CHAPTER 4

HOW TO DESIGN COMMUNITY-DRIVEN STRUCTURAL MEASURES

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF WATER AND IRRIGATION (MWI)
WATER RESOURCES MANAGEMENT AUTHORITY (WRMA)

THE STUDY
ON
INTEGRATED FLOOD MANAGEMENT
FOR
NYANDO RIVER BASIN
IN
THE REPUBLIC OF KENYA

GUIDELINE ON

COMMUNITY DRIVEN FLOOD MANAGEMENT

(STRUCTURAL MEASURES)

MARCH 2009

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1. INTRODUCTION

1.1 Background

The master plan on water resources development in the Nyando river basin was formulated in 1983 consisting of mainly proposed structural measures including dams and dikes with relatively high costs. As a result, most of structural measures have not been put in place, since the government can not arrange such huge investment immediately. In addition, the extensive flood inundation during extraordinary flood events would not have been avoided even if the structural measures were constructed as proposed in the mater plan. Therefore, the structural measures with low cost or non-structural measures on a community basis had to be mainly considered in the present JICA Study. The best mix of strategies in flood management, such as short- middle-, and long-term and structural and non-structural, is one of important elements in an integrated approach to flood management.

The lower reach of the Nyando river has been unfortunately suffering from the frequent flood damages with casualty in the rainy season almost every year. Under such circumstance, there are loud and eager cries for the implementation of low cost structural measures in the number of communities. In July 2007, pilot projects on structural and non-structural measures will be thus implemented in the pilot communities. The implementation of the pilot project were carried out taking into consideration the community driven or participatory approaches by first setting up the Community Flood Management Organization (CFMO), especially in view of disseminating experience and performance of the target communities to adjacent communities.

For coping with the above chronic problems, further small scale and low cost projects will be required by community basis. It is expected that such projects will be implemented in the collaboration with the Water Resources Management Authority (WRMA) and CFMO. In this regard, Guideline on Community Driven Flood Management (Structural Measures) was prepared for the reference of WRMA for further implementation of such projects, so that those projects carry out by user's own responsibility in as many communities as possible.

1.2 Objectives Users and Composition of the Guideline

This Guideline was prepared as a basic reference principally for WARM Staff aiming at smooth and effective implementation of the project for further flood damage mitigation works. The emphasis has been put on necessary technical considerations and procedures including planning, selection of contractors or NGOs, construction supervision (management) and operation and maintenance activities after completion of the project.

The guideline is subsidiary expected to be used by the representatives of CFMOs to be set up in the target community.

The Guideline consists of 5 chapters and Appendix compiling the related materials. Major contents of each chapter are as follows.

1. Introduction: Background and objectives of the guideline,

2. Applicable Structural Measures and Implementation Procedure: Options for applicable small scale structural measures under community initiative and involvement, and overall procedure for the project implementation cycle,

3. Planning and Formulation of the Project: Points kept in mind for formulation of the projects, and standard dimensions of the structures, and sample drawings,

4. Construction Management: Overall procedures at the construction management stage and points kept in mind for construction supervision, and

5. Operation and Maintenance Activities: Maintenance activity cycle on the community basis and key points in mind in each period;

1) Ordinary time: inspection of constructed structures,
2) Pre- flooding: repair works, if needed,
3) During flooding: inspection and flood fighting activities, and
4) Post- flooding: repair works, if needed and return to 1).

Appendix: Reference data for various impacts resulting from implementation of possible structural measures, sample forms of priced bill of quantity and bill of quantity for tender use, etc.

2. APPLICABLE MEASURES AND IMPLEMENTATION PROCEDURE

In order to increase the sustainability of the structural measures built to protect against flooding, it is recommended that small scale structural measures should be built using community initiative and involvement. Involvement of communities in the construction and the knowledge they gain is highly useful for the communities, since they will manage and maintain those structures as their own property.

2.1 Applicable Community Driven Structural Measures

For community driven flood management in the lower Nyando river basin, various small scale structural measures are available as shown in Table 2.1.

Table 2.1 Applicable Community Driven Structural Measures

Structural Measures	Possibility of Community Driven Measures	Remarks
1. Dike construction	- The construction is basically not possible. But installation of ramps for easy and safe access to the river would be possible.	- Locations will be selected by the community. Proper coordination between government and the community should be made.
2. Ring levee	- Small scale ring levee is possible.	- Arrangement of material supply may be required for the community.
3. Excavation/desiltation of drainage canal and ditch	- Most cases are possible. However, impact to communities located in the downstream area should be carefully checked.	- Priority will be considered by both the community and government.
4. Construction of water pan	- Small scale ponds such as water pans are possible.	- Locations will be selected by the community. Land acquisition is needed.
5. Bank protection work	- Small scale protection is possible.	- Material supply will be required for the community.
6. Raising local roads	- Community roads are possible, while inter-community roads should be improved by the government.	- Locations will be selected by the community. Proper coordination between government and the community should be made.
7. Culvert improvement	- Small scale improvement is possible.	- Material supply will be required for the community.

Data source: JICA Study Team

2.2 Procedures for Project Implementation

Throughout the project implementation cycle, the leadership for the implementation is taken by WARM in collaboration with CFMO and Forum in Nyando River Basin. Overall procedures will be as follows.

(1) To set up CFMO in target communities and confirm needs and creation of awareness for project implementation,

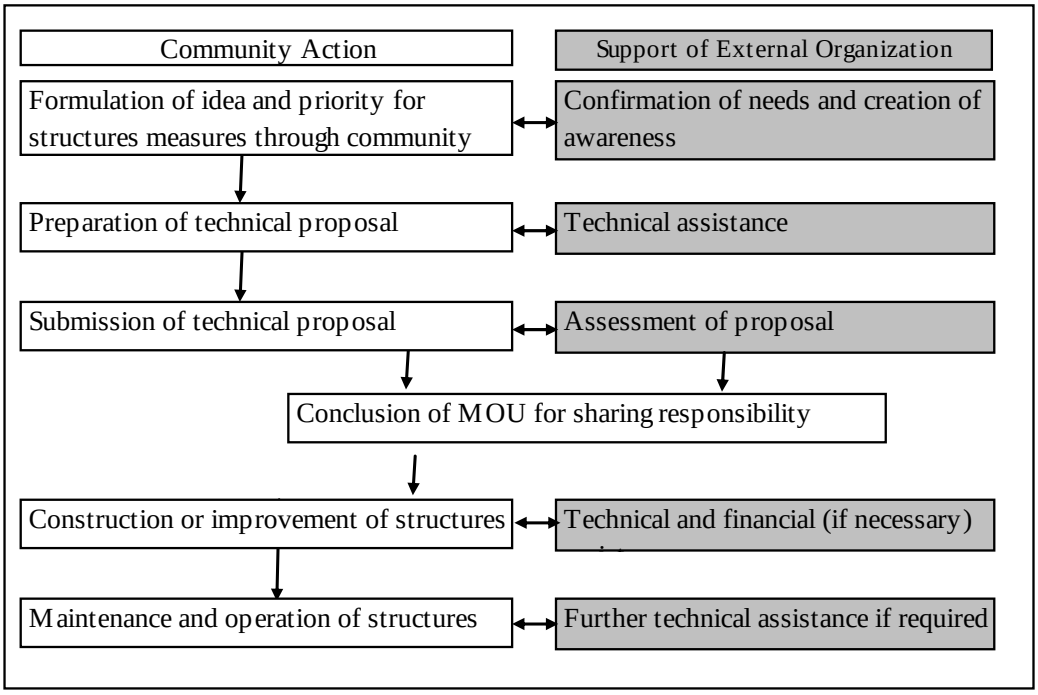
(2) Need survey for project implementation will be conducted. The need survey is made throughout workshop by Participatory Rural Appraisal (PRA) or simple workshop in the objective communities,

(3) Based on the confirmation of community need, planning and design of the project are conducted,

(4) Contractor or NGO is selected by competitive bidding system and construction works will be started, and

(5) After completion of the project, constructed structures and facilities are operated and maintained by the concerned CFMO.

In view of technical aspect, the overall procedure and roles and responsibility between the community and related external organization are illustrated in Figure 2.1.



Source: JICA Study Team

Figure 2.1 Overall Procedures and Responsibility between Community and External Organization

3. PLANNING AND FORMULATION OF STRUCTURAL MEASURES

3.1 Category of Community Driven Structural Measures

As already explained in the above 2.1, there are various community-driven structural measures in flood management. The structural measures taken up in this guideline are only the cases of the small scale measures which are different from those large scales in the pilot project conducted by JICA Study Team in 2007.

The applicable structural measures will be categorized into the following 5 groups by work natures.

(1) Embankment works (for dyke in the minor drainage canal, ring levee and raising elevation of foot path surface),

(2) Excavation and desiltation works (for small drainage canal),

(3) Construction of water pan (for small scale water pan),

(4) River and canal bank protection works (for small drainage canal) and

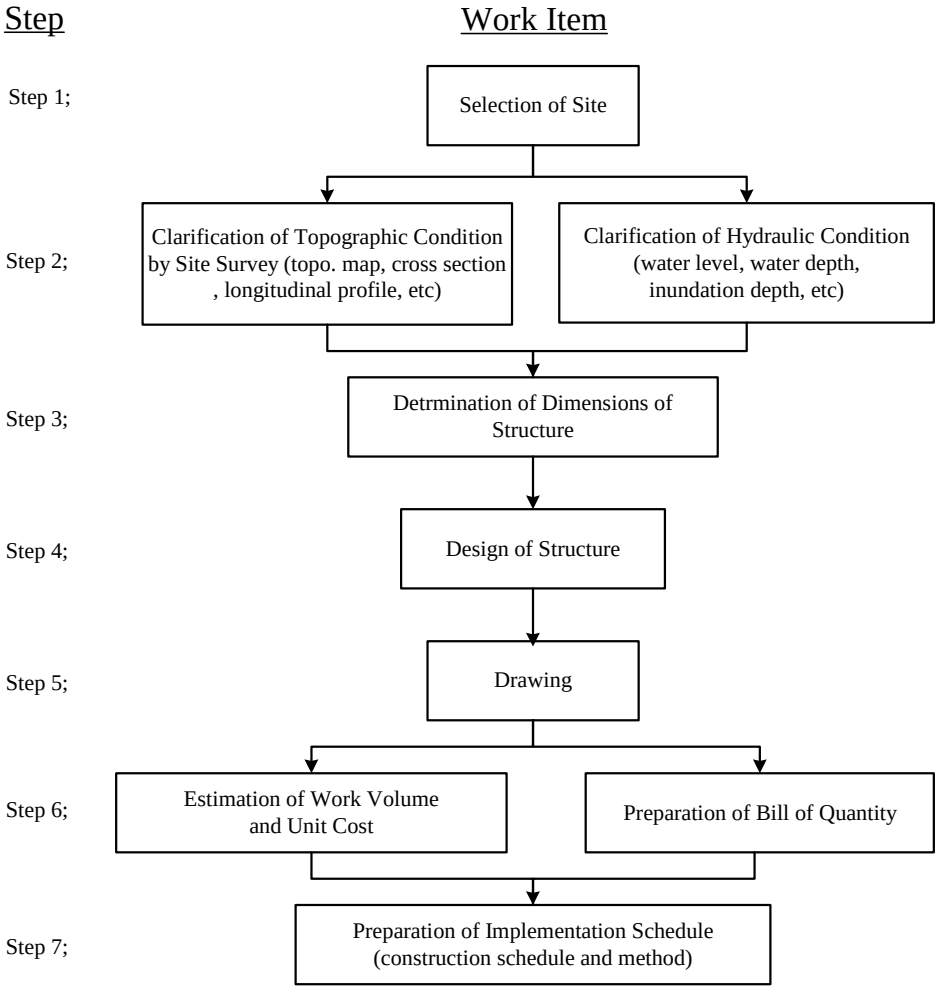
(5) Culvert improvement works (for drainage across under community roads).

An achievement of such categorized works will be quite much contributed to mitigate flood damage or to keep the transportation system operating without interruption during flooding. However, an adverse impact by implementation of the works might be arisen to the lower areas due to increased flow, especially in dyke embankment and desiltation of canal works. A special attention should be paid to planning and design for the respective categorized works. The impacts arisen from the implementation of those measures is described in APPENDIX 1.

3.2 Planning Procedure of the Project

The necessity and urgency of the categorized works (works type) to be taken up in the community driven measures are firstly discussed on the community basis. After selection of the categorized works, planning of the structural measures will be started under the leadership and supervision by WRMA.

The following Figure 3.1 shows the overall procedure for planning of the structural measures for formulating the project.



Data source; JICA Study Team

Figure 3.1 General Planning Flow of Project Formulation

3.3 Preparatory Works

Prior to planning of the projects, it is firstly needed to assess the present conditions of the target area from topographic, hydrologic and environmental viewpoints. The present condition of the target area will be clarified in the following manner.

(1) Joint reconnaissance and inspection in collaboration with the residents including representative from the target community to clarify present conditions of the target area,

(2) Collection of information on hydrological and flooding characteristics (overflow depth, duration, direction, etc), and

(3) Surveying works of cross sections at several points in the objective sites, if needed

(by using level equipment or tape measurement), etc.

(4) In addition, the hydrological study results, the disaster map, etc., explained in the progress report and the interim report prepared by the JICA Study Team so far will be useful tool for your understanding.

3.4 Planning of Community Driven Structural Measures

3.4.1 Embankment Works

(1) General

The embankment works in this category will be applied to;

1) Small scale dyke in the drainage canals and

2) Foot path as community evacuation road.

Major points to be considered in such embankment works will be the determination of dimensions (height, width, slope gradient, etc) of the target structures. The respective dimensions of the target structures will be explained in the following.

(2) Dyke Embankment

The dyke is constructed to confine flood flow within the channel or canal so as not to overflow into both the land sides and basically constructed by excavated earth materials and/or sand bags from the economical viewpoint. The top of the dyke is also expected to be used as the community roads in the ordinary time and as an evacuation route in the emergency time, respectively. Accordingly it is necessary to secure sufficient width and height of the dyke structures; however, this is not based on the detailed hydrological study.

1) Dimension of Dyke

The recommendable standard dimensions of the dyke will be as follows.

Table 3.1 Major Dimensions of Dyke and Ditch

Item	Dimension of Dyke (m)				Remarks
	Height/Depth	Top width	Bottom width	Dyke slope	
Dyke jointly used as community road	1.0 (minimum)	2 to 3	6 to 7	1:2	Dyke surface is protected by sodding.
Ditch for drain	0.5	1.5	0.5	1:1	Apart from 0.5 to 1.0 m from foot of dyke

Data source; JICA Study Team

The points in mind will be as follows.

a. To construct on both the banks along canal,

b. Alignment (toe of the dyke slope) of the dyke is set apart 0.5 to 3.0 m from the existing canal banks considering dyke stability,

c. Extreme bending portion is improved with smooth alignment,

d. Embankment materials are basically obtained in the adjacent borrow pit (clayey soil, see following 2) Embankment Materials),

e. Extra embankment (10 to 30cm height) is needed on the dyke crown (top surface of dyke for the surface ground sinkage (subside) in the future,

f. Top surface of dyke crown is inclined towards side ditches for surface drainage,

g. Side drain at the land side is provided for drainage in the land area,

h. Slopes and top width (crown) of the dyke is covered by sod (turf) to protect from flow attacking, and

i. Following Figure 3.2 is an image of dyke surface covered by sod (turf).

Data source: JICA Study Team

Figure 3.2 Finish Works of Dyke Embankment (sod facing in Japan)

2) Embankment Materials

It can be said that the excavated soil consisting of the black cotton soil in the lower Nyando and other rivers are not suitable to embankment materials according to the site survey. It might be said that such excavated materials are not be used as embankment materials as they are. The suitable materials will be clayey soil.

The pilot project of the embankment works will be experimentally conducted in the Nyando river during the JICA Study period. The dyke in the pilot project is to be constructed in combination with excavated soil as the dyke body and sand bag (with mixing excavated soil and

soil cement). The purpose of sand bag is to reinforce the channel side slope as protection works against scouring by the flow attacking.

In this dyke embankment works, however, it can not help to apply the following alternatives considering the economical viewpoint (low cost works).

a. To use excavated soil in the drainage canal (ideally to mix excavated soil with clayey soil obtained from borrow pit)

b. To use sand bag (mixed excavated soil with soil cement)

3) Sand Bag

The sizes of the sand bag applied in the pilot project will be as follows. The size is subject to change depending on the site condition and purpose of the works.

Table 3.2 Size of Sand Bag

Case	Dimension of Sand Bag	Remarks
Sand bag for bank protection	- 0.1m high* 0.4m wide* 0.4m long (16 litters)	- For raising foot path elevation

Data source; JICA Study Team

The procedure of embankment by the sand bag will be as follows.

Step 1: Filling soil in the bag and tying: by using container: 16 litters depending on bag size (mixing of soil cement by using small scale mixer, if needed)

Step 2: Placing and compaction by plate compactor or wood hammer

Step 3: Placing soil in the openings of sand bag

Step 4: Compaction

Step 5: Repeat for next layer (several layers)

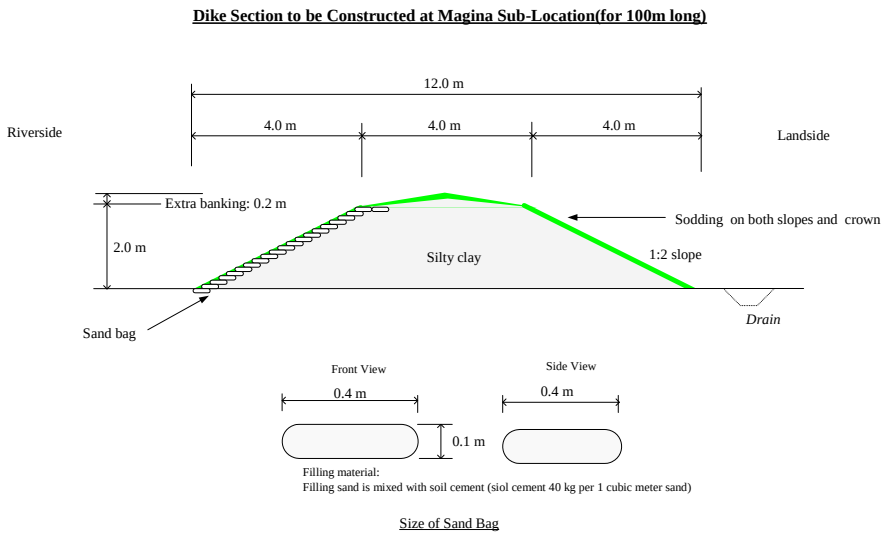
Step 6: Placing soil on surface of foot path or dyke (with thickness 5 cm)

Step 7: Compaction and finish (surface slope is inclined towards side ditches and sod facing)

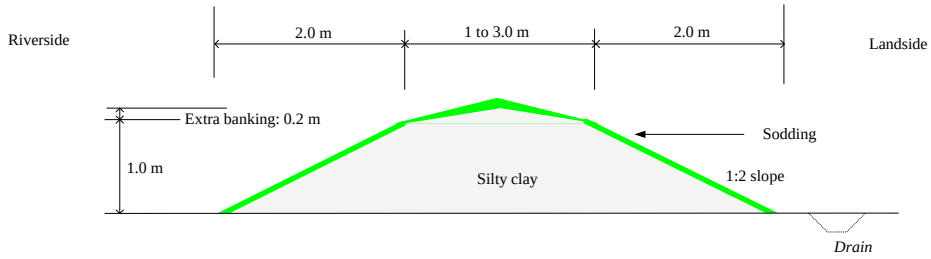
Step 8: Return to Step 1

4) Sample Material for Design

Case 1: with Sand Bag



Case 2: without Sand Bag



Data source; JICA Study Team

Figure 3.3 Sample Section of Dyke Embankment

(3) Raising Surface Elevation of Foot Path

On the other hand, raising the surface elevation of foot path is carried out to keep the transportation system operating without interruption during flooding. In addition, the raised road is sometimes called a secondary dyke, which enhances the degree of safety in the event of failure of the main river dyke. Hence, the raised road is fairly effective as an absorber or buffer against a break of the main river dyke during an extraordinary flood event.

1) Dimension of Foot Path and Embankment Materials

The target works in this category will be the local foot path. The recommendable dimensions of the foot path to be raised will be accordingly as follows.

Table 3.3 Major Dimensions of Foot Path

Item	Dimension of Foot Path (m)				Remarks
	Height/Depth	Top width	Bottom width	Side Slope	
Foot path	0.8 to 1.0 (minimum)	1.5 to 2	3 to 4	1:1.5	- Surface of road is protected by sodding.
Ditch for drain	0.5	1.5	0.5	1:1	- Apart from 0.5m from foot of dyke

Data source; JICA Study Team

The points in mind will be as follows.

a. Surface elevation of existing foot path is raised by embanking,

b. From the purposes and functions of the raised foot path, it is necessary to keep sufficient height with free board (additional height) against inundation depth in the surrounding area,

c. According to the hearing from the residents at several communities, it is reported that average inundation depth is around 50 to 70 cm during the ordinary flood scale,

d. Planned height is to be determined by adding a free board. In this guideline, the free board is adopted at 0.3 to 0.5 m,

e. Required top width of the foot path will be 1.5m in minimum and 2m ideally,

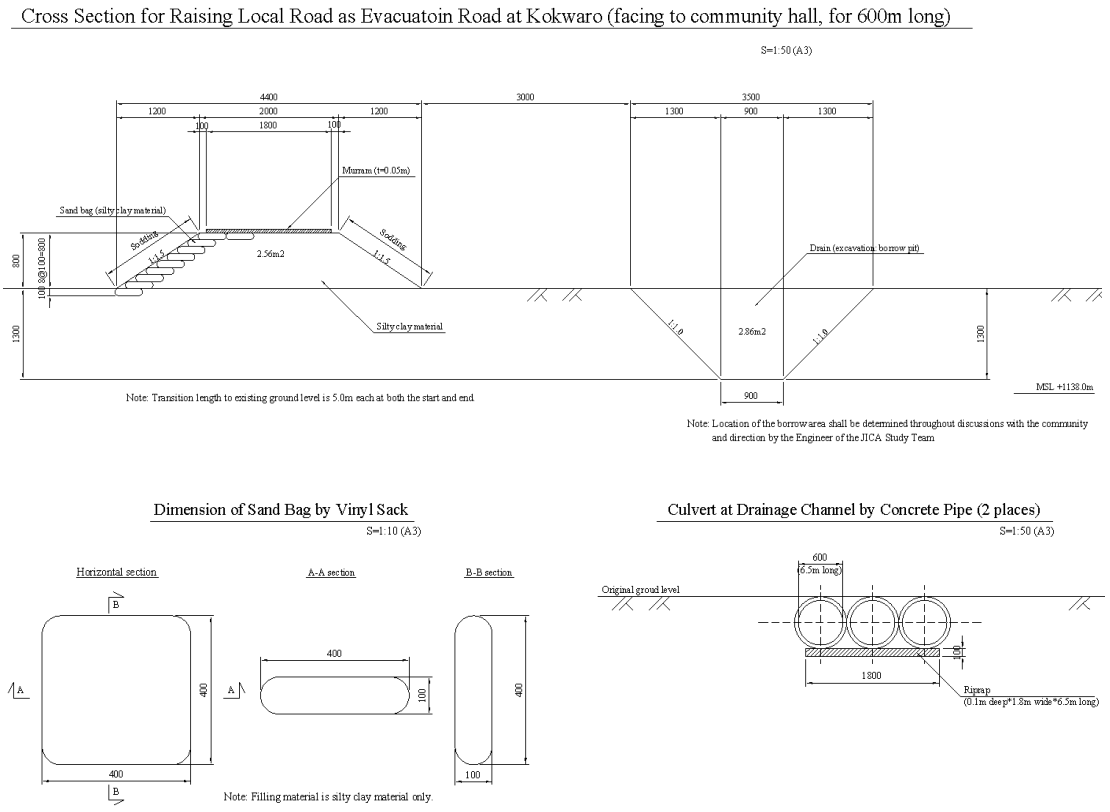
f. Embankment materials is basically obtained from the borrow pit at both the sides of the target foot path,

g. Surface of the raised foot path is covered by sod facing (turf),

h. Gravel (around 5cm thick) as pavement is placed on the top of path as alternative method, and

i. Excavated borrow pit section is diverted, as it is, as side drains for road surface.

2) Sample Material for Design: protection by sand bag



Data source; JICA Study Team

Figure 3.4 Sample Section of Raising Road Surface Elevation

3.4.2 Excavation and Desiltation Works

(1) General

A small drainage canal in the communities will be target in this categorized works. These works are defined as the operation and maintenance activities rather than the construction activity. Major points to be discussed will be longitudinal profile and dimension of cross section of canal to be excavated.

Such excavation and desiltation works of the canal are one of typical measures in the candidate community driven measures. The work itself is fairly simple and low cost. An achievement of this categorized works will be quite much contributed to drainage improvement in the target area in ordinary flooding time. However, an adverse impact by implementation of the works might be arisen to the lower areas due to increased flow. A special attention should be paid to such environmental aspects for the categorized works.

(2) Planning of Excavation and Desiltation Works

In this categorized work, the following 3 alternative cases are recommendable as the standard criteria in the community driven measures.

Table 3.4 Dimensions of Drainage Ditch/Canal to be improved

Item	Dimension				Remarks
	Top Width(m)	Depth(m)	Bottom Width(m)	Slope Gradient	
Case 1 (maximum class)	4.0	1.0	2.0	1:1	
Case 2 (middle class)	3.0	1.0	1.0	1:1	
Case 3 (minimum class)	1.5 to 2.0	0.5	0.5 to 1.0	1:1	Minimum bottom width is 0.5 m

Data source; JICA Study Team

The points in mind will be as follows.

a. As already mentioned in the above, the works are defined as maintenance activities rather than construction ones,

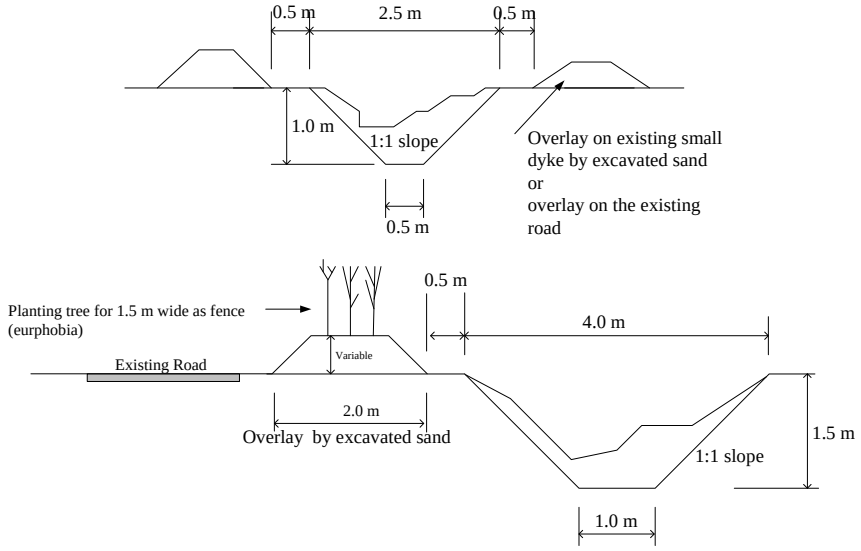
b. Accordingly, excavation or desiltation is to be made within the space of the existing drainage canal,

c. Total width of the canal depends on the sizes of the existing canals. There is also a case that the existing canal is widened in this connection,

d. Depending on the conditions of site and excavated soil materials, it is recommendable that those excavated materials be placed or embanked on the both the riverbanks as road or small dyke, and

e. In such case, some soil quality improvement might be needed to keep sufficient strength of the structures, as explained in the above 3.4.1 (2) 2) Embankment Materials.

(3) Sample Material for Design



Data source; JICA Study Team

Figure 3.5 Sample Section of Desiltation of Drainage Canal

3.4.3 Riverbank Protection Works

(1) General

The target works will be applied to the small scale works in the drainage canals or the local sites of the rivers of Nyamasaria, Ombeyi, Awach Kano, etc. The target sites might be the damaged sites due to the previous floods. In this sense, this categorized works are also defined as maintenance activities rather than construction ones.

(2) Planning of Protection Works

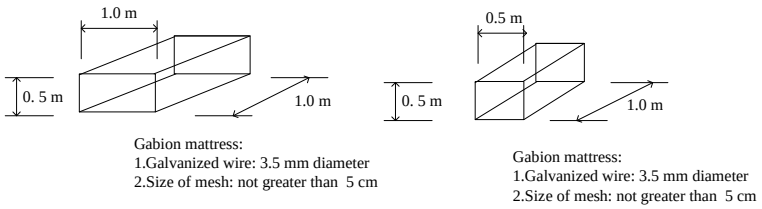
The dimension of the gabion mattress will be as follows.

Table 3.5 Dimensions of Gabion Mattress and Sand Bag

Item	Dimension of Structures	Remarks
Gabion mattress	- Case 1: 0.5 m high* 1.0 to 0.5 m wide* 1.0 m long - Case 2: 0.5 m high* 1.0 m to 0.5 m wide* 1.0 m long	- Galvanized wire: 3.5mm - Mesh size: 30 to 50mm
Sand bag	- Case 1: 0.1m high* 0.4m wide* 0.4m long (16 litters)	- Filling soil: by using container - Compaction: by wood hammer

Data source: JICA Study Team

Sample size of the gabion mattress will be as follows;



Data source: JICA Study Team

Figure 3.6 Various Size of Gabion Mattress

The points in mind will be as follows.

a. Purpose of riverbank protection works is to protect the riverbank from the flow attacking,

b. Among the various protection works, bank protection with gabion mattress would be effective and applicable to the rivers and drainage canals because of ample resources (materials) in the adjacent areas,

c. There are many advantages of the gabion type system over conventional protections that make it an appealing solution for the rehabilitation of riverine environments,

d. Depending on the site conditions, sand bag also will be one of the recommendable alternatives,

e. Longitudinal length and height is decided depending on the damaged site condition,

f. For this category works, it is important to reinforce the foot part (as foundation) of the whole protection works in view of preventing from erosion,

g. Behind of the gabion mattress is covered by placing sheet for protection of washing away of backfilling sand (ex. sheet by papyrus mat),

h. It is effective to use sand bag as already mentioned in the above 3.4.1 (2) 2) Embankment Materials, and

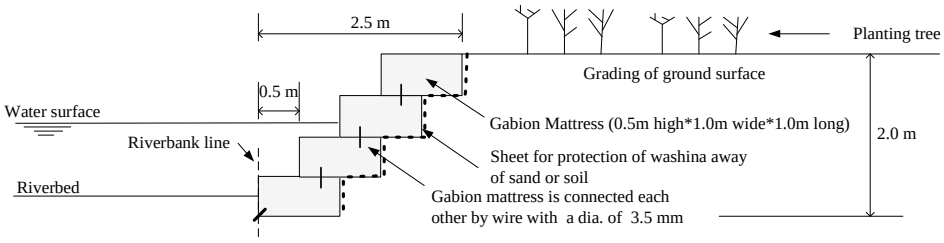
i. Following shows an image of large scale protection works by means of gabion mattress.

Data source: Totetu Co., Ltd, Japan

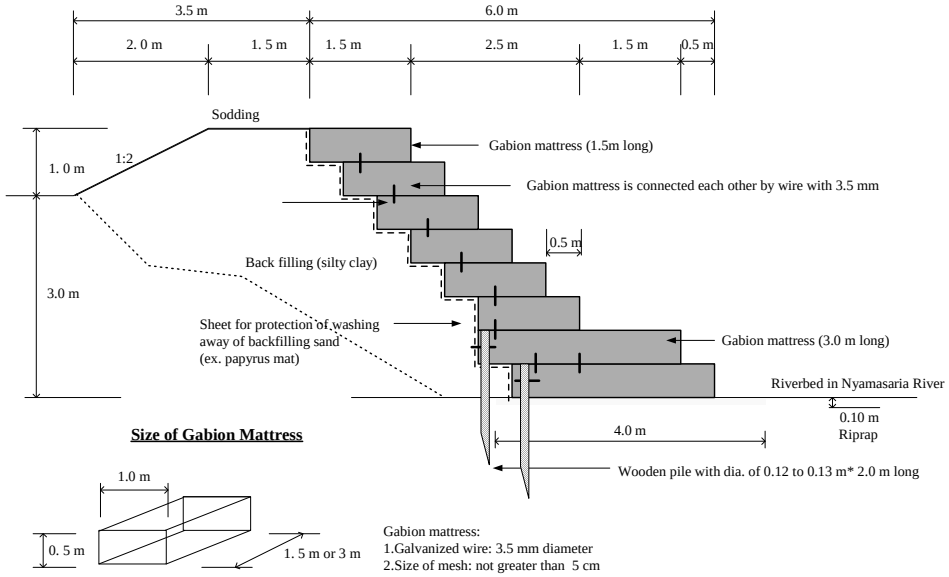
Figure 3.7 Image of Riverbank Protection by Gabion Mattress (in Japan)

(3) Sample Material for Design

Case 1: small scale works



Case 2: large scale works



Data source; JICA Study Team

Figure 3.8 Sample Section of Riverbank Protection

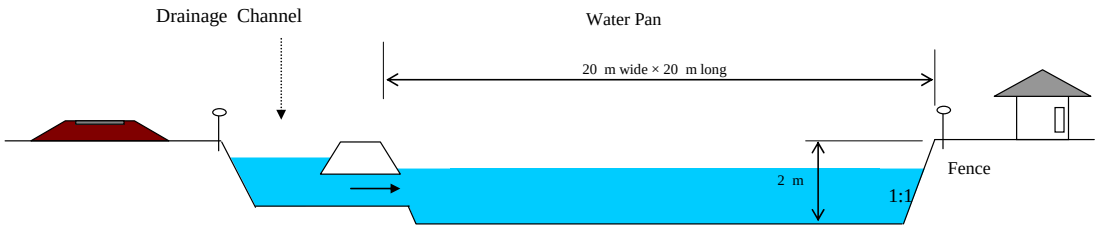
3.4.4 Construction of Water Pan

(1) General

The categorized works will be applied to store river water or local rainfall water for the purposes of irrigation, drinking water of the livestock, etc. The target works will be small scale ones.

(2) Planning of Water Pan

Sample image of the water pan which is taking water from river channel will be as follows;



Data source; JICA Study Team

Figure 3.9 Sample Section of Water Pan (Reservoir)

The points in mind will be as follows.

a. Prior to the planning of the construction of water pan, an important matter is to secure the required area for construction of water pan,

b. Prior consensus must be reached among the related residents in the objective community,

c. Candidate site will be selected with due consideration so as to easily and constantly collect the required water volume throughout the year,

d. Dimension of water pan depends on target community's need. For depth of water pan, maximum depth will be 2 to 3m,

e. Outbreak of mosquito in water surface of the constructed pan will be problem in environmental viewpoint and its countermeasures is needed, and

f. For safety control, fence is recommendable to install along the pond excavated.

3.4.5 Culvert Improvement

(1) General

This categorized works will be applied to small drainage canal in connection with road raising, desiltation of canal, riverbank protection works as foot path bridge in view of improvement of

drainage in the adjacent area.

(2) Planning of Culvert Improvement

The recommendable size of pre-cast concrete pipe will be as follows.

Table 3.6 Major Dimensions of Culvert

Item	Dimension of Pre-cast Concrete Pipe (m)		Remarks
	Diameter	Longitudinal Length	
Culvert improvement	0.6 (minimum for maintenance works) to 1.0	depending on road width	Earth cover depth for pipe will be 0.5 m in minimum

Data source; JICA Study Team

The points in mind in culvert improvement will be as follows.

a. Purpose of the works in this category is to increase drainage capacity by increasing culvert flow area,

b. Target works will be divided as follows,

- Improvement of culverts underneath a road embankment
- Newly construction of culvert

c. In order to improve drainage condition, as a conventional method, it is recommended to employ a pre-cast concrete pipe,

d. Various sizes of the pre-cast concrete piles are available in the market in Kisumu,

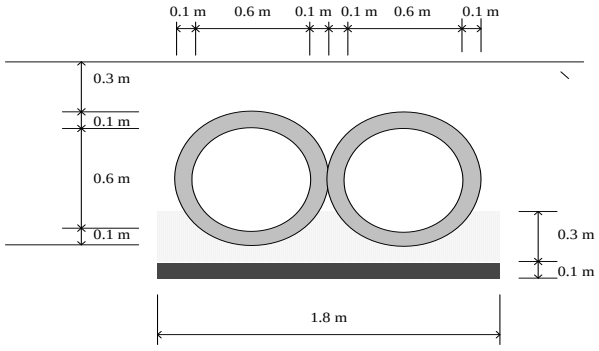
e. Necessary flow area of the questioned culvert is to be required by using several numbers of pipes,

f. In placing concrete pipe, the foundation is firstly graded and then riprap is placed on the foundation to protect from sinking of foundation elevation, and

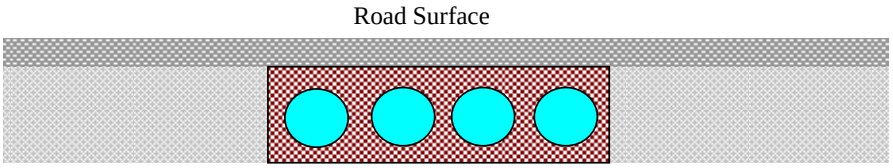
g. After installation of pipes and backfilling, earth covering for the installed pipe is required at a minimum of 30cm as safety measures against concrete pipes.

(3) Sample Material for Design

Case 1: concrete pipe culvert as foot path bridge



Case 2: concrete pipe culvert as relatively larger scale bridge



Data source; JICA Study Team

Figure 3.10 Sample Section of Culvert Improvement

3.5 Project Implementation Schedule

For implementation of proposed structural measures, the fund arrangements and establishment of implementation organization (WRMA and CFMO) are firstly needed. Subsequently, contractor or NGO for the construction works is to be selected. In this section, cost estimate for bill of quantity and construction time schedule for the project is descried below.

3.5.1 Cost Estimate and Bill of Quantity

The points in mind will be as follows.

a. Based on the result of the planning and design of the structural measures, work volume for each work item will be estimated based on the drawings of the objective works,

b. Unit prices will be estimated by the market surveys or referencing the prices in the current similar projects. The unit cost applied in the pilot project (as end of June 2007 price) is shown in Table 3.7,

Table 3.7 Unit Construction Cost Applied in Pilot Project

Work Item	Unit	Unit Price (Ksh)	Remarks
Earth work (embankment and excavation)			
- Clearing, grubbing and stripping	m^2	65	-
- Excavation	m^3	150-400	-
- Backfill	m^3	300-1,000	-
- Embankment	m^3	100	-
- Sodding	m^2	800	-
- Sand bag (0.1mhigh*0.4 wide*0.4mlong)	m^3	7,000	-
- Soil cement	kg	3,600	-
- Planting tree	m^2	500	4 trees per $1m^2$
Bank protection work			
- Riprap (size: 2 to 3 cm)	m^3	2,000-4,000	-
- Gabion mattress (0.5mhigh*1.0mwide*1.5mlong)	m^3	7,000	-
- Papyrus mat	m^2	270	-
- Wooden pile (dia.0.125*2mlong)	nos	200	-
Culvert improvement			
- Concrete pipe (dia.0.6m)	m	5,200	Pre-cast concrete pipe
- Riprap (size: 2 to 3 cm)	m^3	2,000-4,000	-

Data source; JICA Study Team (as end of June 2007 price)

c. In estimating the unit cost, there are 2 methods of;

   1) Inclusive VAT and

   2) Exclusive VAT (included in Summary Table)

   In the community driven works, it is recommendable to apply 1) inclusive VAT,

d. Estimated construction cost is arranged as Bill of Quantity (B/Q Table) as shown in the following Table 3.7 (as end of June 2007 price),

e. In the pilot project, costs for mobilization, demobilization and miscellaneous works are estimated as follows (see following Table 3.8). It should be noted that such costs are subject to change by natures of the target works,

   1) Mobilization cost: 5% of main works cost,

   2) Demobilization cost: 5% of main works cost, and

   3) Miscellaneous cost: 5%to 10% of main works (for various minor works).

The following table is for reference cost inclusive VAT as the engineer's estimate or owner's estimate (budget for contract amount) for the coming tendering procedure. As reference, other samples in the pilot project are attached in APPENDIX 3 (as end of June 2007 price).

For the tendering purpose, the following B/Q Table is to be diverted by deleting values of unit

cost and amount.

Table 3.8 Sample of Cost Estimate (Bill of Quantity)

Bill of Quantity for Restoration of Damaged Riverbank at Odesso in Nyamasaria River

No.	Work Item	Unit	Revised		
			Quantity	Unit Cost (Ksh)	Amount (Ksh)
1. Restoration of of Damaged Riverbank by Gabion Mattress (37 m long)					
1.1	Mobilization	LS	1.0		50,000
1.2	Earth work				
1.2.1	Care of water	LS	1.0		120,000
1.2.2	Clearing and grading	m^2	150.0	100.0	15,000
1.2.3	Excavation of slope in the lower part	m^3	20.0	300.0	6,000
1.2.4	Back fill from stockpile including small dyke (transport for 50 m away)	m^3	1,535.0	300.0	460,500
1.2.5	Sodding	m^2	225.0	800.0	180,000
1.2.6	Miscellaneous	LS	1.0		30,000
	sub total				811,500
1.3	Piling up of gabion mattress				
1.3.1	Placing gravel on riverbed (riprap stone; size: 2 to 3cm)	m^3	15.0	2,000.0	30,000
1.3.2	Gabion mattress (size of stone: 15 to 25 cm, size of gabion mattress: 1m wide, 0.5m high, 3.0 m long, galvanized wire: minimum diameter = 3.5 mm, size of mesh: not greater than 7.5 cm)	m^3	110.0	7,000.0	770,000
1.3.3	Gabion mattress (size of stone: 15 to 25 cm, size of gabion mattress: 1m wide, 0.5m high, 1.5m long, galvanized wire: minimum diameter = 3.5 mm, size of mesh: not greater than 7.5 cm)	m^3	142.0	6,000.0	852,000
1.3.4	Repair of existing gabion mattress	m^3	10.0	2,500.0	25,000
1.3.5	Papyrus mat	m^2	260.0	270.0	70,200
1.3.6	Wooden pile (dia. 0.125 m* 2.0 m long)	nos	74.0	200.0	14,800
1.3.7	Placing gravel on the river slope (slope at lower end, size of stone: 2 to 3 cm)	m^3	6.0	2,500.0	15,000
1.3.8	Miscellaneous	LS	1.0		20,000
	sub total				1,797,000
1.4	Demobilization	LS	1.0		30,000
1.5	Total				2,688,500

Data source; JICA Study Team (as end of July 2007 price)

3.5.2 Construction Schedule

The points in mind for scheduling will be as follows.

a. For implementation of the project smoothly and effectively, it is needed to prepare construction time schedule considering the project natures and work volume,

b. Construction schedule consists of each stage of the preparatory work and construction works,

c. Site works are subject to direct influence by climate conditions, especially rainfall days. Accordingly, sufficient period is needed for the respective natures of the target construction works,

d. Site inspection is needed in daily basis so as to complete the works with high quality as planned and within allotted budget and on time,

e. In this sense, responsible site manager is allocated in daily basis,

f. After completion of the works with completion test or check, the target structure is transferred to CFMO,

g. If some defects are discovered, repair works are promptly conducted by the contractor or NGO,

h. Subsequently, the operation and maintenance works will be started for the constructed structures under responsibility of CFMO (ownership), and

i. As reference, overall construction time schedule applied in the pilot project carried out by JICA Study Team is shown in the following Figure 3.11.

Overall Schedule of Package 4a (Raising Community Road: Kokuwaro and Kasiru Villages)

Description	Sub Item/Major Works/Work Volume	Pr- Construction and Conctruction Priod					Operation and Maintenance Period
		Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	After Nov.-07
Overall Schedule	Submission of proposal/evaluation/negotiation	▼ June 4 to 15					
	Contract signing	▼ June 15					
	Mobilization of works (26 days)	▼ June 20 to July 15					
	Construction works (77 days)		▼ Commencement : July 16			▼ Intended completion : Oct. 1	
	Maintenace by community					▼ Start of operation and maintenance : Oct. 2	

Raising Works of 4a (Kokwaro Village)

Raising Community Road (Total length: 600 m)	Preparatory works	
	Site clearing (4,500 m2)	
	Excavation (1,650 m3)	
	Embankment (1,390 m3)	
	Pile up of sand bag (265 m3)	
	Placing of concrete drain pipe as bridge (36 m)	
	Surface finishing/sodding (1,680 m2)	
	Demobilization	
	Start of maintenance	

Raising Works of 4a (Kasiru Village)

Raising Community Road (Total length: 400 m)	Preparatory works	
	Site clearing (3,000 m2)	
	Excavation (1,100 m3)	
	Embankment (930 m3)	
	Pile up of sand bag (170 m3)	
	Placing concrete drain pipe as bridge (36 m)	
	Surface finishing/sodding (1,120 m2)	
	Demobilization	
	Start of maintenance	

Data source; JICA Study Team

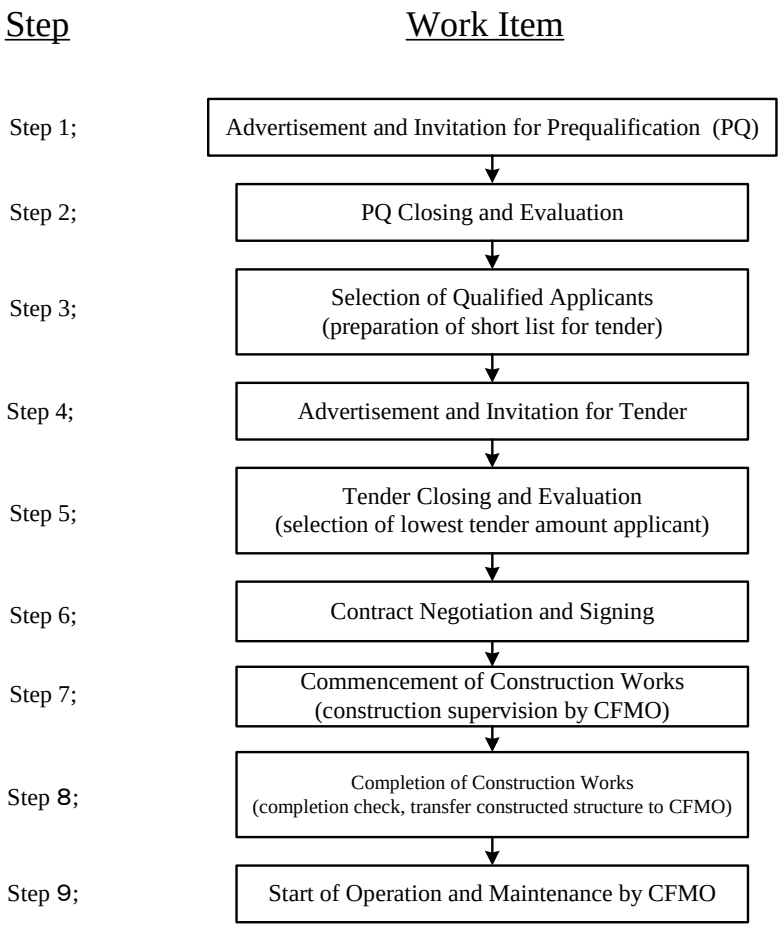
Figure 3.11 Sample of Construction Schedule

4. CONSTRUCTION MANAGEMENT

After the planning and formulation of the project implementation, selection of contractor and/or NGO is to start by the local competitive bidding system with pre-qualification in line with regulation by Kenya Government. Then, construction works will be commenced by the selected contractor or NGO. Finally, the constructed structures will be transferred to CFMO, and operation and maintenance works will be started under the responsibility of CFMO.

4.1 General Flow of Construction Management

The responsible agency in this stage will be CFMO under the direction of WRMA. In this stage, the following events will be progressed.



Data source; JICA Study Team

Figure 4.1 General Procedure for Construction Management

4.2 PQ and Tendering (Bidding)

Contractor and/or NGO for the construction works is to be selected through the local competitive bidding system. The bidding system generally consists of 2 stages of:

Step 1: Prequalification of applicants, and

Step 2: Bidding for inviting the qualified applicants to select contractor or NGO.

The detailed explanation for such events is omitted in this guideline. Further information and sample document are attached in APPENDIX 3.

4.3 Construction Supervision

In construction supervision, planning for construction supervision is necessary both prior to and during the actual construction. Such planning is necessary in order to construct the project within allotted cost and on time, and with sufficient quality as planned originally.

In addition to the points mentioned in the above 3.5.2, check items including those of the preparatory stage will be as follows.

a. Identification of specific activities of work (main work which largely influences construction period)) and interrelationships between other items,

b. Proper sequencing of the specific activities of works so as to complete the project in optimum amount of time,

c. Possession of target site and access road are cleared prior to commencement of the works,

c. Time of delivery of materials and installed equipment,

d. Classification and number of workers needed and period of time they will be needed,

e. Types, quantities, and duration of construction plant and equipment, if needed,

f. Location of candidate borrow pit or dumping site should be checked and selected in collaboration with contractor and/or NGO,

g. Construction supervision is conducted paying attentions to each control of time schedule, quality of structure and cost so that the project is implemented within the allotted cost and on time, and

h. Following checklist is helpful for the supervision activities at the construction sites.

Table 4.1 Checklist of Construction Supervision

1. Earth works

Item	Point to be checked
Embankment works (dyke and raised road)	
Setting out of works	- Setting-out of the works including staking of alignment of dyke and reference pegs
Site clearing and grubbing	- All vegetation, tree stumps, organic materials and other obstacle are cleared and

	stripped. - All cleared materials is disposed off under direction of CFMO
Foundation for embankment	- Prior to following works, cleared site as foundation of dyke is checked
Embankment	- Embankment works consists of moisture of embankment materials, spreading, compaction, placing sod as surface cover, etc. - Eembankment is carried out to lines and levels as specified in drawing. - Fixed ruler is installed so as to follow specified lines and levels - Spreading thickness is 10 to 20 cm or 20 to 30 cm per 1 layer and repeats to design height - Extra embankment is needed (10 to 20 cm) for sinkage in the future
Compaction	- Compact every spreading thickness by tamping roller type - Trial compaction to get 4 to 5 % percent dry side of natural moisture content (?)
Sand bag	- To use container with 10 to 50 litters in filling soil according to the specified sizes, - After filling soil, sand bag is compacted with specified dimension - Placing soil in the opening of piled up sand bags
Finishing of dyke structure	- Tolerance of embankment Surface level of dyke : 5 cm Width and slope: 10 cm
Sod facing/turf	- Sod materials with top soil is used (not separated) - Transplant is done within 24 hours after cutting - After placing sod, soil is placed the gap of each sod and compacted - After finishing, cure of sod is needed until rooted to slope surface (at least 1 month)
Excavation and desiltation works	
Setting out of works	- Setting-out of the works including staking of alignment of excavation and desiltation lines and reference pegs
Site clearing and grubbing	- All vegetation, tree stumps, organic materials and other obstacle are cleared and stripped. - All cleared materials is disposed off under direction of CFMO
Excavation/desiltation	- Excavation/desiltation works consists of excavation and disposal of excavated material - The works in dry condition by providing small dyke is desirable - Excavation/desiltation works is carried out to lines and levels as specified in drawing - Fixed ruler is installed so as to follow specified lines and levels - Fixed ruler is installed so as to follow specified lines and levels - Disposal or embankment as dyke or raising canal banks are carried out under direction of CFMO

2. Gabion works

Item	Point to be considered
Setting out of works	- Setting-out of the works including staking of alignment of bank protection works lines and reference pegs
Site clearing and grubbing	- All vegetation, tree stumps, organic materials and other obstacle are cleared and stripped. - All cleared materials is disposed off under direction of CFMO
Foundation for gabion mattress	- Prior to next works, cleared site as foundation of gabion mattress is checked
Gabion mattress	- All wires shall be flexible hot-dip galvanized steel wires having minimum tensile strength of 40 kg/mm2 and a minimum weight of zine coating of 275 kg/m2 - Mesh is hexagonal woven mesh and the knots is formed by twisting each pair of wires three and half turn - Size of the mesh not be greater than 5 cm - Diameter of the wire shall be 3.5 mm
Piling up of gabion mattress	- Works consists of levelling for foundation, riprap including placing gravel, placing papyrus mat for gabion mattress, placing of gabion mattress, etc. - Fixed ruler is installed so as to follow specified lines and levels

Placing mat behind of gabion mattress	- If needed, behind of the gabion mattress is covered by placing sheet for protection of washing away of backfilling sand (ex. sheet by papyrus mat), - Before spreading mat, any depressions on the slopes are graded to the lines
Backfill of soil	- Backfill thickness is in layers not exceeding 30 cm before compaction Sufficient compaction is needed

3. Culvert improvement

Item	Point to be considered
Setting out of works	- Setting-out of the works including staking of alignment of improvement works lines and reference pegs
Site clearing and grubbing	- All vegetation, tree stumps, organic materials and other obstacle are cleared and stripped. - All cleared materials is disposed off under direction of CFMO
Placing gravel as foundation	- Riprap stone is placed on the riverbed by using manpower - Voids between stones is filled completely with smaller size stones - .Average size of riprap stones: about 3 to 5 cm
Foundation for concrete pipe	- Prior to placing concrete pipe, gravel foundation for pipes is checked
Placing concrete pipe	- Placing works include setting concrete pipes, backfill and other related works
Backfill	- Earth cover depth for pipe is not smaller than 0.5 m in minimum

Data source: JICA Study Team

5. OPERATION AND MAINTENANCE

5.1 General

After completion of the construction works, the structures (as valuable properties) will be transferred to the target owner of CFMO. Physical condition of the properties is to be operated and maintained by the target CFMO. To maintain such properties surely and effectively in the sustainable viewpoint, a periodical inspection will be indispensably important activity.

The maintenance works are generally divided into the following 4 stage ones.

Stage 1: Ordinary time (periodically at least four times in one year, before and after the two rainy season),

Stage 2: Pre- flooding (repair works if needed),

Stage 3: During flooding (as flood fighting team to be established), and

Stage 4: Post- flooding (repair works if any, return to stage 1).

Points in mind in each stage will be as follows.

a. Inspection is conducted mainly to find abnormal condition, functional damage and deterioration of structures or facilities by visual observation at site,

b. In case damage or functional failure is observed, necessary remedial or replacement works are promptly carried out,

c. Repair/remedial works for slight damage are advisably to be conducted by the related CFMO, and

d. In case relatively large scale damage, repair or replacement work is carried out by related agencies such as NWCPC, Ministry of Roads and Public Works, etc.

5.2 Major Inspection and Maintenance Activities

Major inspection and other activity items in the respective stages are outlined in the following Table 5.1.

Table 5.1 Major Inspection Items and Activities for Constructed Facilities

Stage	Dyke/Raised Road	Drainage Canal/Water Pan	Riverbank Protection Works	Culvert Improvement
Ordinary Time (Periodical once in 2 months)	- Erosion or leakage point of dyke body (incl. mole hole) - Condition of inspection road (installed on top of dyke) - Condition of ditch constructed along dyke - Cut of grass (turf) on the dyke slope and digging of weed - Condition of distance post - Illegal activity (dumping of garbage , construction materials, construction of structures, etc.)	- Condition of canal and pan (erosion, slope failure) - Condition of planting trees - Siltation in concrete culvert as bridge - Illegal activity (dumping of garbage, construction materials, construction of structures, etc.)	- Condition of foot Protection (scouring) - Condition of gabion net and stone - Condition of small dyke and cut of grass - Illegal activity (dumping of garbage, construction materials, construction of structures, sand harvesting in front of structure, etc.)	- Condition of road (slope failure, erosion) - Siltation in culvert as bridge - Condition of drain canal along road - Illegal activity (removal of sand bag, dumping of garbage into culvert and canal, etc.) -
Pre-flooding (common for all case)	- Emergent repair of damaged structures and abnormal riverbank scouring - Removal of obstacle in channel and canal - Stock of required materials (sand bag, sheet, shovel, etc.) - Stand by of community flood fighting team			
During flooding (common for all case)	- Activity as flood fighting (Emergency countermeasures) - Evacuation activities			
Post-flooding (common for all case)	- Damage survey - Preparation of damage report - Repair/remedial works for the above			

Data source: JICA Study Team

APPENDIX

for

Guideline on Community-Driven Flood Management

(Structural Measures)

APPENDIX 1: Impacts Resulting From Implementation of Possible Structural Measures

In implementation of the above applicable measures, various impacts might be arisen socially and environmentally. To foresee and understand impacts by project implementation is inevitably important for environmental preservation and future sustainable development. The impact is divided into two categories of positive and negative.

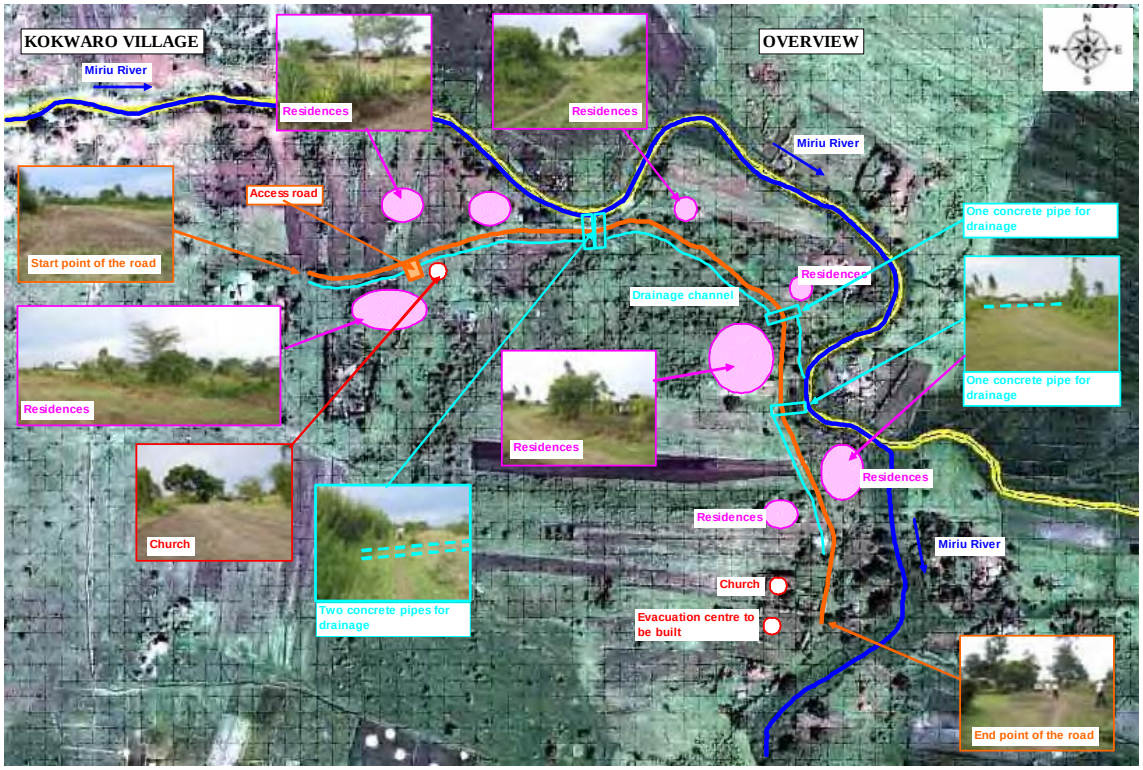
Aside from the above, social and environmental problem during construction period (such as noise, dust, dirty water, etc.) will be temporarily brought about to work sites and however, such temporary ones are also minimized by means of various mitigation measures (adjustment or devise of construction method). The major positive and negative impacts foreseen and those mitigation measures will be described as reference with regard to environmental preservation and future sustainable development in the following.

Table Impacts by Implementation of Applicable Measures

Measure	Positive Impact	Negative Impact	
		Negative Impact	Countermeasure
Construction of river dyke/levee/ring levee	- Mitigation of inundation (livelihood condition is improved) - Effective land use - Dyke is used as community road and evacuation place in emergency time	- Fertile soil into farm land is decreased - Drainage in land area worsen - Access to river channel is not easy - Land acquisition and house compensation, if needed In dyke break, damage may increase	- EIA is needed - Drain is constructed along dyke - Ramp is provided - Top of dyke is used as community road - Resettlement is needed - In emergency time, flood fighting is carried out by using sand bag
Widening and desiltation of low water channel with dyke	- Mitigation of inundation (livelihood condition is improved) - Effective land use - Dyke is used as community road and evacuation place in emergency time	- Land acquisition, if needed - Disposal of excavated materials	- EIA is needed - Proper disposal of excess materials
Construction of water pan/pond	- In dry season, stored water is effectively utilized for various purposed (livelihood condition is improved) - Creation of new echo system, if management is appropriate	- Land acquisition is needed - In dry season, dry up in pond in the worst case -	- EIA is needed - Providing substitute land - Exterminate harmful insects - Maintenance flow to maintain echo system is discharged
Raising of existing road	- In flooding time, raised road is utilized as evacuation road or evacuation place - In flooding, flooded water is confined as secondary dyke	- During raising works, transportation is disturbed	- Bypass is provided - One side construction is applied
Culvert improvement	- Drainage condition is improved - Mitigation of inundation (livelihood condition is improved)	- During improvement works, drainage is disturbed	- Bypass is provided

APPENDIX 2: Sample Planning of Raising Road

Layout of Road to be raised and Determination of Dimensions



Layout of Community Road to be raised and Drainage System

In the planning of this road raising, height, width and required material for the road and evacuation and drainage systems are designed as follows.

(1) Height of the road

Due to insufficient data on flood inundation depths, the height and elevation of the roads were designed, based on interviews with members in the Kokwaro village. Result of the interview showed that 0.5 m deems to be the annual flood depth from the average elevation of the ground level, i.e., el. MSL +1139.5m.

In the design, we also consider 0.3 m as the extra embanking for the safety purpose. Therefore, in total 0.8 m (= 0.5 m + 0.3 m) is the proposed height of the road to be raised in the design. The elevation of the road on the top is el. MSL +1140.3m (= el. MSL +1139.5m + 0.8 m).

We adopt the annual flood depth when designing the height and elevation of the road raising. Although the deepest flood depth in the past should also be addressed in the design processes, due to financial constrains the deepest flood depth could not be adopted for this design. Efforts must, therefore, be made to make village people and CBOs aware of flood risks, the design

standard and possible actions that can be taken to coordinate effective evacuation to minimizing damages due to flooding. Activity for such awareness raising will be carried out in other components as part of the pilot projects.

(2) Width of the road

Village members in Kokwaro requested that the road width on the top be at least 2.0m, taking account of the accessibility of evacuation roads and ferrying their animals during flooding. Therefore, we adopt 2.0m as the road width in the design.

(3) Murram covering

Village members in Kokwaro requested that murram be covered on the road, black cotton soils, which are locally available, will get muddy during flooding, making it difficult for village members to use such muddy roads for evacuation. In order to meet their requirements, we adopt murram with the thickness of 0.1 m to be covered on top of the road. This murram coveting is expected to play a role in keeping the evacuation roads accessible and ferrying their animals during flooding.

(4) Sand bags and sodding

Sand bags are placed on the slope of the road along the Miriu river. Additional sand bags are also placed on the top and bottom of the set of sand bags to be placed on the slope. These sand bags are expected to protect the road slope along the river from being eroded during evacuation activity. We adopted relatively smaller sand bags with the size of 0.1 m high and 0.4 m wide and long. Since the road raising is implemented by the NGO together with village members, we took account of transportability of sand bags in the construction processes. Black cotton soils locally available are used for material to be put in sand bags.

We also adopted sods to be covered on both sides of the road slopes. This sodding is expected to help in protecting road slopes and sand bags from being eroded.

(5) Evacuation and drainage systems

Material for the road raising had to be obtained within the Kokwaro village, since there are no borrow pits that can be allocated and no provision for tracks or machines that can transport large amount of soils from outside of the village. The same volume of soils for the embankments, therefore, had to be excavated within the village. We designated the borrow pits next to the road in the village side, i.e., opposite area from the river, and designed the excavated area to be used as drainage channels after a flood event occurs.

At the same time, the excavated drainage channels must not impede both activity for livelihood during normal situations and accessibility to the evacuation road during flood situations. In order

to fulfill these requirements, evacuation and drainage systems were designed as given in the above Figure.

APPENDIX 3: Priced Bill of Quantity

Bill of Quantity for Restoration of Damaged Riverbank at Odesso in Nyamasaria River

No.		Work Item	Unit	Quantity	Unit Cost (Ksh)	Amount (Ksh)
1. Restoration of of Damaged Riverbank by Gabion Mattress (37 m long)						
1.1		Mobilization	LS	1.0		133,355
1.2		Earth work				
1.2.1		Care of water	LS	1.0		37,000
1.2.2		Clearing and grading	m^2	150.0	10.0	1,500
1.2.3		Excavation of slope in the lower par	m^3	20.0	300.0	6,000
1.2.4		Back fill from stockpile including small dyke (transport for 50 m away)	m^3	1,500.0	500.0	750,000
1.2.5		Sodding	m^2	140.0	110.0	15,400
1.2.6		Miscellaneous	LS	1.0		37,800
		sub total				847,700
1.3		Piling up of gabion mattress				
1.3.1		Placing gravel on riverbed (riprap stone; size: 2 to 3cm)	m^3	15.0	1,000.0	15,000
1.3.2		Gabion mattress (size of stone: 15 to 25 cm, size of gabion mattress: 1m wide, 0.5m high, 3.0 m long, galvanized wire: minimum diameter = 3.5 mm, size of mesh: not greater than 5 cm)	m^3	110.0	5,600.0	616,000
1.3.3		Gabion mattress (size of stone: 15 to 25 cm, size of gabion mattress: 1m wide, 0.5m high, 1.5m long, galvanized wire: minimum diameter = 3.5 mm, size of mesh: not greater than 5 cm)	m^3	170.0	5,600.0	952,000
1.3.4		Repair of existing gabion mattress	m^3	10.0	1,500.0	15,000
1.3.5		Papyrus mat	m^2	260.0	100.0	26,000
1.3.6		Wooden pile (dia. 0.125 m* 2.0 m long)	nos	74.0	1,500.0	111,000
1.3.7		Placing gravel on the river slope (slope at lower end, size of stone: 2 to 3 cm)	m^3	6.0	1,000.0	6,000
1.3.8		Miscellaneous	LS	1.0		78,400
		sub total				1,819,400
1.4		Demobilization	LS	1.0		133,355
1.5		Total				2,933,810

Bill of Quantity for Desiltation of Drainage Canal at Odesso

No.		Work Item	Unit	Quantity	Unit Cost (Ksh)	Amount (Ksh)
1. Desiltation of Drainage Canal (L= 840 m)						
1.1		Mobilization	LS	1.0		9,768
1.2		Earth work				
1.2.1		Clearing, grubbing and stripping	m^2	300.0	10.0	3,000
1.2.2		Excavation	m^3	1,000.0	300.0	300,000
1.2.3		Placing along canal	m^3	1,000.0	100.0	100,000
1.2.4		Concrete drain pipe (inner dia. 0.6 m)	m	9.0	5,000.0	45,000
1.2.5		Placing gravel under pipe(size: 2 to 3 cm)	m^3	0.4	1,000.0	400
1.2.6		Planting tree along bank (Eurphobia: 4 trees per 1 m2= 1 no. per 0.25 m2)	m^2	400.0	100.0	40,000
		sub total				488,400
1.3		Demobilization	LS	1.0		9,768
1.4		Total				507,936

Bill of Quantity for Raising Local Road at Kokuwaro

No.		Work Item	Unit	Quantity	Unit Cost (Ksh)	Amount (Ksh)
1. Raising of Local Road by Embankment (L= 600 m)						
1.1		Mobilization	LS	1.0		31,515
1.2		Earth work				
1.2.1		Clearing and stripping	m^2	4,500.0	10.0	45,000
1.2.2		Excavation (along proposed route: 1 m away)	m^3	1,650.0	300.0	495,000
1.2.3		Embankment	m^3	1,390.0	300.0	417,000
1.2.4		Sand bag by vinyl sack (size of sand bag: 0.2 m high* 0.4 m wide* 0.5 m long)	m^3	265.0	350.0	92,750
1.2.5		Soil cement cement (30 kg per 1	kg	7,950.0	20.0	159,000
1.2.6		Concrete drain pipe (inner dia. 0.6 m)	m	36.0	5,000.0	180,000
1.2.7		Placing gravel under pipe(size: 2 to 3 cm)	m^3	2.2	1,000.0	2,200
1.2.8		Sodding	m^2	1,680.0	110.0	184,800
		sub total				1,575,750
1.3		Demobilization	LS	1.0		31,515
1.4		Total				1,638,780

Bill of Quantity for Construction of New Dyke of Nyando River in Magina Sub-Location

No.		Work Item	Unit	Quantity	Unit Cost (Ksh)	Amount (Ksh)
1. Construction of New Dyke (100 m long)						
1.1		Mobilization	LS	1.0		85,419
1.2		Construction of dyke				
1.2.1		Clearing and stripping	m^2	1,200.0	10.0	12,000
1.2.2		Excavation (silty clay) in high water channel and transport (30 to 50m in distance)	m^3	1,760.0	300.0	528,000
1.2.3		Embankmet (silty clay)	m^3	1,620.0	500.0	810,000
1.2.4		Sand bag by vinyl sack (size of sand bag: 0.4 m wide* 0.2 high* 0.7	m^3	140.0	550.0	77,000
1.2.5		Lower end protection by sand bag by vinyl sack (size of sand bag: 0.4 m wide* 0.2 high* 0.7 m long)	m^3	2.0	550.0	1,100
1.2.6		Soil cement cement (40 kg per 1	kg	5,680.0	20.0	113,600
1.2.7		Sodding	m^2	820.0	110.0	90,200
1.2.8		Miscellaneous	LS	1.0		76,485
		sub total				1,708,385
1.3		Demobilization	LS	1.0		85,419
1.4		Total				1,879,224

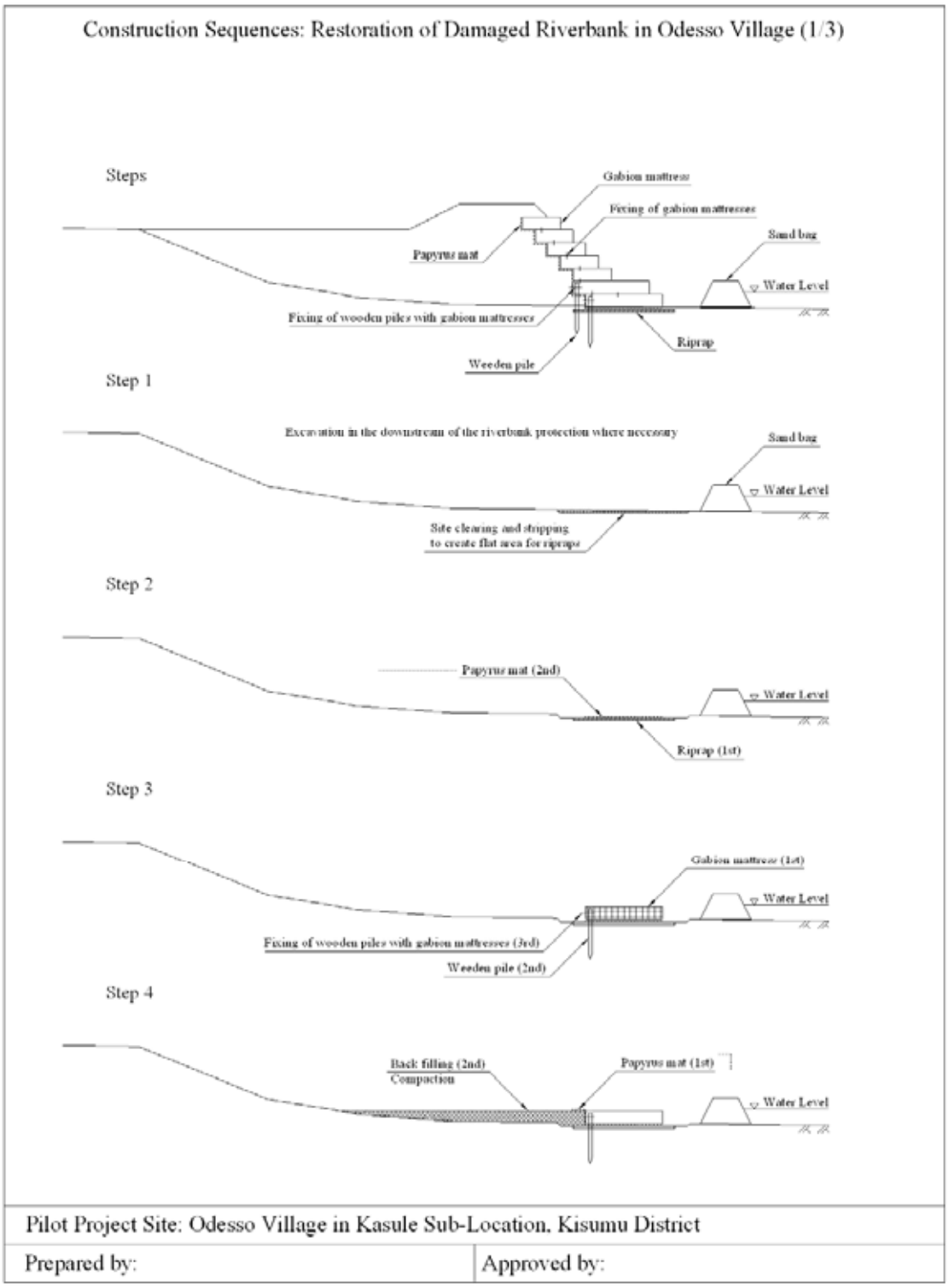
APPENDIX 4: Bill of Quantity for Tendering

BQ Table for Tender

No.		Work Item	Unit	Quantity	Unit Cost (Ksh)	Amount (Ksh)
1. Construction of New Dyke (100 m long)						
1.1		Mobilization	LS	1.0		
1.2		Construction of dyke				
1.2.1		Clearing and stripping	m^2	1,200.0		
1.2.2		Excavation (silty clay) in high water channel and transport (30 to 50m in distance)	m^3	1,760.0		
1.2.3		Embankmet (silty clay)	m^3	1,620.0		
1.2.4		Sand bag by vinyl sack (size of sand bag: 0.4 m wide* 0.2 high* 0.7	m^3	140.0		
1.2.5		Lower end protection by sand bag by vinyl sack (size of sand bag: 0.4 m wide* 0.2 high* 0.7 m long)	m^3	2.0		
1.2.6		Soil cement cement (40 kg per 1	kg	5,680.0		
1.2.7		Sodding	m^2	820.0		
1.2.8		Miscellaneous	LS	1.0		
		sub total				
1.3		Demobilization	LS	1.0		
1.4		Total				

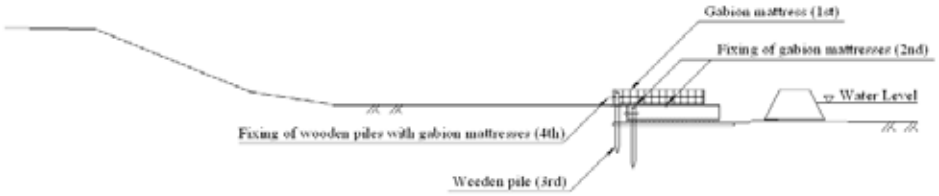
APPENDIX 5: Construction Sequence for Riverbank Protection Works by Gabion

Construction Sequence of Bank Protection Works by Gabion Mattress



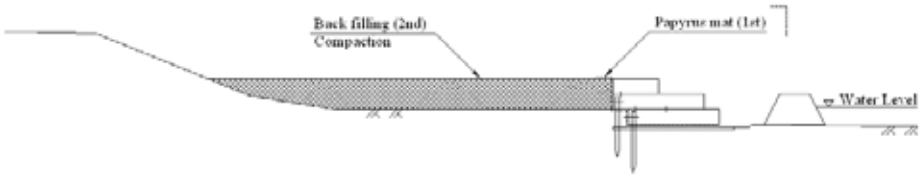
Construction Sequences: Restoration of Damaged Riverbank in Odesso Village (2/3)

Step 5

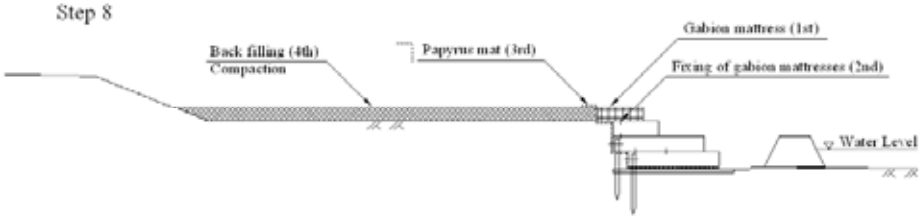


Step 6

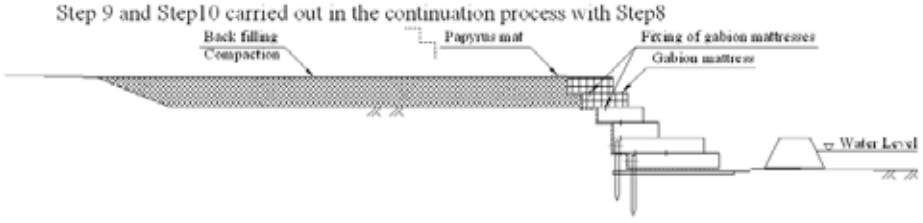
Step 7



Step 8

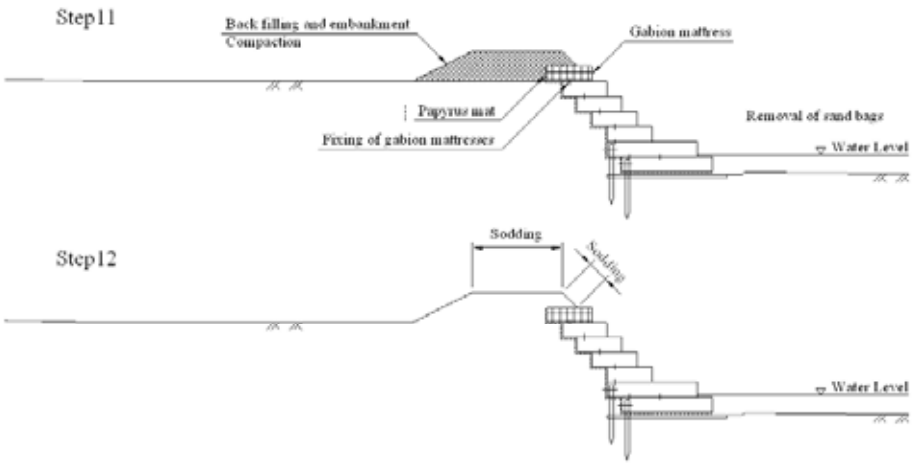


Step 9 and Step10 carried out in the continuation process with Step8



Pilot Project Site: Odesso Village in Kasule Sub-Location, Kisumu District	
Prepared by:	Approved by:

Construction Sequences: Restoration of Damaged Riverbank in Odesso Village (3/3)



Pilot Project Site: Odesso Village in Kasule Sub-Location, Kisumu District	
Prepared by:	Approved by:

CHAPTER 5

HOW TO CONDUCT OPERATION AND MAINTENANCE (O&M) FOR COMMUNITY-DRIVEN STRUCTURAL MEASURES

MANUAL

ON

OPERATION AND MAINTENANCE OF

COMMUNITY-DRIVEN STRUCTURAL MEASURES

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CHAPTER 1 INTRODUCTION

Pilot projects have been implemented in 2007 in five selected communities within the Nyando and Nyamasaria river basin in Kenya. Those communities were 1) Odesso village, Kasule sub-location, Kisumu district; 2) Kokwaro village, Central Bwanda sub-location, Kisumu district; 3) Kasiru village, Kore sub-location, Nyando district, 4) Kochiewo village, Magina sub-locatoin, Nyando district; and 5) Siwot village and Kamiwa village, Chil Chila location, Kericho district.

The pilot projects aimed at establishing a community approach to flood management in the study area within the framework of Integrated Flood Management (IFM). The pilot projects addressed not only small scale structural measures, e.g., riverbank protection works and construction of evacuation roads, but also non-structural measures, e.g., community flood hazard mapping, establishment of community based organizations (CBOs), various activity related to awareness raising about flood risks, preparedness for emergency situations, etc., involving communities and various stakeholders.

In the pilot projects, the following structural works have been put in place:

- Riverbank protection works, adopting gabion mattresses in the Odesso village and Chil Chila location;
- Dykes in the Magina sub-location; and
- Evacuation roads in the Kokwaro village and Kasiru village.

1.1 BACKGROUND

Structural works once constructed require operation and maintenance activities, in order for them to play a key role in the right time they are expected. For example, if a flood event caused breaches in constructed dykes, in the next flood event the damaged dykes might not be able to protect flood water from overflowing into flood plains people live, thereby accelerating devastating consequences of flood events. Therefore, operation and maintenance activities are important and thus should be carried out.

In general, operation and maintenance activities should be carried out by the Governments. However, the limited resources of the Governments make it difficult for them to monitor all of the structural works put in place. Therefore, it is important that communities take their initiatives to operation and maintenance activities for structural works. Activities initiated by communities greatly contribute to reducing vulnerability of communities to flooding and thus building resilient communities.

At the same time, it must be noted that such community based activities have the certain limitation in terms of financial and technical contributions, since communities are not specialized in operation and maintenance activities. Even though various activities related to operation and maintenance can be initiated by communities, support from the Governments is crucial for the successful implementation of such activities. There is a need for interlinking efforts made by communities into Governmental support to be obtained.

1.2 PURPOSE AND OBJECTIVE

This manual addresses operation and maintenance activities required in some of structural components of the pilot projects. This manual has been prepared for members of the Community Flood Management Organizations (CFMOs), which were established within the framework of the pilot projects, and village people in the communities. It aims at providing CFMOs and village people guidance on how to operate and maintain structural works in a sustainable manner. Since the target audience is directed to communities, description has been kept simple and non-technical and explanation by long sentences has been avoided.

We take flood fighting and emergency activities out of the scope from this manual. They have therefore not been discussed. However, how operation and maintenance activities can be connected to emergency activities are briefly introduced.

1.3 TYPES OF STRUCTURAL WORKS ADDRESSED IN THE MANUAL

Structural works we discuss in the manual are: 1) riverbank protection works, adopting gabion mattresses, 2) dykes and 3) evacuation roads. These are essentially addressed to five selected communities for the pilot projects.

1.4 BRIEF DESCRIPTION OF EACH CHAPTER

Chapter 2 introduces activities for operation and maintenance. This chapter provides general guidance on what are the procedures of the activities, what roles can be played by communities, who should have the responsibilities, and what issues should be addressed in each structural work in the activities. This basic knowledge is important to carry out monitoring, assessing, evaluating and maintaining structural works, which are discussed in the subsequent chapters.

Chapter 3 provides guidance on how to carry out monitoring of structural works. The timing and frequency of the monitoring are provided, taking account of a risk management cycle of pre-, during and post-flood situations. Simple forms specifying issues to be monitored are also provided for each structural work, based on which communities can obtain the monitoring results. The results can be used for the subsequent procedures of assessment and evaluation.

Chapter 4 provides guidance on how to compile the result of the monitoring and prepare assessment reports, which prioritize a set of issues that are identified through the monitoring processes. Simple forms for the assessment and evaluation are also provided for each structural work.

Chapter 5 provides guidance on how to carry out maintenance activities to prepare for flooding and recovery activities after a severe flood event. How to call for support from the Governments are also briefly introduced, since in some cases communities cannot handle maintenance activities by themselves, depending on levels of severity of damages and issues that are identified.

Chapter 6 briefly discusses importance of incorporating lessons learned into future activities to further improve activities initiated by communities. This is important to strengthen capacities of communities to coping with flooding.

CHAPTER 2 ABOUT OPERATION AND MAINTENANCE ACTIVITIES

2.1 RECOMMENDED PROCEDURES

Procedures for operation and maintenance activities are broadly consisted of monitoring, assessment and evaluation and maintenance activities. In the case of post-flood situations, monitoring and assessment and evaluation can be replaced with assessment of flood damages to structural works, while maintenance activities can be replaced with recovery activities. Figure 2.1 depicts the recommended procedures for operation and maintenance activities.

Table 2.1 describes a recommended operation and maintenance cycle with reference to communities in the Nyando and Nyamasaria basins.

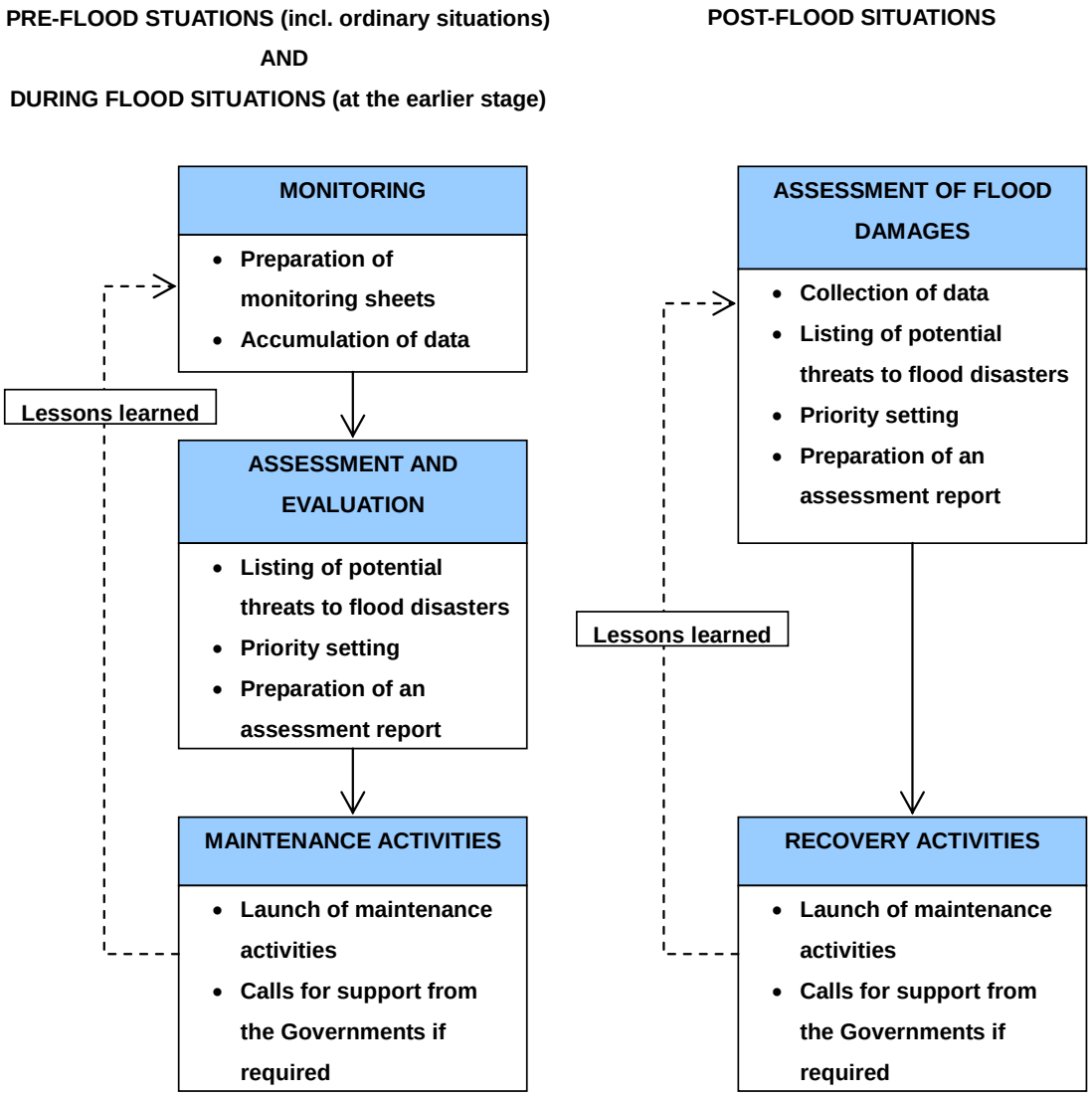

Figure 2.1 Recommended procedures for operation and maintenance activities

Table 2.1 Recommended cycles of operation and maintenance activities (pre-flooding)

Month	Jan. Mar.	Apr. June.	July. Sept.	Oct. Dec.
Rainy seasons				
Monitoring				
Assessment and evaluation				
Maintenance activities				

2.2 ROLES AND RESPONSIBILITIES

Roles and responsibilities of operation and maintenance activities are given in Table 2.1. It is desirable that small scale activities for monitoring and maintenance activities are carried out by communities initiated by the Community Flood Management Organizations (CFMOs). If activities required for the operation and maintenance exceed capacities of the CFMOs, CFMOs should call for support from the Governments responsible for such activities as indicated in Table 2.2.

Table 2.2 Roles and responsibilities of operation and maintenance activities

	Small scale activities	**Large scale activities Technical and financial support**
Riverbank protection works (Odesso village and Chil Chila location)	• CFMO • Communities	• National Water Conservation and Pipeline Corporation (NWCPC) • Water Resources Management Authority (WRMA)
Dykes (Magina sub-location)	• CFMO • Communities	• National Water Conservation and Pipeline Corporation (NWCPC) • Water Resources Management Authority (WRMA)
Evacuation roads (Kasiru and Kokwaro village)	• CFMO • Communities	• Ministry of Roads and Public Works (MRPW)

2.3 WHAT ARE THE ISSUES TO BE ADDRESSED?

This section discusses issues that should be addressed in the operation and maintenance activities. This section provides general guidance on potential threats to flood disasters and items of maintenance activities to be considered for each structural work.

2.2.1 Riverbank protection works: gabion mattress

Below are the potential threats to flood disasters in the case of riverbank protection works, adopting gabion mattresses.

(1) Scouring

Scouring of riverbed material under riverbank protection works weaken their stability, resulting in breaches of the works (see Figure 2.2). This is subject to occurring where are likely to receive high stream power of flood water due to poor alignments of riverbank protection works.

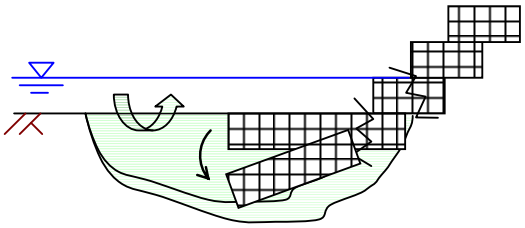

Figure 2.2 An image of scouring of riverbed material under riverbank protection works

(2) Washing away of backfill material

Backfill material behind riverbank protection works, i.e., gabion mattresses, is subject to being washed away, especially when sheet protection, e.g., papyrus mats, is not appropriately equipped (see Figure 2.3).

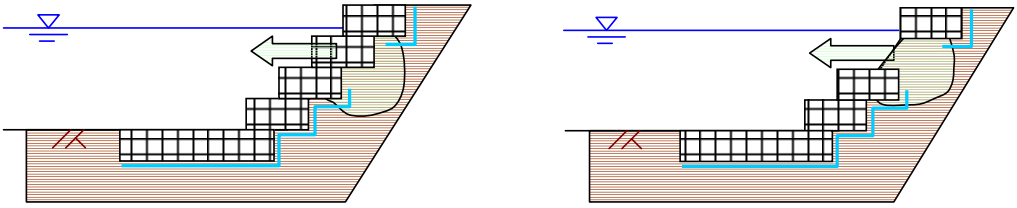

Figure 2.3 An image of washing away of backfill material: riverbank protection works

(3) Erosion along riverbank protection works

Upstream and downstream edges of riverbank protection works are subject to being eroded, where different types of material meet, i.e., gabion mattresses and natural levees (Figure 2.4).

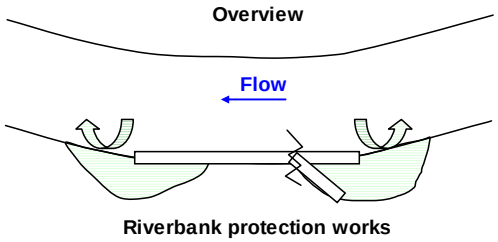

Figure 2.4 An image of erosion at the up/down-stream edges of riverbank protection works

Backfill material on the top of riverbank protection works is subject to being eroded when flood water overflow the protection works (see Figure 2.5).

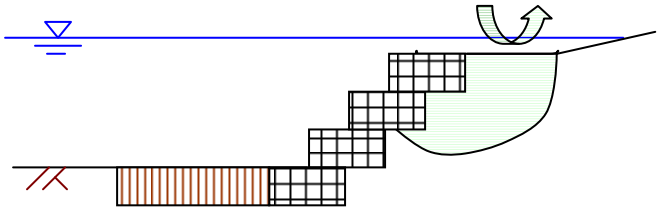

Figure 2.5 An image of erosion at the crest of riverbank protection works

(4) Sliding failure

Slope failure may occur by changes in force balance put on riverbank protection works (see Figure 2.6). When the increased water stage rapidly goes down, a water stage infiltrated into the riverbank protection works remains high. This situation makes the protection works instable and may result in the sliding failure.

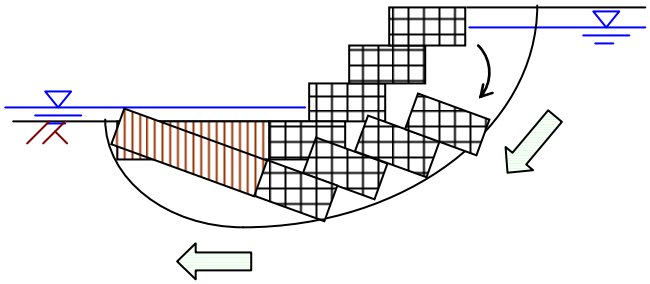

Figure 2.6 An image of sliding failure of riverbank protection works

(5) Corrosion, abrasion and cutting

Corrosion, abrasion and cutting of steel wires used for riverbank protection works, e.g., gabion mattresses, wooden mattresses, wooden fences, etc., weaken the stability and thus are subject to breaches of riverbank protection works.

(6) Instability caused especially by human interventions

Human interventions such as illegal works close to or on dykes such as cultivation, placement of facilities, building, piling, excavation, etc., are subject to affecting stability of dykes.

2.2.2 Dykes

Below are the potential threats to flood disasters in the case of dykes.

(1) Overflowing

Overflowing of flood water over dykes directly affects people living along the dykes. This is subject to occurring:

- Where height of dykes on the top becomes lower than other places of the dykes surrounded;
- Where flood water stages exceed the height of dykes (see Figure 2.7); and
- At the upstream and downstream edges where different types of dyke material meet and if they are not appropriately connected.

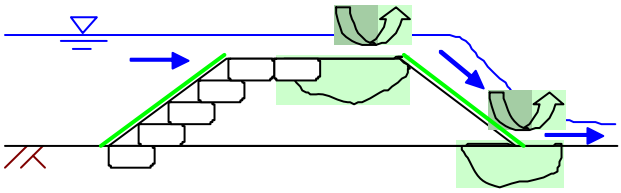

Figure 2.7 An image of overflowing and resulting scouring along embankments

(2) Scouring and erosion

Scouring along dykes weaken their stability, resulting in dyke breaches. This is subject to occurring:

- Where are likely to receive high stream power of flood water due to poor alignments of dykes;
- Where sand bags are not appropriately placed on the dyke slopes of the river side; and
- Where sods are poorly covered on the dyke crest or slopes behind the river, when flood water overflows the dykes.

(3) Washing away of backfill material behind sand bags

Backfill material behind sand bags is subject to being washed away, leading to accelerated erosion (see Figure 2.8).

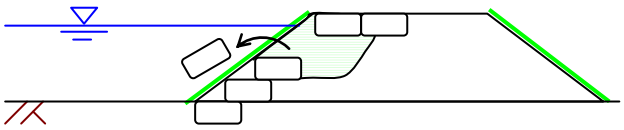

Figure 2.8 An image of washing away of backfill material behind sand bags

(4) Instability caused especially by human interventions

Human interventions such as illegal works close to or on dykes such as cultivation, placement of facilities, building, piling, excavation, etc., are subject to affecting stability of dykes.

2.2.3 Evacuation roads embanked

Below are the potential threats to flood disasters in the case of evacuation roads.

(1) Overflowing

Overflowing of flood water over evacuation roads directly affects people to evacuation activities. This is subject to occurring:

- Where height of evacuation roads on the top becomes lower than other places of the reads surrounded; and
- Where flood water stages exceed the height of evacuation roads (see Figure 2.7 for reference).

(2) Scouring and erosion

Scouring along evacuation roads weaken their stability, resulting in road breaches. This is subject to occurring:

- Where likely to receive high stream power of flood water due to poor alignments of roads;
- Where sand bags are not appropriately placed on the road slopes of the river side;
- Where sods are poorly covered on slopes behind the river, when flood water overflows the road and
- Where structures such as concrete pipes for drainage are located.

(3) Washing away of backfill material behind sand bags

Backfill material behind sand bags is subject to being washed away, resulting in accelerated erosion (see Figure 2.8 for reference).

(4) Instability caused especially by human interventions

Human interventions such as illegal works close to or on dykes such as cultivation, placement of facilities, building, piling, excavation, etc., are subject to affect stability of evacuation roads.

(5) Drain blockage

Drain blockage impedes inundated flood waters to be drained back to the river. This is subject to occurring:

- Where concrete pipes placed in drainage channels and under evacuation roads are filled with garbage, rubbish, soils, etc.; and
- Where elevation of drainage channels on the bottom is higher or lower than other places of the channels surrounded.

CHAPTER 3 MONITORING

3.1 GENERAL

Operation and maintenance activities start with monitoring. Monitoring of structural works enables to identify damages and likely damages to occur in flood situations. Based on accumulated data of the monitoring, one can assess and evaluate the current status of structural works and prioritize actions that should be taken.

3.2 IMPLEMENTATION OF MONITORING

3.2.1 When and how often?

With reference to the Nyando and Nyamasaria river basins, rainy seasons are observed in March to May and in November. Accordingly, it is recommended to carry out monitoring as follows.

(1) Pre-flood

Before and after the rainy seasons, it can be monitored. Although it depends on the meteo-hydrological characteristics of a year, March and June (as beginning and end of the first rainy season) and September and December (as beginning and end of the second rainy season) would be preferable.

(2) During flood (at the early stage)

When a flood event occurs, at the early stage it can be monitored. Apart from operation and maintenance activities, the result can also be given to officers and organizations responsible for emergency activities.

(3) Post-flood

After a flood event occurs, i.e., post-flooding, damage assessment to structural works can be carried out. Items that should be monitored are as same as those of monitoring in pre-flood and during flood situations.

3.2.2 Preparation of monitoring sheets

When carrying out monitoring, monitoring sheets can be used and should be filled in. Table 3.1, Table 3.2 and Table 3.3 are examples of monitoring sheets with special reference to riverbank protections (gabion mattresses), dykes and evacuation roads, respectively. Each monitoring sheet takes account of issues to be addressed in the monitoring, which is already discussed in Section 2.3.

Table 3.1 An example of monitoring sheets to be filled in by communities (riverbank protection works)

MONITORING SHEET

General information

Type of structural works:	Riverbank protection works	**Monitoring sheet ref. no.:** (YYYYMMDD-No.)	
Date and time:		**Location:**	
Written by:		**Whether condition:**	

Monitoring results

Type of impacts	Place	Good condition (Yes/No)	Site (specify the exact place)	Description of damages/ likely damages to occur (specify)	Severity level (1 to 5)
(1) Scouring and erosion	Riverbed				
	Upstream edge				
	Downstream edge				
	Others				
(2) Washing away of backfill material	Behind gabion mattresses				
	Others				
(3) Sliding failure					
(4) Corrosion, abrasion, cutting, poor arrangement, etc.	Gabion mattress				
	Wooden mattress				
	Wooden fence				
	Sheet protection works				
	Others				
(5) Instability caused especially by human interventions					
(6) Others (if any)					

How to fill in the monitoring sheet.

1. Fill in the 'General information' and move to 'Monitoring results'
2. Specify 'Yes' or 'No' in the column 'Good condition'.
3. If the answer is 'No', specify the right columns of 'Site', Description of damages/ likely damages to occur' and 'Severity level' in each row.
4. Severity level' is defined by 1 to 5. '1' refers to the minimum severity level of 'low', while '5' refers the maximum severity level of 'high'.

Table 3.2 An example of monitoring sheets to be filled in by communities (dykes)

MONITORING SHEET

General information

Type of structural works:	Dykes	**Monitoring sheet ref. no.:** (YYYYMMDD-No.)	
Date and time:		**Location:**	
Written by:		**Whether condition:**	

Monitoring results

Type of impacts	Place	Good condition (Yes/No)	Site (specify the exact place)	Description of damages/ likely damages to occur (specify)	Severity level (1 to 5)
(1) Scouring and erosion	River side				
	Residence side				
	Dyke crest				
	Upstream edge				
	Downstream edge				
	Others				
(2) Washing away of backfill material	Behind sand bags				
	Others				
(3) Sliding failure					
(4) Corrosion, abrasion, cutting, poor arrangement, etc.	Sand bag				
	Sod				
	Others				
(5) Instability caused especially by human interventions					
(6) Others (if any)					

How to fill in the monitoring sheet.

1. Fill in the 'General information' and move to 'Monitoring results'
2. Specify 'Yes' or 'No' in the column 'Good condition'.
3. If the answer is 'No', specify the right columns of 'Site', Description of damages/ likely damages to occur' and 'Severity level' in each row.
4. Severity level' is defined by 1 to 5. '1' refers to the minimum severity level of 'low', while '5' refers the maximum severity level of 'high'.

Table 3.3 An example of monitoring sheets to be filled in by communities (evacuation roads)

MONITORING SHEET

General information

Type of structural works:	Evacuation roads	**Monitoring sheet ref. no.:** (YYYYMMDD-No.)	
Date and time:		**Location:**	
Written by:		**Whether condition:**	

Monitoring results

Type of impacts	Place	Good condition (Yes/No)	Site (specify the exact place)	Description of damages/ likely damages to occur (specify)	Severity level (1 to 5)
(1) Scouring and erosion	River side				
	Residence side				
	road crest				
	Near concrete piles				
	Others				
(2) Washing away of backfill material	Behind sand bags				
	Others				
(3) Sliding failure					
(4) Corrosion, abrasion, cutting, poor arrangement, etc.	Sand bag				
	Sod				
	Murram				
	Others				
(5) Drainage blockage	On drainage channels				
	Under evacuation road				
	Others				
(6) Instability caused especially by human interventions					
(7) Others (if any)					

How to fill in the monitoring sheet.

1. Fill in the 'General information' and move to 'Monitoring results'
2. Specify 'Yes' or 'No' in the column 'Good condition'.
3. If the answer is 'No', specify the right columns of 'Site', Description of damages/ likely damages to occur' and 'Severity level' in each row.
4. Severity level' is defined by 1 to 5. '1' refers to the minimum severity level of 'low', while '5' refers the maximum severity level of 'high'.

CHAPTER 4 ASSESSMENT AND EVALUATION

4.1 GENERAL

Based on data accumulated through monitoring processes, assessment reports should be prepared during dry seasons. An assessment report is comprised of 1) a set of monitoring sheets and 2) a list of items concerning damages identified and likely damages to occur during flood situations to structural works. The list of items is also prioritized by hazard levels.

This assessment report enables communities to understand:

- Immediate actions of maintenance and recovery activities that can be taken by communities to be prepared for the next rainy season; and
- What kind of technical as well as financial support have to be requested to the Governments.

The report can be submitted to the related governmental organizations and NGOs for support.

4.2 PREPARATION OF ASSESSMENT AND EVALUATION REPORTS

4.2.1 When and how often?

An assessment report can be prepared during the dry seasons. With reference to the Nyando and Nyamasaria river basins, two times in a year in July (after the first rainy season) and January (after the second rainy season) would be preferable for preparation of the report.

4.2.2 Inventory of issues/ damages identified

First, issues/ damages identified in monitoring sheets accumulated should be itemized in a form shown in Table 4.1.

4.2.3 Priority setting

Second, based on a form itemizing issues identified in the monitoring, those issues can be prioritized. The same table shown in Table 4.1 can be used for this priority setting.

In the process of prioritization, communities should be involved in a participatory manner. They should discuss among them immediate actions that can be taken by themselves and limitation of their capacities to dealing with issues identified. This process makes them clear a decision to be made.

If you need further assistance to prioritize the issues or preparation of assessment reports, you may ask NGOs such as the VIRED International and the Red Cross in the case of this particular pilot projects, since they have been involved in the implementation. NGOs play an important role in operation and maintenance activities.

4.2.4 Compilation of an assessment report

A form prepared for the priority setting and a set of monitoring sheets form an assessment report. Based on the assessment report, communities can go into maintenance and recovery activities.

Table 4.1 An example of an inventory of issues/ damages identified in monitoring sheets

INVENTORY OF ISSUES/ DAMAGES TO STRUCTURAL WORKS

General information

Type of structural works:		**Ref. no.:** (YYYYMMDD-No.)	
Date and time:		**Location:**	
Written by:			

List of damages/ issues

	Type of impacts	Place	Date (damages/ issues identified)	Brief description of damages/ issues identified	Monitoring sheet ref. no.
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

CHAPTER 5 MAINTENANCE AND RECOVERY

5.1 GENERAL

This chapter provides guidance on how to carry out maintenance activities to prepare for flooding and recovery activities after a severe flood event. How to call for support from the Governments are also briefly introduced, since in some cases communities cannot handle maintenance activities by themselves, depending on levels of severity of damages and issues that are identified.

5.2 HOW TO LAUNCH THE MAINTENANCE AND RECOVERY ACTIVITIES?

5.2.1 When and how often?

Maintenance activities should be carried out during the dry seasons after the preparation of assessment reports. It means two times in a year, i.e., in August (after the first rainy season) and February (after the second rainy season) would be preferable.

Recovery activities are carried out immediately after a flood even occurs. This includes smaller scale activities, which can be easily taken by communities, than maintenance activities. Most of measures in the recovery stage should be taken within emergency activities that other organizations are responsible for.

5.2.2 Launch of maintenance and recovery activities by communities

In the maintenance and recovery activities, small scale actions of the following can be taken at the community level. Since issues related to potential threats to structural works are already discussed in Section 2.3, this section focuses only on activities and actions that can be taken by communities.

(1) In the case of overflowing

If height of structural works on the top becomes lower than other places surrounded, embank those places to keep the elevation to the higher level. The material to be used should be compacted after the embankment.

If the upstream and downstream edges of embankments (i.e., dykes and evacuation roads) are not appropriately connected, fill in them by the same material as the original embankments. The material to be used should be compacted after the embankment.

(2) In the case of scouring and erosion

If scouring or erosion of riverbank protection works on the riverbed or at the upstream and downstream edges is observed, place backfill material or sand bags. But, in most of the cases, call for support from the Governments in charge, since this may cause serious damages to the protection works.

If embankments (i.e., dykes and evacuation roads) receive high stream power of flood water due to poor alignments, adjust the alignment to avoid scouring and erosion by placement of embankment material or sand bags. The material to be used should be compacted after the embankment.

If sand bags are not appropriately placed on the slopes of earth works (i.e., dykes and evacuation roads) on the river side, relocate sand bags accordingly.

If sods are poorly covered on slopes of earth works (i.e., dykes and evacuation roads), procure sods and plant them accordingly.

If scoring or erosion near sub-structures such as concrete pipes for drainage is observed, place backfill material or place sand bags to protect from being further scored and eroded.

(3) In the case of sliding failure

If sliding failure is observed or likely to occur, call for support from the Government in charge, since this may cause serious damages to the protection works.

(4) In the case of washing away of backfill material (riverbank protection works)

If backfill material behind gabion mattresses is severely washed away, call for support from the Government in charge, since this may cause serious damages to the protection works.

(5) In the case of washing away of backfill material (dykes and evacuation roads)

If backfill material behind sand bags is washed away, remove sand bags first, fill backfill material, compact them, and then relocate sand bags. Preferably plant sods to be covered on the sand bags.

(6) In the case of corrosion, abrasion and cutting of gabion mattresses/ wooden mattresses/ wooden fences

In the case of corrosion, abrasion and cutting of steel wires used for riverbank protection works (e.g., gabion mattresses, wooden mattresses, wooden fences, etc.), reconnect or repair them where possible. Otherwise, call for support from the Government in charge, since this may cause serious damages to the protection works.

(7) In the case of abrasion and cutting of sand bags

If abrasion and cutting of sand bags are observed, repair them or replace them with new ones.

(8) In the case of drain blockage (evacuation roads)

If concrete pipes placed in drainage channels and under evacuation roads are blocked by garbage, rubbish, soils, etc., remove them.

If elevation of drainage channels on the bottom is higher or lower than other places of the channels surrounded, adjust the height to a flat level by excavation and embanking as far as possible.

(9) Instability caused especially by human interventions

If human interventions such as illegal works close to or on dykes such as cultivation, placement of facilities, building, piling, excavation, etc., are observed, remove them and bring them back to a previous condition.

5.2.3 Calls for support from the government

An assessment report can be submitted to the Governments in charge. Depending on types of structural works, responsible organizations in charge are different. The roles and responsibilities of governmental organizations are as already given in Table 2.1.

If you need further assistance in the process of interlinking your efforts to the Governments, you may ask NGOs such as the VIRED International and the Red Cross in the case of this particular pilot projects, since they have been involved in the implementation. NGOs can play an important role in community approaches in general and such bottom up approaches to operation and maintenance activities in particular.

CHAPTER 6. FURTHER IMPROVEMENT OF THE ACTIVITIES

Every year, activities should be reviewed among members of CBOs and village people. Lessons learned can be used for further improvement of the operation and maintenance activities at the community level. CBOs should take this initiative. Appendix shows the training manual for operation and maintenance for community-based organizations.

APPENDIX

TRAINING MANUAL
ON
OPERATION AND MAINTENANCE
FOR
STRUCTRURAL MEASURES

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BACKGROUND INFORMATION AND INTRODUCTION

The pilot project on integrated flood management (IFM) for the Nyando river basin was designed to come up with pilot structural measures to improve the livelihood of the riparian communities through capacity building of the communities in the pilot sites; Kasiru, Kokwaro, Odesso and Magina. These structural measures and facilities include; the borehole (Kasiru village), the evacuation centre at Kokwaro village, evacuation roads (Kokwaro and Kasiru villages), dyke (Magina), river bank restoration (Odesso village) and lastly the pit latrine at Kokwaro and Kasiru villages respectively.

As a result, these structures put in place have to be maintained by the communities. This manual was produced to enable communities carry out the necessary operation and maintenance procedures regarding the different facilities.

1.1 Components of a piston pump

The key components of piston pumps are a piston or plunger with a sliding seal inside a cylinder and two non-return check valves. On the piston upstroke, water is drawn by the piston up the pipe and into the cylinder through a non-return valve (sometimes called a foot valve).

At the same time the piston displaces water, which is already in the cylinder above the piston (Figure 1), up into the rising main or out through the pump's outlet. On the piston downstroke, the cylinder check valve closes, preventing the cylinder returning down the pipe, and the check valve in the piston opens, so allowing the piston to move down through the water in the cylinder.

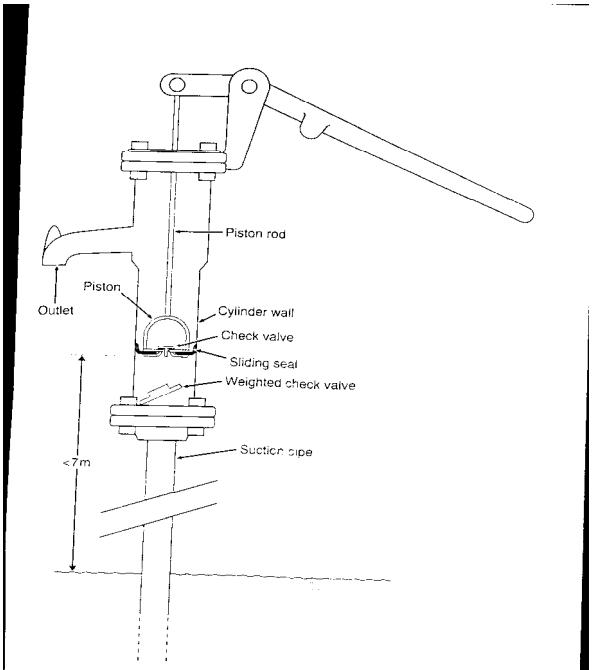

Figure 1: *Parts of a hand pump*

1.2 Operation and maintenance of pumps

1.2.1 Operation

- There will be a fence constructed around the borehole which will be locked and also the handle will be locked.
- There will be no washing of clothes and watering of livestock around the borehole
- There will be charges for the use of water
- There will be 6 committee members 2 from each clan

1.2.2 Maintenance

Maintenance is a term which is used to refer to a wide range of activities from servicing to major repair work. Servicing is the regular, planned inspection and preventive maintenance of the essential equipment to keep the equipment in good running order and to minimize breakdowns. Many routine servicing tasks (e.g. daily checks) can be carried out by operators. Corrective maintenance refers to the repair and replacement of the worn out and broken parts to keep equipment in a reliable operating condition.

Plate 1: **Water pump**

One of the commonest causes of pumping failure is an air leak in the suction line. Therefore, ensure all joints in the suction pipe work are airtight. The joint should be repaired properly as soon as possible. The bearings are lubricated by grease, oil or water. Physical damage to the well-head should be repaired to give a sanitary seal, an apron which drains away from the borehole and a rigid

mounting for the pump and rising main. Damaged pumping equipment will need repair and replacement.

It may be possible to remove pipes which may have dropped down the borehole using borehole 'fishing tools' (consult a local driller or the water department). Steel pipes corrode with age and a rate which is dependent on the chemistry of the water. Pipes often corrode at pipe threads which are not galvanized. When this occurs, discharge rates will at first be lower and as cracks widen, the losses increase until the pipe eventually drops off.

Therefore, if a lowering in discharge rate is detected, check the pipes and threads as soon as possible. It may be possible to clear a borehole which has been blocked with debris using a percussion rig with a bailer. Water which has been standing in a borehole for sometime should be pumped out and the borehole chlorinated. Screens in a borehole may become blocked. Some causes of blocked screens and possible remedies are given in the table 1 below

Table 1: Causes of blocked screens

Problem	Remedy
• Blocked well screen due to: poor well design; poor well development; corrosion; pumping rate too high	• Re-develop the well using borehole development procedure outlined here below.
• Chemical incrustation	• Treat with strong acid solution administered by specialist personnel under strict safety rules
• Biofouling (iron bacteria)	• Treat with a strong chlorine solution (50-500ppm) agitated in the borehole pumped

CHAPTER 2: DYKE AND RIVER BANK PROTECTION (MAGINA AND ODESSO)

2.1 Definitions

a) ***Dyke*:** "A dyke is an embankment, wall, fill, piling, pump, gate, flood box, pipe, sluice, culvert, canal, ditch, drain, or any other thing that is constructed, assembled or installed to prevent the flooding of land".

b) ***River/stream bank protection*:** Is the treatment of slopes of dikes of streams, lakes and other water bodies by placement of riprap (an engineered layer of graded broken rock pieces) or other forms of protection to prevent erosion by surface runoff, stream flows and/or wave action.

c) ***Dyke height*:** The vertical distance from the dike crest level to natural ground as measured at the landside toe of a dyke.

d) ***Riparian vegetation*:** The vegetation immediately in contact with a water body or sufficiently close to direct influence on aquatic habitat values

2.2 Dyke: The Background

A dike (or dyke) is an artificial earthen wall, constructed as a defense or as a boundary. A dike is an embankment to control water, often built along the banks of a river to prevent overflow of lowlands. It is also known in America English as levee, from the French word (elevated). The best known form of dyke is a construction built along the edge of a body of water, to prevent it from flooding onto adjacent lowland. Dykes can be mainly found along the sea, where dunes are not strong enough, along rivers for protection against high-floods, along lakes or along polders.

Plate 2: *Unprotected/ Damaged river bank*

Furthermore, dykes have been built for purposes of emboldening, or as a boundary for an inundation area. The latter can be a controlled inundation by the military or a measure to prevent inundation of a larger area surrounded by dykes. Dykes have also been built as field boundaries and as military defenses. Dykes can be permanent earthworks or emergency constructions (often of sandbags) built hastily in a flood emergency.

2.3 Need for River Bank Protection and Dyke Maintenance

Dyke maintenance activities have the potential to negatively impact fish and fish habitat when undertaken without appropriate forethought and care. This is important to protect fish spawning grounds for the pubic interest. During the period of migration, most juvenile fish concentrate along the edges of rivers. Marsh and riparian vegetation along river edges provide refuge areas for the juvenile fish from predators and from faster currents found mid-river.

They also supply food and nutrients to the riverine food web. For smaller river systems, riparian vegetation can shade the water, providing water temperature regulation through warmer and colder months. Riparian vegetation also intercepts surface water, filtering it and preventing some sediments and pollutants from reaching the river. Sometimes, spawning areas located immediately adjacent to dikes. In these situations additional care should be taken to prevent disturbance to spawning fish and the incubating eggs.

2.4 Principles of Vegetation Management in Dyke Maintenance

Vegetation management guidelines for flood protection dikes are determined by the public safety need for visibility for inspection, access for efficient operation and maintenance, and minimization of detrimental effects to dike fills and bank protection.

Vegetation management should, where possible, include efforts to preserve and enhance fish and wildlife habitat in the overall stream/river corridor. Vegetation (including roots and canopy) can improve both dike safety and habitat through soil conservation and erosion control. Plate 3 indicates unprotected Nyando river dyke at Magina.

Plate 3: *A degraded dykes Nyando river in Magina area, Nyando district*

2.4 Guidelines on Vegetation Management for Flood Protection Works

1. Care should be taken to minimize disturbance to stems and roots of vegetation where possible during site access for maintenance activities.
2. Dike crests shall be kept clear of vegetation other than trimmed grass, and accessible with due regard for inspection sight lines.
3. Dike side-slopes:
    a) The landslide side-slope of dike fills shall be kept clear of vegetation other than trimmed grass, including a minimum 3metre strip beyond the landslide toe. (Increases in the landside strip may be considered where necessary, consistent with minimum needs for efficient operation of mowing equipment.)
    b) The waterside side-slope of riverside and setback dike fills shall be kept clear of vegetation other than trimmed to the toe of the dike fill as determined by the dike height. Large vegetation (greater than 300mm diameter trunk/stem) shall be removed from an additional 2 metre strip measured horizontally. Consideration may be given to increasing the riverside strip consistent with minimum needs for efficient operation of mowing equipment.
    c) Riverside dikes with bank protection – the waterside side-slope of riverside dikes with bank protection shall be cleared above the toe of fill. Portions of bank protection extending below the dike height may contain vegetation clumps.
    d) Provided dike safety is not affected, trees may be retained on the side-slopes of dikes without bank protection, so long as they are spaced and pruned. Trees should be thinned, topped or

removed (especially if higher than 15metres) and the lower 1.5 metres of trees should be regularly pruned of branches to maintain inspection sight-lines.

e) Bank protection – bank protection located on natural riverbanks may contain clumps of controlled vegetation. In sensitive habitat areas, consideration may be given to selective topping, pruning, thinning or stabilization of existing large vegetation provided the bank protection is not compromised.

f) Vegetation clumps – controlled vegetation clumps which are devoid of potentially large growth and/ or excessive vegetation are acceptable in riprap bank protection or on over-width dikes. Controlled vegetation clumps may contain shrubs which do not obstruct inspection visibility, displace riprap or create holes. It is generally recommended that the branches of vegetation clumps be pruned and maintained to have a maximum span of about 3 metres in diameter. To reduce future vegetation maintenance requirements, it is recommended that the branches of vegetation clumps be pruned and maintained to have a maximum span of about 3 metres in diameters and vegetation be selected that will not exceed 5 to 6 metres in height.

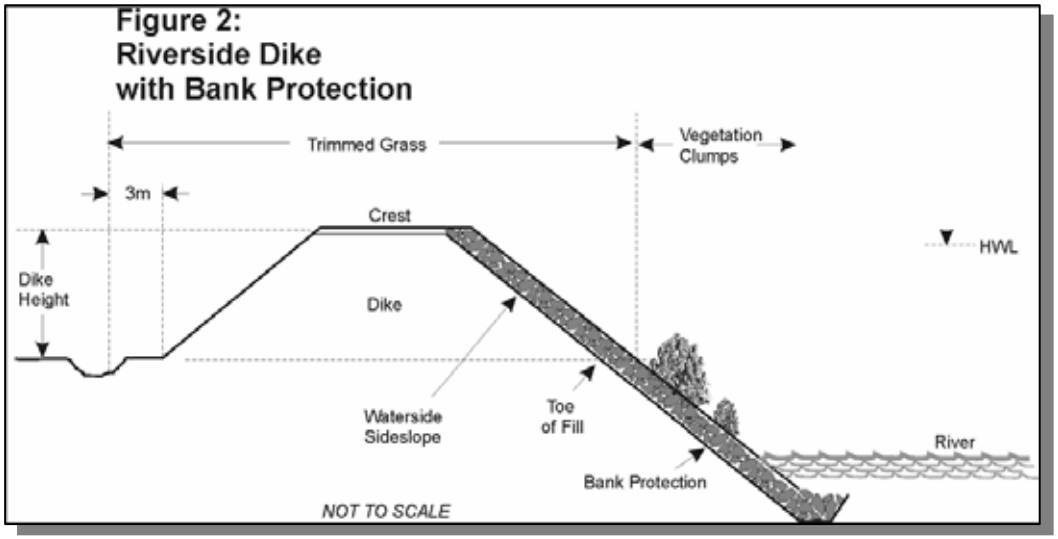

Figure 2 Dike with Bank Protection

2.5 Rules and regulations for river bank protection of Nyamsaria River

- The rules were generated by the community
- Community people do not understand what a river bank is because non currently exists for river Nyamasaria i.e. all the land bordering the river is owned by individuals
- Thus the Rules and regulations here apply to the protection of the river bank when the lost/non-existent riparian land (the river bank) is reclaimed by the line government ministries concerned e.g. water, land, and roads
- The **do's and don'ts** are the following:
  - no cattle should be permitted to step on the reinforced rive bank by JICA IFM structural facility at Nyamasaria bridge
  - sand harvesters should find alternative sources of income
  - signboard with text indicating 'protected area/no-go zone' should be installed at the river bank to cover a stretch of 150m from the bridge

- Trees growing naturally along the river should be left undisturbed
- There should be vegetation establishment and tree species chosen include *Eucalyptus saligna* (Obino) and the grasses e.g. star and Kikuyu grass.
- Washing of cars at and along the river bank should be prohibited
- A stretch of 150 m is a restricted area for sand harvesters (Plate 7).

Plate 4: *Destroyed bank of Nyamasaria river*

Plate 5: *Restored Nyamasaria river bank under JICA protection works*

Plate 6: *Sand harvesters at work in Nyamasaria river*

Plate 7: *Rehabilitated river bank at Nyamasaria (restricted area is 150m downstream from the bridge)*

2.6 Execution of the rules for Nyamasaria River

- ❖ Community members agreed to have a committee to monitor and see that rules formed are adhered to;
- ❖ They also proposed the provincial administration (Chief and their assistants) to help as watch-dogs in the reinforcement of the rules;
- ❖ Other stakeholders that were involved to help in the execution of these rules and regulations included: the village elders, the CBO officials and the ministry of water and irrigation specifically, WRMA.

Committee members to execute the rules are Clera Gogo, Enock Odhiambo, George Othuon , Benson Nyaori (sand harvesting group chairman).

CHAPTER 3: THE ROADS (KASIRU AND KOKWARO)

3.1 Road repair and maintenance

Road maintenance activities include:

- ❖ Clean and re-form ditches
- ❖ Repair and rebuild erosion checks
- ❖ Clean culverts
- ❖ Patch potholes, ruts and gullies
- ❖ Maintain the correct road camber and cross-fall

Plate 8: Destroyed road with pothole

3.1.1 Culverts

Culverts must be kept clear and in good structural condition or the road may be washed out. Culvert maintenance involves clearing silt and debris from the waterway, controlling erosion and doing any necessary structural repairs.

3.1.2 Soft spots

Dig out and fill soft spots. If possible, drain them and allow them to dry out. In urgent cases, it is possible to form temporary matting from felled trees and saplings placed at right angles to reach other bound together to form a raft. Where the road is wide and time is short, consider the repair of just a narrow section, rather than the complete width.

3.1.3 Potholes, ruts and road surface gullies

Brush loose material and water from the area to be repaired. Cut away until sound material is reached and the sides are vertical. The fill should be similar to the existing surface material. Check the moisture content of the fill simply by squeezing the material in the hand. If it sticks together it is suitable but it should be discarded if water can be squeezed out. If the material is dry, wet both the material and the pothole with sprinkled water. Build up the pothole in layers about 70mm deep. Compact each layer with a roller (this can be improvised by putting concrete in a tin drum) so that the finished patch stands slightly above the surrounding surface.

3.1.4 Corrugations

In the dry season, dragging can help to prevent the formation of corrugations and can remove light corrugations. Compaction should be done using a roller after flattening out the corrugations.

3.1.5 Grading

In moist conditions, the surface can be re-formed or graded. Water may be required if the soils are insufficiently moist for binding and compaction. Water and the necessary tankers must, therefore, be availed.

3.1.6 Trench maintenance-

De-silting should be done during the dry season and the silt should be taken at least 1m away.

3.2 Maintenance of riparian vegetation

- ❖ Planting of grass should be done to protect the soil covering the gunny bags.
- ❖ The grass should be protected from livestock

- During the wet season the grass should be kept short by trimming but should not be pulled out. This is to keep away snakes that could hide and pose a danger to people and livestock.
- Weeds should be pulled out when they are still young to prevent the soil being disturbed.
- The grass should be watered during the dry season
- Note: No trees should be planted between the road and the river.

3.3 Road maintenance committees

Committee for Kokwaro Comprises 4 members namely: Dickson Okwaro, John Otieno, Silpa Matito and Jeremial Deya. Committee for Kasiru Comprises 4 members to be identified by the community.

CHAPTER 4: THE PIT LATRINES (KASIRU AND KOKWARO)

4.1 Introduction

The simple Pit latrine is a squatting slab (Figure 3) placed over a hole in the ground. The hole in the slab should have a tightly fitting cover to prevent the movement of flies and reduce odors. A concrete slab provides a durable support and seals the pit and is also easily cleaned.

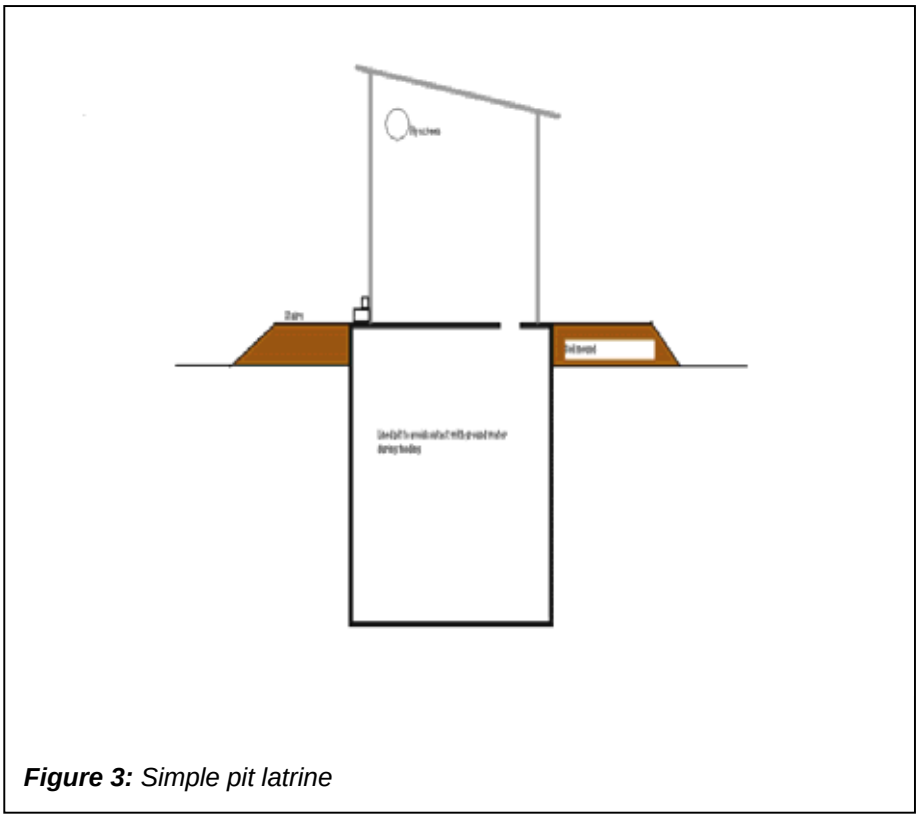

Figure 3: *Simple pit latrine*

4.2 Operation and maintenance

All latrines need regular cleaning, but communal latrines especially, require constant supervision ad cleaning if they are to be kept in a sanitary condition. There may be cultural norms which affect the degree to which certain individuals in a society are prepared to be involved in the handling of faeces and the cleaning of latrines. This can affect the use and care of latrines and the requirement of sanitarians, latrine supervisors and cleaners. Thus small coherent groups such as families are more likely to take responsibility for care and maintenance than large disparate groups.

Children may not be happy using pit latrines, even if they are shallow, because the inside of the latrine is often dark, and children may have a fear of falling down the hole. Therefore, an alternative should be made available for young children to use if they are not to defecate indiscriminately.

At the entrance to the communal latrines, provide anal cleansing material and soil in buckets. Anal cleansing materials should be bio-degradable and easy to manage. The committee in charge of sanitation will choose latrine supervisors on a rotational basis from the community members.

Latrine supervisors should add a further 50-100mm of soil cover periodically to reduce fly breeding. The frequency of additional covering will vary from daily to weekly, depending mainly on the weather. At the exit to communal latrines, provide water and soap for hand washing. Supervisors/committee should ensure that all latrine users wash their hands after defecation.

People will not use communal latrines that are in poor condition, so supervisors should monitor their use and rate of filling, and ensure that they are cleaned regularly. The foot-rests and the surrounding area should be scrubbed with water every few hours, and almost constantly during periods of peak use. Provide latrine supervisors with adequate protective clothing and equipment for cleaning. Use public education campaigns to ensure people know how to use and look after latrines.

- Leaking roofs should be repaired or replaced.
- A wooden cover should be made to cover the hole in the latrine to reduce flies when the latrine is not in use.
- Cracks on the wall and in the floor should be repaired under masonry works.
- Door hinges should be greased regularly.

4.3 Sanitation/latrine committees

- A committee comprising two members for Kokwaro CBO namely: Julius Okwaro and Penina Deya is in charge of sanitation
- Kasiru CBO committee members for the toilet comprised of

4.4 When the latrine is full

It is essential for full latrines to have soil cover to reduce fly breeding. Fill the latrine with soil when full to within 150mm of the surface with a soil cover of 0.5m. Prepare new latrines in advance of closing existing latrines. Remove any super structure fro the old latrine and back fill soil. Heap and compact the soil in a mound to allow for settlement and to mark the site. Fence off the area until the content and backfill have settled. In certain circumstances where it is not possible to dig new latrines, it may be necessary to organize pumping out of full latrines which requires careful planning and specialized equipment.

5.1 Taps, gutters and the tanks

Leakage at taps from open, worn or broken taps can waste valuable water and create muddy and unsanitary pools. Therefore taps must be constantly maintained and immediately repaired when faulty. Taps can be left open when there is no flow so that when flow is restored a lot of water can be wasted.

Plate 9: *The Water tank for roof water harvesting*

The gutters and the tanks must be thoroughly and constantly checked to prevent blockage and accumulation of unwanted materials (dirt, leaves etc) that form conducive environment for proliferation of microbial organisms e.g. bacteria, fungi etc. gutters should be cleared of any material especially leaf litter and other substances that may cause water borne diseases. Tanks must be cleaned regularly to prevent the breeding of disease causing agents e.g. *Salmonella typhi*, *Escherichia coli* etc.

5.2 Wastewater and solid waste management

Management of wastes is very important at the evacuation centers.

This minimizes chances of contamination/cross contamination and the resultant outbreak of diseases to the evacuees.

Wastewater from the evacuation centre i.e. kitchen will be channeled to a soak pit (Figure 4).

The soak pit is filled with stones simply support the sides and roof of an unlined pit.

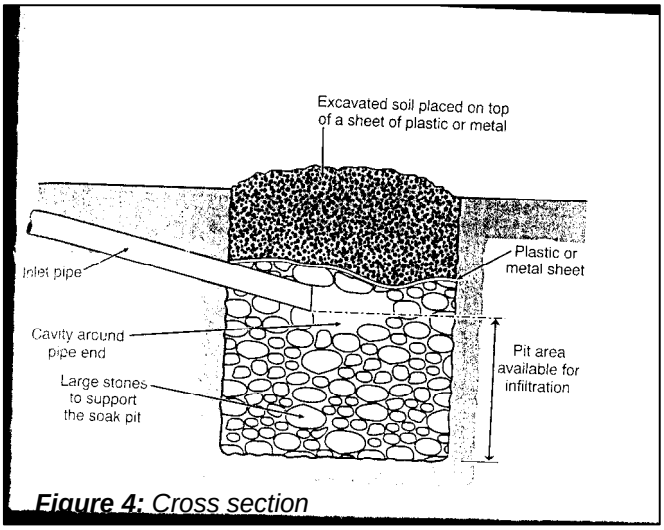

Figure 4: *Cross section*

5.3 Refuse collection

Refuse bins will be provided of bins for degradable and non-degradable

Containers for refuse collection should be kept covered to prevent scavenging by animals and children. Composting (Heap) will be done for biodegradable waste

5.3.1 Composting

Composting is a great way to reduce and recycle kitchen and garden waste. Composting will transform discarded peels and unwanted pruning into valuable garden products.

Compost is derived from broken down kitchen and garden waste, which if managed correctly, will eventually break down to a rich organic substance called humus. Humus is a natural fertilizer, valuable to the garden. As well as adding nutrients humus helps to conserve water and encourages earthworms. Composting is great for the environment because it can reduce the amount of household and garden waste by 30%. A compost heap can be made on soil and covered in black plastic. A compost heap should be located in a convenient spot on level ground to prevent it from falling over. It should be placed in an area where there is shade which will prevent it from cooking in the sun.

5.3.2 What to put in compost heap

- Fruit and vegetable peelings and leaves
- tea leaves/ tea bags
- fallen leaves
- grass clippings
- soft pruning
- weeds (use only young weeds; those with seed, or about to set seed, are better disposed of in the garbage bin)
- cow ,sheep and goat manures
- ash (from open fireplaces)

5.3.3 What not to put in a compost heap

It is important that the heap is not treated simply as a dump.

- Meat, fish, chicken, dairy products & cooking oils - these may attract vermin such as mice and other pests.
- Non-living things such as plastics, bottle tops, food wrappers, metals etc
- Diseased plants
- Fruit fly infested fruit
- Pet droppings: these may contain diseases that can affect humans and other pets.

5.3.4 How do you compost?

- A good mixture of the above-mentioned materials ('what to put in compost') is the start to good compost. It is best not to add too much of the one thing. Balance is the key.
- The smaller the pieces, the faster they break down. Chop up larger and tougher items before they go in the bin.
- Occasionally add a thin (3-5cm) layer of soil to help things move along. The addition of manure will also help the compost break down more quickly.
- The compost should be regularly turned over to help it to break down faster.

5.3.5 Compost additives

Many materials compost satisfactorily, but additional ingredients such as nitrogen will help speed up the process. Nitrogen may be provided as artificial fertilizer or as well-rotted manure. Nitrogen can be added to the compost heap in alternative layers of organic material and manure.

5.3.6 Compost problems

Smelly compost

- If the compost smells like sulphur (rotten eggs) then it's possible that it's too wet. Add dry ingredients such as grass clippings, dried leaves or shredded newspaper.
- Turning the compost over to incorporate air and adding lime may also help to reduce odors.
- If the compost smells like ammonia (acidic) add materials containing carbon, such as ash.

Vermin

- If pests, such as blowflies, dogs, cats or rodents, are attracted to the compost heap it is usually because improper materials have been added. Avoid putting any meat, chicken fish or other fatty food scraps in the compost.
- Vermin may also be attracted to the warmth of the pile.
- Being high in nutrients the compost heap may also attract a range of harmless insects including the "compost fly" which in fact indicate that the compost is working properly - they are all part of the natural process of composting.
- Using a compost bin and keeping the lid on, will reduce the number of insects attracted.
- Covering each addition of food with a layer of soil may also help.

Ants

- A dry compost heap can become an ant heap but no harm will be done. The ants will redistribute all the material, so the heap will not need to be tossed. It may help to water the pile and add moisture-rich ingredients.
- The day before using ant-infested compost, water it well and the ants will leave.

Too wet or too dry

- Compost needs to be kept moist but not wet. If the heap or bin is covered it will be necessary to wet the compost down with a hose occasionally.
- If the compost gets too dry fungal spores (a fine powder) may form which when disturbed can be dangerous to breathe in. If this occurs, wet the heap, cover with soil and allow to sit for a few days.
- If the compost gets too wet turning it to incorporate air should help as will the addition of some dry material such as grass clippings.

Taking too long to break down

- If a compost is too wet or too dry, or if there is not enough air it may take too long to break down. This might mean there is an imbalance in the ingredients for example thick layers of grass clippings or newspaper quickly absorb moisture, forming a dense mass which resists decomposition and prevents proper air movement

5.3.7 How to use compost

When the compost is dark, crumbly and sweet-smelling it is ready to use in the garden.

- Compost can be dug into the existing soil of a garden bed. If the compost is mature, there should be no risk of it burning plants so harm will not be done if it touches the stems.

Compost can also be used as mulch around existing plants. Established shrubs and fruit trees will benefit from a ring of compost. Fork it in around the drip line, where water drips from the outermost leaves. The fine roots will benefit from this as they grow outward and the ground will retain moisture in hot or windy weather.

5.4 Stores

Dangerous items including fuels, insecticides, and pesticides, chlorine-based, toxic or corrosive substances should be supplied with markings denoting the nature of the hazard and warning instructions regarding their handling and storage.

The persons in charge of the store should keep the following in mind:

- Stack with care.
- Store flammable substances away from the main building and prohibit smoking or open flames within 10m of the storage area.
- Never store chemicals or cement in the same store as food.
- Medical supplies should be carefully managed in close consultation with medical personnel (Community health workers)
- Repackaging of items should be minimized and if it is done, then the containers should be properly labeled to prevent confusion and wrong use of items.

5.5 Security

Security of the evacuation centre and other facilities should be provided. Security committees were formed to take care of the different facilities installed within the community.

Security provision at the evacuation centre – maintenance of perimeter fence –barbed wire.

5.6 Management structure for the management of the evacuation centre – the sub-committees

- Water and sanitation
- Tanks, latrines, solid waste and wastewater management
  - Latrines- 2 Committee members (1 woman and 1 man)
  - Water-2 Committee members (1 woman and 1 man)
- Security-2 Committee members(2 men)
- Social welfare - 4 Committee members (2 women and 2 men)
- Health -2 Committee members(Community health workers) (1 woman and 1 man)
- Liaison/information desk-1 Committee member
- Arbitrator -2 Committee members(1 women and 1 man)
- Storekeeper-2 Committee members(1 woman and 1 man)
- Food (1 woman and 1 man).

CHAPTER 6

HOW TO EXECUTE COMMUNITY-DRIVEN EVACUATION DRILL

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF WATER AND IRRIGATION (MWI)
WATER RESOURCES MANAGEMENT AUTHORITY (WRMA)

THE STUDY
ON
INTEGRATED FLOOD MANAGEMENT
FOR
NYANDO RIVER BASIN

GUIDE

FOR

COMMUNITY-DRIVEN EVACUATION DRILL

PREFACE

Perennial floods in Nyando River Basin demands community preparedness against this inevitable natural phenomenal. Many lives have been lost and property destroyed as a result of floods.

It has been recognized that structure measures cannot be relied on holistically as mitigation efforts against floods and therefore creating a need for non-structure measures.

In recognition of these efforts towards non-structure measures in flood management, this manual is prepared as a guideline for organizing a successful evacuation drill.

This manual envisages evacuation as an important aspect in saving lives and minimize property damage and more so put a system in place that enable early warnings for communities to evacuate, how to evacuate, what is to be done while at the evacuation centre, how to deal with the injured and the sick during evacuation, dissemination of information to government and humanitarian organization and the management of evacuation centre.

As the English proverb goes “Practice makes perfect”. This manual aims at success of evacuation drills in acknowledgement that these drills are means to perfection of the actual evacuation exercise during floods.

GUIDE
FOR
COMMUNITY-DRIVEN EVACUATION DRILL

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CHAPTER 1 PREPARATORY STAGE

1.1 Preparatory Meeting

Preparatory meeting is held by the Community Flood Management Organisation (CFMO) where date and time for the drill is proposed. All members of the CFMO are expected to assist in mobilizing the community and participating in the evacuation drill event. The following issues are to be discussed and agreed upon in this meeting:

Points to check:

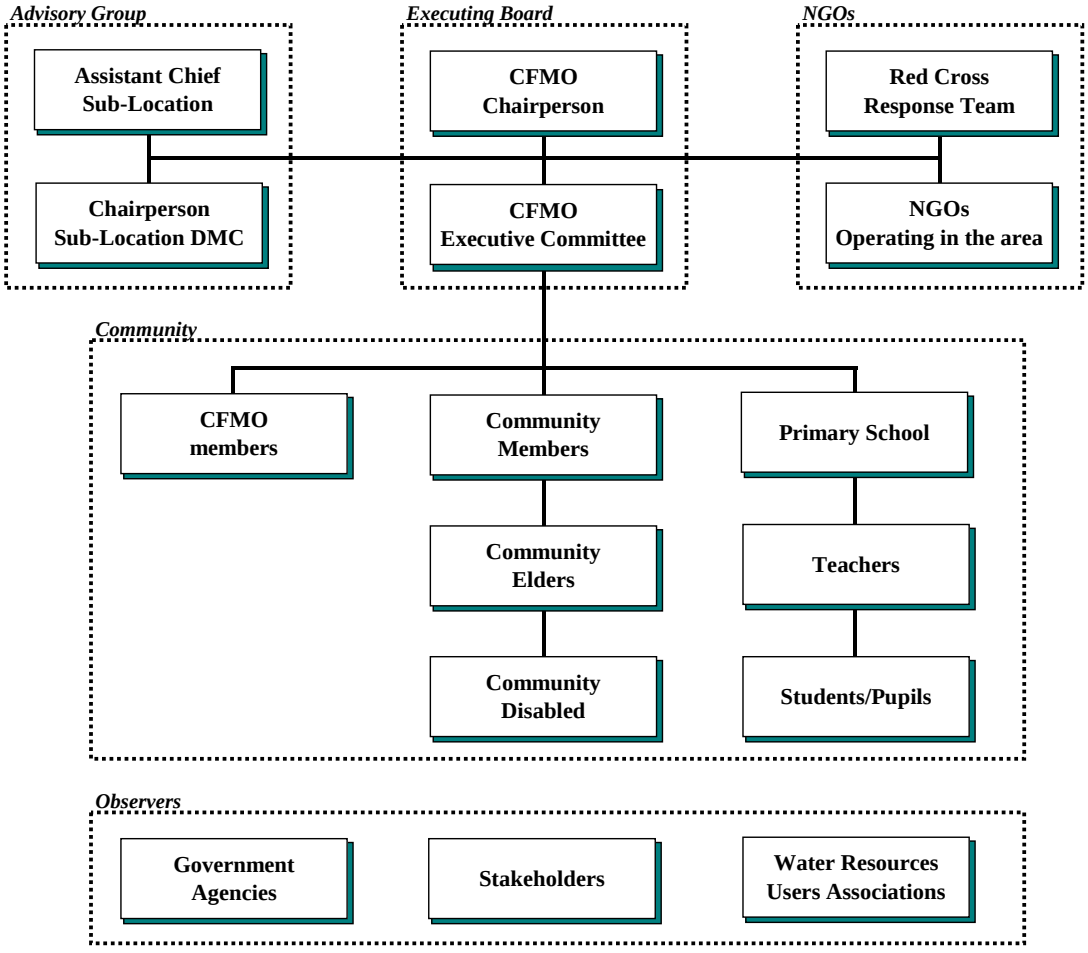
- **Notify the police about the evacuation drill date for security purposes and obtaining a license for a public meeting**
- **During the meeting a tentative programme schedule is drawn which indicates the time the drill will commence and when it ends.**
- **Identify the speakers who will address the gathering**
- **Write letters of invitation to concerned governmental agencies (e.g. Ministry of Water and Irrigation, WRMA) stakeholders and other interested observers**

CFMO members meeting discussing evacuation drill

1.2 Confirmation of Executing Board and Organisation

CFMO organized the executing committee prior to the implementation of evacuation drills. The organization chart consists of five groups, namely, Executing Board, Community members, Advisory Group, NGOs and Observers from Government agency, stakeholders and water resources users associations (WRUAs).

Participation of students and pupils is favourable for getting knowledge for flood management as part of disaster management education.



Organization Chart of Evacuation Drill

1.3 Implementation Program

(1) Situation of a flood in the evacuation drill

On _____, there is a heavy rain for several days causing the river water level to rise in the Nyando river basin. As a result, the risk of flood disaster in the community is increased. Based on the information from sub-location on water level of _____ river, CFMO chairman announces immediate evacuation to the village people and all people is starting evacuation.

(2) Roles of actors concerned

Table 1 Roles of Actors Concerned (Example)

Part	Contents	Actor	Items to be confirmed
Confirmation of river water level	CFMO member carries out patrol to confirm river water level, and report the high possibility of flood from the river to CFMO chairman by mobile.	CFMO member	Existing method of patrol (confirmer, check point, method of confirmation of river water level) and timing for report.
Request aid	CFMO chairman reports increasing river water level above river bank/dike and a possible evacuation situation to DMC (Sub-Location) by mobile, and requests for aid from the DMC.	CFMO chairman	
Announcement of evacuation	CFMO chairman instructs the executive committee members to evacuate to the nearest evacuation center.	CFMO chairman	
	CFMO members move from homestead to homestead warning community members to evacuate.	CFMO members	Announce method (siren, drum, shouting)
Set up an evacuation center	CFMO members set up reception for evacuees at the evacuation center	CFMO members	Basic necessities should be made available like water and firewood
Questionnaire survey	CFMO executive committee members carry out questionnaire survey to participants upon their arrival until completion of evacuation.	CFMO executive committee	referring to (5)
Reporting a number of evacuees	Reception counts a number of evacuees and reports total number with a proper breakdown of evacuees i.e. the sick, the injured, children, and	CFMO member	Vulnerable persons, the injured and the sick.

	pregnant women to CFMO chairman.		
	CFMO chairman report a number of evacuees and evacuation place condition to Assistant Chief.	CFMO chairman	
First- aid training	Demonstration and training for first- aid of injury these will include: **1) Resuscitation** A-Airway B-Breathing -Look -Listen -Feel C.P.R-Cardiopulmonary Resuscitation **2) Airway Disorders** Chocking Drowning (near drowning) **3) Foreign bodies in the eye, ear and nose** -Eyes-pour cool clean running water -Ears-pour vegetable oil -Nose-blow one side **4) Bleeding and wounds** Clean the wounds and stop bleeding **5) Bites and Stings** Bites-dogs, snakes, cats Stings, bees, wasps, ants etc. **6) Transportation-Moving casualty from one place to another** -Fireman's crawl -Stretchers -Hand lifts **7) Fainting and Shock** -Recovery position	Red Cross/ trained first-aid attendant	Demonstration on First-Aid should be based on the major injuries concerns often suffered by community members during flood triggered evacuation.
Wrap-up meeting	Wrap-up meeting which reviews the evacuation process and problems encountered are highlighted and discussed.	CFMO Executive Committee facilitates	Scheduled speakers address the participants.

(3) Setting-up time table

CFMO establishes a time table for evacuation drill. Table 2 shows an example of time table which was carried out Kokwaro Village on 02 November 2007.

Table 2 Time Table for Evacuation Drill (Example)

Time	Steps	Contents
Before 8:00	Standby	-Community members await warnings to evacuate in their homes. - CFMO member patrol the river check point.
8:00	Announcement of evacuation	- CFMO member carries out patrol to confirm river water level, and report the high possibility of flood from the river to CFMO chairman by mobile. The chairman is already in a meeting with CFMO executive committee when the phone rings - CFMO chairman immediately reports the matter to the executive committee members - CFMO chairman reports to DMC Chairperson that the river water level has risen above the river bank/dike and that the communities will soon be evacuating. This is done through mobile phone and CFMO chairman makes a request for aid. - CFMO chairman instruct the executive committee members to announce to each homestead to evacuate to the nearest evacuation center.
	Set up an evacuation center	- CFMO members set up reception at the evacuation center.
	Evacuation starting	-Participants move to evacuation center. -CFMO secretary registers the arriving participants at reception.
(8:00 ～ 9:30)	Questionnaire survey	-CFMO Executive Committee members carry out questionnaire survey (about 50 samples) to participants until completion evacuation.
9:30	Reporting a number of evacuees	-Reception counts a number of evacuees and reports total number with a complete breakdown to CFMO chairman. -CFMO chairman report the number of evacuees and evacuation center condition to Assistant Chief. -Assistant Chief informs the number of evacuees and evacuation center condition to district DMC which is headed by the District Commissioner. (by use of a mobile phone)
9:35 ～ 10:30	First- aid training	Demonstration and training for first-aid -First- aid for injury (cut) -Artificial breathing etc.
10:30 ～ 11:00	Review	-WRMA, DMC, CFMO chairman
11:00 ～ 12:00	Wrap-up meeting	-Meeting by participants
12:00	Close, Breakup	-CFMO chairman closes the meeting

CHAPTER 2 EXECUTION OF EVACUATION DRILL

2.1 Step 1 : Commencement of Drill

The evacuation drill commences with the CFMO executive committee meeting. The agenda of the meeting is the increased observations of the flood early warnings in the village.

Points to check

- **Chairperson of the CFMO taking the leading role in the discussions and the decision making.**
- **Discussing and mentioning of the observed flood early warnings**
- **Chairperson impression that he or she is in contact with the local provincial administration (assistant chief) and if possible the assistant chief should be part of the members in the meeting**
- **Chairperson's impression is that he or she was in constant communication with the sub-location disaster management committee chairperson**
- **Discussion on village preparedness for floods especially on evacuation center**

Discussion and Decision making for the needs of evacuation

2.2 Step 2 : Checking River Water Level

CFMO chairperson delegates one or two of the executive committee members to go and observe the river level

Points to check

- **The chairperson gives a directive to one of the executive committee member to go and observe the river level (in case the river is close by)**
- **The chairperson explains to the executives that he or she had already directed one of the executive to be at the river to observe it (in case the river is not nearby)**
- **The chairperson gets the feedback from the executive committee member who is observing the river through mobile phone that the river is bursting its banks**

A CFMO member is observing the river water level and the possibility of flooding.

The CFMO member communicates with the chairperson of CFMO about the present river water level.

A Village elder, one of CFMO members, disseminates a warning by blowing a whistle.

2.3 Step 3: Dissemination of information to community.

The chairperson of CFMO calls the chairperson of sub-location Disaster Management Committee (DMC) and informs him/her of a possible flood situation. Thereafter the chairperson calls the village elder and informs him/her to start shouting for the community members to evacuate. The chairperson and his/her executive committee members begin to shout as well asking the community to evacuate as they go round the village informing community members that the river has overflowed its banks. While one of the executives using his/her mobile phone remains at the meeting point communicating with members of the community who have handsets and asking them to evacuate alongside their immediate neighbours.

Points to check

- **Cooperation between CFMO and sub-location DMC must be reflected either by phone call communication or in person as an active actor in the CFMO executive meeting on issues involving floods**
- **Participation of village elders in assisting the community during evacuation**
- **The importance of mobile phone as a way of enhancing communication during disaster particularly floods**
- **Assistance to the vulnerable persons like the disabled, pregnant women, children, sick people**
- **Registration and of evacuees and their number noted down and given to the chairperson of CFMO and assistant chief**

Chairperson of the CFMO sounding the alarm for community to evacuate

Community members are evacuated under the guidance of the assistant chief, village elder and CFMO chairperson.

2.4 Step 4: Dissemination of information for External Assistance

The Assistant Chief calls for help from district provincial administration office and other government agencies like Ministry of Health. The chairperson or assistant chief also calls the humanitarian organizations like the Red Cross and NGOs operating in the area for assistance.

Points to check

- **Mobile phone communication between the chairperson and assistant chief concerning requesting for relief assistance to the evacuees (in cases where the assistant chief is not available during the drill)**
- **Assistant chief makes a phone call to the district provincial administration. The name of the department must be mentioned and a proper description of the flood situation is made.**
- **Assistant chief or chairperson calls Red Cross. The approximate number of the affected persons and house holds, what is lacking at the evacuation center in terms of basic needs, number of the injured or sick persons should be mentioned.**

The assistant chief makes a phone call requesting external organizations for relief assistance.

A group of pregnant women set aside waiting for medical assistance.

2.5 Step 5: Settling of Evacuees at the evacuation center

Evacuees move into the evacuation center. Evacuees are registered as they enter into the evacuation center the chairperson takes the leading role in ensuring peaceful settlement of these evacuees. Village elders play an important role in helping the evacuees to settle down at the evacuation center.

Points to Check

- **Evacuees are registered as they settle at the evacuation center**
- **Chairperson plays a pivotal role in the settling of evacuees**
- **Village elders assist in the settling of evacuees**
- **Injuries and damage assessment done mainly by CFMO executive committee members**
- **Ensuring the safety of the vulnerable especially children, the aged, disables and pregnant women**

Evacuees with their properties move into an evacuation centre.

Evacuation centre is crowded with community people and livestock.

Women in the community are cooking emergency food for community members in evacuation centre.

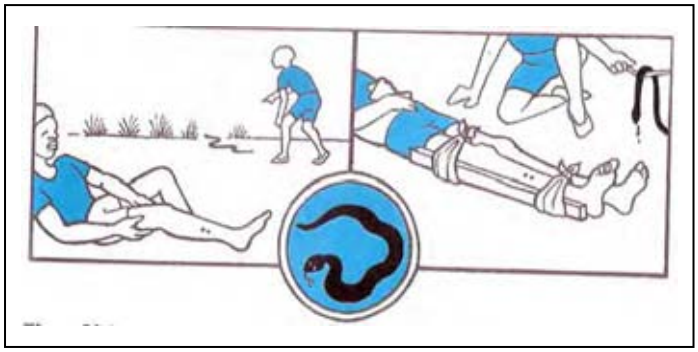
2.6 Step 6: First Aid demonstration

This demonstration is to be carried out by Red Cross official or a First-Aid trained attendant. Emphasis during the demonstration should be on injuries that are often experienced during evacuation and the ones encountered while at the evacuation center.

Points to Check

- **The first-aid demonstration is carried out by a competent first-aid trained attendant.**
- **First-aid attendant must state that first-aid is not in itself a complete medical treatment but a step whereby the risky medical condition is minimized as the injured person is taken to hospital for medical treatment**
- **Demonstration should deal mainly with injuries that are prevalent during the flooding period e.g. drowning, cuts, bleeding, fainting, shock and snake bites among other like related injuries**

First-Aid demonstration performed by Red Cross during evacuation drill



Illustrations showing the first-aid during evacuation

2.7 Step 7 : Questionnaire survey.

The CFMO executive committee carries out a questionnaire survey on the evacuees in efforts of establishing the damage level of their homesteads, the challenges encountered when evacuating, assistance to the vulnerable and properties salvaged

Points to check

- **Evacuees are asked the number of persons in a homestead and how many people they evacuated with**
- **Evacuees are asked the extend of the damaged in their homes e.g. damaged houses in the homestead**
- **Evacuees must indicate the difficulties and challenges they encountered while evacuating**
- **Evacuees are asked if they assisted any one during evacuation the sick or the vulnerable in the community like the disabled, pregnant women or children**
- **An evacuee states the properties he or she has moved with into the evacuation center.**

CFMO executive committee members carrying out a questionnaire survey on evacuees

2.8 Step 8: Wrap up Meeting

This the final meeting that wraps up the whole evacuation drill. Accordingly persons scheduled to address the participants as arranged by the CFMO take to the podium and give their short speeches of not more than five minutes per person. The CFMO chairman thereafter addresses the participants in closing.

Points to check

- **Speakers should keep time and operate within the five minutes time frame**
- **Speakers should focus on issues concerning flood management**
- **Gender should be consider when selecting the speakers**
- **The chairperson should address the highlighted challenges and difficulties of the evacuees and make proposals of possible solutions**
- **The chairperson should highlight the CFMO's efforts towards flood managements in terms of the activities that are being carried out by the CFMO**
- **The chairperson closes the meeting immediately thereafter his speech**

Observer (stakeholders) and Assistant chief address the meeting in closing.

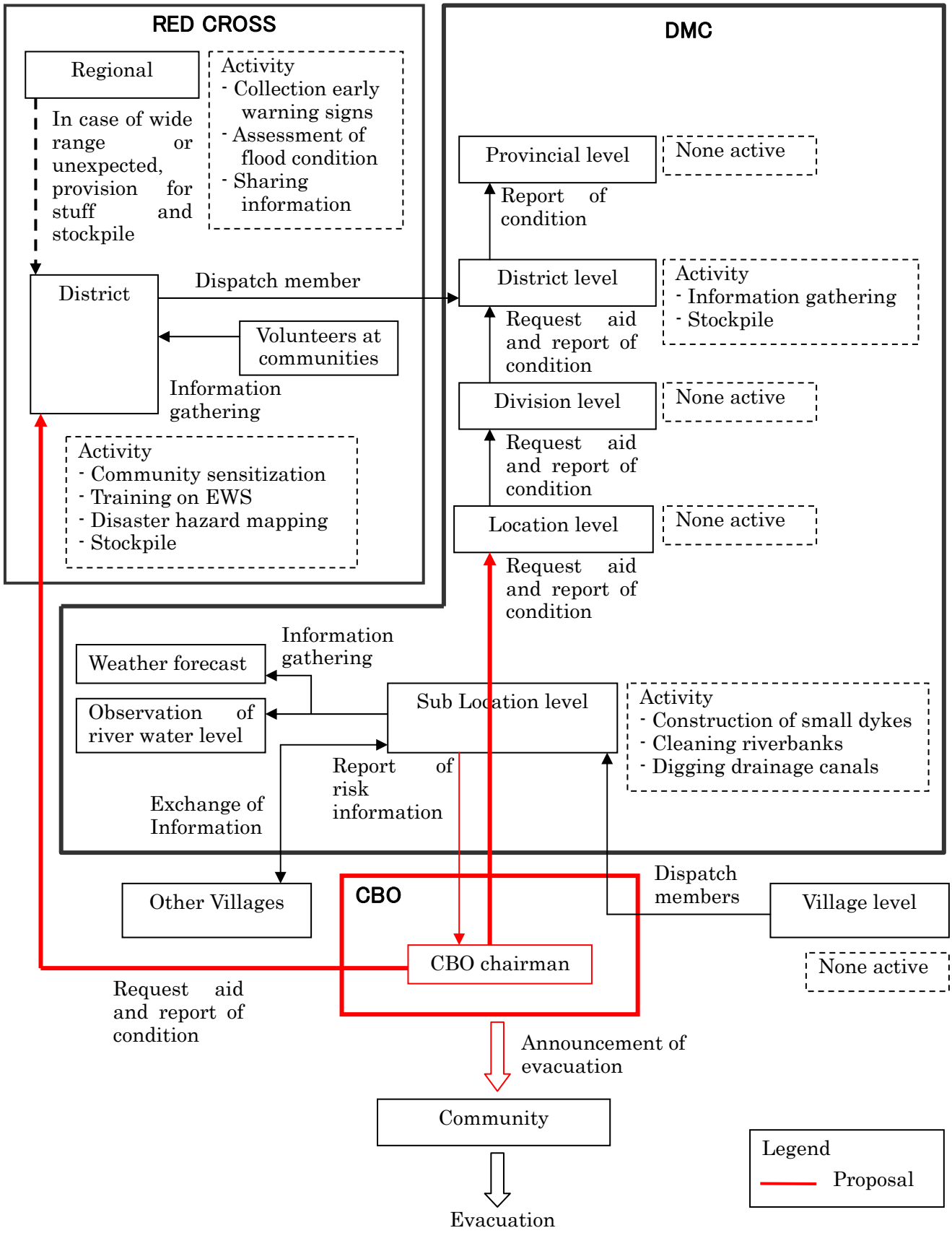
Chairperson of the CFMO addresses the meeting in closing.

APPENDIX

COMMUNICATION FLOWCHART

BEFORE, DURING AND AFTER FLOODS

Plate 1 : Information dissemination & activity of organization before flood



*In pilot communities, village DMC member hold sub location member and CBO member.

PLATE 2 : Information dissemination & activity of organization during flood

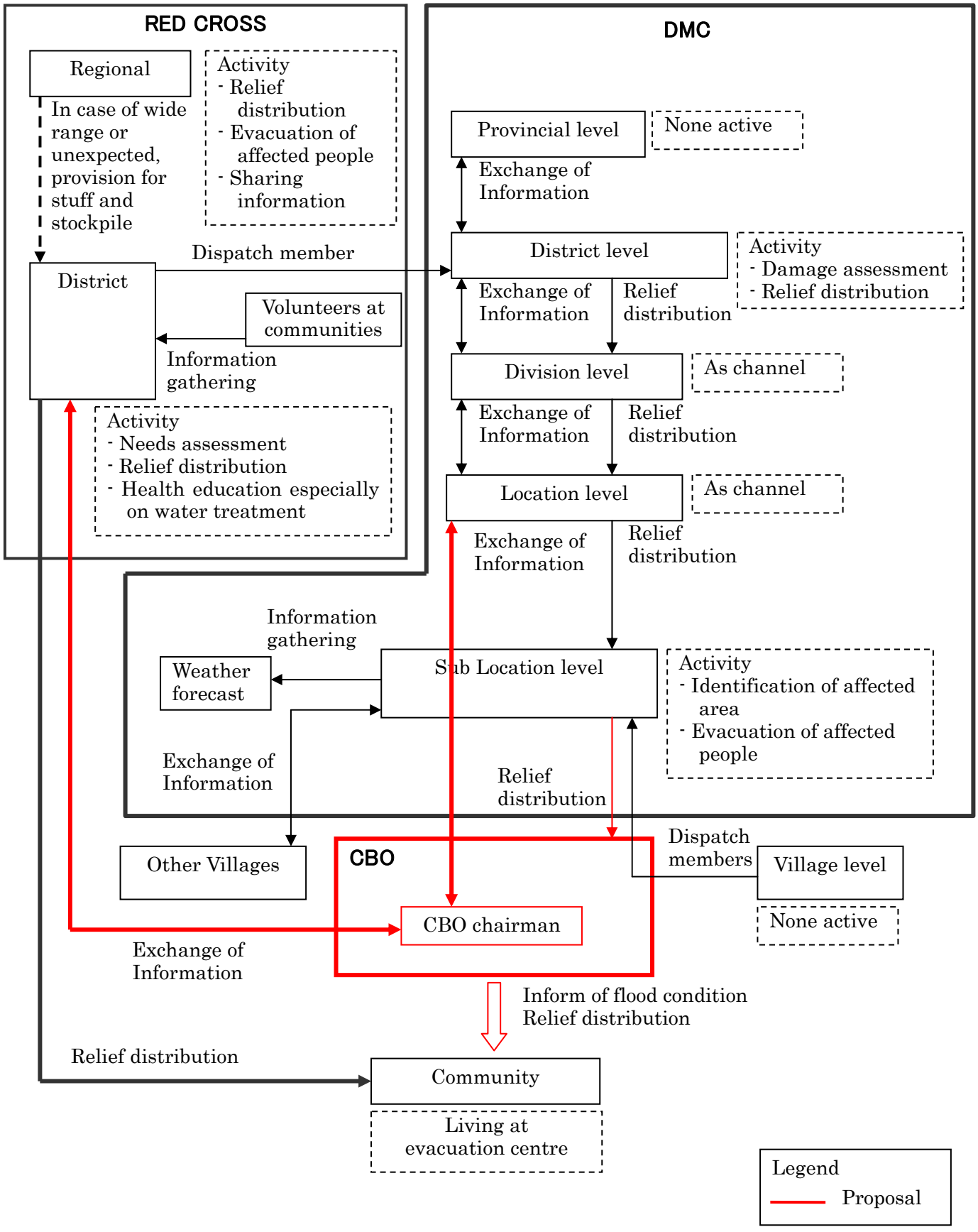
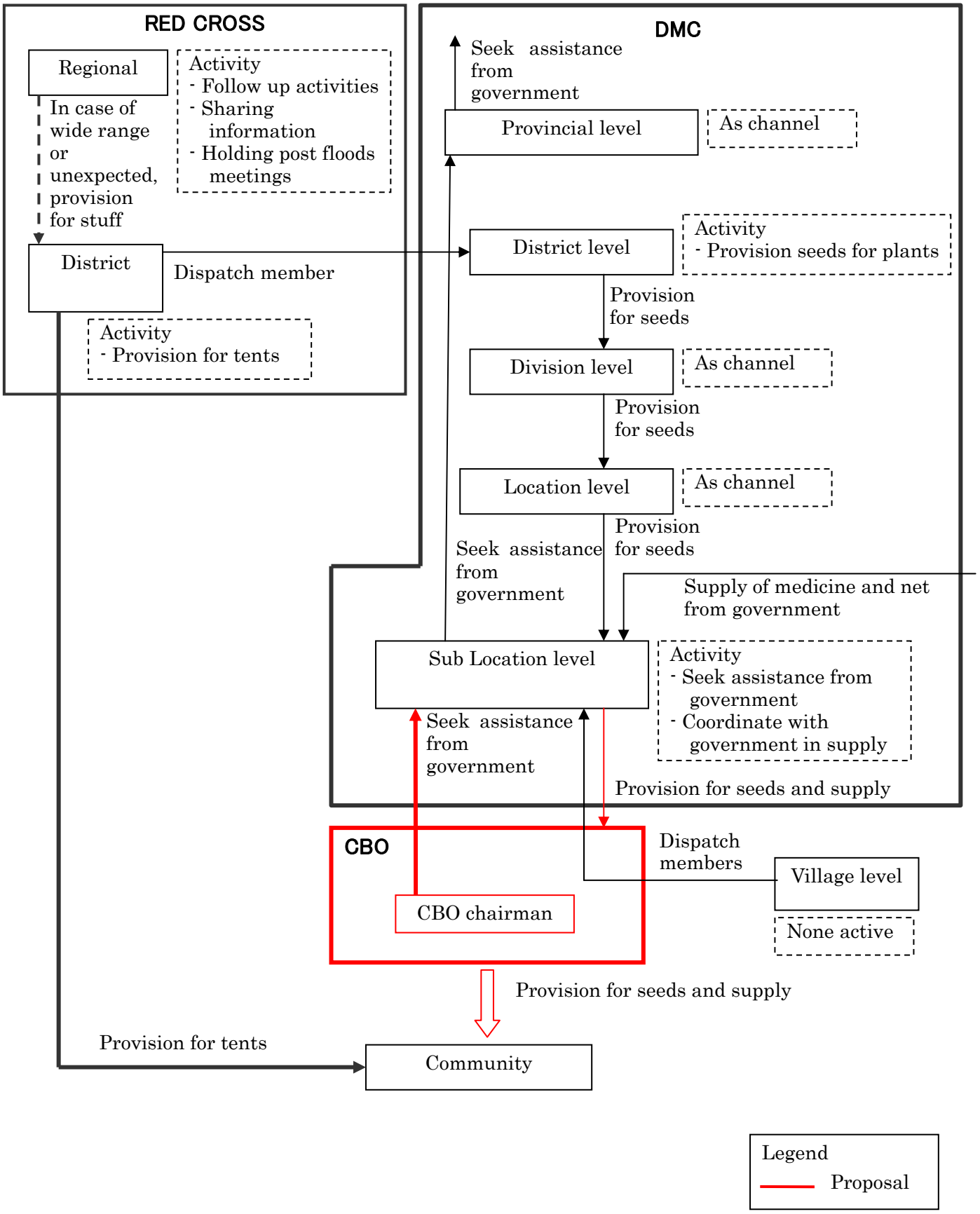


PLATE 3 : Information dissemination & activity of organization after flood



CHAPTER 7

HOW TO CONDUCT DISASTER MANAGEMENT EDUCATION

1. Introduction

Flood management is not covered in the Kenyan schools and teacher training college curricula. However, it was a recognized fact, that for meaningful and sustainable flood management, training of pupils in schools especially in the flood prone areas was of utmost importance. The schools are part of the community, and to build the capacity of the community members in flood management, it was more productive to target the young in the community, so that they grow up having the correct skills, appropriate knowledge, and the right attitude towards flood management.

In view of the aforementioned reasons, education programme was therefore identified as an integral part of the Integrated Flood Management for Nyando River Basin.

The education programme aimed at implementing flood disaster management education in Bwanda Primary as a pilot school.

The specific objectives of the education programme were to:

- Develop a training manual for teachers;
- Develop a flood disaster management textbook for primary schools;
- Carry out flood disaster management education training for teachers;
- Pilot flood disaster management teaching at Bwanda primary school;
- Evaluate flood disaster management education programme at Bwanda Primary School.

Under the education programme, training manual for teachers and flood disaster management textbook for primary school were drafted, modified based on the actual use in the class as described below.

2. Development of Teachers' Training Manual

The content of the course was decided carefully and a training manual developed to be used for the training. The training manual was planned for to cover:

- The general principles of disaster management;
- Flood disaster management;
- Infusion and integration of flood disaster management into primary school curriculum;
- Teaching and learning approaches to flood disaster management in primary schools;
- Planning for flood disaster management teaching and learning.

The preparation process was followed by a meeting by the resource persons to deliberate on the structure and the content of the training manual. Relevant literature review was then done by the resource persons. A meeting of the resource persons followed, where the content and the sequence of the topics were discussed and adopted. Thus, a training manual on flood disaster management structured into modules covering the following areas was produced:

- The general principles of disaster management;
- Flood disaster management;
- Infusion and Integration of flood disaster management into primary school curriculum;
- Teaching and learning approaches to flood disaster management in primary schools;
- Planning for flood disaster management teaching and learning.

Thus, the developed teachers' training manual are attached hereto as Appendix-I

3. Development of Flood Disaster Management Textbook for Primary School

The book writing workshop was a follow up of the teachers training workshop. The main aim of the workshop was to come up with an appropriate textbook on flood management for primary schools. Class five, was identified in the earlier training workshop to be the focus class for implementation.

The identified topics were listed and the sequence of the topics was arranged. Selected teachers among those trained were then assigned the various units to go and research on and prepare a draft to form the basis for the discussion. The units identified and the orders of arrangement proposed were as follows:

UNIT 1: Introduction to floods
UNIT 2: Causes of floods
UNIT 3: Areas affected by floods in Kenya
UNIT 4: Effects of floods (both positive and negative)
UNIT 5: Flood management measures

Thus, the developed flood management textbook are attached hereto as Appendix-II.

Appendix-I

Teachers Training Manual

on
Flood Disaster Management
for
Integration
in
Primary School Curriculum

July 2007

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LIST OF FIGURES AND PLATES

BACKGROUND

This manual has been developed to assist in training teachers, education officials and other players in flood management and disaster prevention within the local and national Education sector, non-governmental organizations interested in flood management, disaster prevention planning, training, governmental disaster commissions and local or community disaster committees among others.

The manual is arranged in modules and units that are aimed at achieving specific objectives as outlined, all of which prepare teachers, education officials and other trainers for flood management and disaster prevention education through practical approaches and programmes. The content and tasks are specifically designed to equip trainees with appropriate knowledge, awareness, skills, values and attitudes that will enable them educate for disaster prevention.

The manual is not designed as a complete course but rather, to provide a wide range of guidelines for application at different locations and situations. The local situation has necessitated focus on Floods and the methods for enhancing Flood disaster management in the primary school curriculum.

MODULE I

INTRODUCTION TO DISASTER MANAGEMENT

Module Objectives:

By the end of this module, the participant should be able to:

- define disaster;
- describe disaster classification;
- explain phases of disaster and preparedness measures appropriate for each phase.

1.1 DEFINITION OF DISASTER

A **disaster** is a catastrophic event, sudden or gradual, that causes damage, disruption of economic activities and patterns of life, with possible multiple injury and loss of human life and property, deterioration in health and health services on a scale sufficient to warrant extraordinary response from outside the afflicted community (*Nakajima, 1991*).

Disaster is also defined as 'the harm or destructive occurrence of a magnitude that requires external assistance to deal with, by the afflicted community (*Mitchell, 1999*)
According to IFRC (2000), a **disaster** is an extreme disruption of the functioning of a society that causes widespread human, material, or environmental losses that exceed the ability of the affected society to cope using its own resources.

The above definitions show that events such as earthquakes, floods and cyclones by themselves are not considered disasters. Rather, they become disasters when they adversely and seriously affect human life, livelihoods and property.

1.2 DISASTER CLASSIFICATION

There are different ways to classify disaster. Disaster classifications matter because preparedness, response and risk reduction measures as well as the specialists and agencies involved depend on the types of disaster. Disasters are often classified according to:

- their cause;
- speed of onset;
- whether due to acts of nature or acts of man.

1.2.1 According to causes

Disaster classified according to cause is named after hazard which results in the disastrous social and economic consequences. Thus, this classification includes:

- earthquakes
- floods
- tornadoes
- landslides

- mud flows
- drought
- pest and insect infestation
- chemical explosion among others

1.2.2 According to speed of onset

The speed of disaster onset is another way of to distinguish between disaster and the type of measures that may be required. The disasters are either:

- Rapid onset disasters: - which are events or hazards that occur suddenly, with little warning, taking the lives of people and destroying economic structures and material resources. Rapid onset disaster may be caused by earthquakes, floods, storm, winds, tornadoes or mud flows.

- Slow onset disasters: - occur over time and slowly deteriorate a society's and a population's capacity to withstand the effects of the hazard or threat. Hazards causing these disaster conditions typically include droughts, famines, environmental degradation, desertification, deforestation and pest infection. The El Nino phenomenon is an example of such disaster.

1.2.3 According to acts of nature or acts of humans

The disasters are classified according to whether they are natural or human made disasters.

- Natural disasters – include disasters caused by floods, tidal waves and earthquakes.
- Human – made disasters are also called human caused disasters – These include disasters caused by chemical or industrial accidents, environmental pollution, transport accidents and political unrest.

1.2.4 Phases of disaster

- Non disaster or Inter disaster phase
- Pre disaster phase
- Impact phase
- Relief (Emergency) phase
- Reconstruction or Rehabilitation / Recovery Phase

Task for Participants:

1) List two disasters that have been experienced in and around your school.
2) For each of the disasters listed, classify it according to cause, speed of onset and acts of nature of act of human.

1.2.4.1 Non disaster or inter disaster phase
Is the phase when there is no disaster or the phase between one disaster and the next. It is long before the disaster occurs. This is the time for prevention, preparedness and mitigation. Activities essential for disaster management include:

- mapping of specific location of potential disasters and associated risk;
- conducting vulnerability analysis i.e. what makes a place to suffer the disasters;
- taking inventory of resources for rapid mobilization;
- planning implementation of appropriate preventive and mitigative measures;
- conducting education and training.

1.2.4.2 Pre disaster or warning phase
It is the period just preceding the occurrence of a disaster. **This is the time to issue timely warning based on the prediction of impending disaster**. It is the time to implement preventive measures. However it is important to note that not all disasters will give warning. Some pre disaster or warning phase may be too short, others too long.

1.2.4.3 Impact phase
This is the time when the disaster strikes and the effects will depend on the nature of the disaster, the degree of preparedness, population density, economic factors, material resources, manpower, and skills to deal with the occurrence, infrastructure, communication, security and public utility. This is when most deaths, injuries, damages, losses and disruptions occur.

NB: *Community profile is required for proper preparedness.*

1.2.4.4 Relief (Emergency) phase
It is the period just after the disaster occurs. It is a time when the afflicted community members will still be relying on themselves. There is still no external assistance; it therefore calls for community preparedness.

The primary victims in times of disaster are those that bear the full brunt of the disaster while secondary victims are those people caught up in the disaster. This phase therefore involves actions to save life, both for the primary and secondary victims. It involves:

- search and rescue operation
- first aid
- emergency health (services) care
- restoration of public utilities
- evacuation of victims from vulnerable areas
- public health surveillance

NB: The existence of community preparedness plan increases self reliance and reduces disaster related mortality and morbidity in this stage.

The afflicted community will strive to organize their own rescue and assistance because it is an isolated period when the afflicted community is cut from the rest of the world***.*** ***Emergency*** means 'any situation in which the life or well-being of humans will be threatened unless immediate and appropriate action is taken and which demands an extra ordinary response and exceptional measures'.

1.2.4.5 Reconstruction or Rehabilitation / Recovery Phase
This is the time measures are put in place that result in restoring the afflicted community to their normal living conditions or pre-disaster conditions. Developments taking place at this time include; re-establishing public utilities, health services, assessing and repairing damaged buildings, roads, and schools among others.

This is the time to reflect on the response to the past disaster in order to improve future disaster managed by putting in place preparedness and mitigative measures.

1.3 DISASTER MANAGEMENT

Disaster management is defined as the body of policy and administration decisions and operational activities, which pertain to the various phases of a disaster at all, levels (*UNDP, 1992*).

Disaster management is a complex phenomenon requiring multi-disciplinary team approach and the need to co-ordinate and manage a wide variety of skills and information. It involves a series of inter- related activities. These activities go on and sometimes overlap, hence referred to as cycles of disaster management. Cycle of disaster management involves:

- Prevention;
- Preparedness;
- Mitigation;
- Response;
- Recovery.

These activities are important in minimizing the ill effects of disaster. Planning and prevention are thus emphasized.

1.3.1 Prevention

Involves regulatory and physical measures to ensure that emergencies are prevented or their effects mitigated. Some of the prevention measures are:

- building codes;
- building regulations;
- levee banks or debris control for flood control;
- land use regulation and zoning;
- public education.

1.3.2 Mitigation

These are measures taken to lessen or reduce the impact of disasters or hazards. The measures involved are:

- Structural or engineered measures;
- Non-structural measures.

1.3.2.1 Structural or engineered measures

- dykes
- groynes
- reservoirs
- channel improvement
- canals
- pumping system
- sluices to reduce effects of floods

1.3.2.2 Non-structural measures

- forecasting and warning system
- disaster control planning
- institution building / disaster center
- education and training
- mobilizing people
- vulnerability assessment
- Self reliance and self help structures or measures.

1.3.3 Preparedness

Is the readiness to take action before, during and after the disaster. It means those arrangements to ensure that, should an emergency occur, all those resources and services which are needed to cope with the effects can be efficiently mobilized and deployed. The Preparedness measures include:

- planning
- mutual aid agreements
- public information
- communication system
- public education
- warning systems
- training of personnel and exercising
- stock piling of resources
- earmarking or mobilizing funds
- vulnerability assessments
- response mechanism

In order to maintain preparedness level, the following need to be carried out:

- Training activities
- Conducting exercise and tests
- Doing functional and readiness checks
- Doing post disaster review

- Doing external assistance liaison i.e. contract people
- Public awareness activities and education in schools.

1.3.4 Response

These are actions taken in anticipation of, during, and immediately after an emergency to ensure that its effects are minimized and that people affected are given immediate relief and support. It involves taking time- sensitive actions to save life and property as well as to stabilize life structure. The following are important requirements for response:

- information
- general preparedness
- early warning
- evaluation
- activation of the response system
- security
- health and sanitation
- evacuation
- shelter
- communication-enquiry desk
- search and rescue
- activating welfare services
- water and power supply
- coordination of the response operation
- maintenance of public morale

1.3.5 Recovery

Is the coordinated process of supporting emergency affected community in reconstruction of the physical infrastructure and restoration of emotional, social, economic and physical well-being. Recovery activities include:

- financial support and assistance
- medical care
- counseling services
- public information
- temporary housing
- restoration of essential services
- health and safety information
- physical restoration and reconstruction
- review of prevention measures.

1.4 IMPORTANT CONCEPTS IN DISASTER MANAGEMENT

Task for participants:

Explain what you understand by the following terms

- Hazards
- Vulnerability
- Risk

1.4.1 Hazard

Is the trigger event which sets off the disaster. The event or the material has the potential to cause harm. It is also the potential occurrence, in a specific time period and geographic area, of a natural phenomenon that may adversely affect human life, property or activity to the context of causing a disaster.

The hazard may either be natural or man –made.

Natural hazards: are the natural trigger events which set off the disaster. A natural disaster could be any one of the natural phenomena. They are classified as:

i) Geographical hazards
- Earthquakes
- Tsunami
- Volcanic eruption
- Landslides

ii) Climatic hazards
- Floods
- Drought
- Tropical cyclones

iii) Environmental hazards
- Environmental pollution
- Deforestation
- Desertification
- Pest infection

iv) Epidemics

Man made or artificial hazards: are man made materials or events having the potential to cause harm.

These may include:
- Industrial accidents
- Road accidents
- Military arsenals among others

1.4.2 Vulnerability

Is the degree of loss to each element should a hazard of given severity occur. It is the lack of capacity to protect against damage, injury or harm from a hazard. There are two types of vulnerability:
- structural or physical vulnerability
- human vulnerability

Structural or physical vulnerability*:* is the extent to which a structure is likely to be damaged or disrupted by a hazard event. For instance a wood frame house with large headed roofing nails, rafter tie – downs, anchor bolts and solid foundation is less

vulnerable structurally to severe cyclone winds than similar –looking house which does not have these structural details.

***Human vulnerability**:* is the relative lack of capacity of a person or community to anticipate, cope with resist and recover from the impact of a hazard. Of all factors poverty is perhaps at the root of what makes most people vulnerable to the impact of most hazards.

1.4.3 Risk

Is the likelihood of a specific hazard occurring and its probable consequences for people, property and environment. It is the probability that a disaster will occur. To determine risk the following are looked at:

- the hazard occurrence probability;
- the elements at risk;
- the vulnerability of the elements

The hazard, vulnerability and risk information illustrate the value of disaster threat information as applied to practical disaster management. The information is used for:

i) formulation of disaster plans
ii) formulation of relevant programmes for disaster training and public awareness
iii) definition and application of measures to reduce vulnerability.
iv) formulation and utilization of long term programmes for comprehensive disaster management. The hazard, vulnerability and risk information is obtained from hazard analysis, and vulnerability and risk assessments.

Hazard x Vulnerability = Risk

Task for participants:

List two disasters and for each identify:

- the hazard
- vulnerability
- Elements at risk

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MODULE II

FLOOD DISASTER MANAGEMENT

Module Objectives:

By the end of this module, the participant should be able to:

- Explain the causes of floods
- Describe the factors intensify effects of floods
- Describe the impacts of floods on human
- Develop flood prevention and preparedness measures
- Develop flood response activities

2.1 DEFINITION OF FLOOD

Flood is a situation in which water from a river, stream, and channel overflows its banks and covers large areas of dry land.

Flood can also occur when water from heavy rains cover large area of land that was dry before.

Floods occur in the flood plains. Floodplains are low-lying flat areas next to rivers, streams or lakes which are always exposed to flooding after heavy rains.

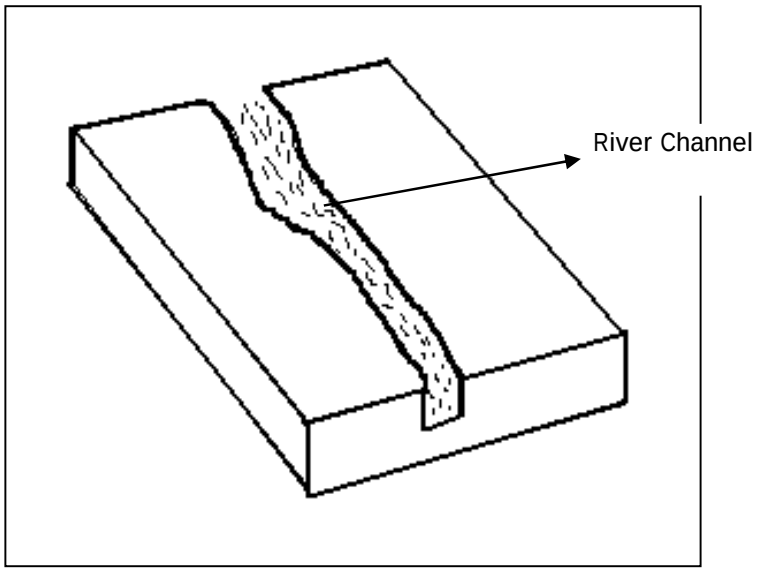


Figure 1: *Diagram showing a floodplain*

2.2 FLOOD AS A DISASTER

Disaster is an event or occurrence which may be sudden or gradual causing damage to human life, livestock, crops and physical facilities.

When floods occur in the Nyando River Basin, it affects human life, settlement, health, crops, livestock and physical facilities such as roads, houses, churches, hospital, schools, bridges etc.

2.3 TYPES OF FLOODS IN NYANDO RIVER BASIN

There are two main types of floods in the Nyando River Basin, namely:

- Flash floods
- River floods

2.3.1 Flash floods

It is the flood that occurs soon after a heavy rainfall. It occurs on a large area but clears within a short time.

2.3.2 River floods

It is the flood caused by river, stream or channel water overflowing its banks after heavy river catchments.

Tasks for participants:

- Define the term floods.
- Describe the two main types of floods
- Describe places where floods are common in the Nyando river basin.
- List four things damaged by floods.

MODULE III
CAUSES OF FLOODS

Floods in the lower Nyando River Basin are a big problem to the people in the area whenever they occur. Floods may occur seasonally or annually whenever there is excess rainfall. There are two ways in which floods occur, namely:

- Excessive rainfall covering the land;
- When water overflows its natural channels.

Activity:

Draw a sketch of the water channel and label it appropriately.

3.1 CAUSES OF FLOODS IN THE NYANDO RIVER BASIN

These may be classified into two main groups:

- Natural causes
- Human causes

3.1.1 Natural causes

- Excessive rainfall in the upper Nyando River catchments (Nandi and Kericho Highlands).
- Characteristics of the lower Nyando River Basin.
- The velocity of the water.

3.1.1.1 Excessive rainfall in the Nyando River Basin (Nandi and Kericho Highlands):

Heavy rains in Nandi and Kericho Highlands lead to a lot of water flowing to the lowlands at a high speed. This forces the river to burst its banks causing floods. For example during the El-Niño rains of 1997, many places that normally don't experience floods were flooded due to the excessive rainfall both in the Kericho and Nandi highlands and the Kano plains.

Plate 1: *River bursting its banks during heavy rains*

3.1.1.2 Characteristics of the Nyando River Basin.

- *Dr*ainage pattern
- Gradient
- Type of soil
- River meanders

i) Drainage pattern

It is the way through which rain flows on the surface to the water bodies. These include rivers, streams, swamps, lakes etc. the river and streams flow through which water flows in the lower Nyando river basin are:

- River Nyando
- Awach stream
- Nyalbiego stream
- Asawo stream
- Ombeyi stream
- Miriu stream
- Sondu river
- Omondo stream
- Nyaidho stream
- Irrigation canals

These stream and rivers are made shallow by silt deposits causing the water to overflow their channels thereby causing floods.

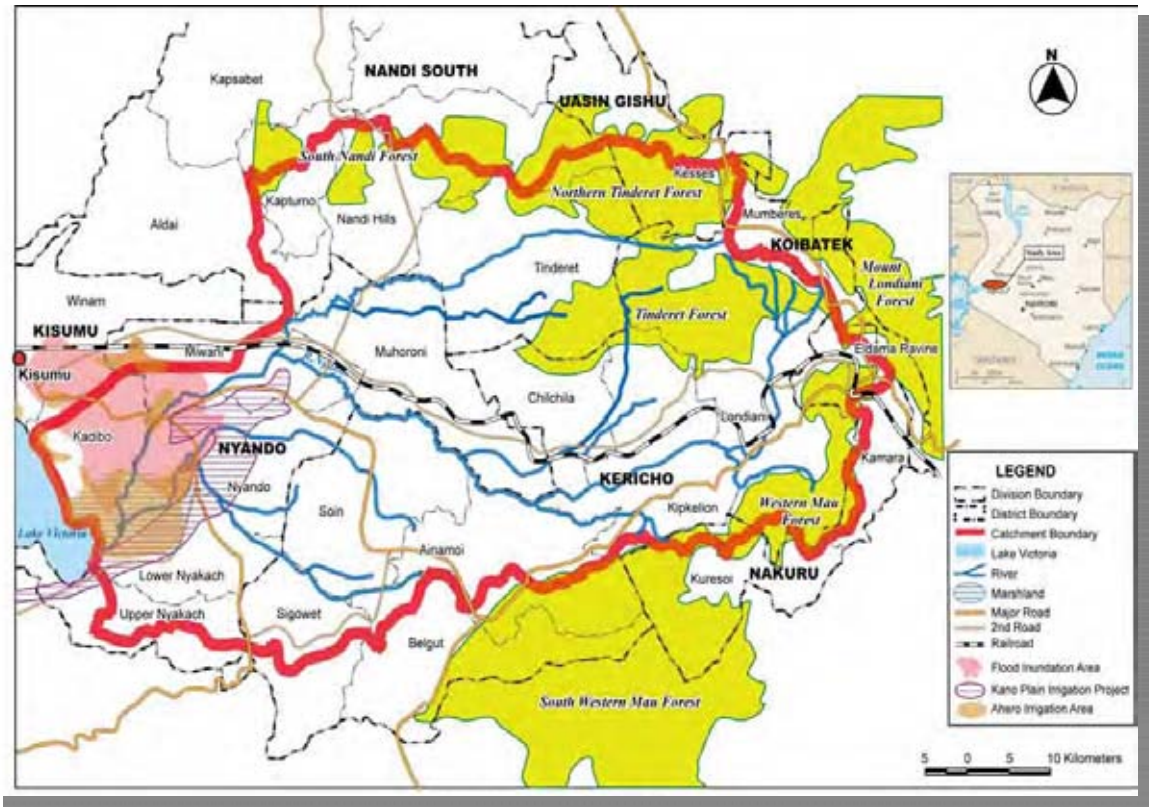


Figure2: *Drainage pattern for Nyando River (Source: JICA IFM Study Team)*

ii) Gradient

It is the general slope of the land. In the highlands the slope are steep, water therefore flows at a high speed. The water carries a lot of debris to the lowlands, which get deposited in the channels due to low speed. The deposits make the channels shallow and may also block them, causing the water to overflow the traditional channels, resulting to floods.

iii) Type of soil and vegetation blocking the water channel

The lower Nyando river basin has black cotton soil (clay soil) which has fine particles. The fine particles close up when wet, reducing the rate of water infiltration into the soil. A lot is therefore retained on the surface causing flooding. Heavy vegetation blocking the water channel causes the water to overflow the already shallow channels thereby causing floods.

Plate 2: *A river channel blocked by water plants*

Task for participants:
To find out water retention capacity of different soils:

1.) Collect three identical plastic bottles

2.) Collect three different soil samples: clay, loam and sand of equal amount

3.) Collect cotton wool and water

4.) Prepare the apparatus as shown below:

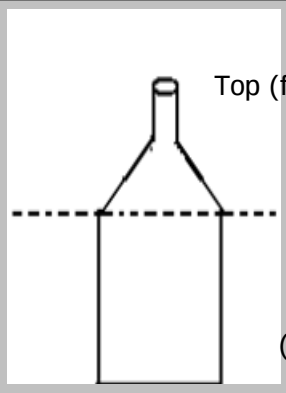


Figure 3

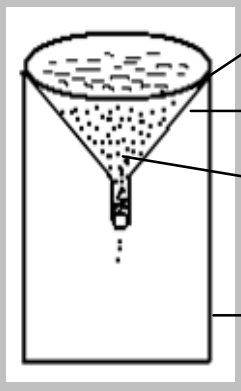


Figure 4

Step 1: Cut each of the three bottles as shown in the diagram above to have three identical funnels and three collecting cans.

Step 2: Arrange the apparatus as shown in figure two above and label them 1, 2, and 3.

Step 3: Put cotton wool of the same size in each funnel.

Step 4: Put equal amounts of different soils in different funnels.

Step 5: Pour equal amount of water into each funnel.

Step 6: Leave the set up for five minutes and observe.

Questions:

1.) In which set up was the highest amount of water colleted?

2.) In which set up was the least amount of water collected?

3.) In which of the three set ups had clay soil?

iv) River meanders
In the lower catchments of Nyando river basin the gradient is low, thereby reducing the speed of water flowing in river channel. This results in high deposits of silts blocking the channel. The river water therefore finds a new channel in which it flows on, by meandering, hence causing floods.

3.1.1.3 The velocity of water.
The speed of water in the lower catchments is low. This leads to high silts and debris deposit which make the river channel shallow. Therefore increase of water levels in this channel leads to overflowing of the river which results into floods.

3.1.2 Human activities

3.1.2.1 Settlement pattern
Some people build their homes on waterways, blocking them causing flooding. Waterways are the normal channels, depressions or general areas; water passes through during the normal flow. Channels are defined depressions or natural canals through which water flows. These may include the river, stream, or drainage canals. When people build their houses in these areas, they block the normal flow of water during rainy seasons thereby, causing flooding.

3.1.2.2 Poor farming methods
These poor farming methods include cultivating the riverbanks, ploughing up and down the slope, overgrazing, overstocking, continuous cultivation etc. these lead to soil erosion and the eroded soil particles get deposited and block the water channels causing floods.

3.1.2.3 Deforestation
Deforestation is the cutting down of trees where they have been growing. Clearing of forest in the upper catchments of Nyando river basin lead to soil erosion. The eroded soil particles get deposited in the waterways in the lower catchments, causing flooding.

Tasks for participants:

1.) Explain how floods can be classified.

2.) Describe 4 natural causes of floods in Nyando river basin.

3.) Describe the human activities that cause flood in Nyando river basin.

4.) Describe three characteristics of Nyando river basin that cause floods.

5.) Name 4 rivers or streams found in lower Nyando River.

6.) Define deforestation

MODULE IV
AREAS AFFECTED BY FLOODS IN KENYA

The areas affected by floods in Kenya include:
- ☑ Tana River in Coast province
- ☑ Budalangi in Western province
- ☑ Nyando in Nyanza province
- ☑ Kisumu in Nyanza province
- ☑ Rachuonyo in Nyanza province
- ☑ Garissa in North Eastern
- ☑ Kwale in Coast
- ☑ Kilifi in Coast
- ☑ Ijara in North Eastern
- ☑ Wajir in North Eastern

There are many places in Nyanza province that are commonly affected by floods. Such areas include:
- ☑ Kano plains in Nyando and Kisumu East districts
- ☑ Lower Nyakach and west Nyakach in Nyando districts
- ☑ Kadem in Migori district
- ☑ Yala swamp in Bondo and Siaya districts
- ☑ Kimira valley and Osodo bay in Rachuonyo districts
- ☑ Oluch in Homa Bay districts

Table 1: *Areas affected by floods in Nyando River Basin*

	Area	**Streams**
1.	Kamagaga, Okana, Sidho, Kobura, Kabonyo, Kanyagwal	Ombeyi, Orije, Miriu, Nyatini.
2.	Kabodho, Wasare.	Asawo and Omondo
3.	Katolo, Ayweyo, Gem Rae, Magina	Awach, Nyalbiego and Onguo
4.	Kamagaga, Wangaya, Kobura, Kobung'o, Konim, Kakola, Kochogo, Kabonyo, Kanyagwal, Magina and Singida.	Nyando
5.	Kayla, Kogelo, Wagunga, Ayweyo Magina	Nyaidho, Nyalbiego.

Task for participants:
1.) Describe 5 areas in Kenya frequently affected by floods?
2.) Describe 5 areas in Nyanza Province frequently affected by floods?
3.) Describe 5 areas frequently affected by floods in Nyando river basin.
4.) List 2 rivers that cause flooding in Kanyagwal and Wawidhi Locations

MODULE V
EFFECTS OF FLOODS

In the previous units, we defined floods, discussed its causes and identified the areas which are commonly affected by floods in Kenya, Nyanza province and in the Nyando River Basin.

Floods have both good and bad results on human life and property.

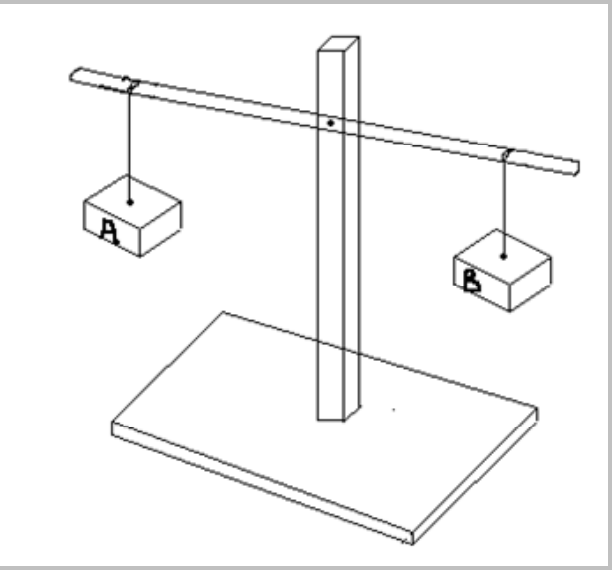
Task for participants:

1.) Have you ever experienced floods?

2.) What were its advantages?

3.) What were its disadvantages?

4.) Supposing you were to put the advantages and disadvantages on a weighing balance, which one would be heavier?



5.) On which side will you put:

Advantages _____

Disadvantages _____

To answer the above questions, let us group and discuss the effects of flood in terms of the good effects on one side and the bad effects on the other.

Good effects of floods	**Bad effects of floods**
1.) Provide breeding, nesting and feeding for fish, birds and wildlife	1.) Human and livestock death due to drowning
2.) Improves fertility of the soil	2.) Result in water-related diseases
3.) Flood can be used for irrigation	3.) Contamination of water source
4.) Allow pasture growth and regrowth	4.) Description of human settlement
5.) Refills underground water	5.) Destruction of crops
	6.) Disruption of learning
	7.) Disruption of transport and communication
	8.) Destruction of buildings

5.1 GOOD EFFECTS OF FLOOD (ADVANTAGES)

5.1.1 Provide breeding, nesting and feeding ground for fish, birds and wildlife

5.1.2 Improves soil fertility

Flood deposit silts and the fertile top soil from the upper catchments in the flood plains making it fertile for crop production.

5.1.3 Pasture regeneration

Flood improves soil moisture and promotes growth of grasses for animal grazing.

5.1.4 Irrigation

Flood water can be used for irrigation of crops such as rice, onions, kales (*sukumawiki*), tomatoes, watermelon, arrowroots etc.

Plate 3: *A maize plantation*

5.1.5 Recharging groundwater

Flood water infiltrates the soil increasing the volume of underground water or raising the water table.

Plate 4: *A shallow-well filled with water during floods*

5.2 BAD EFFECTS OF FLOOD (DISADVANTAGES)

Floods cause damage to human life and physical facilities. Damage to human life includes:

5.2.1 Human and livestock death due to drowning

Fast moving water can knock down and drown people and animals in relatively shallow depths. Animals such as chicken, goats, sheep, cattle etc can easily be swept by currents of moving or turbulent water.

Slow flooding causes relatively few direct deaths or injuries, but often increases occurrences of snake bites.

5.2.2 Water-related diseases

A number of diseases may break out during and after flooding. Some of these diseases are:

- Malaria
- Typhoid
- Cholera
- Bilharzias
- Dysentery

5.2.3 Contamination of water source

The flood water sweeps over a large area carrying a lot of dirt. The dirt contaminates the surface water sources and the unprotected underground sources, making them unsafe for human and animal use.

4.2.4 Disruption of human settlement

During floods some people move away from their affected homes. This disrupts their way of life. They are exposed to cold, wind and dangerous animals at night. The extreme cold may expose people to diseases like pneumonia.

5.2.5 Destruction of crops

Flood water uproots and sweeps away crops such as tomatoes, maize, potatoes etc. this may lead to famine and starvation.

Plate 5: *People displaced with floods camping on safe ground*

Plate 6: *Crops washed away by floods*

5.2.6 Disruption of learning

Some schools get submerged temporarily during floods. The schools are therefore forced to close down thereby disrupting learning.

Plate 7: *A submerged school during floods*

Plate 8: *Difficulties in movement due to flooding*

5.2.7 Disruption of transport and communication

Roads and bridges are washed away by floods, making movement to and from such places are difficult.

5.2.8 Destruction of buildings

Flood water destroys houses, classrooms, hospital structures, pit latrines and market structures. This interferes with social and health services.

The contents of the collapsed latrines contaminate water sources, leading to outbreak of cholera, typhoid and diarrhea diseases.

Plate 9&10: *Collapsed building after floods (left) and latrine (right)*

Revision Questions:

1.) Foods have _____and _____effects

2.) List at least four good effects of floods:

i) _____

ii) _____

iii) _____

iv) _____

3.) Name three common flood related diseases

i) _____

ii) _____

iii) _____

4.) Bad effects of flood are: _____

_____

5.) The physical facilities commonly damaged by floods include

_____

_____

6.) Identify five water related diseases from the grid below:

M	**D**	**M**	**C**	**S**	**B**	**T**
A	**Y**	**N**	**H**	**T**	**I**	**R**
L	**S**	**Q**	**O**	**P**	**L**	**O**
A	**E**	**T**	**L**	**U**	**H**	**N**
R	**N**	**Y**	**E**	**M**	**A**	**E**
I	**T**	**O**	**R**	**E**	***R***	**S**
A	**R**	**W**	**A**	**V**	**Z**	**Y**
T	**Y**	**P**	**H**	**O**	**I**	**D**
M	**P**	**T**	**Q**	**Z**	**A**	**P**

7.) Read the poem below:

Flood, floods go away,
Go down to the lakes,
Go down to the valleys,
Leave us alone, I beg you,
Go down to the lakes and
Go down to the valleys.

How does Mary see the floods. Good or bad?

MODULE VI
FLOOD DISASTER MANAGEMENT

This is a way in which a community acts to protect its members and their property from the danger created by flood. These actions are taken before, during and after floods. It is not possible to completely prevent floods; however there are activities that can be carried out to reduce the damage caused by floods. These activities are:

- Flood preparedness
- Flood mitigation
- Flood response management
- Recovery

6.1 FLOOD PREPAREDNESS

These are actions taken before, during and after flooding. It involves the arrangements to ensure that, should floods occur, all resources and services needed to cope with the effects can be made available and used effectively.

The preparedness measures can be classified into three major groups; namely:

a) Self help
b) Mutual help
c) Official help

6.1.1 Self help

These are flood preparedness measures that community members undertake on their own. Incase they are unable; they can seek external assistance from governmental & non-governmental organizations, well-wishers, charitable organizations etc.

Self-help flood preparedness measures include:

(i) Preparation of disaster kit

It contains safe drinking water, food, medical etc.

(ii) Understanding the terminology of community hazard map and flood warning

A community map shows flood prone areas. Terms used in community hazard map may include: flood plain, assembly points etc. flood warning systems may involve signs and mode of communication e.g. warning bells, sirens, croaking of frogs, vocals, phones, radio etc.

Plate 11: *Kokwaro Village hazard map*

(iii) Recognizing evacuation routes and location of evacuation centers
Signboards indicating evacuation routes and centers are put in place to assist during evacuation.

- Evacuation routes are escape routes used by community members to move to safe areas.
- Evacuation centers are the safe areas, where basic services such as healthcare, water, food, shelter, blankets among others can be provided to the affected people.

(iv) Small-scale works for clearing water channels and improving drainage

(v) Recognizing the vulnerable group against flood
These vulnerable groups include children, aged and physically challenged.

(vi) Preparation of communication network
It involves having contacts e.g. mobile telephones numbers, email addresses of the people \ organization \ government \ agencies that can be of help at times of flood.

(vii) Participation in evacuation drill
These are mock \ rehearsal exercises carried out by community members that illustrates rescue operations during flood evacuation.

6.1.2 Mutual Help

These are flood preparedness measures which a community may jointly undertake with Non-Governmental Organizations like Kenya Red Cross, CARE, UNDP, FAO, UNICEF World Vision and VIRED. These are:

i) Developing and updating a community flood management plan (manual / guideline)
A community flood management plan is a guideline on activities that are to be undertaken by the community to manage floods.

ii) Holding evacuation drills
It is the joint mock exercises done by both the community and support organizations.

iii) Joint inspection of existing infrastructure
This involves checking the conditions of:

- Houses
- Roads and bridges
- Latrines
- Health facilities
- Evacuation centers and evacuation route for use during floods.

iv) Public / school education and awareness building
It involves the training of pupils, teachers and the community on flood disaster management. Awareness on flood and its impact is carried out in the community.

v) Small scale construction /repair works
These involve the removal of silt from the water channels, construction of water storage points tanks, water pans, water ponds and community water dams etc and raising community roads.

Plate 12: *A community flood management training session*

6.1.3 Official Help

These are flood preparedness measures largely taken by a support organization. It is done to improve the affected community.
These entails:

i) Maintenance of infrastructure (physical facilities)
It involves work such as river bank stabilization, construction of roads, bridges, evacuation centers and evacuation routes.

Plate 13: *Community participation in improving infrastructure and flood water mitigation*

ii) Improve capacity, coordination and management for flood risk
Includes training of a lead group (CBO) in coordination and management for flood risk

iii) Planning for emergency operation
Putting in place ways of carrying out evacuation, provision of relief services e.g. food, medical services, counseling of search and rescue operation.

6.2 FLOOD MITIGATION

These are ways of reducing the negative effects of floods. These are grouped into two major categories:

i) Mutual help
ii) Official help

6.2.1 Mutual help

i) Community flood hazard mapping
The flood hazard mapping is done to highlight areas mostly affected by floods within the community. This will allow the appropriate measures to be put in place to reduce the bad effects of floods on life and property.

Plate 14: *A cut-off drain to reduce flooding*

ii) Flood fighting corps
This is where the community and support organizations establishes and train people specifically to participate in flood response activities.

iii) Planning the flood control structures project
This involves setting up organs that will assist in the construction of dams, levees, water channel improvement, clearing of debris and sediments from streams and ponds and river banks stabilization.

6.2.2 Official Help

i) Implementing flood control structure projects
This is where the dams and levees are constructed, channel improvement is done, clearing of debris and sediments from streams, ponds, and river bank stabilization is carried out as outlined in the plan.

ii) River observation and data collection
This is a process that involves the studying of the behavior of a river before, during and after rains to determine the time it swells and bursts its banks.
This information about the level of water in the river can be used to predict times of floods as an early warning sign and also to determine when and where to put up structures that will restrict the river water within its channels.

iii) Flood forecasting and warning system
Flood forecasting means flood prediction. Flood forecasting can be done through:
- *Volunteers who observe rainfall and stream water levels.*
- *The use of gauges*
- *Computerized models (Automated Local Evaluation in Real Time) - ALERT.*
- Warning systems may include:
  - Radio
  - Television
  - Warning sirens
  - Warning bells
  - Public address systems
  - Vocals
  - Croaking of frogs
  - Movement of certain types of birds.

6.3 FLOOD RESPONSE MANAGEMENT

These are immediate measures taken to save life and property. They are also done to stabilize flood situations.
A number of activities are carried out at this stage. These activities also fall into three groups namely:
- Self-help
- Mutual help
- Official help

6.3.1 Self-help

a) Assembly of Community Flood Management Organization (CFMO) meeting for flood management. The meeting plans the activities for flood management.

b) Patrol by CFMO along river channels to collect flood information-members move along the river channel to assess the points at which the river water has burst its banks or is almost bursting its banks.

c) Self-initiated evacuation –during floods communities may decide to move by themselves to the safe grounds (evacuation centers)

6.3.2 Mutual help

Dissemination of flood information from the community above on extends of flood damage, casualties and needs. The community seeks information about safety ground, relief services, expected rainfall etc.

i) Flood fighting

- Involves repairs of levees, dykes, evacuation of people and property at risk –setting up of temporary bridges
- Clearing debris on trenches, channels, canal

ii) Provision and distribution of relief aids

This includes food, bedding, medical services, mosquito nets, temporary shelters, mobile toilets (mobilets)

6.3.3 Official help

Monitoring the latest flood information and warnings:

- This is the checking for the information about the flooding trends to establish the extend of damage on dykes, levees, bridges, roads, houses, crops, livestock etc
- To look for indications whether the flooding is likely to continue or reduce.

i) Dissemination of the latest flood information and warnings

Information gathered during monitoring is given out to the relevant government agencies, NGOs, well-wishers, support partners, charitable organization. This information will enable them to offer assistance and support to the evacuation people.

ii) Evacuation order and evacuation directives

Based in the information relayed from the affected community about the floods and indications that flooding will continue this will enable arrangements to be put in place for evacuation.

iii) Mobilization of relief aid

Based on the information received from the affected community various aid organizations will look for donation of relief aid to assist with the affected communities.

6.4 POST-FLOOD RECOVERY

These include the measures put in place to restore the flood affected community to their normal living conditions or pre-flood conditions. The measures undertaken generally under these categories:

- Self help

- Mutual help

5.4.1Self help activities

The community undertakes:

i) Community driven (based) road maintenance
The roads within the community are improved to allow easy movement. These may involve raising the road and stabilizing the road sides. These activities are carried out by the community.

ii) Restoration of houses
The flood damaged houses are repaired by the individual owners of these houses or the community members can come together to assist the members to rebuild or repair their houses to habitable conditions.

5.4.2 Mutual help activities

i) Income generation activities
The community together with the support organizations identifies and establishes ways of getting income through farming, trade etc. this will provide the effected people with money for day to day up-keep.

ii) The badly damaged roads are repaired by the community with help from public works ministry, support organizations and NGOs.

iii) Debris and solid waste removal
The pebbles, tree trunks and silt deposited in the water channels are removed. This will clear the channels to allow free flow of water. This will lead to reduced flooding in the next rainy season.

v) Measures for prevention of disease outbreaks
Water related diseases such as malaria, typhoid, cholera etc often break out after the floods. The situation is monitored to prevent these diseases from occurring. Measures taken include provision of safe drinking water, draining of stagnant water, destroying the mosquito breeding areas and giving preventive treatment which helps to control these diseases.

v) Repair of damaged river structures and facilities
The river structures and facilities include dykes, levees, bridges, banks etc. these are usually damaged by floods. Small scale or large scale repair works may be carried out depending on the extend of damage.

vi) Damage assessment and study of the causes of damage
The extent of damage caused by floods is checked so that the necessary preparedness measure is put in place. The cause of the damage is also established to assist in putting in place prevention measures.

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MODULE VII

APPROACHES FOR ENHANCING FLOOD MANAGEMENT EDUCATION IN THE PRIMARY SCHOOL CURRICULUM

Module Objectives:
By the end of the unit the participant should be able to:-

- describe Didactic, Expository, Empiricist, Heuristic, Inquiry / Discovery / Investigative, Constructivists and ASEI / PDSI approaches.
- utilize Didactic, Expository, Empiricist, Heuristic, Inquiry / Discovery / Investigative, Constructivists and ASEI / PDSI approaches in flood management education..
- describe the advantages and disadvantages of each learning approach in flood management education.
- develop an effective combination of various learning approaches for flood management education

Task for participants:

- Suggest learning approach(es) that can be used effectively in flood management education.
- Describe how best the enquiry / discovery / investigative approach and ASEI / PDSI can be used in flood management education.
- Describe the role of a teacher in ASEI / PDSI approach

7.1 LEARNING APPROACHES

There are several learning approaches that can be employed in a learning situation. These include:

7.1.1 Didactic approach

It is mainly teacher dominated. Learners are given rigidly formulated statements which they memorize and regurgitate when required to do so by the teachers. The learners are simply made to cram things.

7.1.2 Expository approach

The teacher gives facts, explains concepts and gives illustrations. Learners' participation is limited to listening, answering and asking questions and writing notes as the lesson progresses. Used to teach abstract concepts.

7.1.3 Empiricist approach

Emphasizes the need to acquire knowledge through observation. The learner is given an opportunity to at least handle apparatus and make observation thus developing interest and manipulative skills.

7.1.4 Heuristic approach

Learners are involved in observation, recording, analyzing data and drawing conclusions on their own. It involves inquiring which could lead to understanding of the theory. It takes time.

7.1.5 The inquiry / Discovery / Investigative approach

Is a learner – centered approach with a high degree of involvement of all those who participate. The teacher involves students in activities that help in the development of skills for problem solving. It involves projects which encourage learners to understand better the concepts. The philosophy followed is the Chinese proverb that says "***I hear and I forget, I see and I remember, I do and I understand".***

7.1.6 Constructivist approach

This approach takes cognizance that by the time a learner enters formal education he / she has already interacted with the environment and has developed ideas and concepts in relation to what he / she has experienced. Emphasis is that learning should build on the learner's practical experience while at the same time correcting any misconceptions of learner's alternative frameworks. The learning activities should encourage the ability to plan and carry out investigations in which learners observe, compare, describe note and express themselves.

7.1.7 Activity, student – centered, Experiments and Improvisation / plan, Do, See Improve approach. (ASEI / PDSI)

The role of the teacher is that of a:

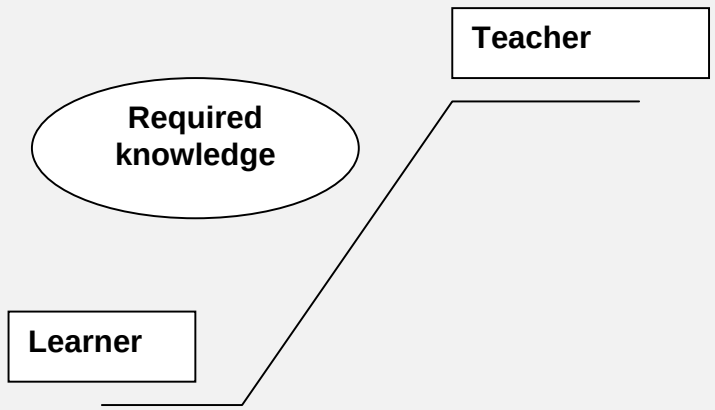
- facilitator
- guide
- counselor
- motivator
- innovator
- researcher

It is recommended there must as many activities during one lesson as possible. These activities must be learner centered involving a lot of improvisations.

The learners get to appropriate the ever –present learning opportunities in the surrounding for problem solving.

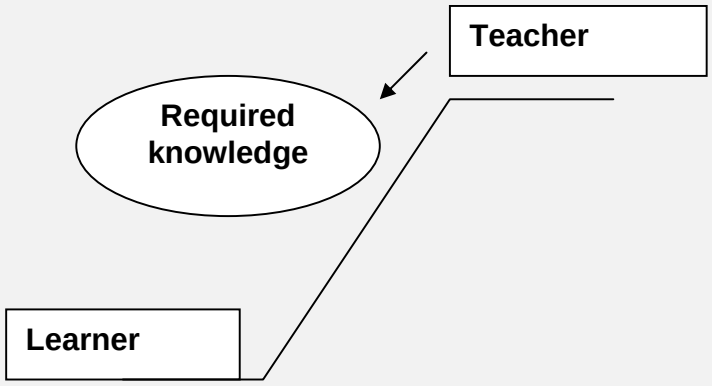
Task for participants

Study the analogy below

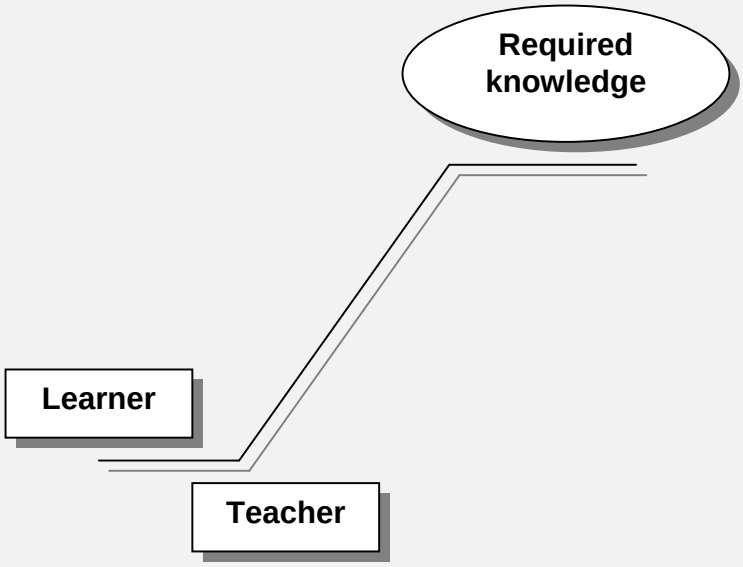


At this moment learners do not posses the required knowledge. Education is an activity that will enable students to gain the 'required knowledge' on top. To gain the 'Required knowledge' consider the following three approaches and suggest the best approach.

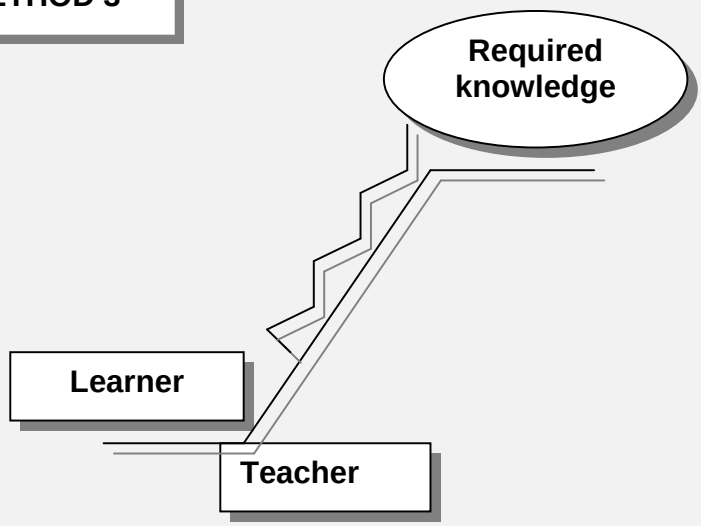
METHOD 1



METHOD 2



METHOD 3



1. Teacher throws the required knowledge to the student.
2. Teacher does nothing except initiating learners climbing the hill.
3. Teacher prepares steps and the student climbs the hill.

7.2 Teaching Methods in Flood Management Education

The particular method that a teacher uses is determined by a number of factors. These includes:

- the concept to be taught
- the objectives, which the teacher plans to achieve
- availability of teaching and learning resources and the ability and willingness of the teacher to improvise if conventional teachings aids are not available
- evaluation and follow-up activities

The teaching method includes.

Lecture (chalk and talk) method

Involves giving factual information with very little or no participation by the learners. It is most effective for transmission of large amount of subject matter. However it is widely found to be outmoded.

Teacher Demonstration method

Provides the means for the teacher to explain or clarify certain parts of the content quickly and economically. It is useful when the apparatus and / or materials to be used are not enough, or highly dangerous or too delicate to be entrusted to the students.

Practical work method

Involves the activities conducted by the students under the guidance or supervision of the teacher. The learners are put in groups and provided with the materials and apparatus as well as instructions to be followed.

Project work

This method enables the learners to actually engage in scientific investigation in an area of their own interest. The basic steps combined with the skills involved are as follows:

- Observation
- Identification of problem
- Discussion
- Formulation of question to be answered
- Design of the investigation
- Data gathering
- Data analysis
- Making deduction
- Report writing and presentation.

Teacher supervision and guidance are important pre requisite for successful project work.

Field work

Fieldwork result from a need to illustrate the natural development or technological application of certain topics dealt with in the classroom. Provides learners with first –

hand evidence of scientific phenomena and how they impact on everyday life. Learners also get an opportunity to interact with experts in particular fields.

Discussion method
Is used at the beginning of a topic to ascertain learners' pre conceived notion of the subject matter or towards the end of the topic by presenting learners with a new situation and asking them to explain it in terms of what they have just learned.

Simulation
It is the imitation of the appearance or a character of the real. Involves the use of models to represent real situation.

Skit
This method involves role-play. An activity is designed such that learners are involved in short comedies to make a particular concept to be easily understood.

Games and puzzles
Games and puzzles are designed based on the topic or concept being taught. It requires creativity and proper scripting.

Tasks for participants:
- discuss ways of improving learner - centered teaching / learning
- discuss effectiveness of learner – centered teaching / learning

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MODULE VIII

WORK PLANNING FOR FLOOD MANAGEMENT EDUCATION

Module Objectives:
By the end of this module, the participants should be able to:
- describe integration and infusion as methods for localizing the curriculum to enhance flood management education.
- Develop infusion and integration plans for flood management education.
- Develop infusion and integration schemes of work for flood management education.
- Develop infusion and integration lesson plans for flood management education.

8.1 WORK PLANNING

Refers to the systemization of activities to be carried out in a given time schedule in order to achieve a certain goal. In relation flood prevention education the goal is flood management.

8.2 DEMOCRATIC PARTICIPATORY APPROACH

The teaching of flood prevention education requires teachers to facilitate learning process within and in settings beyond the traditional confines of the formal classroom. Outdoor lessons are the best for flood prevention education. However, when this can not be accomplished, nature should instead be brought into the classroom.

The teacher should begin from what the learner already knows. The teacher should learn from the flood experience of the learner, explore the learners perception of flood. The home grown interventions and the community's general approach to flood disaster management revisited. This would make the concepts taught more familiar and improve acceptability.

The greatest and most available teaching resource is the local environment. The teacher should therefore identify all components of the local environment; decide the ways in which they can be best used in teaching and developing relevant materials.

The aim of flood disaster management education should be towards solving environmental and sustainability problems. The way to go, is equipping both the learners and the teachers with the correct knowledge, appropriate skills and the right attitude towards flood management.

Flood management education does not introduce a new curriculum but, rather intends to enrich the existing curriculum in order to solve a local problem of floods. The approaches to use are: **integration** and **infusion.**

8.2.1 Integration

Refers to the incorporation of content and skills into existing carrier subjects without jeopardizing the integrity of the subjects while respecting the integrity of both scope and sequence of the content and skill.

8.2.2 Infusion

Is the incorporation of content and skills into existing non carreer subjects without distorting scope, sequence of the content and skills. For example in English, a poem or composition can be used to develop language, skill such as creative public writing or speaking while at the same time addressing flood prevention issues.

The lesson plan follows the conventional format but may have additional column to cater for the flood management phase. The lesson plan has to be consistent with the infused scheme of work where flood prevention has been infused.

Infusion Plan for Flood Management Education: English Class 7

CORE MESSAGE	PLUG IN POINT (Topic & Sub topic)	CLASSES/ LESSONS				REFERENCE
		1	2	3	4	
Need for flood Management	CREATIVE WRITING ⌑ Imaginative composition ⌑ Short stories INSTITUTIONAL WRITING ⌑ Posters ⌑ Business letters					Syllabus book Flood management book.

FLOOD MANAGEMENT EDUCATION: INFUSION SCHEME OF WORK

WEEK	LESSON	TOPIC/ SUB TOPIC	SPECIFIC OBJECTIVES	TEACHING ACTIVITY	LEARNING ACTIVITY	T/ LEARNING RESOURCES	REMARKS
1	1	CREATIVE WRITING Composition	⌑ By the end of the lesson the learner should be able to write a flowing composition on flood effects.	⌑ Explain the effects of flood ⌑ Guide the learner to identify the negative effects of floods	⌑ Learners take short notes ⌑ Learners write a short composition	⌑ Flood management text book ⌑ Nearby flood plain	

FLOOD MANAGEMENT EDUCATION INFUSION LESSON PLAN FOR ENGLISH CLASS 7

CLASS	ROLL	TIME

TOPIC **:** Creative Writing
SUB TOPIC : Imaginative composition writing
SPECIFIC OBJECTIVES : Write a short composition describing the negative effects of floods
TEACHINGS/LEARNING RESOURCES

- Flood management text book
- Writing materials
- Syllabus

LESSON PRESENTATION

STEP/STAGE	TEACHING ACTIVITIES	LEARNING ACTIVITIES
Introduction	⌑ Explain the effects of floods. ⌑ Explain the purpose of the composition.	⌑ Listening and taking notes
Lesson Development	⌑ Guide a discussion on the effects of floods ⌑ Highlight negative effects of flood asses learners work	⌑ Contribute on the discussion ⌑ Discuss and ask questions ⌑ Develop writing skills
Conclusion	⌑ Summarizing. ⌑ Give an extended activity.	⌑ Learners ask questions

Evaluation……
……

INTEGRATION PLAN FOR FLOOD MANAGEMENT EDUCATION SCIENCE AND AGRICULTURE CLASS 7

CORE MESSAGE	PLUG IN POINT (Topic & Sub topic)	CLASSES/ LESSONS				REFERENCE
		1	2	3	4	
Need for settlement planning and Agriculture	Flood situation in Kenya Factors that lead to flooding and food security in Nyando River basin. Remedies of flooding in Nyando River					Syllabus book Flood management text book.

FLOOD MANAGEMENT EDUCATION, INTEGRATION SCHEME OF WORK

WEEK	LESSON	TOPIC/ SUB TOPIC	SPECIFIC OBJECTIVES	TEACHING ACTIVITY	LEARNING ACTIVITY	T/ LEARNING RESOURCES	REMARKS
2	1	Factors affecting Agriculture	By the end of the lesson the learner should be able to: Describe the factors that lead to food insecurity in Nyando river basin Describe ways of flood prevention	Explain the effects of settlement in the flood plain. Explain how flooding causes flood insecurity Ask learners to describe their experiences with floods	Learners take short notes. Learners discuss effects of floods on Agriculture Learners ask questions	Flood management text book Nearby farm affected by floods.	

FLOOD MANAGEMENT INTEGRATION LESSON PLAN FOR SCIENCE CLASS 7

CLASS	ROLL	TIME

TOPIC : Food security
SUB-TOPIC : Factors affecting food security.
Specific Objectives **:** By the end of the lesson the leaner should be able to explain the effects of floods on food production.

Teaching/ Leaning Resources:

- Science and Agriculture class 7 book
- Writing materials
- Syllabus

LESSON PRESENTATION

STEP/STAGE	TEACHING ACTIVITIES	LEARNING ACTIVITIES
Introduction	Ask questions to link the previous topic with the current topic. Explain the meaning of food security.	Listening and answering questions.
Lesson Development	Guide discussion on factors affecting food security Highlight effects of floods in food production	• Contribute on the discussion • Ask questions • Take short notes
Conclusion	• Summarize • Give extended activity.	• Learners ask questions.

Evaluation……
……

8.3 Types of planning

There are two types of planning namely:
- mental planning
- formal planning

8.3.1 Mental planning

The teachers spontaneous response to events in the classroom, the teacher considers situations and respond intuitively. Mental planning is part of teaching that is crucial for effectiveness but it cannot be easily observed, recorded or detailed.

8.3.2 Formal planning

Is what most teachers recognize as legitimate and necessary teaching activity. Formal planning is structured and documented.

8.4 Tools for planning

These include:
- Schemes of work
- Lesson plan
- Record of work
- Others

8.4.1 Schemes of work

Is a detailed work plan made in advance for teaching / learning of subject topics for a given period of time?

i) Reasons for scheming

- To make logical ordering of the coverage of the topics and sub-topics.
- To allocate learning time for
  - Each item of the content
  - Assessment
- To state depth and scope of treatment of each topic as in the syllabus
- To outline teaching / learning activities.
- To specify the teaching / learning resources.

To make logical ordering of the coverage of the topics and sub-topics.

Topics/ and sub-topics should be arranged in a logical order. The order may not be necessarily as shown in the syllabus. Some of the approaches for ordering the topics include:

Hierarchical approaches:

In this approach topics are arranged from simple to more complex ones, e.g. in Chemistry the atom is taught earlier than radioactivity, in mathematics trigonometry comes earlier than navigation while in physics electricity comes earlier than electronics.

Historical approaches:
Topics are arranged in the order they were discovered, for instance, in physics the equation of linear motion associated to Galileo, Galileo (born in Pisa in Italy in 1564 and died in 1642) are taught earlier than Newton's laws of motion, by Sir Isaac Newton (1687- when he documented the three laws of motion.)

Thematic approaches:
Topics are arranged into themes. Once a topic has been covered, it is not revisited again. For example, in mathematics statistics can be taught once (i.e. combining Statistics II and I) not to be revisited later. In physics all topics of mechanics can be covered, then another module is followed, i.e. electricity waves, sound, electronics, etc. Mostly this method is applied at the universities.

Spiral approaches:
A topic is covered only to a certain level of depth and then the same topic is revisited later. For example, in biology classification I is covered in form one the revisited in form three as electrostatics II. In mathematics statistics I, is taught in form and in form four it is taught as statistics II. In chemistry effect of electric current on substances is covered in form one and then revisited again in form four as electrochemistry. This approach is commonly used in 8-4-4 curriculum.

Matrix approaches:
This involves teaching different topics that lead to understanding of a given concept, i.e. the transformation of energy into different forms like the chemical, electrical, mechanical, nuclear, etc. in this case the students need to have understood other topics and so it is only useful at higher levels and normally for revision purposes.

To allocate time for:

Each time of the content:
Some topics require time for teaching than others depending on the scope and depth of treatment. It is through scheming that a teacher can assign enough time yet not overlooking other topics.

Assessment:
A general outline of contents and the corresponding tests, quizzes and projects is planned well ahead.

State the depth and scope of treatment:
The depth and scope of a topic as shown in the syllabus should be examined and suitable learning experiences and example for each topic/sub-topic set out. The teacher can therefore be able to acquaint the students with necessary concepts and skills.

Outline teaching /learning activities:
An outline of experiments and other activities to be undertaken are specified. Examples of such activities include class experiments, teacher demonstrations, project work, problem solving, discussion, individual and group work etc.

Specify teaching/learning resources:
The materials, equipment and apparatus necessary for lesson activities are identified early enough through the schemes. The helps the teacher to place orders for them in good time, where applicable. The laboratory assistant (wherever available) is also able to organize for experiments in good time. Materials to be purchased could be bought in good time to avoid the last minute rush.

Clarify skills and concepts:
Skills and concepts are specified and clarified during scheming. This helps the teacher in preparation of lesson plans. The concepts refer to the basic knowledge of facts, principles and rules that have been established. The skill refers to mental and physical capabilities towards problems solving. These skills may be manipulative to enable the learners to handle and use the apparatus effectively, process skills that enable the learner to develop appropriate attitude for problem solving and production skills to enable them to design their own projects.

ii) Factors to consider when scheming
- Content
- Learners needs
- Learners background knowledge
- Time available
- Teaching and learning resources.

Content:
This involves considering the topics and sub-topics given in the syllabus. From these, teachers should drive a logical sequence or order of topics. From the objective outlined in the syllabus, a teacher is able to:
- Derive the scope and depth of covering a given topic
- Choose suitable teaching/learning methods and topics.

Learners needs:
These needs of the learners are derived from the general objectives stated for different topics and sub-topics as seen from the syllabus. The learner needs depend on:
- The academic level of the learner e.g. in physics a learner at higher level will be taught the details of an instrument like the vernier calipers.
- What the learners already know/background e.g. primary pupils may know an atom as the smallest part of an element that can exist on its own. It is from this background that the teacher builds from and introduces other /new concepts e.g. electron, proton and neutron as part of an atom.

NB.

These needs determine the type of learning activities (experiments and others) that the Teacher will select. Hence the teacher should consider the learning needs of the learners, as categorized in the Benjamin Bloom's taxonomy.

Cognitive needs refer to understanding and logical thinking, knowledge and application to daily life needs.

needs refer to attitude, emotion, willingness, cooperation, inquiry and scientific mindedness etc.

Psychomotor needs refer to skills, hands on, designing, gathering, constructing, observing, experiments, manufacturing, taking care of plants and animals.

Time available:

By considering the number of lessons per week, number of teaching weeks per term and the whole year, the topics to be taught can be divided into suitable units. Time available will influence the type of activities that may be used to illustrate a given concept or skill. If a skill has to be learnt, then class experiments are very useful. The enhancement of affection for and understanding concepts is very useful. The enhancement of affection for and understanding concepts may be done through demonstration, problem solving, projects, assignments, homework etc.

The other way of looking at time is change in seasons. Certain topics may be taught more effectively in one season and not in other e.g. flower may be more available during the rainy season.

Teaching and Learning resources:

A teacher requires knowing the resources available in the school and when the resources are available before scheming. He/she should also check on the locally and/or waste materials available for making improvised equipments/apparatus e.g. blown up filament bulbs for mains electricity can be used as boiling tubes

.

iii) Components of a scheme work

The essential components of a scheme of work include the following:-

- Time allocated in terms of periods, weeks etc.
- Content or topics and sub-topics to be covered in a specified period of time.
- The objectives which specify the skills and concepts to be learnt.
- Teaching and learning activities that are determined by objectives.
- Teaching / learning resources.
- References
- Remarks – is for evaluation of every lesson after teaching.

Task for participants:

- Develop a scheme of work for one week in flood prevention education.
- Identify the areas of difficulty.

SCHEMES OF WORK FORMAT

School: _____ **Subject:** _____

Class: _____ **Year:** _____ **Term:** _____ **Name of teacher:** _____

Week and Date	Period (Lesson)	Topic Sub-Topic	Objectives	Learning / Teaching activities	Learning / Teaching resources	References	Remarks

8.4.2 Lesson plan

Is a document that translates the goal and content of a course instruction into an operational plan. It outlines the flow of the lesson specifying the methods and activities to be carried out in order to achieve the objectives.

i) Reasons for lesson planning

- Helps the teacher to organize his / her thoughts on what should happen during the lesson.
- Act as a guide during lesson preparation and help him or her to know when to ask question during the lesson.
- Help the teacher to analyze and evaluate the lesson.
- Forms a framework for making judgments on the teacher's performance and planning for improvement.
- Serves as a record so that in future years, the teacher can look and see how he/ she organized the teaching of certain topics or planned a certain practical.

ii) Components of a lesson plan

- Topic
- Sub-topic
- Objectives
- Teaching / learning resources
- Introduction
- Development
- Conclusion
- References.

iii) Lesson plan structure

Topic : _____
Sub-topic : _____
Class : _____
Duration : _____
Objectives : _____
Teaching and learning resources: _____

STAGE / TIME	TEACHING / LEARNING ACTIVITIES	LEARNING POINTS	REMARKS
Introduction			
Development			
Summary / conclusion			
Evaluation			

REFERENCES

Ayot, H.O, and Patel, M.M., (1992). Instructional Methods (General Methods). Education Research and Publication. Ltd. Nairobi, Kenya.

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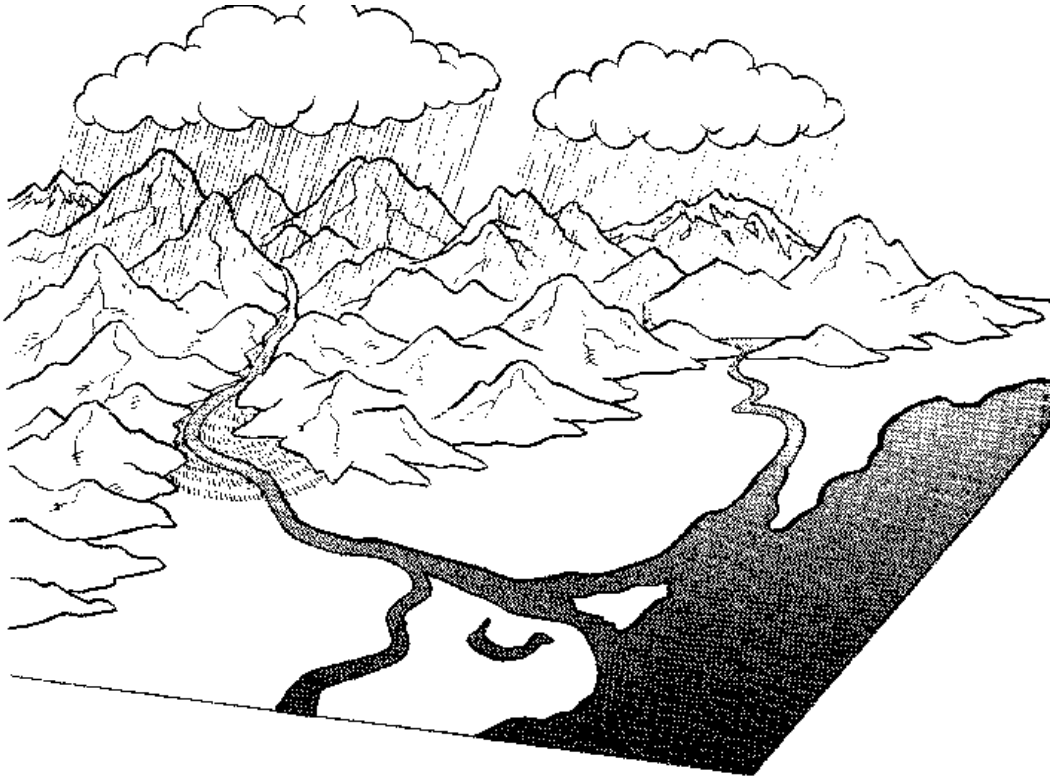
Appendix-II

TEXTBOOK FOR PRIMARY SCHOOL

INTEGRATED FLOOD MANAGEMENT

FLOOD AND OUR ENVIRONMENT



Japan International Cooperation Agency (JICA)

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UNIT 1 : What is flood ?

1.1 Flood ?

Flood is a situation in which water from a river, stream, and channel overflows its banks and covers large areas of dry land.

Flood can also occur when water from heavy rains cover large area of land that was dry before.

Floods occur in the flood plains. Floodplains are low-lying flat areas next to rivers, streams or lakes which are always exposed to flooding after heavy rains.

Figure 1 Diagram showing Floodplain (for Colouring)

1.2 Flood as a disaster

Disaster is an event or occurrence which may be sudden or gradual causing damage to human life, livestock, crops and physical facilities.

When floods occur in the Nyando River Basin, it affects human life, settlement, health, crops, livestock and physical facilities such as roads, houses, churches, hospital, schools, bridges etc.

1.3 Various Signs of Flood

Immediately before floods, several warnings are observed by communities living in the Nyando River Basin. The representative signs are:

a) Increased peculiar noise of frogs croaking;
b) Strong eastward wind blows;
c) Appearance of certain species of migratory birds, locally known as “Okok” and “Wi Wi”;
d) Rising of river water level;
e) Foaming of river water with flotsam; and
f) Noise of overflowing water

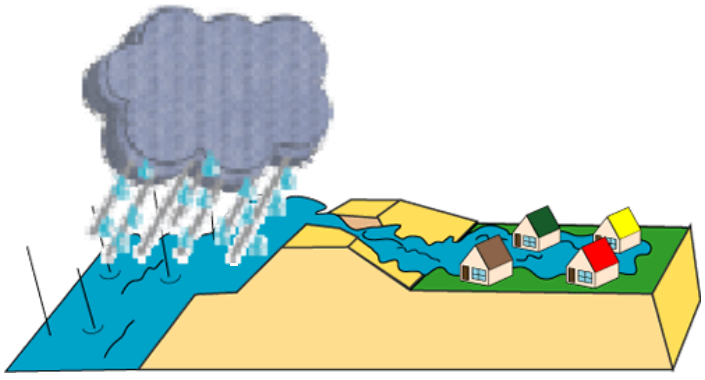
a) Peculiar noise of frogs

b) Eastward winds

c) Certain species of birds

d) Rising of river water level

e) Flotsam and foam



f) Noise of Overflow

Figure 2 Various Signs of Flood

1.4 Types of floods in Nyando River Basin

There are two main types of floods in the Nyando River, namely:

☑ Flash floods

☑ River floods

(1) Flash floods

It is the flood that occurs soon after a heavy rainfall. It occurs on a large area but clears within a short time.

(2) River floods

It is the flood caused by river, stream or channel water overflowing its banks after heavy river catchments.

😐 **Revision Questions**

1.) Flood is _____

_____

2.) The two main types of flood are _____ and

_____

3.) Floods are common in the _____plains.

4.) List four things damaged by floods,

a) _____

b) _____

c) _____

5.) An occurrence or event that causes damages to human life and property (crops, Livestock, houses etc) is called a _____ type of flood that occurs soon after a heavy rainfall and clears after a short time.

UNIT 2 : Why does flood occur ?

2.1 CAUSES OF FLOODS

Floods in the lower Nyando River Basin are a big problem to the people in the area whenever they occur. Floods may occur seasonally or annually whenever there is excess rainfall. There are two ways in which floods occur, namely:

☑ Excessive rainfall covering the land.

☑ When water overflows its natural channels.

These may be classified into two main groups:

☑ Natural causes

☑ Human causes

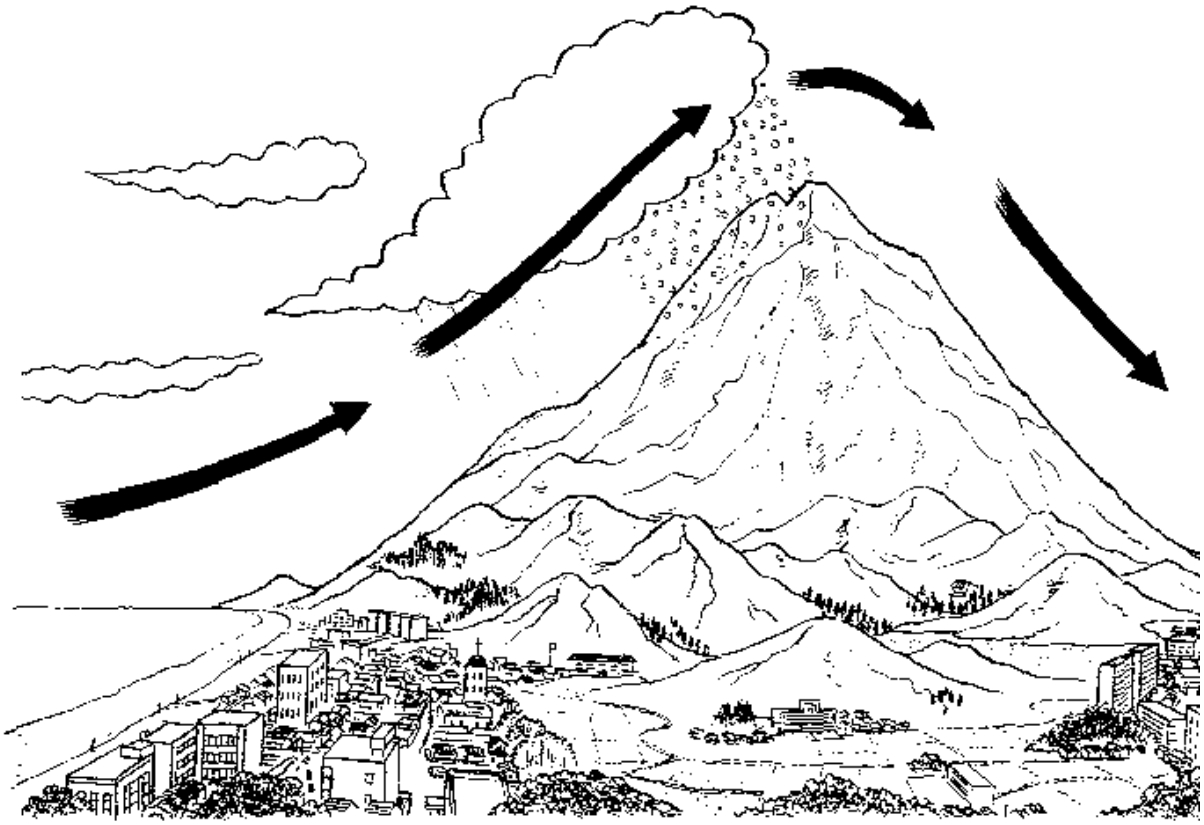


Figure 3 Wet Wind and Cloud bring about Excessive Rainfall

😐 **Activity**

Draw a sketch of the water channel and label it appropriately.

2.2 Natural Causes

- ☑ Excessive rainfall in the upper Nyando River catchments (Nandi and Kericho Highlands).
- ☑ Characteristics of the lower Nyando River Basin.
- ☑ The velocity of the water.

(1) Excessive rainfall in the Nyando River Basin (Nandi and Kericho Highlands):

Heavy rains in Nandi and Kericho Highlands lead to a lot of water flowing to the lowlands at a high speed. This forces the river to burst its banks causing floods. For example during the El- Niño rains of 1997, many places that normally don't experience floods were flooded due to the excessive rainfall both in the Kericho and Nandi highlands and the Kano plains.

Plate 1 River bursting its banks during heavy rains

Plate 2 Ahero Bridge at dry season

Plate 3 Ahero Bridge during Flood

(2) Characteristics of the Nyando River Basin.

- ☑ Drainage pattern
- ☑ Gradient
- ☑ Type of soil
- ☑ River meanders

i) Drainage pattern

It is the way through which rain water flows on the surface to the water bodies. These include rivers, streams, swamps, lakes etc. The rivers and streams form water channels through which water flows in the lower Nyando river basin.

These stream and rivers are made shallow by silt deposits causing the water to overflow their channels thereby causing floods.

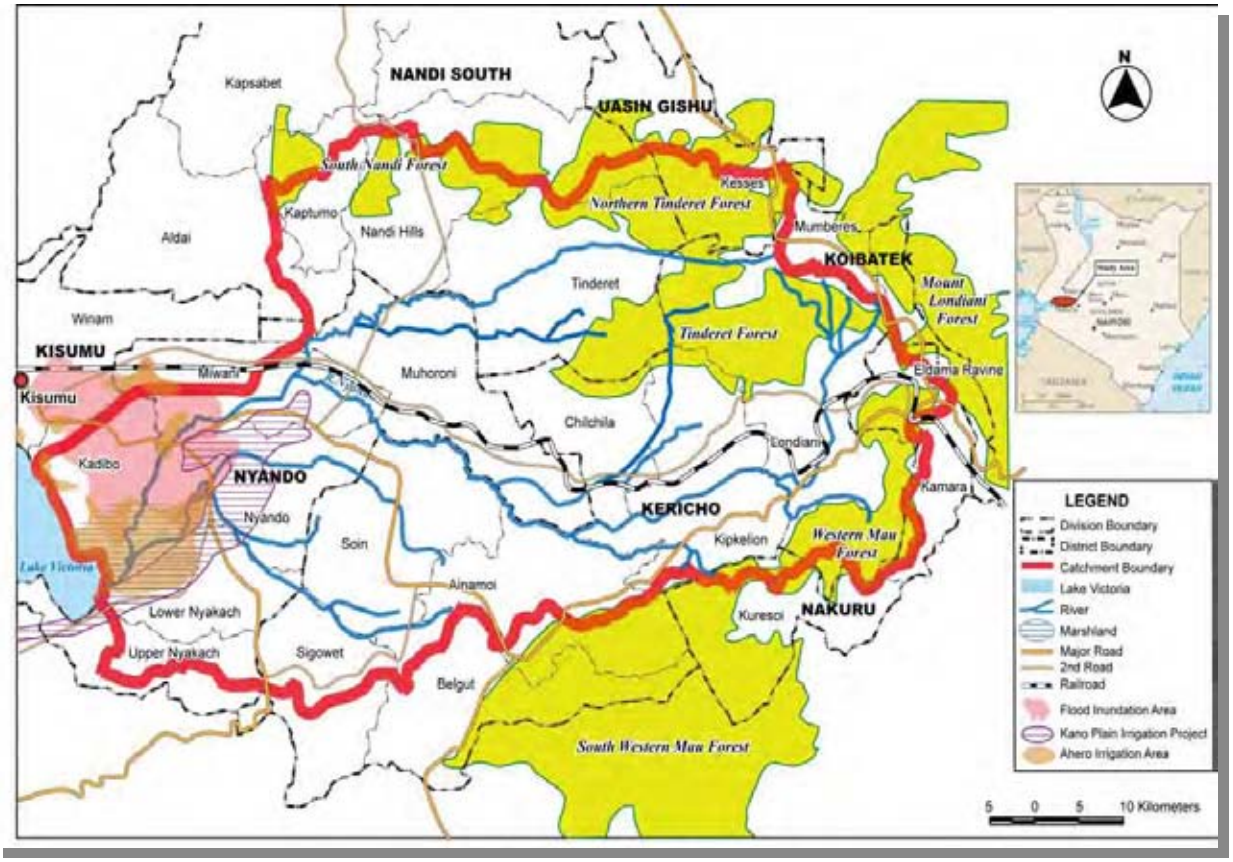


Figure 4 Drainage pattern for Nyando River (Source: JICA IFM Study Team)

ii) Gradient

It is the general slope of the land. In the highlands the slope are steep, water therefore flows at a high speed. The water carries a lot of debris to the lowlands, which get deposited in the channels due to low speed. The deposits make the channels shallow and may also block them, causing the water to overflow the traditional channels, resulting to floods.

Plate 4 Heavy Soil Erosion

Plate 5 Culverts buried with sand.

iii) Type of soil.

The lower Nyando river basin has black cotton soil (clay soil) which has fine particles. The fine particles close up when wet, reducing the rate of water infiltration into the soil. A lot is therefore retained on the surface causing flooding.

Plate 6 Cracks at River Bank

Plate 7 Muddy Road after Rains

☞ Activity

To find out water retention capacity of different soils

1.) Collect three identical plastic bottles

2.) Collect three different soil samples: clay, loam and sand of equal amount

3.) Collect cotton wool and water

4.) Prepare the apparatus as shown below:

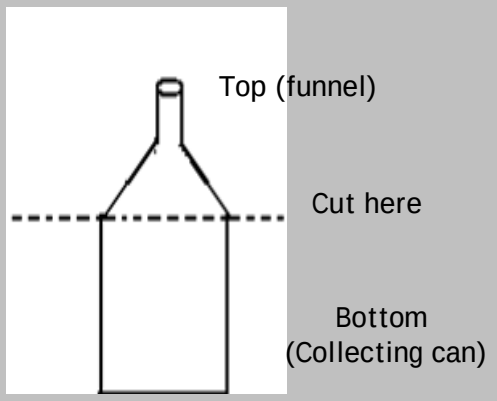


Figure 3

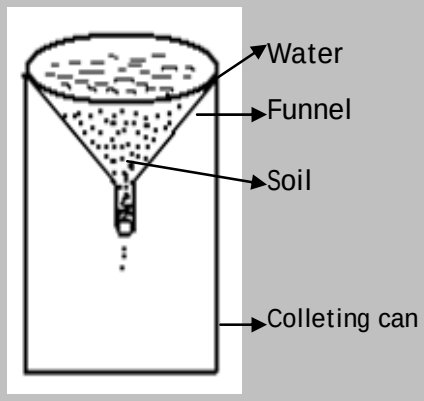


Figure 4

Step 1: Cut each of the three bottles as shown in Figure 3 above to have three identical funnels and three collecting cans.

Step 2: Arrange the apparatus as shown in Figure 4 above and label them 1, 2, and 3.

Step 3: Put cotton wool of the same size in each funnel.

Step 4: Put equal amounts of different soils in different funnels.

Step 5: Pour equal amount of water into each funnel.

Step 6: Leave the set up for five minutes and observe.

Questions:

1.) In which set up was the highest amount of water colleted?

2.) In which set up was the least amount of water collected?

3.) In which of the three set ups had clay soil?

iv) River Meanders.

In the lower catchments of Nyando river basin the gradient is low, thereby reducing the speed of water flowing in river channel. This results in high deposits of silts blocking the channel. The river water therefore finds a new channel in which it flows on, by meandering, hence causing floods.

Plate 8 River Meandering

(3) The velocity of water.

The speed of water in the lower catchments is low. This leads to high silts and debris deposit which make the river channel shallow. Therefore increase of water levels in this channel leads to overflowing of the river which results into floods.

Plate 9 Silt Deposition at Lower Catchment

2.3 Human activities

i) Settlement pattern

Some people build their homes on waterways, blocking them causing flooding. Waterways are the normal channels, depressions or general areas; water passes through during the normal flow. Channels are defined depressions or natural canals through which water flows. These may include the river, stream, or drainage canals. When people build their houses in these areas, they block the normal flow of water during rainy seasons thereby, causing flooding.

ii) Poor farming methods

These poor farming methods include cultivating the riverbanks, ploughing up and down the slope, overgrazing, overstocking, continuous cultivation etc. these lead to soil erosion and the eroded soil particles get deposited and block the water channels causing floods.

Plate 10 Cultivation along River Bank

iii) Deforestation

Deforestation is the cutting down of trees where they have been growing. Clearing of forest in the upper catchments of Nyando river basin leads to soil erosion. The eroded soil particles get deposited in the waterways in the lower catchments, causing flooding.

Plate 11 Deforestation at Upper Catchment

😐 Revision Questions

1.) Floods can be classified into two groups according to their causes namely _____ and _____

2.) State 4 natural causes of floods in Nyando River Basin

i) _____

ii) _____

iii) _____

iv) _____

3.) List human activities that cause flood in Nyando River Basin

_____

4.) Name three characteristics of Nyando River Basin that cause floods.

i.) _____

ii) _____

iii) _____

5.) Floods are dangerous to human life. True or false.

6.) Name 4 rivers or streams found in lower Nyando River Basin.

i) _____

ii) _____

iii) _____

iv) _____

7.) Draw a meandering river.

8.) What is deforestation? _____

UNIT 3 : Where affected by flood in Kenya ?

3.1 Areas Affected by Flood in Kenya

The areas affected by floods in Kenya include:

- ☑ Tana River in Coast province
- ☑ Budalangi in Western province
- ☑ Nyando in Nyanza province
- ☑ Kisumu in Nyanza province
- ☑ Rachuonyo in Nyanza province
- ☑ Garissa in North Eastern province
- ☑ Kwale in Coast province
- ☑ Kilifi in Coast province
- ☑ Ijara in North Eastern province
- ☑ Wajir in North Eastern province

Plate 12 A flooded area in Budalang'i in Western Kenya

There are many places in Nyanza province that are commonly affected by floods. Such areas include:

- ☑ Kano plains in Nyando and Kisumu East districts
- ☑ Lower Nyakach and west Nyakach in Nyando districts
- ☑ Kadem in Migori district
- ☑ Yala swamp in Bondo and Siaya districts
- ☑ Kimira valley and Osodo bay in Rachuonyo districts
- ☑ Oluch in Homa Bay districts

Table 1 Areas affected by floods in Nyando River Basin

	Area	**Streams**
1.	Kamagaga, Okana, Sidho, Kobura, Kabonyo, Kanyagwal	Ombeyi, Orije, Miriu, Nyatini.
2.	Kabodho, Wasare.	Asawo and Omondo
3.	Katolo, Ayweyo, Gem Rae, Magina	Awach Nyalbiego and Onguo
4.	Kamagaga, Wang'aya, Kobura, Kobong'o, Konim, Kakola, Kochogo, Kabonyo, Kanyagwal, Magina and Singida.	Miriu and Nyatini, Nyando
5.	Kaila, Kogelo, Wagunga, Ayweyo Magina	Nyaidho, Nyalbiego.

😐 Revision Questions

1.) Name 5 areas in Kenya frequently affected by floods

i) _____

ii) _____

iii) _____

iv) _____

v) _____

2.) List 5 areas in Nyanza Province frequently affected by floods

i) _____

ii) _____

iii) _____

iv) _____

v) _____

3.) Using the map of Nyando River Basin given below, identify:

a) 5 areas frequently affected by floods

b) 2 rivers that cause flooding in Kanyagwal and Wawidhi Locations

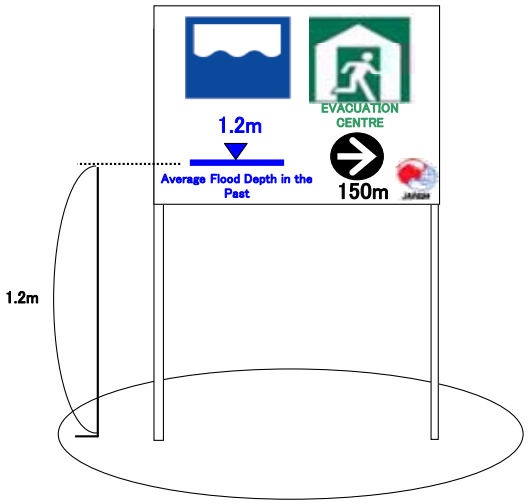


Figure 5 Signboard showing flood depth and Distance to Evacuation Centre
(See details on the back cover of this textbook)

UNIT 4 : What are the effect of flood ?

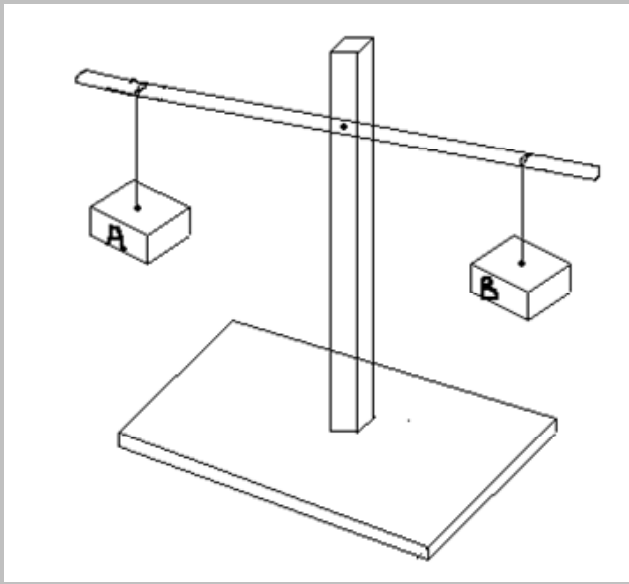
4.1 Effects of Flood

In the previous units, we defined floods, discussed its causes and identified the areas which are commonly affected by floods in Kenya, Nyanza province and in the Nyando River Basin.

Floods have both good and bad results on human life and property.

☞ **Activity**

1.) Have you ever experienced floods? _____
2.) What were its advantages? _____
3.) What were its disadvantages? _____
4.) Supposing you were to put the advantages and disadvantages on a weighing balance:
a.) Which one would be heavier?



b.) On which side will you put:

Advantages? _____

Disadvantages? _____

To answer the above questions, let us group and discuss the effects of flood in terms of the good effects on one side and the bad effects on the other.

Good effects of floods	Bad effects of floods
1.) Provide breeding, nesting and feeding for fish, birds and wildlife	1.) Human and livestock death due to drowning
2.) Improves fertility of the soil	2.) Result in water-related diseases
3.) Flood can be used for irrigation	3.) Contamination of water source
4.) Allows pasture growth and regrowth	4.) Description of human settlement
5.) Refills underground water	5.) Destruction of crops
	6.) Disruption of learning
	7.) Disruption of transport and communication
	8.) Destruction of buildings

4.2 Good Effects of Flood (advantages)

(1) Provide breeding, nesting and feeding ground for fish, birds and wildlife

(2) Improves soil fertility

Flood deposit silts and the fertile top soil from the upper catchments in the flood plains making it fertile for crop production.

Plate 13 Animals within a river bank

(3) Pasture regeneration

Flood improves soil moisture and promotes growth of grasses for animal grazing.

4.1.4 Irrigation

Flood water can be used for irrigation of crops such as rice, onions, kales (*sukumawiki*), tomatoes, watermelon, arrowroots etc.

Plate 14 Rice irrigation in the Nyando Floodplains

4.1.5 Recharging groundwater

Flood water infiltrates the soil increasing the volume of underground water or raising the water table.

Plate 15 A shallow-well filled with water during floods

4.3 Bad Effects of Flood (disadvantages)

Floods cause damage to human life and physical facilities. Damage to human life includes;

4.2.1 Human and livestock death due to drowning

Fast moving water can knock down and drown people and animals in relatively shallow depths. Animals such as chicken, goats, sheep, cattle etc can easily be swept by currents of moving or turbulent water.

Slow flooding causes relatively few direct deaths or injuries, but often increases occurrences of snake bites.

4.2.2 Water-related diseases

A number of diseases may break out during and after flooding. Some of these diseases are:

- ☑ Malaria
- ☑ Typhoid
- ☑ Cholera
- ☑ Bilharzias
- ☑ Dysentery

4.2.3 Contamination of water source

The flood water sweeps over a large area carrying a lot of dirt. The dirt contaminates the surface water sources and the unprotected underground sources, making them unsafe for human and animal use.

Plate 16 Garbage in the river

4.2.4 Disruption of human settlement

During floods some people move away from their affected homes. This disrupts their way of life. They are exposed to cold, wind and dangerous animals at night. The extreme cold may expose people to diseases like pneumonia.

4.2.5 Destruction of crops

Flood water uproots and sweeps away crops such as tomatoes, maize, potatoes etc. this may lead to famine and starvation.

Plate17 People displaced with floods camping on safe ground

Plate 18 Tomatoes washed away by floods

4.2.6 Disruption of learning

Some schools get submerged temporarily during floods. The schools are therefore forced to close down thereby disrupting learning.

Plate 19 A submerged school in Nyando River Basin during floods

4.2.7 Disruption of transport and communication

Roads and bridges are washed away by floods, making movement to and from such places are difficult.

Plate 20 Difficulties in movement due to flooding

4.2.8 Destruction of buildings

Flood water destroys houses, classrooms, hospital structures, pit latrines and market structures. This interferes with social and health services.

The contents of the collapsed latrines contaminate water sources, leading to outbreak of cholera, typhoid and diarrheal diseases.

Plate 21 Isolated House during Flood

Plate 22 Collapsed latrine after Flood

😐 Revision Questions

1.) Foods have _____and _____effects

2.) List at least four good effects of floods:

i) _____

ii) _____

iii) _____

iv) _____

3.) Name three common flood related diseases

i) _____

ii) _____

iii) _____

4.) Bad effects of flood are:

_____

5.) The physical facilities commonly damaged by floods include

_____

_____

6.) Identify five water related diseases from the grid below:

M	D	M	C	S	B	T
A	Y	N	H	T	I	R
L	S	Q	O	P	L	O
A	E	T	L	U	H	N
R	N	Y	E	M	A	E
I	T	O	R	E	R	S
A	R	W	A	V	Z	Y
T	Y	P	H	O	I	D
M	P	T	Q	Z	A	P

7.) Read the poem below written by Mary.

Flood, floods go away,
Go down to the lakes,
Go down to the valleys,
Leave us alone, I beg you,
Go down to the lakes and
Go down to the valleys.

How does Mary see the floods. Good or bad?

UNIT 5 : How do we manage flood ?

5.1 Flood Disaster Management

This is a way in which a community acts to protect its members and their property from the danger created by flood. These actions are taken before, during and after floods.

It is not possible to completely prevent floods; however there are activities that can be carried out to reduce the damage caused by floods. These activities are:

- ☑ Flood Prevention/Mitigation
- ☑ Flood Preparedness
- ☑ Flood Response
- ☑ Recovery/Rebuilding

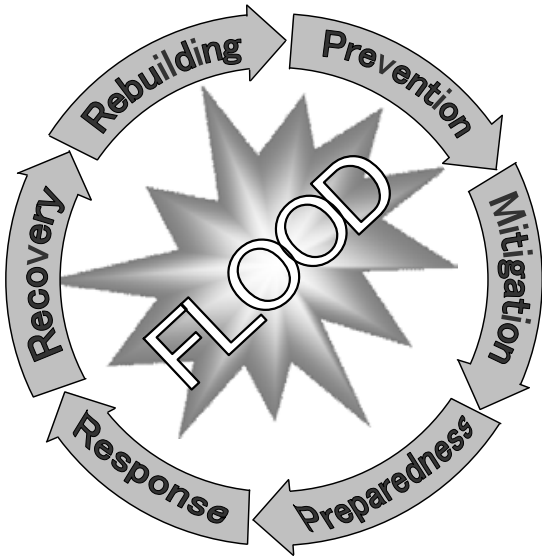


Figure6 Disaster Management Cycle

Furthermore, the activity can be classified into three major groups; namely:

a) Self help : Activities to be taken by community members
b) Mutual help : Community participatory activities with external assistance
c) Official help : Activities by the Government

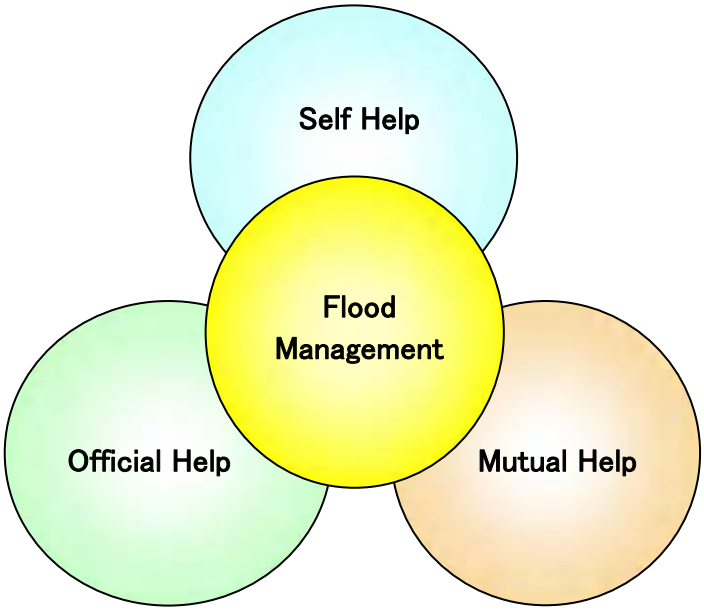


Figure 7 Three Major Groups for Flood Management

5.2 Flood Prevention/Mitigation

These are actions taken before flooding. It involves the arrangements to ensure that, should floods occur, all resources and services needed to cope with the effects can be made available and used effectively.

(1) Self help

These are flood prevention/mitigation measures that community members undertake on their own. Incase they are unable; they can seek external assistance from governmental and non-governmental organizations, well-wishers, charitable organizations etc. Self-help flood preparedness measures include:

a) Developing and updating a community flood management plan

A community flood management plan is a guideline on activities that are to be undertaken by the community to manage floods.

b) Understanding the terminology of community hazard map

A community map shows flood prone areas. Terms used in community hazard map may include: flood plain, assembly points etc. flood warning systems may involve signs and mode of communication e.g. warning bells, sirens, croaking of frogs, vocals, phones, radio etc.

Plate 23 Kokwaro Village hazard map

c) Recognizing evacuation routes and location of evacuation centers

Signboards indicating evacuation routes and centers are put in place to assist during evacuation.

- ☑ Evacuation routes are escape routes used by community members to move to safe areas.
- ☑ Evacuation centers are the safe areas, where basic services such as healthcare, water, food, shelter, blankets among others can be provided to the affected people.

Figure 8 Logos showing Basic Services during Floods

d) Small-scale works for clearing water channels and improving drainage

e) Recognizing the vulnerable group against flood

These vulnerable groups include children, aged and physically challenged.

f) Preparation of communication network

It involves having contacts e.g. mobile telephones numbers, email addresses of the people \ organization \ government \ agencies that can be of help at times of flood.

g) Participation in evacuation drill

These are mock \ rehearsal exercises carried out by community members that illustrates rescue operations during flood evacuation.

Plate 24 Evacuation Drill

(2) Mutual Help.

These are flood preparedness measures which a community may jointly undertake with Non-Governmental Organizations. These are:

a) Joint inspection of existing infrastructure

This involves checking the conditions of:

- ☑ Houses
- ☑ Roads and bridges
- ☑ Latrines
- ☑ Health facilities
- ☑ Evacuation centers and evacuation route for use during floods.

b) Public / school education and awareness building

Plate 25 Discussion in Community

It involves the training of pupils, teachers and the community on flood disaster management. Awareness on flood and its impact is carried out in the community.

c) Small scale construction /repair works

These involve the removal of silt from the water channels, construction of water storage points tanks, water pans, water ponds and community water dams etc and raising community roads.

Plate 26 Community Participation

(3) Official Help

These are flood preparedness measures largely taken by a support organization. It is done to improve the affected community.

These entails:

a) Maintenance of infrastructure (physical facilities)

It involves work such as river bank stabilization, construction of roads, bridges, evacuation centers and evacuation routes.

b) Improve capacity, coordination and management for flood risk

It includes training of a lead group (CBO) in coordination and management for flood risk.

c) Planning for emergency operation

Putting in place ways of carrying out evacuation, provision of relief services e.g. food, medical services, counseling of search and rescue operation.

5.3 Flood Preparedness

These are ways of reducing the negative effects of floods.

(1) Self help

a) Preparation of disaster kit

It contains safe drinking water, food, medical etc.

(2) Mutual help

a) Community flood hazard mapping

The flood hazard mapping is done to highlight areas mostly affected by floods within the community. This will allow the appropriate measures to be put in place to reduce the bad effects of floods on life and property.

b) Flood fighting corps

This is where the community and support organizations establishes and train people specifically to participate in flood response activities.

c) Planning the flood control structures project

This involves setting up organs that will assist in the construction of dams, levees, water channel improvement, clearing of debris and sediments from streams and ponds and river banks stabilization.

(3) Official Help

a) Implementing flood control structure projects

This is where the dams and levees are constructed, channel improvement is done, clearing of debris and sediments from streams, ponds, and river bank stabilization is carried out as outlined in the plan.

b) River observation and data collection

This is a process that involves the studying of the behavior of a river before, during and after rains to determine the time it swells and bursts its banks.

This information about the level of water in the river can be used to predict times of floods as an early warning sign and also to determine when and where to put up structures that will restrict the river water within its channels.

c) Flood forecasting and warning system

Flood forecasting means flood prediction. Flood forecasting can be done through:

☑ *Volunteers who observe rainfall and stream water levels.*

☑ *The use of gauges*

☑ *Computerized models (Automated Local Evaluation in Real Time) - ALERT.*

☑ Warning systems may include:

- Radio
- Television
- Warning sirens
- Warning bells
- Public address systems
- Vocals
- Croaking of frogs
- Movement of certain types of birds.

5.4 Flood Response

These are immediate measures taken to save life and property. They are also done to stabilize flood situations. A number of activities are carried out at this stage.

(1) Self-help

a) Assembly of Community Flood Management Organization (CFMO) meeting for flood management. The meeting plans the activities for flood management.

b) Patrol by CFMO along river channels to collect flood information-members move along the river channel to assess the points at which the river water has burst its banks or is almost bursting its banks.

c) Self-initiated evacuation –during floods communities may decide to move by themselves to the safe grounds (evacuation centers)

(2) Mutual help

Dissemination of flood information from the community above on extends of flood damage, casualties and needs. The community seeks information about safety ground, relief services, expected rainfall etc.

a) Flood fighting

- ☑ Involves repairs of levees, dykes, evacuation of people and property at risk –setting up of temporary bridges
- ☑ Clearing debris on trenches, channels, canal

b) Provision and distribution of relief aids

This includes food, bedding, medical services, mosquito nets, temporary shelters, mobile toilets (mobilets)

(3) Official help

Monitoring the latest flood information and warnings:

- ☑ This is the checking for the information about the flooding trends to establish the extent of damage on dykes, levees, bridges, roads, houses, crops, livestock etc
- ☑ To look for indications whether the flooding is likely to continue or reduce.

a) Dissemination of the latest flood information and warnings

Information gathered during monitoring is given out to the relevant government agencies, NGOs, well-wishers, support partners, charitable organization. This information will enable them to offer assistance and support to the evacuation people.

b) Evacuation order and evacuation directives

Based in the information relayed from the affected community about the floods and indications that flooding will continue this will enable arrangements to be put in place for evacuation.

c) Mobilization of relief aid

Based on the information received from the affected community various aid organizations will look for donation of relief aid to assist with the affected communities.

5.5 Post-flood Recovery/Rebuilding

These include the measures put in place to restore the flood affected community to their normal living conditions or pre-flood conditions.

(1) Self help activities

The community undertakes:

a) Community driven (based) road maintenance

The roads within the community are improved to allow easy movement. These may involve raising the road and stabilizing the road sides. These activities are carried out by the community.

b) Restoration of houses

The flood damaged houses are repaired by the individual owners of these houses or the community members can come together to assist the members to rebuild or repair their houses to habitable conditions.

(2) Mutual help activities

a) Income generation activities

The community together with the support organizations identifies and establishes ways of getting income through farming, trade etc. this will provide the effected people with money for day to day up-keep.

b) The badly damaged roads are repaired by the community with help from public works ministry, support organizations and NGOs.

c) Debris and solid waste removal

The pebbles, tree trunks and silt deposited in the water channels are removed. This will clear the channels to allow free flow of water. This will lead to reduced flooding in the next rainy season.

(3) Official help activities

a) Measures for prevention of disease outbreaks

Water related diseases such as malaria, typhoid, cholera etc often break out after the floods. The situation is monitored to prevent these diseases from occurring. Measures taken include provision of safe drinking water, draining of stagnant water, destroying the mosquito breeding areas and giving preventive treatment which helps to control these diseases.

b) Repair of damaged river structures and facilities

The river structures and facilities include dykes, levees, bridges, banks etc. these are usually damaged by floods. Small scale or large scale repair works may be carried out depending on the extent of damage.

c) Damage assessment and study of the causes of damage

The extent of damage caused by floods is checked so that the necessary preparedness measure is put in place. The cause of the damage is also established to assist in putting in place prevention measures.

😐 Revision Questions

1.) Flood disaster preparedness measures include:

a) Preparation of _____kit.

b) Recognizing _____ routes and _____ centers.

c) Small scale works for clearing _____channel and drainage.

d) Holding _____drills.

e) Maintenance _____structures.

2.) Flood mitigation involve putting in place measures to _____ the effects of flood.

3.) Flood mitigation measures include:

a) Community _____mapping

b) flood _____corps.

c) _____ forecasting and _____system

4.) Flood response activities involve:

a) Mobilization of _____ aid.

b) _____ order and _____ directions.

c) _____ evacuation.

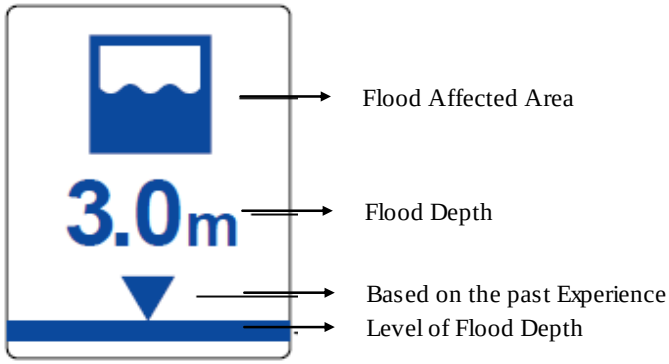
5.) Post flood recovery measures include:

a) Community driven _____maintenance.

b) _____ of houses.

c) Repair of damaged _____

d) Repair of damaged _____



Flood Affected Area and Flood Depth

Water Point

First Aid

Evacuation Centre

JAPAN