
4. Estimate the project cost based on the preliminary design of the flood control facilities
5. Estimate the benefit to be accrued after the project implementation
6. Calculate the cost/benefit ratio .

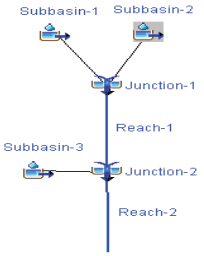
Allocation of Target Discharge (Example)

Alternative Case	Existing Flow Capacity (m^3/s)	River Improvement by Widening (m^3/s)	Dam Cut (m^3/s)	Target Discharge (m^3/s)
1	2,000	3,000	0	5,000
2	2,000	1,500	1,500	5,000
3	2,000	1,000	2,000	5,000
4	2,000	0	3,000	5,000

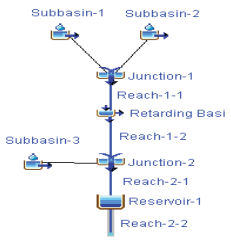


Runoff Model for Alternatives

The same runoff model used to obtain the design/probable discharge is also used to evaluate the effect of flood control or the reduction in discharge due to flood control measures/facilities, such as dam, retarding basin and floodway.

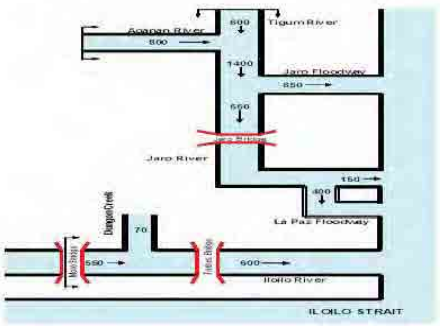


Model for Design Discharge



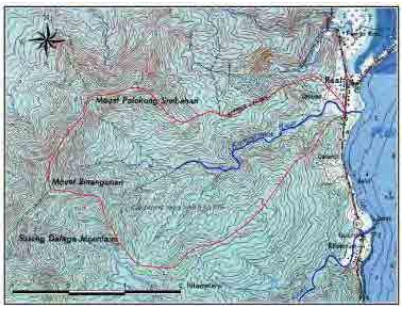
Model for Allocation of Design Discharge

Design Discharge Distribution for the Ilo-ilo Flood Control Projects 50 year return period



Source : DPWH Ilo-ilo Flood Control Project Progress Report

KINANLIMAN RIVER (EXAMPLE IN PHILIPPINES)



Kinanliman River Basin Map *Source: FLOOD CONTROL MASTER PLAN AND FEASIBILITY STUDY FOR KINANLIMAN RIVER*

Flood Damage

Flash Flood in Kinanliman River in 2004
Source: FCSEC, DPWH

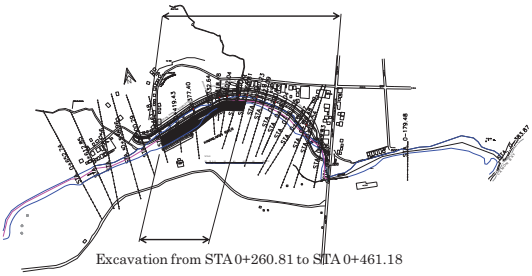
Flash Flood in Kinanliman River in 2004
Source: FCSEC, DPWH

Newly-built Houses in Kinanliman River, left bank, near Poblacion I
Source: Study on the Selection of Pilot Projects, July 2006, Project for Strengthening the Flood Management Function of DPWH

Upstream of Kinanliman River: Traces of Debris Flow
Source: Study on the Selection of Pilot Projects, July 2006, Project for Strengthening the Flood Management Function of DPWH

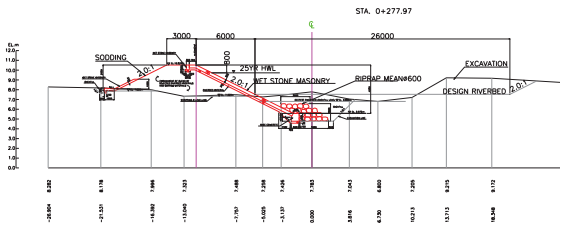
River Channel Improvement

Dike (left bank) from Kinanliman (STA 0+000) Bridge to STA 0+500.29



Excavation from STA 0+260.81 to STA 0+461.18

Cross section



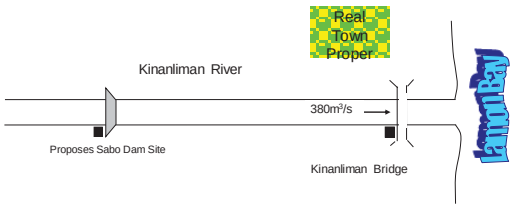
Design Discharge Distribution

Probable Flood Discharge

Probable Flood Discharge (Debris Flow)

Return Period	Kinanliman Bridge (m3/s)	Proposed Sabo Dam (m3/s)
2 years	201	189
5 years	281	266
10 years	323	306
25 years	380	362
50 years	413	393
100 years	459	438

Design Discharge Distribution



Flood Inundation Analysis

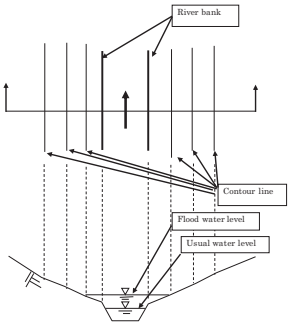
Flood Inundation Modeling

Regarding to the topographic character and location of river, Flood inundation phenomena is divided three types as follows.

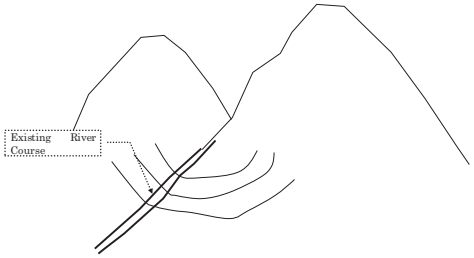
1) Flow down type flood
2) Quickly spread type flood
3) Slowly spread and storage type flood

1) Flow down type flood

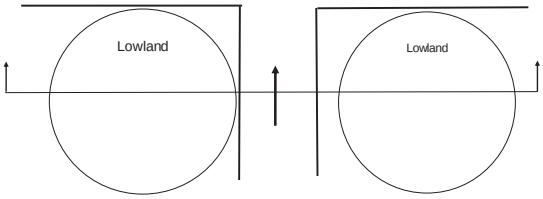
If flood occurs in a river in mountainous area, flood water may flow down along the river channel.



2) Quickly spread type flood



3) Slowly spread and storage type flood



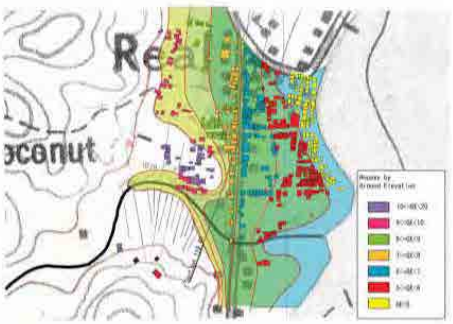
Flood water may overflow the natural dike/embankment and spread in lowland area.

Estimation of Flood Inundated Area in Some Return Periods

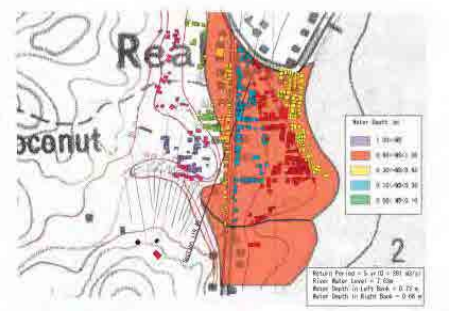
Ground elevation

Aerial Photo form Google Map of Southern Part of Real

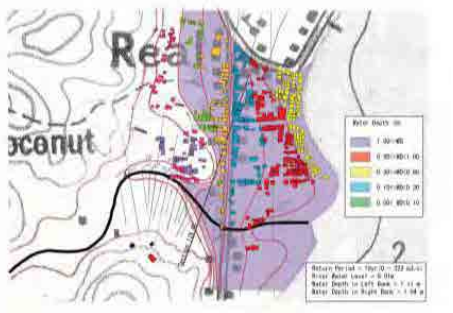
Houses by ground elevation



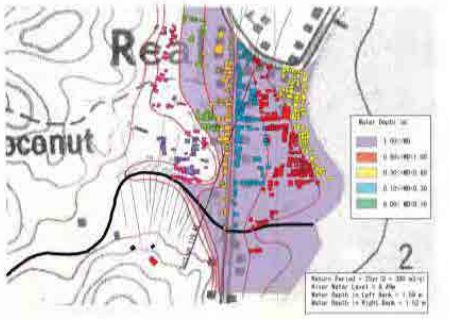
5-years-return-period flood Inundation area



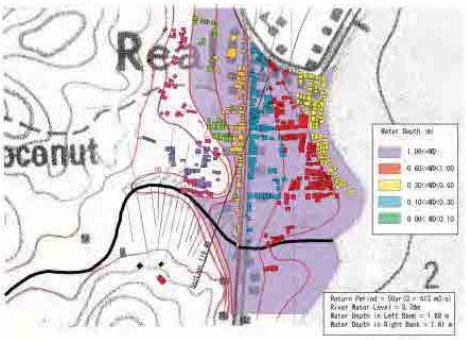
10-years-return-period flood inundation area



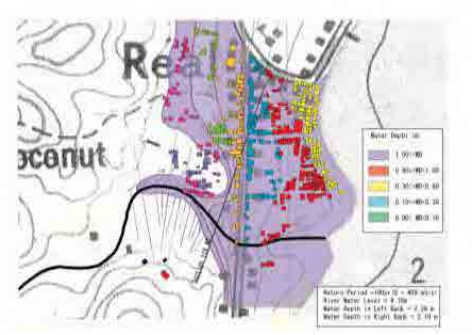
25-years-return-period flood inundation area



50-years-return-period flood inundation area



100-years-return-period flood inundation area



Estimation of Damage

Damage Rate

Assets	Inundation Depth (m)	Damage Factor
Built-up Area	0.10 ~ 0.30	0.025
	0.30 ~ 0.60	0.030
	0.60 ~ 1.00	0.035
	> 1.00	0.040
Agri-aquacultural Area	0.10 ~ 0.30	0.550
	0.30 ~ 0.60	0.600
	0.60 ~ 1.00	0.650
	> 1.00	0.700

Estimated Flood Damage

Cross Section: 119.48m, Left Bank Land Elevation (EL.m): 6.9, Right Bank Land Elevation (EL.m): 6.97

Return Period (years)	Discharge(m3/s)	Water Surface Level (EL.m)	Water Depth in Left Bank Land (m)	Water Depth in Right Bank Land (m)
2	201	6.83	0	0
5	281	7.63	0.73	0.66
10	323	8.01	1.11	1.04
25	380	8.49	1.59	1.52
50	413	8.78	1.88	1.81
100	459	9.16	2.26	2.19

Estimated Flood Damage (2)

Return Period (years)	Numbers of Houses by Ground Elevation													
	Left Bank h<5	Left Bank 5≤h<6	Left Bank 6≤h<7	Left Bank 7≤h<8	Left Bank 8≤h<9	Left Bank 9≤ h<10	Left Bank 10≤ h<20	Right Bank h<5	Right Bank 5≤h<6	Right Bank 6≤h<7	Right Bank 7≤h<8	Right Bank 8≤h<9	Right Bank 9≤ h<10	Right Bank 10≤ h<20
2	90	126	75	54	29	43	34	0	2	0	0	0	0	2
5	90	126	75	54	29	43	34	0	2	0	0	0	0	2
10	90	126	75	54	29	43	34	0	2	0	0	0	0	2
25	90	126	75	54	29	43	34	0	2	0	0	0	0	2
50	90	126	75	54	29	43	34	0	2	0	0	0	0	2
100	90	126	75	54	29	43	34	0	2	0	0	0	0	2

Estimated Flood Damage (3)

Return Period (years)	Inundated or no-inundated													
	Left Bank h<5	Left Bank 5≤h<6	Left Bank 6≤h<7	Left Bank 7≤h<8	Left Bank 8≤h<9	Left Bank 9≤ h<10	Left Bank 10≤ h<20	Right Bank h<5	Right Bank 5≤h<6	Right Bank 6≤h<7	Right Bank 7≤h<8	Right Bank 8≤h<9	Right Bank 9≤ h<10	Right Bank 10≤ h<20
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	1	1	1	0	0	0	1	1	1	1	0	0	0
10	1	1	1	1	1	0	0	1	1	1	1	1	0	0
25	1	1	1	1	1	0	0	1	1	1	1	1	0	0
50	1	1	1	1	1	0	0	1	1	1	1	1	0	0
100	1	1	1	1	1	1	0	1	1	1	1	1	1	0

if inundated: 1, if no-inundated: 0

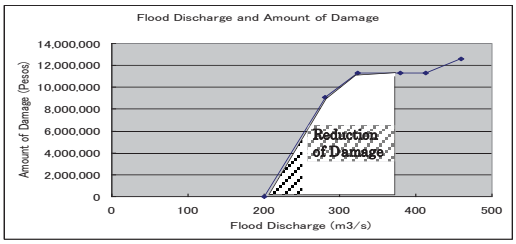
Return Period (years)	Number of inundated houses													
	Left Bank h<5	Left Bank 5≤h<6	Left Bank 6≤h<7	Left Bank 7≤h<8	Left Bank 8≤h<9	Left Bank 9≤ h<10	Left Bank 10≤ h<20	Right Bank h<5	Right Bank 5≤h<6	Right Bank 6≤h<7	Right Bank 7≤h<8	Right Bank 8≤h<9	Right Bank 9≤ h<10	Right Bank 10≤ h<20
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	90	126	75	54	0	0	0	0	2	0	0	0	0	0
10	90	126	75	54	29	0	0	0	2	0	0	0	0	0
25	90	126	75	54	29	0	0	0	2	0	0	0	0	0
50	90	126	75	54	29	0	0	0	2	0	0	0	0	0
100	90	126	75	54	29	43	0	0	2	0	0	0	0	0

Estimated Flood Damage (4)

Return Period (years)	Number of houses by water depth in left bank				Number of houses by water depth in right bank				Ave. Assess Value	Damage Ratio by Inundation Depth				Damage by Inundation Depth (Left Bank)				Damage by Inundation Depth (Right Bank)				Total Damage
	0.10≤h<0.30	0.30≤h<0.60	0.60≤h<1.00	1.00≤h	0.10≤h<0.30	0.30≤h<0.60	0.60≤h<1.00	1.00≤h	yen/unit	0.10≤h<0.30	0.30≤h<0.60	0.60≤h<1.00	1.00≤h	0.10≤h<0.30	0.30≤h<0.60	0.60≤h<1.00	1.00≤h	0.10≤h<0.30	0.30≤h<0.60	0.60≤h<1.00	1.00≤h	
2	0	0	0	0	0	0	0	0	750,000	0.025	0.030	0.035	0.040	0	0	0	0	0	0	0	0	0
5	0	0	345	0	0	0	2	0	750,000	0.025	0.030	0.035	0.040	0	0	9,656,250	0	0	0	52,500	0	9,708,750
10	0	0	0	374	0	0	0	2	750,000	0.025	0.030	0.035	0.040	0	0	0	11,220,000	0	0	0	60,000	11,280,000
25	0	0	0	374	0	0	0	2	750,000	0.025	0.030	0.035	0.040	0	0	0	11,220,000	0	0	0	60,000	11,280,000
50	0	0	0	374	0	0	0	2	750,000	0.025	0.030	0.035	0.040	0	0	0	11,220,000	0	0	0	60,000	11,280,000
100	0	0	0	417	0	0	0	2	750,000	0.025	0.030	0.035	0.040	0	0	0	12,510,000	0	0	0	60,000	12,570,000

Damage Reduction

River Discharge	Return Period		Amount of Damage			average damage reduction of interval	Probability of interval	Annual Damage reduction	Accumulation of annual damage reduction
			Without Project	with Project	Reduction of Damage				
201	2	0.5	0	0	0				0
281	5	0.2	9,108,750	0	9,108,750	4,554,375	0.300	1,366,313	1,366,313
323	10	0.1	11,280,000	0	11,280,000	10,194,375	0.100	1,019,438	2,385,750
380	25	0.04	11,280,000	0	11,280,000	11,280,000	0.060	676,800	3,062,550
413	50	0.02	11,280,000						
459	100	0.01	12,570,000						



Economic Evaluation

Economic Internal Rate of Return (EIRR)

$$\sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t} = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t}$$

The NPV is expressed as "B-C" and defined by the following formula:

$$NPV = B - C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} - \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

The B/C Ratio is defined by the following formula:

$$B/C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} \Big/ \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

Project on Capacity Development for Effective Flood Management in Flood Prone Areas (PCDEFM)

WRMA Flood Management Training

7-2 Flood Damage Mitigation Non-Structural Measures including Community Based Measures

19 FEB 2014

Prepared by Hideki Sawa
Team Leader, JICA Project Team
Presented by Simon-San

(A) Structural measures
① Architectural Works

1) Raised Evacuation center (See the pamphlet of Nyando)
2) Storage facility (See the pamphlet of Nyando)
3) Raised Toilet (See the pamphlet of Nyando)
4) Raised houses
5) Boat for evacuation

Pre-Construction Activities

- **1) Initial Activities and Site Survey**
- **2) Design Stage**
  · Detailed Design Report
  · Quantity Calculation Report
  · Pre-qualification Documents
  · Tender Document
- **3) Tendering Stage**
  The tendering process for the construction activities
- **4) Supervising Stage**
  The Consultants engage in the supervision works, developing a quantity, quality, and progress control manual for the purpose of supervision, quality and progress control for construction activities.

Raised Evacuation center (See the pamphlet of Nyando)

- Community members are trained on O&M of an evacuation centre.


Raised Storage facility (See the pamphlet of Nyando)

- CFMO members in front of the cleaned storage after O&M training


Raised Toilet (See the pamphlet of Nyando)

- People clean the toilet during the toilet O&M training



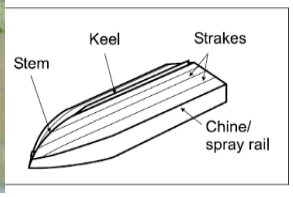

Raised houses

- Raise houses by stones and/or cemented soil to make your house stronger against floods.




Boat for evacuation

- During rainy season, there are many floods, and local residents lost roads. Boat can help to cross the temporally ponds.

② Borehole Works

- 1) Borehole (See the pamphlet of Nyando)
  2) Hand-Pumps and Apron (See the pamphlet of Nyando)

Borehole (See the pamphlet of Nyando)

- Consultant representative marks site for Borehole to be constructed
- Villagers maintain cleanliness at the borehole surroundings



Raised Hand-Pumps and Apron (See the pamphlet of Nyando)

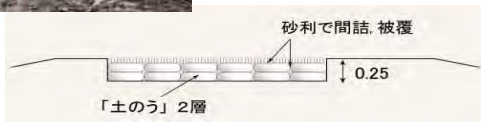
- Facilitator demonstrates how to replace components of a hand pump during O&M training


③ Civil Works

- 1) Raised roads by sandbags
- 2) Dike by sandbags
- 3) Retarding basin
- 4) Gabion wall
- 5) Footbridge (See the pamphlet of Nyando)
- 6) Culvert (See the pamphlet of Nyando)

Raised roads by sandbags

- Mud/eroded road can be maintained by sandbags.
- Raising roads is better to keep road condition.



Dike/Embankment by Sandbag

Construction of the embankment in dry season (Hight : 1.5 m, 7,500 Do-nou used)

The embankment during rainy season (It was stable.)

Source: NPO Michibushin-nin

Retarding basin

- Play ground is suitable as a temporally water reservoir after heavy rain.
- Water channel is necessary to lead flash flood.

Gabion Wall

- Gabion is one of the protection from erosion and flood.
- It can be maintained by residents.

Footbridge (See the pamphlet of Nyando)

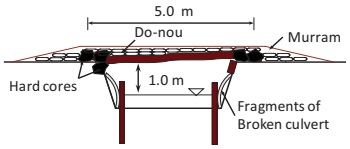
- Villages participate in a slope embankment work of a footbridge

Culvert (See the pamphlet of Nyando)

- Villagers participate in an O&M practical training

Empower community through road maintenance

After road maintenace with do-nou, the villagers were motivated and did repair a bridge by themselves.



Labor cost
Material cost
} 3,000 US$

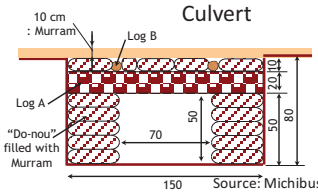
Negotiation with local government
Contribution
Volunteer

Source: Michibushin-nin

APPLICATIONS TO RURAL INFRASTRUCTURE

Retaining wall

Culvert

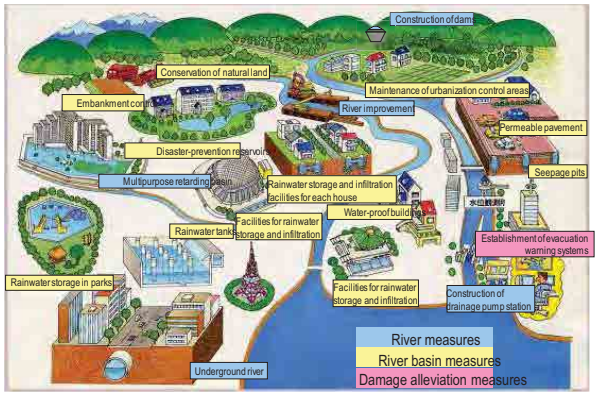


Source: Michibushin-nin

Dam (water harvest)

20

Comprehensive Flood Control Measures



21

(A) Non-structural measures

- ① Capacity Building (See the pamphlet of Nyando)
- 1) Mechanism of Flood
- 2) How to prevent/ reduce floods damage

Supervisors explain the mechanism and some approaches against floods by lectures.

② Technical Training

1) Disaster Imagination Game (DIG) for risk mapping
2) Three-dimensional mapping by cardboard
3) Evacuation sign/sign board (See the pamphlet of Nyando)
4) Sandbagging training
5) Rain gauge
6) River gauge
7) Early warning system

Disaster Imagination Game (DIG) for risk mapping

DIG is one of the self-risk-mapping method.

Residents develop their own local risk map with discussions and considering past disasters.

Three-dimensional mapping by cardboard

- Local government in Mexico made 3D risk map. It is easy to understand their risks.

Evacuation sign/sign board (See the pamphlet of Nyando)

- Flood hazard map and evacuation signboard are beneficial for public awareness

Sandbagging training

- Sandbags could protect low level floods, beside the river, fountain, and your house.

Rain gauge/Community Based Flood Early Warning System

- If it rains at mountain area, lower area will have flash flood within some hours.
- People who lives at mountain area can make alert to lower stream residents in case of big rainfall.

River gauge /Community Based Flood Early Warning System

- Automatic river gauge can make the alert of flood.
- The cost is approximately 2-300USD, and local people can maintain by themselves.
- The National Coordination for Disaster Reduction of Guatemala (CONRED) makes river gauge with automatic radio transmission by themselves, and distribute many points along the river basin. The volunteers who have been given mobile phone and handy radio by CONRED, report the current situation to CONRED in case of heavy rain and raising river level.

Early warning system

- For quick evacuation, early warning system (EWS) is effective in case of disasters.
- EWS can set on the river.

Early warning system (cont.)

- El Salvador has a small laud speakers for EWS, when the big hurricane came and had flood, a community leader has put on alarm button for immediate evacuation. This cost is very low.

③ Awareness Campaign

1) Workshop on Disaster Prevention and Reduction
2) Evacuation Drill
3) New type Disaster Drill, enjoyment with children (Iza! Kaeru Caravan)

Workshop on Disaster Prevention and Reduction

Awareness campaign using posters about flood management is a good opportunity for school children, they can draw with their experiences

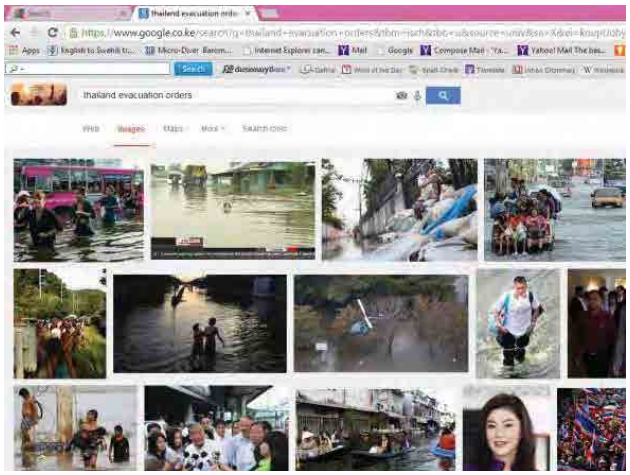
Evacuation Drill (See the pamphlet of Nyando)

- CFMO organizes community members during evacuation drill in Wasiese Village on Dec. 3, 2010
- Community members assists an injured evacuee during evacuation drill in Mombasa Wangaya Village on Dec. 6, 2010

New type Disaster Drill, enjoyment with children (Iza! Kaeru Caravan)

Learning through fun; a new disaster reduction training program for families.


Search for people, places and things
marikina
marikina


thailand evacuation orders


FloodList
Flood Warning for Southern Thailand
Registering a company?


Thank you for your attention!!
Asante Sana

Module 7

7-2 Flood Damage Mitigation for Non-Structural Measures including Community-based Measures

Project on Capacity Development for Effective Flood Management in Flood Prone Areas (PCDEFM)

WRMA Flood Management Training

7-2 Flood Damage Mitigation Non-Structural Measures including Community Based Measures

19 FEB 2014

Prepared by Hideki Sawa
Team Leader, JICA Project Team
Presented by Simon-San

(A) Structural measures
① Architectural Works

1) Raised Evacuation center (See the pamphlet of Nyando)
2) Storage facility (See the pamphlet of Nyando)
3) Raised Toilet (See the pamphlet of Nyando)
4) Raised houses
5) Boat for evacuation

Pre-Construction Activities

- **1) Initial Activities and Site Survey**
- **2) Design Stage**
  · Detailed Design Report
  · Quantity Calculation Report
  · Pre-qualification Documents
  · Tender Document
- **3) Tendering Stage**
  The tendering process for the construction activities
- **4) Supervising Stage**
  The Consultants engage in the supervision works, developing a quantity, quality, and progress control manual for the purpose of supervision, quality and progress control for construction activities.

Raised Evacuation center (See the pamphlet of Nyando)

- Community members are trained on O&M of an evacuation centre.


Raised Storage facility (See the pamphlet of Nyando)

- CFMO members in front of the cleaned storage after O&M training


Raised Toilet (See the pamphlet of Nyando)

- People clean the toilet during the toilet O&M training



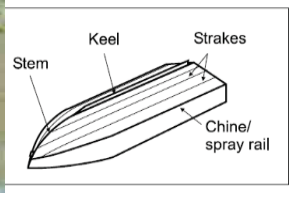

Raised houses

- Raise houses by stones and/or cemented soil to make your house stronger against floods.



Boat for evacuation

- During rainy season, there are many floods, and local residents lost roads. Boat can help to cross the temporally ponds.

② Borehole Works

- 1) Borehole (See the pamphlet of Nyando)
  2) Hand-Pumps and Apron (See the pamphlet of Nyando)

Borehole (See the pamphlet of Nyando)

- Consultant representative marks site for Borehole to be constructed
- Villagers maintain cleanliness at the borehole surroundings



Raised Hand-Pumps and Apron (See the pamphlet of Nyando)

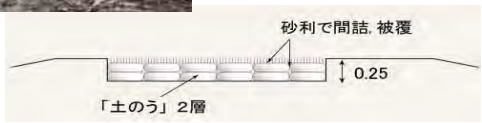
- Facilitator demonstrates how to replace components of a hand pump during O&M training


③ Civil Works

- 1) Raised roads by sandbags
- 2) Dike by sandbags
- 3) Retarding basin
- 4) Gabion wall
- 5) Footbridge (See the pamphlet of Nyando)
- 6) Culvert (See the pamphlet of Nyando)

Raised roads by sandbags

- Mud/eroded road can be maintained by sandbags.
- Raising roads is better to keep road condition.



Dike/Embankment by Sandbag

Construction of the embankment in dry season (Hight : 1.5 m, 7,500 Do-nou used)

The embankment during rainy season (It was stable.)

Source: NPO Michibushin-nin

Retarding basin

- Play ground is suitable as a temporally water reservoir after heavy rain.
- Water channel is necessary to lead flash flood.

Gabion Wall

- Gabion is one of the protection from erosion and flood.
- It can be maintained by residents.

Footbridge (See the pamphlet of Nyando)

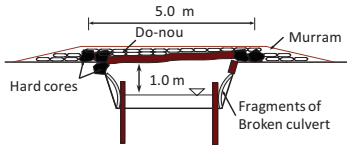
- Villages participate in a slope embankment work of a footbridge

Culvert (See the pamphlet of Nyando)

- Villagers participate in an O&M practical training

Empower community through road maintenance

After road maintenace with do-nou, the villagers were motivated and did repair a bridge by themselves.



Labor cost
Material cost
} 3,000 US$

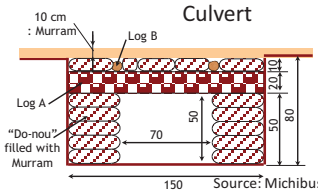
Negotiation with local government
Contribution
Volunteer

Source: Michibushin-nin

APPLICATIONS TO RURAL INFRASTRUCTURE

Retaining wall

Culvert

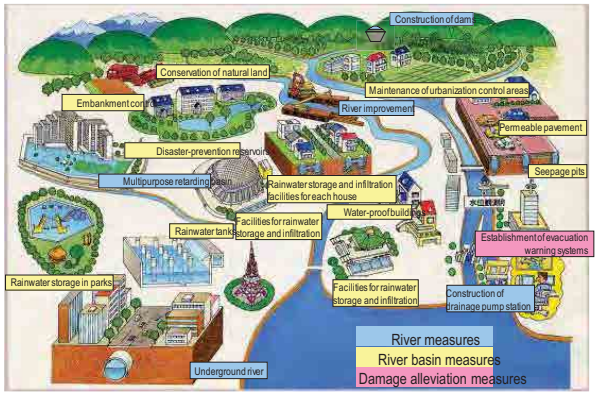


Source: Michibushin-nin

Dam (water harvest)

20

Comprehensive Flood Control Measures



21

(A) Non-structural measures

- ① Capacity Building (See the pamphlet of Nyando)
- 1) Mechanism of Flood
- 2) How to prevent/ reduce floods damage

Supervisors explain the mechanism and some approaches against floods by lectures.

② Technical Training

1) Disaster Imagination Game (DIG) for risk mapping
2) Three-dimensional mapping by cardboard
3) Evacuation sign/sign board (See the pamphlet of Nyando)
4) Sandbagging training
5) Rain gauge
6) River gauge
7) Early warning system

Disaster Imagination Game (DIG) for risk mapping

DIG is one of the self-risk-mapping method.

Residents develop their own local risk map with discussions and considering past disasters.

Three-dimensional mapping by cardboard

- Local government in Mexico made 3D risk map. It is easy to understand their risks.

Evacuation sign/sign board (See the pamphlet of Nyando)

- Flood hazard map and evacuation signboard are beneficial for public awareness

Sandbagging training

- Sandbags could protect low level floods, beside the river, fountain, and your house.

Rain gauge/Community Based Flood Early Warning System

- If it rains at mountain area, lower area will have flash flood within some hours.
- People who lives at mountain area can make alert to lower stream residents in case of big rainfall.

River gauge /Community Based Flood Early Warning System

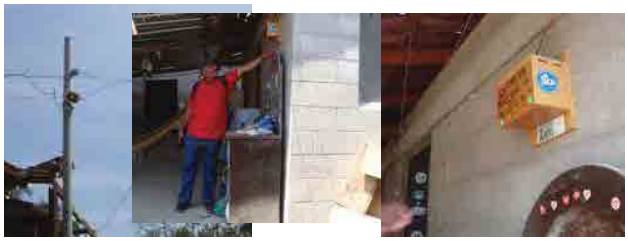
- Automatic river gauge can make the alert of flood.
- The cost is approximately 2-300USD, and local people can maintain by themselves.
- The National Coordination for Disaster Reduction of Guatemala (CONRED) makes river gauge with automatic radio transmission by themselves, and distribute many points along the river basin. The volunteers who have been given mobile phone and handy radio by CONRED, report the current situation to CONRED in case of heavy rain and raising river level.

Early warning system

- For quick evacuation, early warning system (EWS) is effective in case of disasters.
- EWS can set on the river.

Early warning system (cont.)

- El Salvador has a small laud speakers for EWS, when the big hurricane came and had flood, a community leader has put on alarm button for immediate evacuation. This cost is very low.



③ Awareness Campaign

1) Workshop on Disaster Prevention and Reduction
2) Evacuation Drill
3) New type Disaster Drill, enjoyment with children (Iza! Kaeru Caravan)

Workshop on Disaster Prevention and Reduction

Awareness campaign using posters about flood management is a good opportunity for school children, they can draw with their experiences

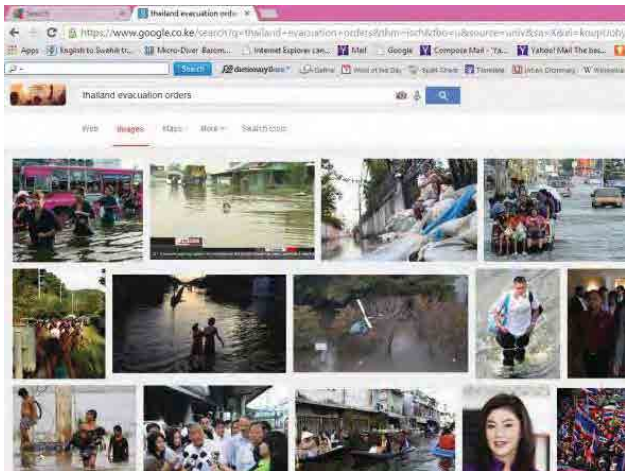
Evacuation Drill (See the pamphlet of Nyando)

- CFMO organizes community members during evacuation drill in Wasiese Village on Dec. 3, 2010
- Community members assists an injured evacuee during evacuation drill in Mombasa Wangaya Village on Dec. 6, 2010

New type Disaster Drill, enjoyment with children (Iza! Kaeru Caravan)

Learning through fun; a new disaster reduction training program for families.


Search for people, places and things
Like · Comment


thailand evacuation orders


FloodList
Flood Warning for Southern Thailand
Registering a company?


Thank you for your attention!!
Asante Sana

Module 7

7-3 Flood Damage Mitigation Structural Measures including Community-based Measures

WATER RESOUCES MANAGEMENT AUTHORITY
JAPAN INTERNATIONAL COOPERATION AGENCY

FLOOD MANAGEMENT TRAINING

Module7-3

Flood damage mitigation structural measures including community-based measures

19 FEB. 2014

Mr. Joseph Kimanga

Project on Capacity Development for Effective Flood Management in Flood Prone Areas

Learning objective

To enable the participants to lecture on;

1. Types of flood mitigation structural measures
2. Process of implementing a construction project
3. Basics of construction of flood mitigation structures
4. Operation of flood mitigation structures
5. Maintenance of structural measures.

Presentation outline

A. Types of flood mitigation structural measures
B. Process of implementing a construction project
C. Basics of construction of flood mitigation structures
D. Operation of flood mitigation structures
E. Maintenance of structural measures.

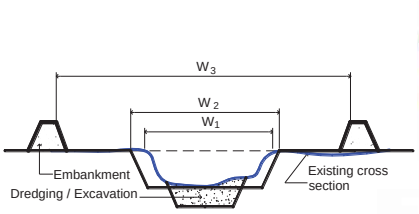
A. Types of flood mitigation structural measures

A1. Case examples of structural measures; design, construction, and O&M

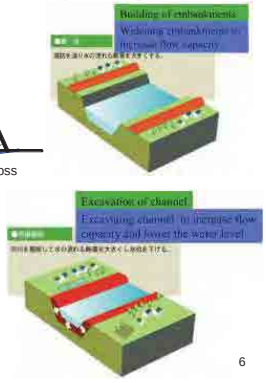
A2. Case examples of traditional flood control structures

	Category	Facility/Measure
a.	Increase of river flow capacity	- Dike/Levee - Widening of waterway/river - Dredging/Excavation - Combination of above
b.	Reduction/control of the peak discharge of flood	- Dam - Retarding basin - Floodway
c.	Prevention of bank collapse	- Revetment (Soda works) - Spur dike (Groyne) - Change of waterway/Cut-off channel
d.	Prevention of riverbed degradation	- Groundsill

a. Increase of River Flow Capacity

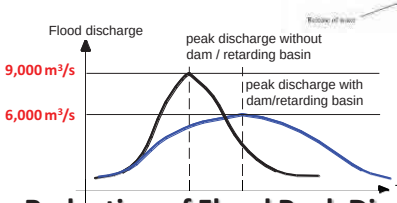


W_1 = Existing river width
W_2 = Improved river width by widening
W_3 = Improved river width by diking



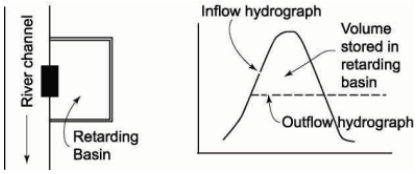
River Improvement

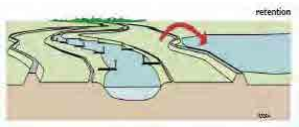
Discharge of Flood (1/7)



Reduction of Flood Peak Discharge by Dam / Retarding Basin

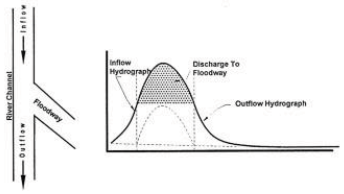
Discharge of Flood (4/7)





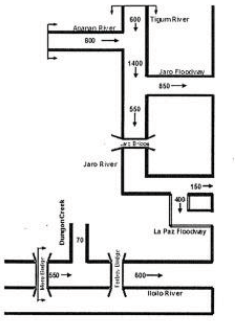
Flood Control by Retarding Basin

Discharge of Flood (5/7)

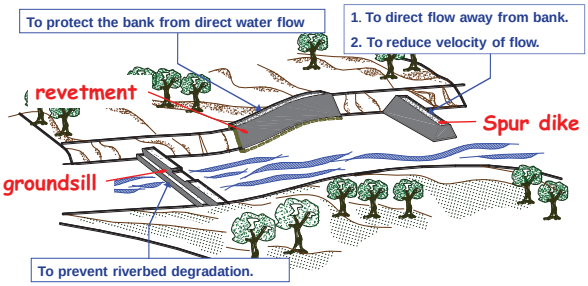


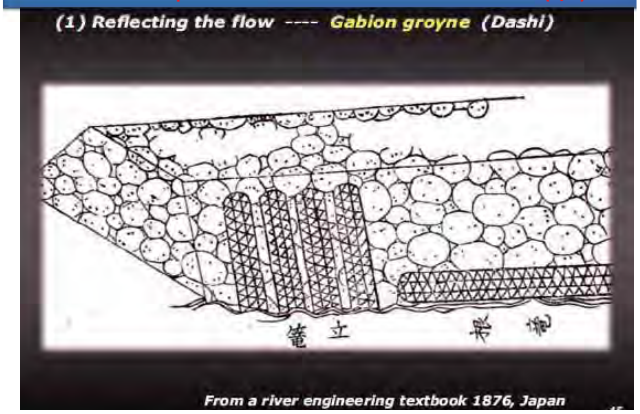
Source: TSG for Flood Control Structure, Part 1 Planning, DPWH Philippines

Flood Control by Floodway

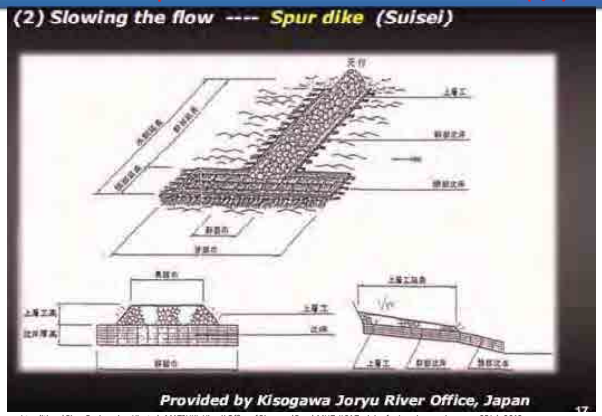


c. Prevention of Bank Collapse
d. Prevention of Riverbed Degradation



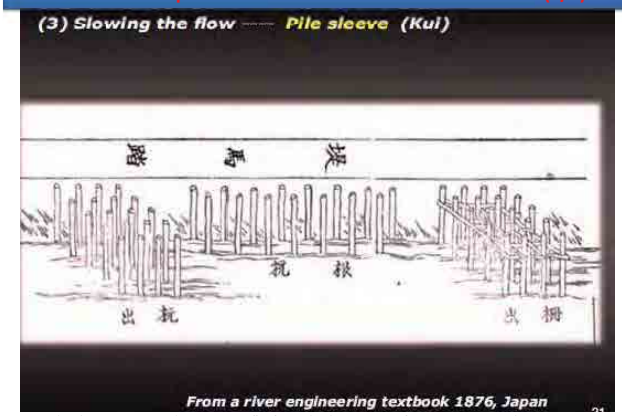


Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012



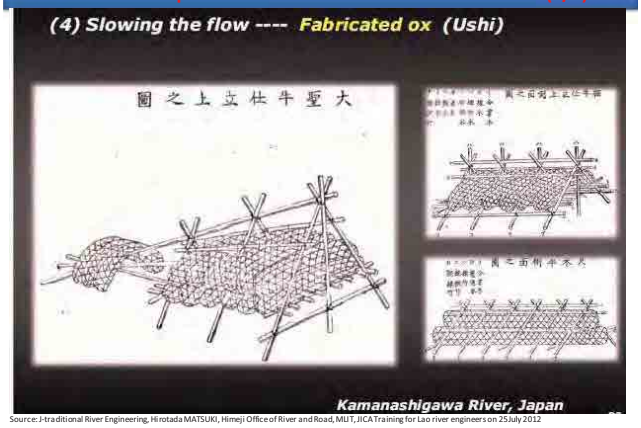
Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

A. Types of flood mitigation structural measures
A2. Case examples of traditional flood control structures (3/8)



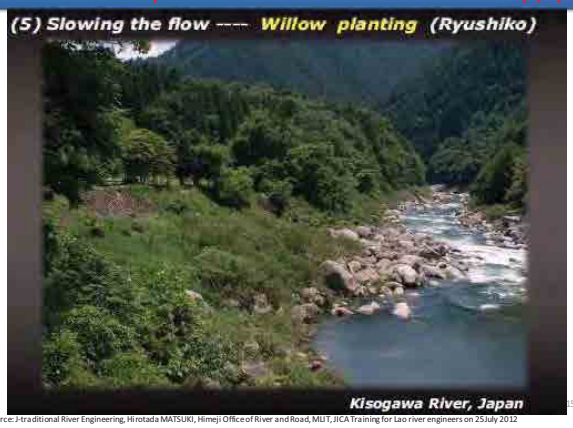
Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

A. Types of flood mitigation structural measures
A2. Case examples of traditional flood control structures (4/8)



Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

A. Types of flood mitigation structural measures
A2. Case examples of traditional flood control structures (5/8)

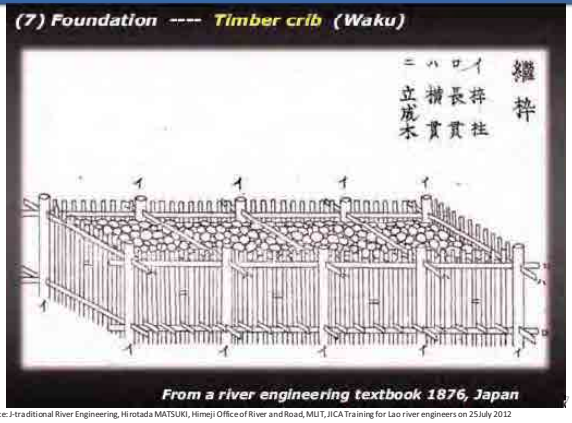


Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

A. Types of flood mitigation structural measures
A2. Case examples of traditional flood control structures (6/8)

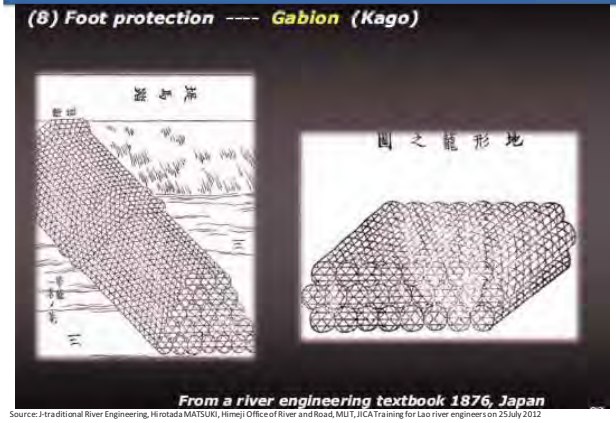
Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

A. Types of flood mitigation structural measures
A2. Case examples of traditional flood control structures (7/8)



Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

A. Types of flood mitigation structural measures
A2. Case examples of traditional flood control structures (8/8)



Source: J-traditional River Engineering, Hirotada MATSUKI, Himeji Office of River and Road, MLIT, JICA Training for Lao river engineers on 25July 2012

B. Process of implementing a construction project

B1. Comparison of alternatives

B2. Environmental Impact Assessment (EIA)

B3. Procurement (contracting works)

B4. Construction supervision

B. Process of implementing a construction project
B1. Comparison of alternatives

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

EIA Guidelines in Kenya

Purpose of Guidelines

The purpose of the guidelines is to assist project proponents, EIA practitioners, members of the public and lead agencies to understand and follow the EIA process as well as for them to know the levels at, and the basis on which decisions on EIA applications are made. It is hoped that this in turn will facilitate greater consideration and integration of environmental concerns in development projects, policies, plans and programmes. Different sectors are required to develop their own EIA guidelines using the framework national EIA Guidelines developed by NEMA.

REPUBLIC OF KENYA

NATIONAL ENVIRONMENTAL MANAGEMENT AUTHORITY

DRAFT

ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

ENVIRONMENT IMPACT ASSESSMENT GUIDELINES AND ADMINISTRATIVE PROCEDURES

NOVEMBER 2002

Source: REPUBLIC OF KENYA NATIONAL ENVIRONMENTAL MANAGEMENT AUTHORITY, DRAFT ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT (No 8 of 1999), ENVIRONMENT IMPACT ASSESSMENT GUIDELINES AND ADMINISTRATIVE PROCEDURES, NOVEMBER 2002 , http://www.nema.go.ke/index.php?option=com_phocadownload&view=category&id=34:eia-guidelines&Itemid=567

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

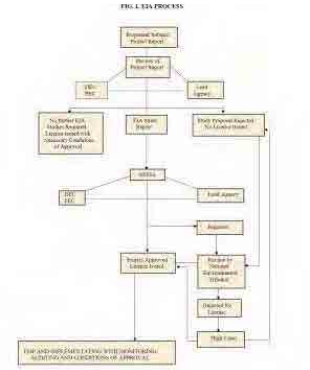
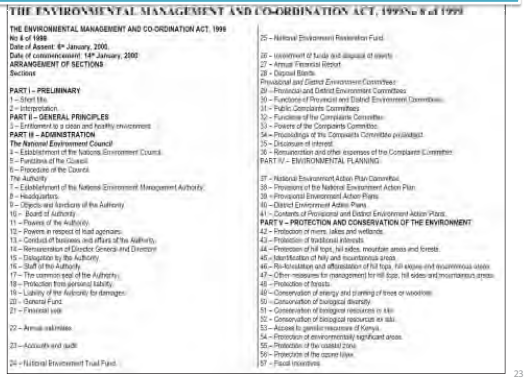


FIG. 1 EIA PROCESS

Source: REPUBLIC OF KENYA NATIONAL ENVIRONMENTAL MANAGEMENT AUTHORITY, DRAFT ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT (No 8 of 1999), ENVIRONMENT IMPACT ASSESSMENT GUIDELINES AND ADMINISTRATIVE PROCEDURES, NOVEMBER 2002 , http://www.nema.go.ke/index.php?option=com_phocadownload&view=category&id=34:eia-guidelines&Itemid=567

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT, 1999No 8 of 1999



THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT, 1999No 8 of 1999

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT, 1999
No 8 of 1999
Date of Assent: 6th January, 2000.
Date of commencement: 14th January, 2000
ARRANGEMENT OF SECTIONS
Section

PART I – PRELIMINARY
1 – Short title.
2 – Interpretation.
PART II – GENERAL PRINCIPLES
3 – Entitlement to a clean and healthy environment.
PART III – ADMINISTRATION
The National Environment Council
4 – Establishment of the National Environment Council.
5 – Functions of the Council.
6 – Procedure of the Council.
The Authority
7 – Establishment of the National Environment Management Authority.
8 – Headquarters.
9 – Objects and functions of the Authority.
10 – Board of Authority.
11 – Powers of the Authority.
12 – Powers in respect of lead agencies.
13 – Conduct of business and affairs of the Authority.
14 – Remuneration of Director General and Directors.
15 – Delegation by the Authority.
16 – Staff of the Authority.
17 – The common seal of the Authority.
18 – Protection from personal liability.
19 – Liability of the Authority for damages.
20 – General Fund.
21 – Financial year.
22 – Annual estimates.
23 – Accounts and audit.
24 – National Environment Trust Fund.
25 – National Environment Restoration Fund.
26 – Investment of funds and disposal of assets.
27 – Annual Financial Report.
28 – Dispute Boards.
Provincial and District Environment Committees
29 – Provincial and District Environment Committees.
30 – Functions of Provincial and District Environment Committees.
31 – Public Complaints Committees.
32 – Functions of the Complaints Committee.
33 – Powers of the Complaints Committee.
34 – Proceedings of the Complaints Committee presumptuous.
35 – Disclosure of interest.
36 – Remuneration and other expenses of the Complaints Committee.
PART IV – ENVIRONMENTAL PLANNING
37 – National Environment Action Plan Committee.
38 – Provisions of the National Environment Action Plan.
39 – Provisional Environment Action Plans.
40 – District Environment Action Plans.
41 – Contents of Provisional and District Environment Action Plans.
PART V – PROTECTION AND CONSERVATION OF THE ENVIRONMENT
42 – Protection of rivers, lakes and wetlands.
43 – Protection of traditional interests.
44 – Protection of hill tops, hill sides, mountain areas and forests.
45 – Identification of hilly and mountainous areas.
46 – Re-forestation and afforestation of hill tops, hill slopes and mountainous areas.
47 – Other measures for management for hill tops, hill sides and mountainous areas.
48 – Protection of forests.
49 – Conservation of energy and planting of trees or woodlots.
50 – Conservation of biological diversity.
51 – Conservation of biological resources in situ.
52 – Conservation of biological resources ex situ.
53 – Access to genetic resources of Kenya.
54 – Protection of environmentally significant areas.
55 – Protection of the coastal zone.
56 – Protection of the ozone layer.
57 – Fiscal incentives.

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION (WETLANDS, RIVER BANKS, LAKE SHORES AND SEA SHORE MANAGEMENT) REGULATIONS, 2009

SPECIAL ISSUE 31

LEGAL NOTICE NO. 19

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION (WETLANDS, RIVER BANKS, LAKE SHORES AND SEA SHORE MANAGEMENT) REGULATIONS, 2009

ARRANGEMENT OF REGULATIONS

PART I-PRELIMINARY

1-Citation
2-Interpretation

PART II – MANAGEMENT OF WETLANDS AND WETLAND RESOURCES

3-Application of Part
4-Objectives of Part
5-General Principles
6-The Standards Enforcement Review Committee.
7-The District Environment Committee.
8-Protected Wetlands
9-Procedure for Declaration of Protected Wetlands
10-Inventory of Wetlands.
11-Permitted use of Wetlands.
12-Wetland Resource Use Permit
13-Temporary Permit
14-Duty of Land Owners, users and occupiers

PART III- MANAGEMENT OF RIVER BANKS, LAKE SHORES AND SEA SHORE

15-Application of Part.
16-Objective of Part.
17-General Principles.
18-Identification of Degraded River banks, Lakes shores and Sea shore.
19-Resource Use Permit
20-Duty of District Environment Committee

PART IV – MISCELLANEOUS

21-Requirement for Environment Impact Assessment.
22-Environmental Restoration Order.
23-Duty of Environment Officer
24-Sanitation

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

What are Environmental and Social Considerations (ESC)?

A project aiming for economic and social development may nevertheless entail a risk of having negative impacts on the environment or society, such as pollution, loss of natural habitat, involuntary resettlement, and infringement of people's rights. Avoidance or minimization of such risks must be realized as an integral part of the project itself, with its cost included into the development cost.1 This is the gist of Environmental and Social Considerations, and they must be applied to JICA projects in accordance with the Guidelines for Environmental and Social Considerations (ESC Guidelines).

Source: The Basics of Environmental and Social Considerations Introduction to the JICA Guidelines for Environmental and Social Considerations

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

Impacts on the environment

- Pollution (e.g., impacts on air, water, and soil and impacts caused by waste)
- Impacts on biota and ecosystems
- Trans-boundary or global impacts including climate change and loss of biological diversity

Impacts on society

- Involuntary resettlement, migration, and urbanization
- Unfair distribution of benefits, local conflicts of interest, and impacts on local economy
- Impacts on vulnerable populations such as indigenous peoples and the poor, gender equality, and children's rights
- Impacts on community health and safety (including accidents and epidemics such as HIV/AIDS)
- Impacts on, or caused by, the labour environment (including occupational health and safety)
- Impacts on social structures, social infrastructures, and social services
- Impacts on cultural heritage

Source: The Basics of Environmental and Social Considerations Introduction to the JICA Guidelines for Environmental and Social Considerations

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

Category A

The project is likely to have significantly adverse impacts on the environment or society. For example:

- A project with a wide range of impacts, impacts that are irreversible, complicated, or unprecedented, and impacts that are difficult to assess.
- A project for a sector that requires special attention (e.g., a sector that involves large-scale infrastructure development), involves activity that requires careful consideration (e.g., large-scale involuntary resettlement), or takes place inside or adjacent to a sensitive area (e.g., protected natural habitat).

Category B

The project may have adverse impacts on the environment or society, but these impacts are less significant than those of Category A projects. These impacts are site-specific; few, if any, of them are irreversible; in most cases, they can be mitigated more readily than Category A projects. Responsibilities of the project proponents include the planning and monitoring of necessary ESC activities.

ESC procedures such as Initial Environmental Examination and stakeholder participation may be required, depending on the scale and nature of the adverse impacts.

Source: The Basics of Environmental and Social Considerations Introduction to the *JICA Guidelines for Environmental and Social Considerations*

B. Process of implementing a construction project
B2. Environmental Impact Assessment (EIA)

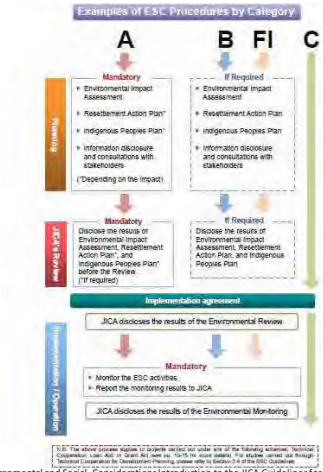
Category C

The project is likely to have minimal or no adverse impact on the environment or society.

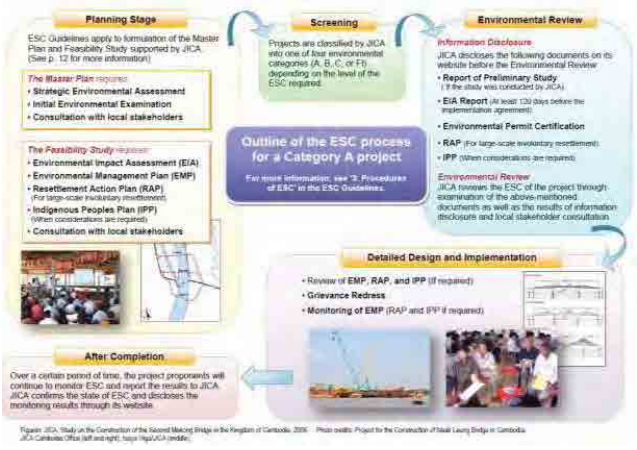
Category FI

JICA provides funds to a Financial Intermediary, which in turn implements sub-projects that may have adverse impacts on the environment or society, but these impacts cannot be identified in detail prior to JICA's approval. If there is a sub-project that can be categorized as Category A, it needs to go through the same procedure as a Category A project including JICA's environmental review and information disclosure prior to its implementation.

Source: The Basics of Environmental and Social Considerations Introduction to the JICA Guidelines for Environmental and Social Considerations



Source: The Basics of Environmental and Social Considerations Introduction to the JICA Guidelines for Environmental and Social Considerations



Source: The Basics of Environmental and Social Considerations Introduction to the JICA Guidelines for Environmental and Social Considerations


Thank you for your attention!!
Asante Sana

Module 8

8-1 Co-operation and Co-ordination between Upstream and Downstream WRUAs in a River Basin

Module 8-1

Co-operation and Co-ordination between Upstream and Downstream WRUAs in a River Basin

Mrs. Elizabeth Diego-Lusimba
Assistant Technical Coordination Manager - Community Development

Objectives

- Collaboration with upstream and downstream WRUAs within a river basin
- Cooperation and coordination process within WRUA members and other stakeholders in dealing with a flood disaster risk

Collaboration, Coordination and corporation of upstream and downstream

- WRUAs can provide appropriate forums for such coordination and integration.
- The best examples of such practice are likely to be found where circumstances required the coordination and cooperation of existing institutions (Floods)
- Challenge faced is promotion of coordination and cooperation across functional and administrative boundaries rather than river drainage basin boundary

Cont'

- Water related disasters, such as floods and droughts, because they play an important part in determining sustainable development, need to be integrated into water resources management.
- To ensure Collaboration and coordination between upstream and downstream in a river basin firstly identify WRUAs upstream and downstream

Areas of Cooperation and information sharing

- Hydro-meteorological monitoring network, rainfall patterns and flood events
- Establishing community early warning system
- Mapping flood prone areas and ensuring all the WRUAs are informed accordingly
- Establishing focal committee members for easy communication
- Networking among the WRUA members in both the upstream and downstream areas in the river basin

Importance of Cooperation, Coordination and information sharing

- Allows for real-time flood mitigation planning, coordination, evacuation, response and rescue cooperation in order to:
  - Avoid damage to downstream flood mitigation structures and people
  - Reduce flood risks in the downstream areas
  - Prepare for evacuation
  - Provide early warning to the downstream sections of river

Importance of co-operation and co-ordination of activities in the river basin among the WRUAs and community members

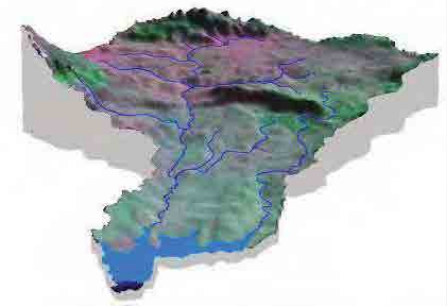
- Water use demands among the users
- Equitable sharing of the water resources and sustainability
- Networking and knowledge sharing among the WRUAs
- Communication networks on flood disaster risks
- Collaboration with other stakeholders
- Active community participation and ownership

WRUA and community participation

- Initial community and WRUA meetings
- Identifying areas of co-operation and co-ordination
- Drawing areas of need to be addressed.
- Making a plan of action for implementation purposes

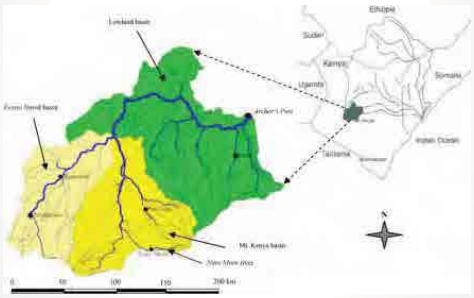
River Basin Characteristics

River Nzoia



Ewaso Ngiro North

Varied climato-vegetation cover



Land use pattern in the Upper Catchments - Usambaras

Areas of Deforestation and land degradation

???? Bridge

Reduce flood risks in the downstream areas About 21 people killed and 60,000 homeless in eastern Kenya

Prepare for evacuation

Ewaso Ngiro, Samburu Lodge 04/03/2010

Disaster Impact - 6 September 2010

Community Flood Hazard Map

To involve downstream % Upstream?
To cover specific areas; Downstream?
Upstream?

Which way is the best?
Integrated FMP of upstream And downstream.

ASANTENI

HAPPY KENYA AT 50!

Module 8

8-2 Role of Co-operation and Co-ordination

Module 8-2
Role of Cooperation and Coordination

Eng.Matagaro W.O
WRMA

introduction

We need to understand who we are cooperating with and why we are cooperating with him.

We need to understand why we are coordinating.

We need to have A Well structured cooperation and coordination to deal with a flood.

We need to understand that Floods management is integrated.

Introduction cont.

- It touches on various sectors of the economy
- It involves various institutions/stakeholders

- It touches on various levels of government
- International
- National
- County for that matter
- It involves upstream and down stream WRUAs

- It involves district disaster management committee.

Questions to ask

What are the existing flood risk mitigation measures in the river drainage basin or flood area?

What issue would they like the WRUA committee to address

Who will be the stakeholder groups within the catchment

What will be the roles of the community in the plan of action?

Who will execute the plan of action

What is the time frame for the implementation of the flood risk reduction plan of action

Example in Japan (Yamato River)

Catchment area 1070 ha
Length of mainstream 68km

There are always conflict between areas
Upper stream (frequent flood) and lower stream (possibility of catastrophic flood)
Left bank and right bank
Also water quality, environmental conflict

Upper and Downstream floods

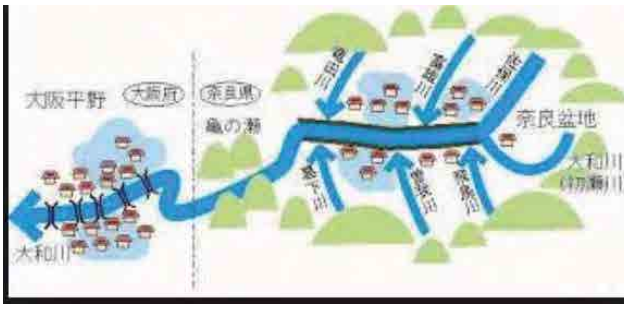
// flood between upper and down stream

Upper stream

- Recently urban development high
- Frequent flood due to Kamenose valley is narrow (due to the land slide) and flood water capacity limited

Downstream

- Very highly populated area but not experienced flood from Yamato river more than 100years



7

cordination

1. Flooding of Yamato River is very important for both prefecture
2. In japan the Central government makes coordination and implementation

- The central government does landslide rehabilitation
- Exchange information and draft River Plan and river channel improvement
- Prepare Comprehensive flood management plan

8

cooperation

Yamato clean day
20,000 and 120t

Forum and committee

9

Module 8

8-3 Co-operation with County Government, WRUA and DDMC

8-4 Role of District Disaster Management Committee (DDMC)

Module 8-3 and 8-4
Co-operation with County Government, WRUA and DDMC

21th February, 2014
Sunset Hotel, Kisumu

Willis MEMO
Assistant Technical Coordination Manager- Community Development
Water Resources Management Authority (WRMA)

willismemo@ymail.com

1

OUTLINE

- Objectives of the presentation
- Introduction to cooperation and coordination with local government and WRUA
- Role and functions of County Government
- Role of WRUA in Floods management
- Role of DDMC

2

Objectives and Expected Outcomes

- Clear understanding of basin linkages – upstream/downstream, actors, institutions, planning levels
- Roles of key institutions in flood management- data and information gathering and dissemination, early warning, planning, rescue operations and recovery.

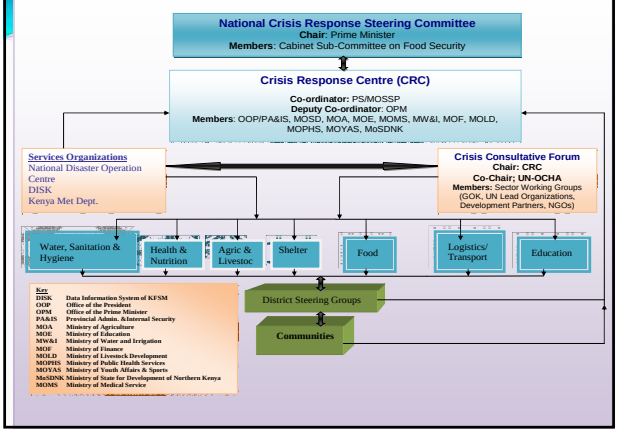
3

Cooperation and coordination with Local and County Governments and WRUA

- Cooperation and Coordination (NDOC)
- Community members
- Local government officers
- Academia
- NGOs
- CBOs

4

CO-ORDINATION STRUCTURE FOR THE CRISIS RESPONSE



Role of CRC

- Prepares costed floods contingency plans
- obtains real time daily updates from the District Disaster Committees and/or District Steering Group.
- supports relevant Ministries in carrying out Post Disaster Assessment on damages and losses.

6

ROLE OF CRC CONT./

- Serves as the Secretariat of the Technical Committee comprising the PSs
- Convenes Crisis Consultative Forum so as to engage other Development partners
- Prepares memos for appraising the Cabinet on damages and their costs

7

Functions of National Disaster Operation Centre

- To co-ordinate and control of disaster response efforts,
- To act as the command centre for all communications and information relating to response operations, and
- To liaise with responsible ministries on national response efforts.

8

Responsibilities of the NDOC [1]

- Coordination at the national level of all disaster management activities before, during and after the disaster
- Ensuring that all personnel and volunteer agencies are informed of the activation of disaster contingency plans
- Translating the decisions of the National Disaster Coordinating Committee (NDCC) into action and/or instructions and ensuring that those instructions are transmitted and carried out by the Ministries/Departments to whom they are directed

9

Responsibilities of the NDOC [2]

- Preparing all inventories of resources and assets countrywide
- Developing a prioritized list of needs for donors to meet shortfalls in relief supplies
- Preparation of evacuation plans, shelter and refugee areas including identification of executing agencies
- Arranging clearance for aircraft, ships as well as customs and visa clearance for overseas relief personnel and agencies

10

Responsibilities of the NDOC [3]

- Preparation of media programmes for public information and press briefings at the centre
- Carrying out an annual review, evaluation and validation of national and sectoral disaster mitigation plans with a view of improving their effectiveness and efficiency
- Preparing and issuing a daily situation report (SITREP) to the subscribing ministries/departments

11

County Government

- Role: Disaster monitoring; assessment; PPP
- All county policies, plans and initiatives should integrate DRR issues.
- Constitutional requirements
- Constituent members of the DDMC
- Functional capability of DDMC

12

Functions of the County Government[1]

- Ensure that DRR is a county priority with a strong institutional and coordination mechanism.
- Develop or strengthen disaster preparedness mechanism for effective response at community level.
- Develop disaster information data base, communication and dissemination strategy on county disaster risks and enhance early warning.

13

Functions of the County Government[2]

- Ensure Disaster Risk Management (DRM) is integrated into critical sectors including but not limited to health, construction, infrastructure, agriculture, environment and natural resources, county economic plans and physical planning.
- Mainstream climate change related risks.
- Establish county disaster dissemination and education strategy including factoring DRR issues into county education system and community awareness strategy.

14

Responsibilities of CDMC [1]

- Coordinating emergency response in liaison with MRDM.
- Operating communication and early warning system.
- Coordinating compilation of disaster contingency plans.
- Administering and accounting for disaster funds.
- Appointing lead and partner agencies, through MoUs, to coordinate emergency responses in their areas of jurisdiction.
- Conducting inventory on the response capacity of the emergency services and disaster experts including volunteers.

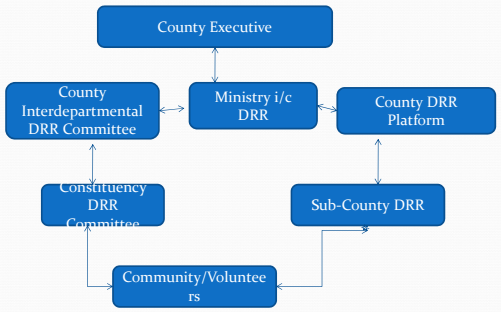
15

Responsibility of CDMC [2]

- Working with other committees to support community in DM.
- Organising and participating in DM education and training needs assessment in conjunction with local experts, volunteers and trained personnel.
- Monitoring and evaluating DM activities in the provinces.
- Coordinating training and public awareness activities.
- Coordinating DRR activities and main streaming them in development plans.

16

County DRR Coordination mechanism



17

District Disaster Management Committee

- District Commissioner – responsible for security and disaster warning, contingency planning, evacuation and recovery.
- District Disaster Committees (DDC)
- Location and Sub-location level
- Role: Functional capability

18

Tasks of DDMC

- Vulnerability Assessments of the district or county
- Reviewing the threats of disaster
- Evaluating the preparedness
- Raising housing structures
- Clearing drainage ways
- Identify safe grounds for evacuation
- Plan for the kind of interventions
- Stocking of drugs/medicine/food resources.
- Considering suggestions for the improvement of the District Disaster Management Plan

19

Who are WRUAs?

- WRUAs an association of water users, riparian land owners, or other stakeholders who have formally and voluntarily associated for purposes of cooperatively sharing, managing and conserving a common water resource.
- addresses water resource problems and conflicts.

20

Community or WRUAs

- Community members are inescapably the first responders
- Importance of local information
- Impact on better react and response to disasters
- Enables prompt recovery from damages – Capacity improved
- Builds community resilience from disasters.

21

WRUAs during Pre-flood disaster Phase

- Public awareness creation;
- Identify raised ground for safety;
- Conduct evacuation drills;
- Inspection of infrastructure and
- Resource mobilization.

22

During Flood

- Creating partnerships with NGOs such as Red Cross
- Rescue and moving to raised ground
- Provision of relief aid
- Counselling and guidance to the victims

23

Post Flood Disaster

- Dispatching community to their homes
- Damage assessment
- Provision off relief aid
- Minor reconstruction of community roads, latrines, footbridges and schools.

24

Community first to Respond

25

Importance of local information

26

WRUA Assessment of the flood depth

27

WRUAs Collaboration

Identify areas of co-operation and information sharing such as;

- Communication networks on rainfall patterns and flood events
- Establishing community early warning system
- Mapping flood prone areas and ensuring all the WRUAs are informed accordingly.
- Establishing focal committee members for easy communication
- Networking among the WRUA members in both the upstream and downstream areas in the river basin

28

Activities of the CFMOs at village level

- Public awareness creation
- Identify raised ground for safety
- Conduct evacuation drill
- Rescue and moving to raised ground
- Counselling and guidance to the victims
- Collaborating with other agencies like Red-cross , etc
- Dispatching Community to their homes
- Drainage Assessment

29

Responsibilities of committee members

- To educate the public on different flood and other man-made or natural hazards
- What protective steps should be taken to minimize impact of disasters
- To make arrangements for emergency action
- To effect evacuation from the affected villages when necessary
- Rescue and Rehabilitation
- Post disaster action and review

30

Results of Cooperation and Coordination

- Real-time flood mitigation planning, co-ordination, evacuation, response and rescue operation to afford the following;
- Avoid damage to downstream flood mitigation structures
- Reduce flood risks in the downstream areas
- Prepare for evacuation
- Provide early warning to the downstream sections of the river
- etc

31

Private sector Participation

- **Early Warning** - 30/04/ 2010, KENGEN issued a flood alert warning of imminent floods due to release of excess waters in excess through Masinga Dam, over 150,000 people are likely to be affected in Garissa and Tana Delta

32

Role of Media in Flood Management

- Early Warning and bulletins
- Relief and recovery support
- Dissemination of information and regular briefs

33

THE END

THANKS FOR LISTENING

34