No.

MINISTRY OF WATER
AND IRRIGATION (MWI)

WATER RESOURCES
MANAGEMENT AUTHORITY (WRMA)

JAPAN INTERNATIONAL
COOPERATION AGENCY (JICA)

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

FINAL REPORT

VOLUME I: SUMMARY

MARCH 2009

Nippon Koei Co., Ltd.
IDEA Consultants Inc.

GED
JR
09-039

LIST OF REPORTS

The output of the Study was submitted to Ministry of Water and Irrigation (MWI) and Water Resources Management Authority (WRMA), the counterpart agencies of the Government of Kenya for the Study. The report is organised into (i) one volume of the Summary, (ii) one volume of the Main Report, (iii) one volume of the Supporting Report, (iv) one volume of the Data Book. This volume is the Summary of all the reports. The complete set of the reports is listed below.

Volume I : Summary

Volume II : Main Report

Volume III : Supporting Report

Volume IV : Data Book

CURRENCY EQUIVALENTS (AS OF JUNE 2007)

1 US$ = 66.77 Kenyan Shilling (TTB) = 121.59 Japanese Yen (TTB)

KENYAN FINANCAL YEAR

July 1 to June 30

FOREWORD

In response to the request from the Government of Kenya, the Government of Japan decided to conduct “The Study on Integrated Flood Management for Nyando River Basin in the Republic of Kenya” and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched a study team headed by Mr. INOUE, Yoshikimi of Nippon Koei Co., Ltd. in association with IDEA Consultants Inc. during the period from July 2006 to December 2008. In collaboration with Kenyan counterparts, the study team conducted the field survey and held a series of discussions with the officials concerned of the Government of Kenya. After the team returned to Japan, further studies were made and then the report was finally completed.

I hope that this report will contribute to the integrated flood management in Nyando river basin and to the enhancement of the friendship between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Kenya for their close cooperation extended to the study team.

March 2009

MATSUMOTO, Ariyuki
Vice President
Japan International Cooperation Agency

March 2009

Mr. MATSUMOTO, Ariyuki
Vice President
Japan International Cooperation Agency

Dear Sir,

LETTER OF TRANSMITTAL

We are pleased to submit herewith the Final Report of the Study on Integrated Flood Management for Nyando River Basin in the Republic of Kenya. The Study aimed at (1) formulating a plan of Integrated Flood Management (IFM) for the Nyando river basin covering review of existing flood control plans and community-based activities, (2) supporting communities to strengthen capacities in flood management and (3) developing the flood management capacity of concerned authorities through on-the-job training including site training and implementation of pilot projects. This report presents all the results obtained through the study activities in both Kenya and Japan from July 2006 to December 2008.

The Master Plan is formulated including the structural measures and non-structural measures toward year 2020 in line with the concepts of official help, mutual help, and self help. The priority schemes are selected and preliminary designs are made. The implemented pilot projects verified the effectiveness of the Master Plan. We hope that the Master Plan would contribute to the improvement of flood management and living standard and further development in the study area.

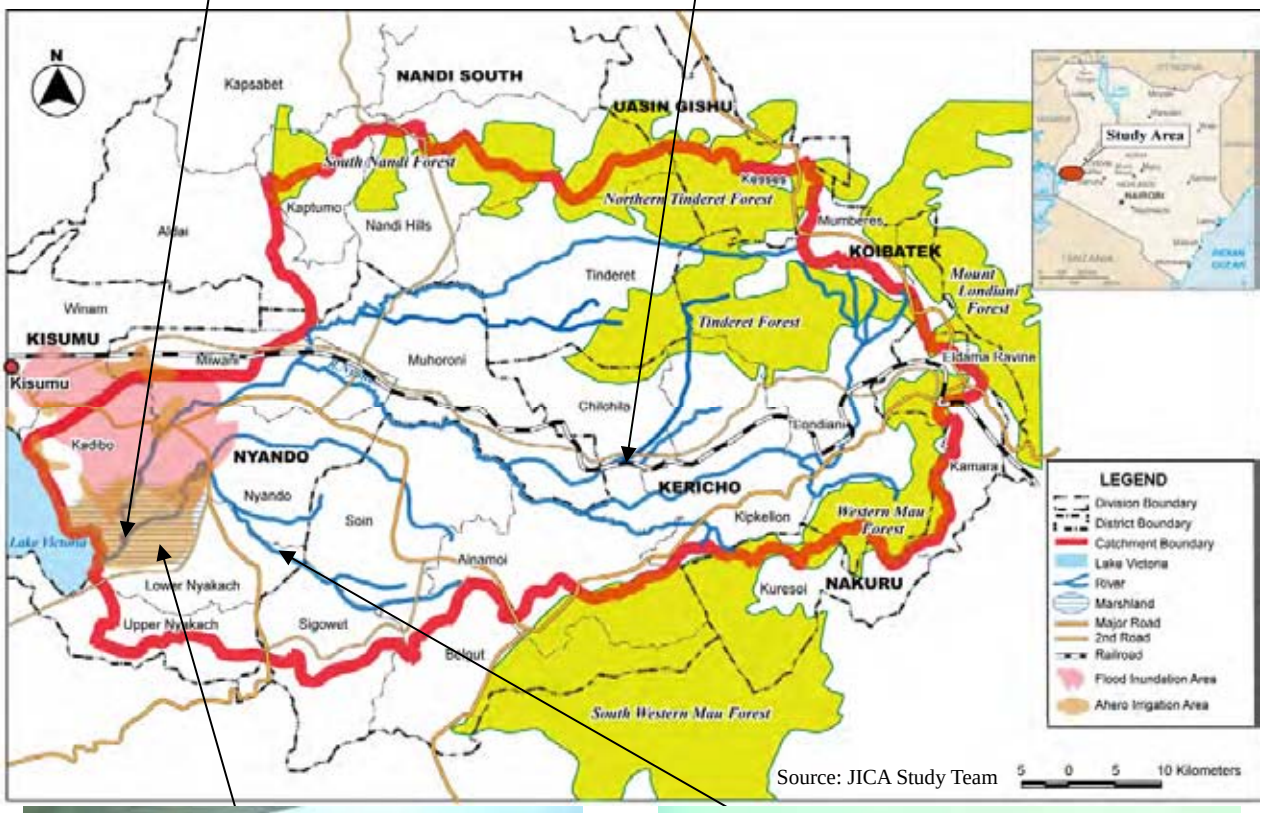
We would like to express our deep appreciation and sincere gratitude to all related officials who provided their extensive assistance and cooperation to the JICA Study Team, in particular Ministry of Water and Irrigation and Water Resources Management Authority. We also acknowledge the officials of your agency, Kenya Office, Ministry of Foreign Affairs, Ministry of Land, Infrastructure, Transport and Tourism, and Embassy of Japan in Kenya for their support and valuable advices in the course of the Study.

Sincerely yours,

INOUE, Yoshikimi
Team Leader for the JICA Study Team
The Study on Integrated Flood Management for Nyando River Basin in the Republic of Kenya

River Flow at Lower Catchment

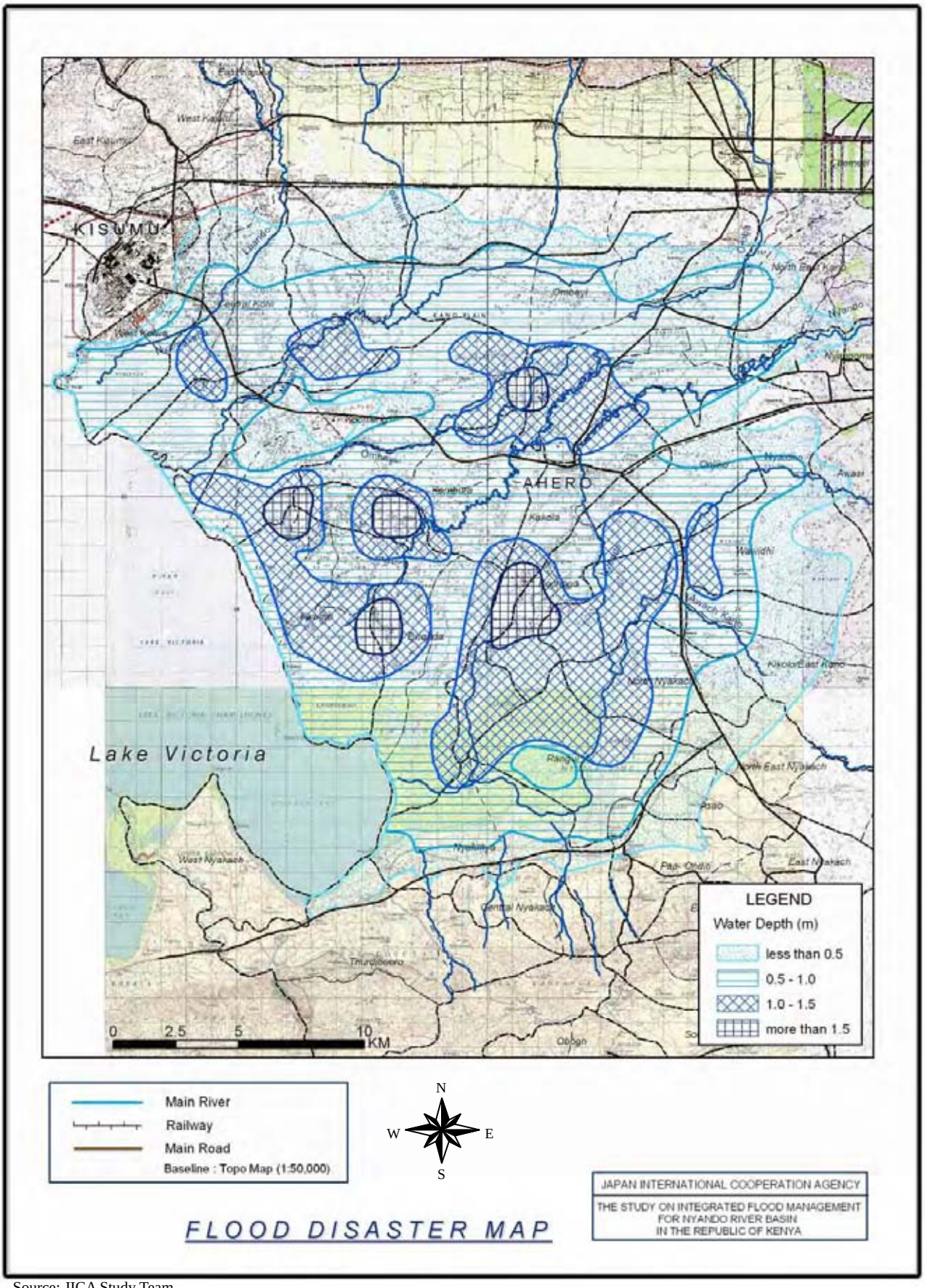
Tea Plantation at Upper Catchment



Flood Prone Area at Lower Catchment

Gully Erosion at Middle Catchment

Location Map of the Study Area



Source: JICA Study Team

Flood Disaster Map

EXECUTIVE SUMMARY

1. NYANDO RIVER BASIN

1.1 The Nyando river basin lies in the western part of Kenya and has a catchment area of 3,625 km^2. The Nyando River originates in the Tinderet Forest, flows westward and pours into Lake Victoria. The river basin is characterised by relatively high average annual rainfall of 1,298 mm and high potential for agricultural production in comparison with other areas of Kenya. However, a low lying area called the Kano Plain suffers from frequent floods.

1.2 The Nyamasaria river basin of 859 km^2 is situated adjacent to the Nyando river basin. Several small rivers originate in the Nandi Forest, flow into the Kano Plain, and pour into Lake Victoria. Flash floods are triggered frequently by torrential showers and flow down through these small rivers with rather steep riverbed gradients.

1.3 Most of the river basin administratively belongs to Nyando, Kisumu, Kericho and Nandi South Districts. Population was 750,000 in the 1999 Census with a growth rate of 3% per annum on average. Although the major industry is agriculture, the price of sugar cane has slumped recently and bankruptcy of a sugar factory increased unemployment. Furthermore, rice production has declined because of the malfunction of irrigation systems due to siltation and frequent flooding. The ratio of households categorised in absolute poverty in the Nandi South and Nyando districts is higher than the Kenyan average by 13%. This fact indicates that the northern part of the basin is rather poor, even by Kenyan standards.

2. FLOOD MITIGATION PLAN

2.1 Flood mitigation schemes were based on a master plan (1983)[1]. However, few flood mitigation projects have been accomplished due to budgetary constraints. The Study[2] on the National Water Master Plan also emphasised the necessity of flood mitigation schemes and placed the top priority for flood control on the Nyando river basin.

2.2 In line with the Water Act 2002, the strategy[3] for integrated flood management was formulated for Lake Victoria Basin in 2004, which focused on such strategies as: flood management, integrated management approaches, integration of flood mitigation and

[1] Nyando Pre-investment Study, ItalConsult, 1983
[2] National Water Master Plan, JICA, 1992
[3] Strategy for Flood Management for Lake Victoria Basin, Kenya, WMO, 2004

flood preparedness (structural and non-structural measures), promotion of flood forecasting and warning systems, community participation, and capacity building.

3. JICA'S TECHNICAL ASSISTANCE

3.1 The Government of Kenya (GOK) made a request to the Government of Japan (GOJ) for technical assistance for implementing "The Study on Integrated Flood Management for Nyando River Basin in the Republic of Kenya". Subsequently, JICA dispatched a preparatory study mission in October 2005 to consult on the framework of the Study. The Scope of Work was agreed on 21 October 2005 and the Study was executed from July 2006 to March 2009.

3.2 The objectives of the Study agreed upon in the Scope of Work are:

- To formulate a plan of Integrated Flood Management (IFM) for the Nyando river basin covering a) review of existing flood control plans, and b) community-based activities,
- To support communities to strengthen capacities in flood management, and
- To develop the flood management capacity of concerned authorities through on-the-job training including site training and implementation of pilot projects.

4. THE STUDY

4.1 In accordance with the Scope of Work agreed on 21 October 2005, the Study is mainly divided into two phases; formulation of a master plan for flood management and preparation of community-driven priority projects in Phase I, and implementation of pilot projects in Phase II. The Study was implemented over a period of 32 months from July 2006 to March 2009

4.2 During the discussion in the Steering Committee Meeting on 02 August 2006, GOK was keen to implement pilot projects as early as possible; therefore, the work schedule of the Study was modified so that the implementation of pilot projects would commence in April 2007.

5. RESPONSIBLE AND IMPLEMENTING AGENCIES FOR THE STUDY

5.1 The responsible agency for the Study is the Ministry of Water and Irrigation (MWI) and the implementing agency is the Water Resources Management Authority (WRMA). WMI is the principle sponsor of the policy and legal reforms in the water sector, while WRMA was established under the Water Act 2002 and is charged with being the lead agency for water resources management.

5.2 At the start of the study period in July 2006, an "Inter-Ministerial Steering Committee",

and a "Project Working Group (PWG)" were organised by MWI and WRMA. Also, a "Flood Management Unit" was established by WRMA in line with the strategy of flood management (2004).

5.3 A regional office of WRMA in Kisumu also assigned a "flood management officer" and a "stakeholder liaison officer" as full-time counterparts of the Study. They are in charge of the planning, monitoring and project coordination of the flood management.

5.3 The regional office of WRMA also organised a "Nyando River Water Management Forum" with various stakeholders, not only from lower catchments but also from upper catchments, as a coordinating body for the selection and monitoring of community-driven pilot projects executed in the Study.

6. CURRENT INSTITUTIONAL FRAMEWORK FOR DISASTER MANAGEMENT

6.1 The coordination and management of various disasters are handled through the Disaster Management Committees (DMC). The DMC operates at all levels from national level to location level. Since the nature of the disaster relief and response requires a multi-sectoral and multidisciplinary approach, DMC consists of various government organisations and NGOs.

6.2 There was no presence of WRMA at DMC activities. In the recent norms of decentralisation, the roles of provincial administration have been shrinking, particularly in the events such as floods on the ground. Initiatives for the flood relief / mitigation activities are taken at lower levels such as districts and divisions.

6.3 Food-for-work is being implemented by NGOs. Their works extend to de-silting/opening ditches and the raising and rehabilitation of roads through community flood control committees. Those scales of activities are rather small but effective at the spots where works have been done, and the resulting appreciation of communities is high.

7. INSTITUTIONAL STRENGTHENING

7.1 MWI, WMO and JICA collaborated to organise a National Workshop on IFM for Nyando River Basin on 03 August, 2006. The overall objective of the Workshop was to seek a synergetic approach to flood management in the Nyando River Basin as a target area. The participants consisted of the representatives from line-ministries, government parastatals, regional authorities, private sector and development partners. The discussion was focused on the opportunities and challenges of development in the basin vis-à-vis the flood risks, enabling community participation in the process, addressing needs and requirements, and proposed actions to overcome the challenges of development.

7.2 An Institutional Development and Organisation Strengthening (ID/OS) Workshop was held on 22-24th August 2006 in Kisumu. There were 37 participants from various government authorities. The main objectives were to work out, in a participatory way, the organisational framework of IFM in Nyando River Basin and a capacity development plan for the WRMA's organisation. The major threats were the lack of capacity both at institutional and community levels, lack of coordination, reluctance to form Water Users Associations (WRUAs) and the community perception of floods as benefits.

7.3 The various training programmes based on the seminar or trip types were formulated and have been implemented. The objectives of the trainings programme are to: i) develop basic capacity of WRMA staff for flood management, and ii) leaned the cases on flood management in other counters. The total seven topics were covered from August 2006 to October 2008.

8. FLOOD DISASTER MAPPING

8.1 Flooding in the lower catchments of Nyando river basin is generally categorised into three types; 1) overflowing from the main channel of Nyando River, 2) flash floods in the Awach Kano and Nyamasaria rivers, and 3) spot flooding or inundation at depressions caused by local torrential rain. However, the quantitative information on inundation was quite limited. A flood damage survey, therefore, was conducted at 350 spots in frequent inundation areas of 240 km^2 over the period from August to September 2006.

8.2 A new flood disaster map was developed for both annual inundation and maximum inundation in the past. For the purpose of verifying the accuracy of the map, public hearings were held three times with 340 participants in total from 6 to 8 November 2006. The map was finalised on the basis of the experience and knowledge of the participants who live in the communities of the inundation areas. This map would be available as a base map for preparing community-based flood hazard maps and specifying evacuation routes for the communities situated in flood prone areas.

9. INTEGRATED FLOOD MANAGEMENT AGAINST CLIMATE CHANGE

9.1 The Intergovernmental Panel on Climate Change (IPCC) states that global temperatures will increase by 1.4-5.8^oC by 2100; sea levels are rising and are expected to reach 14-88 cm by 2100. Rainfall patterns are changing, El Nino events are increasing in frequency and intensity, and tropical mountain glaciers, such as Mt. Kilimanjaro and Mt. Kenya, are retreating. Severe droughts will occur, while wetter climates and more floods are predicted for parts of East Africa. Among all, Nyando river basin is nominated as hotspot for high mortality risk due to drought and flood.

9.2 An increase of more than 20% in the very extreme high rainfall events is simulated for around the year of 2100. Among the rainfall stations in Nyando river basin, the annual rainfall is almost stable for last 40 years, while the numbers of heavy rainy days of more than 50 mm show increasing trend at Kericho. The optimum development scale of structural measures was evaluated with the economic index of B/C and the development scale of a 10-yr flood event was adopted as short-term target in the Master Plan. However, the design scale of 10-yr flood would be equivalent to about 5-yr flood event as the heavy rainfall occurs frequently in the future.

9.3 It is not practical at present to set larger design scales for structures against intensified flood, when considering it requires quite a long time to complete the implementation of structures by the protection levels for confining fully flood discharge in the river channel with dike system. As well as structural measures, comprehensive flood control measures such as land-use regulation/guidance and prioritization/designation of flood prone areas and establishment of flood forecasting/ dissemination system could be applied.

9.4 The implementation of adaptation strategies will not stop flooding. Floods above that level constitute a residual flood risk, which extends year by year due to frequent heavy intense rainfall. It is therefore necessary to ensure that the community in the flood prone area understands the consequences of flooding above the design flood level and takes effective action to minimize damage and loss of production and prevent loss of life when a flood of greater magnitude occurs as climate changes.

10. MASTER PLAN

10.1 The long-term target of on-going flood control structures was set at a level to protect against an event with a probability of once in 50 years in the master plan (1983). However, MWI' s report [4] recommended the tentative protection level of once in 25 years taking into account the major land use of agriculture in flood prone areas and available financial resources.

10.2 An increase in measured peak flood discharges for all return periods was reported as being due to catchment degradation in the upper catchments. However, the increase was mainly due to a change in the water level measurement methods. Manual readings had been done twice a day before 1988 and automatic recording has been carried out since 2001. The peak discharges recorded by the automatic water level recorder are greater than those recorded by manual reading. Probable flood peak discharges were re-examined.

[4] Nyando Flood Control Project、MoWD and LBDA, 1988

Probable Flood Peak Discharge (unit: m^3/sec)

Return Period	5-yr	10-yr	25-yr	50-yr	100-yr
Master Plan (1983)	450	550	650	750	850
This Study (2006)	610	730	890	1,000	1,130

Source : JICA Study Team (2006)

The above table shows that the design discharge with the probability of once in 25 years adopted by MWI for the current development scale of structural measures is equivalent to that of less than 10 years.

10.3 The relationship between annual flood damage and development cost of flood mitigation measures was also evaluated. The magnitude of a design flood of once in 10 years, which is almost equivalent to a 25-year event in the studies in the past, is the most viable development scale from the economic viewpoint. Hence, the protection level of once in 10 years was adopted as the optimum development scale for the structural measures toward the year 2020.

10.4 The structural measures proposed in this Study are divided into five categories; 1) raising evacuation roads, 2) dyke and dam development, 3) river training, 4) de-silting and 5) catchment conservation for tributaries. Non-structural measures to manage flood inundation are to be incorporated in order to cope with extraordinary floods beyond the control of structural measures.

10.5 The implementation schedule was prepared as phased development; namely, short (2007-2012), medium (2013-2020) and long-term (after 2021) as enumerated in Table ES.1. The short-term plan aims to strengthen the currently existing dykes, establish a network of evacuation roads in flood prone areas, and de-silt currently clogged river channels. The establishment of the Disaster Management Centre as an institutional core of IFM is also proposed as part of the short-term plan. The medium-term plan aims to reduce flood peak discharge by structural measures including two dams and establish flood forecasting and warning systems as non-structural measures, while the long-term plan is for expansion of the flood management system to all the communities situated in flood prone areas. The cost is estimated at Ksh. 11,810 million excluding the construction cost of potential dams included in the long-term plan.

10.6 Catchment conservation in the upper catchment has to be paid much attention. A review of land management policy is required to restore land capacity to hold rainwater through i) intervention to land use in slope areas, and ii) intervention to recreate hydrological buffer zones as temporary retarding basins for reducing flood peak discharge. Furthermore, programmes such as construction of water pans, management of woody vegetation and restriction of settlement would mitigate soil erosion.

10.7 The arrangement of roles and responsibilities among the institutions within the sector of water resources management are still on-going. Since flooding is one of the serious disasters in the Study Area and it requires a comprehensive approach to conduct disaster management, it is proposed to establish a Disaster Management Centre as a core function for the regional disaster management. It is also necessary that WRMA become a key member of the committee, and become an important authority to connect the water sector institutions and disaster management committees, specifically in the area of flood forecasting and early warning systems, utilising its own data and information resources.

10.8 There are several types of flood control or disaster management bodies at grass-root level. These are typically implementing small-scale structural measures, while some are receiving training in flood management from NGOs. However, these measures have limitations to prevent flood damage, and there is no well-organised flood management organisation on a community basis. It is noted that flood prevention activities need some economic and social development in flood affected communities. Other measures as by-products of the flood prevention measures have to be considered. This approach provides good incentive for the affected community to maintain and improve flood prevention activities. The best-mix between community-driven disaster prevention and community development will be focused on throughout the implementation of pilot projects for prioritised communities.

10.9 Among the proposed priority schemes are the strengthening of existing dykes downstream from Ahero Bridge along the Nyando River and the establishment of a network of evacuation roads traversing affected communities.

(1) Strengthening of existing dykes:

Several stretches of existing dykes are deteriorated seriously due to insufficient compaction during construction and lack of maintenance. The dykes should be strengthened employing proper construction methods. Ramps with gentle slopes for crossing the dykes will be built.

(2) Network of evacuation roads traversing affected communities:

The frequently submerged section of A1 trunk road should be raised for ensuring its role as one of the main passable roads for relief and evacuation activities in case of emergency. The network of community roads connecting to A1 trunk road is also to be raised for utilising community-driven disaster management.

(3) Capacity development of community-driven flood management:

Capacity development on flood management to prioritised communities should be

implemented as packaged programmes through preparation of community flood hazard maps, establishment of community-driven flood management organisations, training on flood management including evacuation drills, and construction of community-driven structural measures.

(4) Establishment of hydrological monitoring network:

Water level measurement at more than half of the stations has been terminated or abandoned due to financial constraints. The hydrological monitoring network should be refurbished urgently and automatic water level recorders should be provided for the prioritised water level gauging stations. These efforts lead to increase the accuracy of flood forecasting and warning systems which are proposed to be implemented in the medium-term plan.

11. PILOT PROJECTS

11.1 The objectives of the pilot projects are to: i) examine the effectiveness of community-driven flood management comparing both mutual and self help efforts, ii) develop capacity in flood management through implementation, and iii) learn lessons for finalising the priority projects proposed in the master plan. The goal of the pilot projects is to achieve long-term well-being for all through sustaining and expanding community-driven flood management in the flood prone areas.

11.2 Five communities for implementation of pilot projects were selected considering past studies, discussion results with PWG and the Forum, the results of the flood damage surveys, the flood disaster map, and the sub-location meetings. It was confirmed that the selection was properly done, since great need of flood management or soil conservation were observed in the community survey. In the PRA workshop, the communities formulated community action plans (CAP) indicating the major problems, necessary action, roles and resources of actors, time and monitoring indicators.

11.3 Based on the CAP, the pilot projects were formulated considering technical feasibility, impact on flood management at the community level, impact on other communities, and sustainability of the measures.

(1) Odesso Village, Kasule Sub-Location: River bank protection in the Nyamasaria River in addition to a packaged programme on flood management

(2) Kokwaro Village, Central Bwanda Sub-Location: Construction of an evacuation centre with evacuation roads as well as a model education programme on flood management in addition to packaged programmes on flood management.

(3) Kasiru Village, Kore Sub-Location: Improvement of the evacuation centre and

evacuation roads in addition to packaged programmes on flood management.

(4) Kochiewo Village, Magina Sub-Location: Rehabilitation of the dike in addition to packaged programmes on flood management.

(5) Siwot and Kamiwa Villages, Chil Chilla Location: River bank protection with ramps for cattle in the Baraget River.

11.4 The related key organisations and institutional framework are: WRMA-LVSC (overseer), JICA Study Team (financer and supervisor), Local Administration at location level (assistance to the community), and the Community as a whole (project owner and beneficiary).

11.5 Most of structure measures construction delayed by 4 months at maximum case behind the original schedule when the absence period of JICA Study Team (Jan-Jun 2007) is excluded. All the river works were completed and no damage is observed as of July 2008 except the case that the iron mesh and planted trees were stolen at Chil Chila location. Drilling work at Kasiru was completed as schedule and the number of water well users is around 500 household. On the other hand, building work and raising road were completed by October 2008.

11.6 Training programmes including organisation, O&M, flood management, evacuation drill have been completed as scheduled. According to the interview result, the communities are satisfied with the training. However, the shortage of time for the training is also pointed out. Out of 4 communities trained, it was confirmed that Community-driven Flood Management Organisations (CFMOs) in Odesso, Kasiru and Kochiewo utilised skills acquired from training. On the other hand, in Kokwaro has poorly used these skills, based on the observation that account book has not been maintained well and no meeting record had been prepared.

11.7 Education programme was implemented for pupils at Class 4, 5, 6 and 7 of Bwanda Primary School in October and November 2008 as scheduled. According to the interview result, the pupils and teaches are satisfied with the education programme.

12. ADDITIONAL 24 COMMUNITY-DRIVEN FLOOD MANAGEMENT PROJECTS

12.1 GOK officially requested GOJ in June 2008 to assist with implementing 24 Community-Driven Flood Management Projects (the Projects) following the completion of the Study. In response to this request, JICA decided to implement a study to formulate a plan for the Projects.

12.2 The Study utilised a participatory approach for plan formulation, as well as a consensus building approach between concerned stakeholders. Through location meetings 24

communities were successfully selected to consider the present flood damage.

12.3 In general, the high priority structural measures proposed in the CAP were selected on the basis that the structural measures were: i) related to flood management at a community level, ii) constructed at a community level and not an inter-community level; iii) unlikely to cause negative impacts for other communities; and iv) not in conflict with existing land arrangements and the current consensus amongst community members. In total, 80 structural measures for 24 communities were proposed in the Study.

12.4 In order to establish CFMOs and develop their capacities for flood management, almost the same non-structural measures that were implemented in the Pilot Project were applied, namely: i) institutional training of CFMOs; ii) community flood management training; and iii) technical O&M training for structural measures.

12.5 In addition, public dissemination of information was carefully considered in order to establish an institutional framework for future flood management projects. For example, the use of radio programmes, posters and mass production of textbooks for education programmes on disaster prevention.

13. CONCLUSION AND RECOMMENDATIONS

13.1 The Master Plan on Integrated Flood Management for the Nyando River Basin was prepared by incorporating the professional views of the JICA Study Team, fully considering actual flood conditions though flood damage surveys, preparation of flood disaster maps, and taking into account the stakeholders' opinions via the Nyando River Basin Water Management Forum. The JICA Study Team therefore recommends that the Government of Kenya implements the Master Plan. The JICA Study Team is of the view that implementation of this Master Plan will ensure the protection of human life and property that would otherwise be lost or damaged by flooding, as well as the improvement of economic and social conditions in the flood prone area.

13.2 The effectiveness of community-driven flood management programmes was confirmed through implementation of pilot projects in five communities. The JICA Study Team therefore recommends that community-driven flood management programmes should be realised as one of the components proposed in the Master Plan, with full involvement of the local communities. Doing this will increase effectiveness and sustainability of the Master Plan.

13.3 It is recommended the following actions to be taken by Government of Kenya.

Other Recommendations

Recommendation	Necessary Action
1. Consistency with the Catchment Management Strategy	The actions proposed in the Master Plan should reflect the Catchment Management Strategy of WRMA-LVSC and sub-catchment strategy of WRMA-Kisumu.
2. Implementation Capacity of WRMA	A coordination committee comprising MWI, Ministry of Roads, NWCPC, and WRMA for supervision of the project should be established.
3. Preparatory Work	The preparatory works should be done, namely: i) preparation of an Implementation Programme (IP) and ii) undertaking an EIA for the components proposed in the Master Plan.
4. Development of Institutional Framework	WRMA should continue to support the Nyando Forum as the Secretariat and coordinate with provincial and district administrations as a member of the Disaster Management Committee (DMC).
5. Transfer Technology on Integrated Flood Management to Other Regions	The technology transfer should be done to other regional offices of WRMA, namely, i) flood disaster maps; ii) community flood hazard maps; iii) development cycles for community-driven flood management projects; iv) disaster education programmes; and v) evacuation drills.
6. Updating of the Master Plan	The implementation schedule of the Master Plan should be revised from time to time by considering actual progress.

Table ES.1 IMPLEMENTATION SCHEDULE AND CONSTRUCTION COST

DESCRIPTION	Government Agency			Implementation Schedule			Cost
	Coordi-nation	Executing	O&M	Short	Medium	Long	(M.K.Shs)
STRUCTURAL MEASURES							**7,532.3**
A. NYANDO RIVER IMPROVEMENT	WRMA	NWCPC	WRMA				
a.1 Dike system in lower/middle reach				●			1,363.0
a.2 Desiltation/Channelling in swamp area in downstream end					●		192.0
B. AWACH KANO RIVER BASIN IMPROVEMENT	WRMA	NWCPC	WRMA				
b.1 Desiltation in Awach Kano river				●	●		173.1
b.2 Desiltation in Tributary of Awach Kano				●	●		176.4
b.3 Desiltation in Nyaidho river					●		50.0
C. DRAINAGE IMPROVEMENT IN AWACH KANO BASIN							
c.1 Drainage improvement along A1 National Road	WRMA	NWCPC	WRMA		●		33.5
c.2 Raising of A1 National Road (Ahero - Katito Section)	WRMA	MOPW	MOPW	●			660.0
D. NYAMASARIA RIVER BASIN IMPROVEMENT	WRMA	NWCPC	WRMA				
d.1 Desiltation in Nyamasaria river and ditch					●		70.4
d.2 Desiltation in Luando river					●		276.7
d.3 Desiltation in Ombeyi river and ditch					●		186.9
d.4 Desiltation in Miriu river and ditch					●		224.2
d.5 Dyke construction in Oroba river					●		173.2
E. DRAINAGE IMPROVEMENT IN NYAMASARIA BASIN	WRMA	NWCPC	WRMA				
e.1 Construction of drainage channel along A1 road					●		52.4
F. RAISING SECONDARY ROAD	WRMA	MOPW	WRMA				
f.1 Raising secondary road as evacuation road				●			273.0
G. DAM AND RESERVOIR	WRMA	LBDA	LBDA				
g.1 Two dams, (Nyando and Kibos)					●		3,300.0
H. SEDIMENT RETENTION AND EROSION PROTECTION	WRMA	NWCPC	WRMA				
h.1 Middle/Upstream catchment of small rivers					●	●	327.5
NON-STRUCTURAL MEASURE/COMMUNITY PARTICIPATORY WORKS WITH GOVERNMENT ASSISTANCE							**1,590.5**
A. DISASTER MANAGEMENT CENTRE							
a.1 Main Building and Branch Office	OP/LA	OP	OP/LA	●	●		95.0
B. FLOOD EMERGENCY MANAGEMENT							
b.1 Updating of Flood Preparedness	DMC	WRMA	WRMA	●	●	●	16.9
b.2 Inspection/Spread of Knowledge for Disaster Prevention	DMC	Cty/LA	Cty/LA	●	●	●	478.2
b.3 Relief/Evacuation	DMC	OP/LA	Cty/LA	●	●	●	64.1
b.4 Restoration	DMC	Cty/LA	Cty/LA	●	●	●	55.0
b.5 Review/Improvement	DMC	WRMA	WRMA	●	●	●	35.5
C. FLOOD FORECASTING AND WARNING SYSTEM							
c.1 Installation of Monitoring Station	WRMA	WRMA	WRMA	●			9.4
c.2 Installation of Telemetering Station/Warning Station	WRMA	WRMA	WRMA	●	●		216.0
c.3 Installation of Additional Station	WRMA	WRMA	WRMA	●	●	●	474.3
c.4 Operation and Maintenance	WRMA	WRMA	WRMA	●	●	●	84.2
D. UPPER WATERSHED MANAGEMENT							
d.1 Guidance for Restoring Hydrological Balance	WRMA	MOA	Cty	●	●	●	18.3
d.2 Guidance for Protection of Soil Erosion	WRMA	MOA	Cty	●	●	●	43.7
COMMUNITY INITIATIVE WORKS							**2,688.0**
A. COMMUNITY SURVEY	WRMA	WRMA	Cty	●	●		220.0
B. FLOOD MANAGEMENT TRAINING	WRMA	WRMA	Cty	●	●		535.0
C. COMMUNITY-DRIVEN STRUCTURAL MEASURE (Including retarding pond)	WRMA	Cty	Cty	●	●		1,605.0
D. O&M OF COMMUNITY-DRIVEN STRUCTURAL MEASURE	WRMA	Cty	Cty	●	●	●	104.0
E. MONITORING AND EVALUATION	WRMA	WRMA	Cty	●	●	●	224.0
TOTAL							**11,811**

Note : Short-term : 2007-2012, Medium-Term : 2013-2020, Long Term : after 2021

Legend: Cty: Communities MOPW: Ministry of Public Works OP: Office of the President MOA : Ministry of Agriculture
LA: Local Authority NWCPC: National Water Conservation and Pipeline Corporation
WRMA: Water Resources Management Authority DMC : Disaster Management Committee
LBDA: Lake Basin Development Authority

THE STUDY
ON
INTEGRATED FLOOD MANAGEMENT FOR NYANDO RIVER BASIN

FINAL REPORT

SUMMARY

Foreword

Letter of Transmittal

Location Map of the Study Area

Flood Disaster Map

Executive Summary

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ABBREVIATIONS

1: ORGANISATIONS

CAAC	Catchment Area Advisory Committee
CBO	Community Based Organization
CFMO	Community-Based Flood Management Organization
DANIDA	Danish International Development Agency
DERC	Disaster Emergency Response and Coordination
DMC	Disaster Management Committee
DOC	National Disaster Operation Centre
EU	European Union
GOK	Government of Kenya
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
IMF	International Monetary Fund
KfW	Kreditanstalt für Wiederaufbau
LVSC	Lake Victoria South Catchment
MWI	Ministry of Water and Irrigation
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organization
NIB	National Irrigation Board
OP	Office of President
R&R	Relief and Rehabilitation Section
SIDA	Swedish International Development Agency
USAID	United States Agency for International Development
WAB	Water Appeal Board
WB	World Bank
WMO	World Meteorological Organisation
WRMA	Water Resources Management Authority
WRUA	Water Resources Users Association
WSB	Water Services Board
WSP	Water Services Provider
WSRB	Water Services Regulatory Board
WSTF	Water Services Trust Fund

2: OTHERS

CAP	Community Action Plan
CMS	Catchment Management Strategy
DDP	District Development Plan
EIA	Environmental Impact Assessment
EPR	Environmental Project Report
NDMP	National Disaster Management Policy
NDP	National Development Plan
NPEP	National Poverty Eradication Plan
NWRMS	National Water Resources Management Strategy
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper

1. Introduction

Background

The Government of Kenya (GOK), Ministry of Water and irrigation (MWI) and Water Resources Management Authority (WRMA), made a request to the Government of Japan (GOJ) for technical assistance for implementing "The Study on Integrated Flood Management for Nyando River Basin in the Republic of Kenya" (The Study). The Scope of Work was agreed on 21 October 2005 and the Study was executed from July 2006 to March 2009.

Objective

The objectives of the Study as agreed in the Scope of Work are to:

- Formulate an Integrated Flood Management (IFM) Plan for the Nyando river basin,
- Support the communities in strengthening their capacities for flood management, and
- Develop the flood management capacity among the concerned authorities through on-the-job training that includes site training and implementation of pilot projects.

Outline

The Study can be divided into three major components.

(1) Formulate an Integrated Flood Management Plan for the Nyando River Basin

- Review of Existing Flood Control Plans
- Formulation of the Master Plan including structure and non-structure measures
- Pre-F/S for Priority Projects

(2) Capacity Building

- National Workshop for Integrated Flood Management
- Institutional Development Plan based on ID/OS Workshop
- Technical Transfer to WRMA staff

(3) Establishment of Method for Community-Driven Flood Management

- Establishment of Nyando River Basin Water Management Forum
- Implementation of Pilot Projects
- Identification of Key Lesson Learned from Pilot Projects

Transparency

The regional office of WRMA organised a "Nyando River Water Management Forum". The coordinating body, which consist of various stakeholders, not only from lower catchments but also from upper catchments, is responsible for the selection and monitoring of the pilot projects executed in the Study.

Counterpart

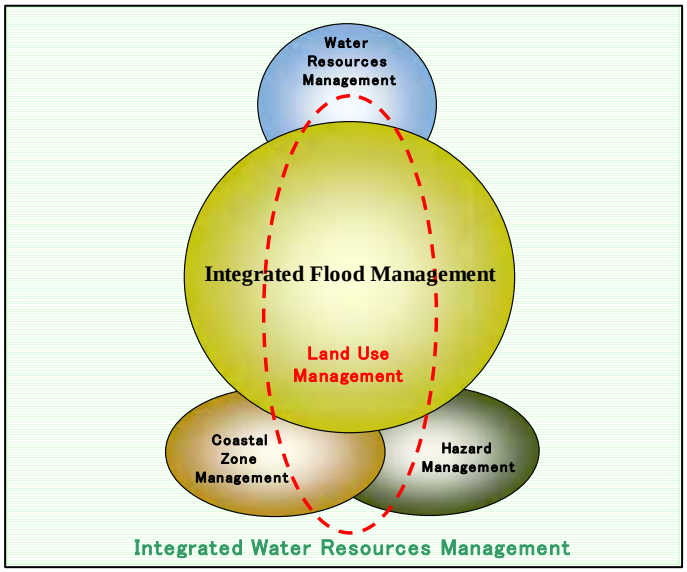
An "Inter-Ministerial Steering Committee" and a "Project Working Group (PWG)" were organised by MWI and WRMA. Also, a "Flood Management Unit" was established by WRMA in line with the strategy of flood management. A regional office of WRMA in Kisumu assigned a full-time "flood management officer" and a "stakeholder liaison officer" for this Study.

2. Concept of Integrated Flood Management

In line with the concept of Integrated Flood Management as illustrated in Figure 2.1, the following strategies are referred in the Nyando river basin.

2.1 From Flood Protection to Flood Management

It is important to acknowledge the fact that complete protection against flood is impossible. Therefore, the flood management approach of allowing certain level of floods in areas that are less vulnerable should be applied in Nyando river basin.



Source: Concept Paper, Integrated Flood Management (WMO, 2006)

Figure 2.1 IFM Model within the Context of Integrated Water Resource Management

2.2 Factors Increasing Flood Disaster

Increasing of flood disasters in Nyando river basin is an area of major concern. With the increasing number of flooding instances, it has directly affected the population occupying the flood prone areas. Now they are more vulnerable and their vulnerability is continuously rising. The WMO (2004) depicts three major anthropogenic factors for the increase in flood disaster: i) population pressure, ii) deteriorating infrastructure, and iii) environmental degradation. These factors should be considered in the flood management of Nyando river basin.

2.3 Stakeholder Involvement

The Nyando River Basin Forum (the Forum) is composed of number of stakeholders from various fields, who are directly or indirectly related to water resources management of the Nyando river basin. The members includes Government institutions, Parastatals, NGOs, Private Organisations, and Community Based Organisations (CBOs), which are locally based in the Nyando river basin or are involved in the water management of the Nyando river basin. It is expected that the Forum will mature to its capacity and function with the new vision for water management in the basin.

2.4 Vulnerability of Communities to Floods

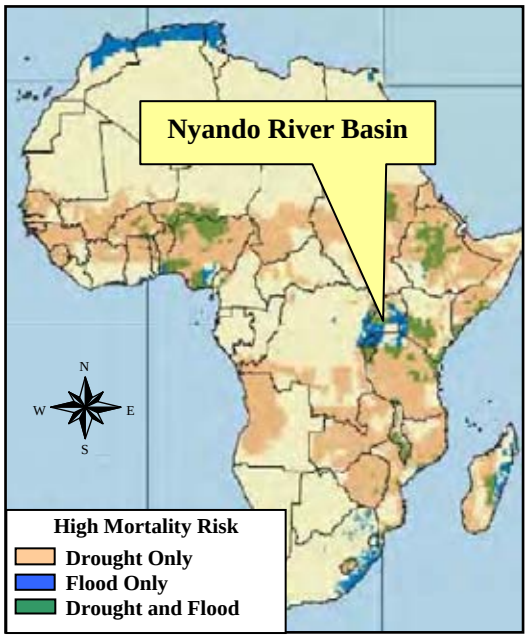
Vulnerability of farming communities to floods reflects lack of real improvements in their living conditions and the poor state of infrastructure which hampers the delivery of supplies and essential services. In the absence of a clear and comprehensive disaster management policy, the GOK's response to flood disasters has tended to be ad-hoc and uncoordinated. People are also unaware of the applicability of structural and non-structural measures adopted elsewhere that can help them in coping up with the floods. These aspects should be considered for the flood management in the basin.

3. Integrated Flood Management against Climate Change

3.1 Assessment by the Intergovernmental Panel on Climate Change (IPCC)

Global temperatures will increase by 1.4-5.8°C by 2100; sea levels are rising and are expected to reach 14-88 cm by 2100, flooding low-lying areas and displacing hundreds of million people. Rainfall patterns are changing, El Nino events are increasing in frequency and intensity, and tropical mountain glaciers, such as Mt. Kilimanjaro and Mt. Kenya, are retreating.

The consequences of these changes assuming concerted global efforts are also dire. According to IPCC Report, agricultural productivity in Africa could decrease by 30% this century. Severe droughts will occur, while wetter climates and more floods are predicted for parts of East Africa. Among all, Nyando river basin is nominated as hotspot for high mortality risk[1] due to drought and flood as shown in Figure 3.1.



Source: Natural Disaster Hotspots: A Global Risk Analysis Synthesis Report, Columbia University and World Bank, March 2005

Figure 3.1 High Mortality Risk Areas in Africa

3.2 Impacts due to Climate Change

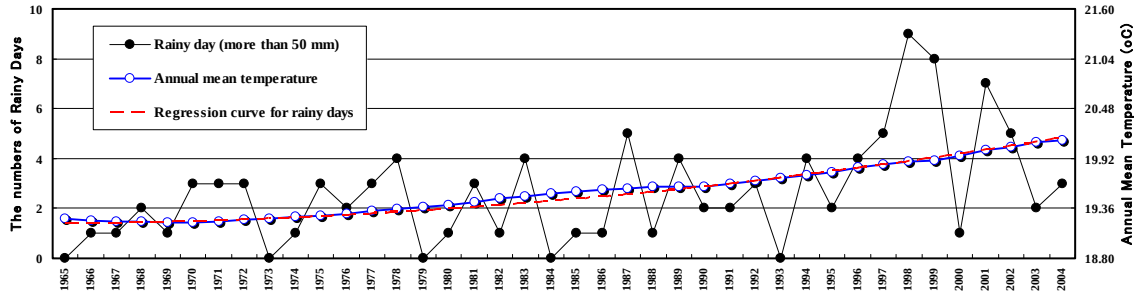
(1) Long-term Trend of Annual Rainfall and Heavy Rainy Days

The monthly temperature time series were extracted from the database of Kenya Meteorological Department (KMD). Kericho in the highland of Nyando river basin was chosen as the location of interest. It consists of a nonlinear trend, with an inflection point in the 1970s followed by an increase in the 1980s and 1990s of +0.5°C and in the 2000s of almost 1.0°C.[2] Many of the impacts of climate change will materialise through changes in extreme events such as droughts, floods, and storms. The meteorological models[3] show a high degree of agreement in simulating an increase in the extreme high rainfall over East Africa. An increase of more than 20% in the very extreme high rainfall events (one-in-100-years) was simulated for around the year of 2100. The indications of an increase in extreme rainfall events during the long-rains season could have long-term implications for flood impacts.

Figure 3.2 shows the long-term trends of the numbers of heavy rainy days with the variation of annual mean temperature. The regression curve for the numbers of heavy rainy days is well fitted with the long-term trend of temperature increase. The global warming is likely to the increase in the frequency

[1] "Natural Disaster Hotspots : A Global Risk Analysis", International Bank for Reconstruction and Development (UNDP), The World Bank and Columbia University, March 2005
[2] "Malaria resurgence in the East African highland: Temperature trends revisited", M.Pascual, J.A.Ahumade, L.F.Chaves, X.Rodo, and M.Bouma, April 2006
[3] "Climate Change Impacts on East Africa A Review of the Scientific Literature", World Wide Fund For Nature (WWF), November 2006

and intensity of heavy rainfall in the highland.



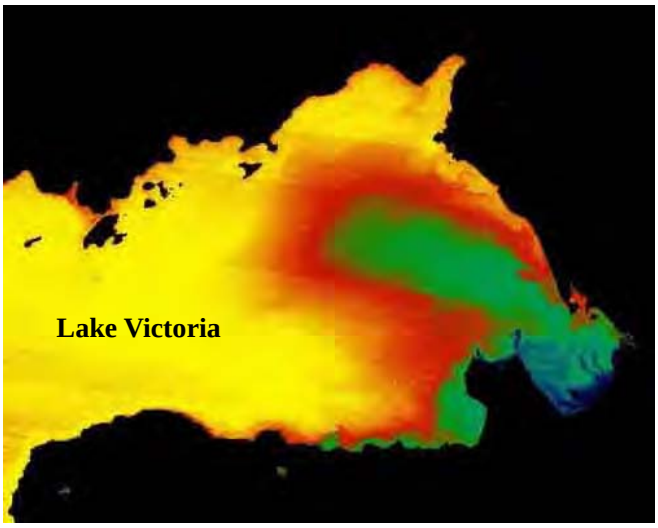
Source : Hydrological databases of LVSWSB and KMD

Figure 3.2 Long-term Trends of the Number of Rainy Days and Annual Mean Temperature

Expanding fluctuation of heavy rainy days under constant annual rainfall causes higher risk of flood and drought. The optimum development scale of structural measures was evaluated with the economic index of EIRR and the development scale of a 10-yr flood event was adopted as short-term target. However, the design scale would decrease from 10-yr to less than 10-yr flood event as the heavy rainfall occurs frequently in the future.

(2) Catchment Degradation

For the Nyando river basin, interviews with local people suggest that many of the major soil erosion problems either started or were dramatically accelerated during the early 1960's. It is speculated that rapid land use changes, deforestation, infrastructure development and over-grazing structurally altered the landscape during the first half of the 20th century. Prevailing conditions during the early 1960's may then have been such that the basin was essentially primed for massive erosion/sedimentation during a period of extraordinarily heavy rainfall in the region. The Nyando river basin is particularly vulnerable to the large rainfall events occurred in the early 1960's. Such an event could result in unprecedented mass soil movement from the lake plain into the lake as shown in Figure 3.3.



Source: ICRAF's 1999 annual report and in Science Online. 2000

Figure 3.3 Sediment Plume in Lake Victoria

(3) Flood Inundation

Various characteristics of the heaviest flood water level and average annual flood level which occurs almost every year were obtained from the interview survey results. The volume of flood inundation was estimated at 441.0 million cubic metres (MCM) for heaviest flood and 286.9 MCM for annual average inundation. The series of annual maximum discharges shows that heaviest flood at the interview survey,

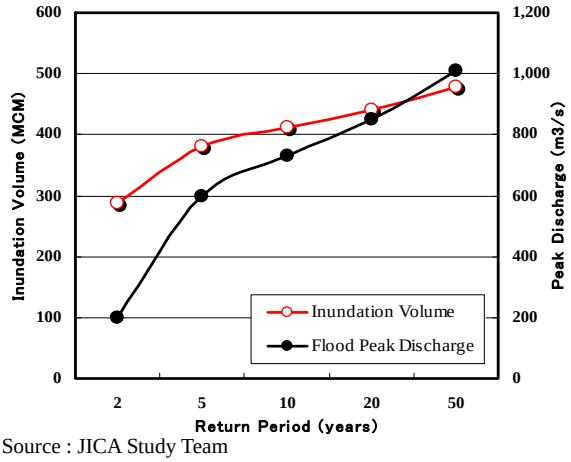
i.e. people's memory, would be 2002 flood event which is equivalent to the flood magnitude of once in 20 years. The flood inundation volume was estimated by return period in proportion to the magnitude of probable flood peak discharges as given in Table 3.1 and Figure3.4.

Table 3.1 Flood Inundation Volume

Return Period (years)	Probable Peak Discharge (m3/s)	Flood Inundation Volume (MCM)
2	200	286.9*
5	600	381.7
10	730	412.6
20	850	441.0*
50	1,010	478.9

Note : "*" shows the survey result

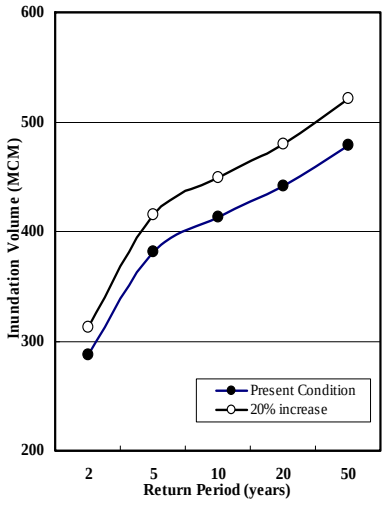
Source :Flood Survey, JICA Study Team(2006)



Source : JICA Study Team

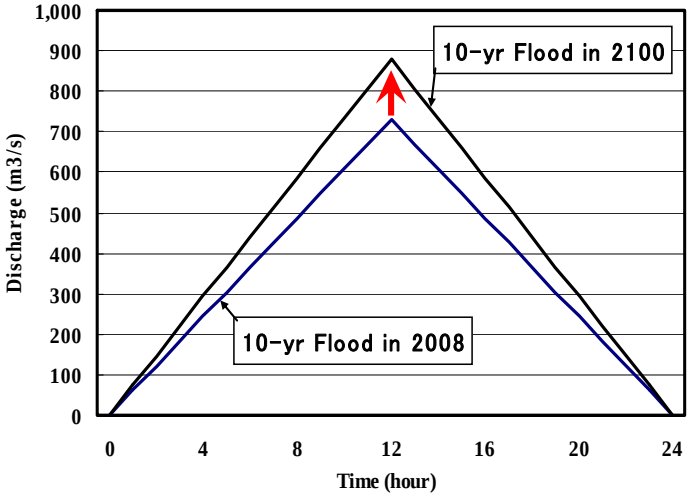
Figure 3.4 Inundation Volume and Peak Discharge

The volume of flood inundation of 441 MCM was estimated at 44% of the volume of basin rainfall of 997 MCM. The magnitude of flood inundation volume was evaluated assuming that heavy rainfall events would increase by 20% in the future and 44% of the basin rainfall retards in the low-lying area. The magnitude of 10-yr flood at present condition would be equivalent to about 5-yr flood event in the future as shown in Figure 3.5. The increase of heavy rainfall events by 20% also causes the variation of volume of 10-yr flood event. The flood peak discharge would increase from 730m^3/s in 2008 to 880m^3/s in 2100, which is almost equivalent to 20-yr probable peak discharge in 2008 (Figure 3.6).



Source: JICA Study Team

Figure 3.5 Flood Inundation Volume

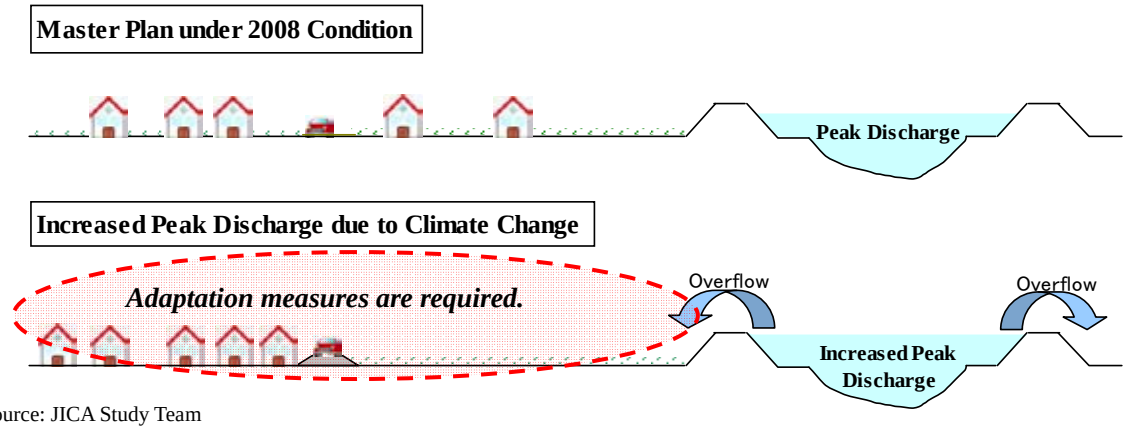


Source: JICA Study Team

Figure 3.6 10-yr Probable Flood Hydrograph

3.3 Adaptation Strategy against Climate Change

The protection level of flood protection structures would be lower year by year as global warming progresses. However, it is not practical at present to set larger design scales for structures against intensified flood, when considering it requires quite a long time to complete the implementation of structures by the protection levels for confining fully flood discharge in the river channel with dike system. Although structural measure should be implemented continuously to achieve the current design levels, some additional necessary measures are carefully reviewed from the viewpoint of social conditions[4]. As well as structural measures, comprehensive flood control measures such as land-use regulation/guidance and prioritization/designation of flood prone areas and establishment of flood forecasting/ dissemination system could be applied as shown in Figure 3.7. Community-driven projects could also be promoted for creating a community of water-disaster adaptation with primary focus on urban environment and the reduction of flood disaster risk in addition to economic efficiency and convenience.



Source: JICA Study Team

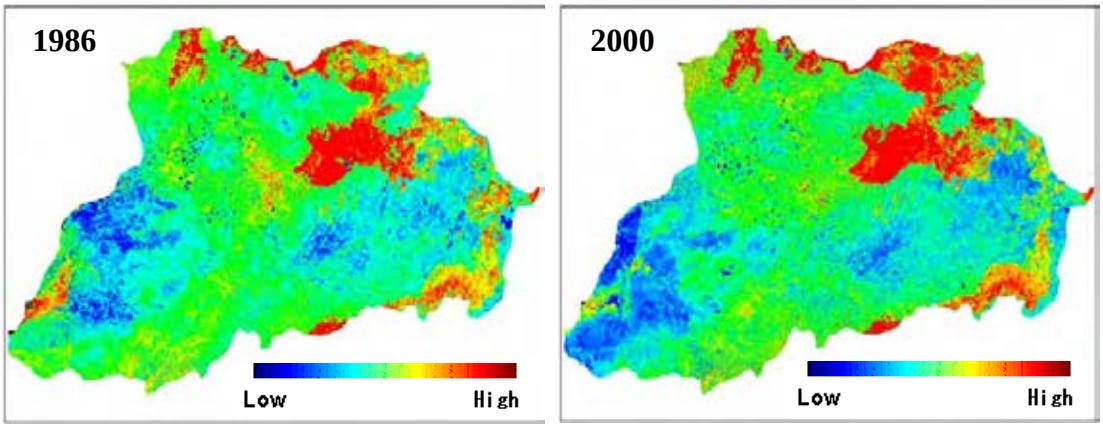
Figure 3.7 Concept on Adaptation Measure against Climate Change

The implementation of adaptation strategies will not stop flooding. Flooding will continue to occur unless the area is protected against maximum probable flood. As it is neither feasible nor economically justifiable to adopt the maximum probable flood as the basis for flood control planning, a lesser flood level is selected to set planning controls and protection levels. Floods above that level constitute a residual flood risk, which extends year by year due to frequent heavy intense rainfall. It is therefore necessary to ensure that the community in the flood prone area understands the consequences of flooding above the design flood level and takes effective action to minimize damage and loss of production and prevent loss of life when a flood of greater magnitude occurs as climate changes. In general, adaptation strategies for frequent flood due to climate change are formulated by upper, middle and lower catchments, taking into account topography, river morphology, and social and living conditions.

[4] Climate change adaptation strategies to cope with water-related disasters due to global warming (Policy Report), June 2008, Panel on Infrastructure Development, Ministry of Land, Infrastructure, Transport and Tourism, Japan

3.4 Adaptation Measure in Upper and Middle Catchments

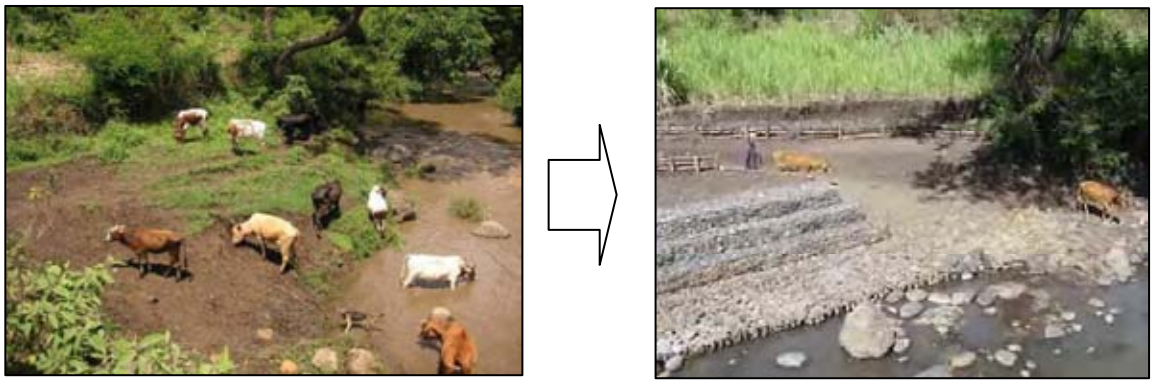
Deforestation in this area appears in three distinct forms; (i) expansion of agricultural areas into the forests, (ii) reduction in tree density within the forests, and (iii) reduction in the density of trees in forest remnants outside of the gazetted forests. However, it appears that total tree cover is remaining more stable as shown in Figure 3.8, which indicates the variation of vegetation cover index between 1986 and 2000. The effort on afforestation should be continued by the institutions, the NGOs and the community people with the assistance of government agencies.



Source : JICA Study Team

Figure 3.8 Changes in Vegetation Cover Index in Nyando River Basin

The above fact induces the rate of surface soil erosion is rather smaller than the riverbank erosion in the upper and middle catchments. As part of adaptation measures, community participation in riverbank protection works is an approach in coping with riverbank erosion better and in a timely manner. This concept was introduced as pilot projects in this master plan study when community-based organizations elected by the people became functional at village levels as shown in Figure 3.9. The establishment of a community-oriented institutional framework for implementing flood management (both structural and non-structural) was examined during the implementation of pilot projects and an effective and practical participation strategy developed.



Before Construction **Riverbank Protection with Slope**

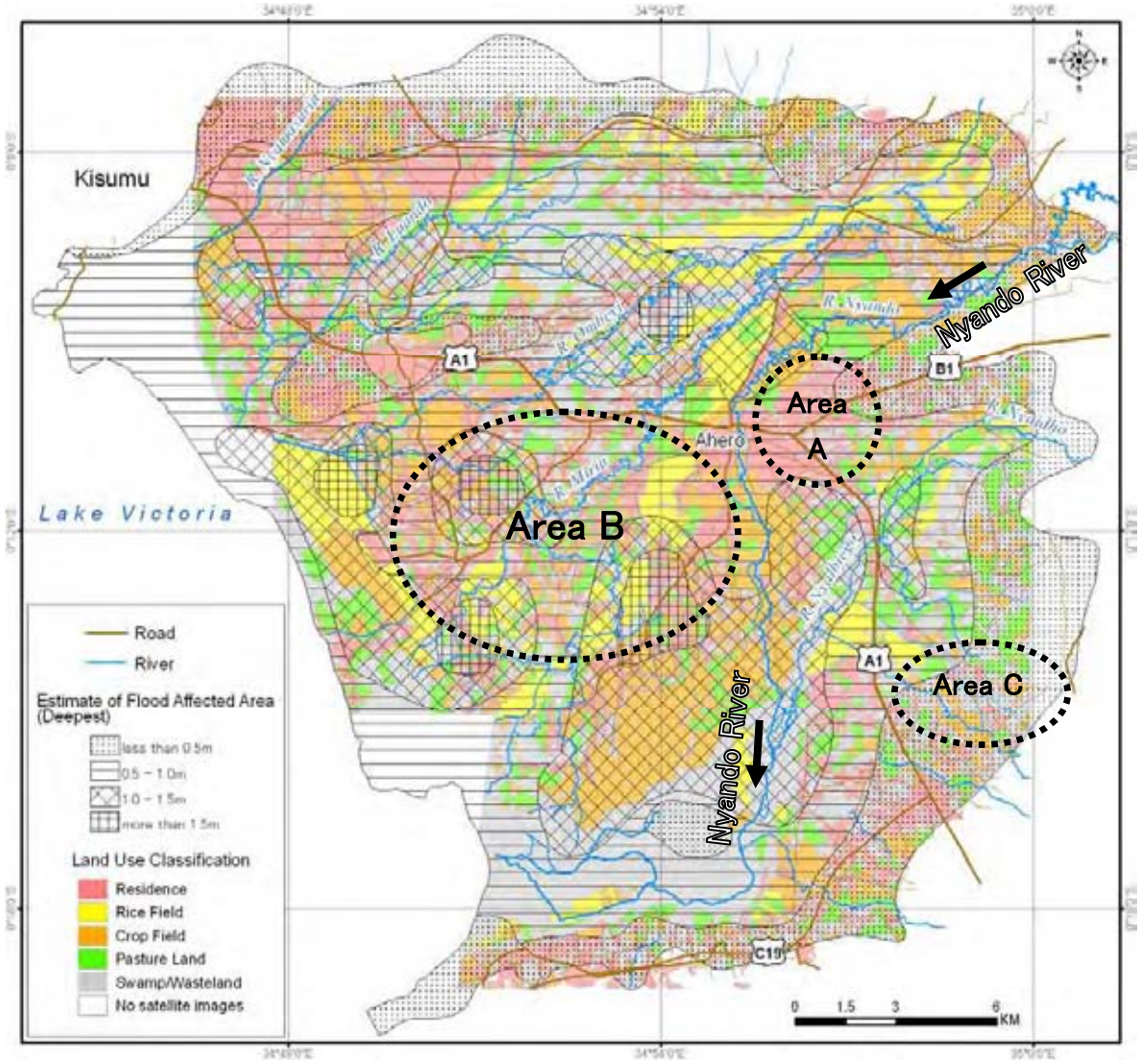
Source: JICA Study Team

Figure 3.9 Community-driven Riverbank Protection Work at Middle Catchment

3.5 Adaptation Measure in Lower Catchment

(1) Priority Areas for Structural Measure

Flood risk cannot be banned totally although the effort has been done to confine flood water into the river channel with high embankment at both river banks. In recent years, a tolerable flood inundation has been discussed when the protection measures are subject to extreme flood events due to climatic change. In the Nyando river basin, the priority for providing possible measure is given to the three areas as shown in Figure 3.10: namely, (i) Area A : Residential area around a junction of A1 and B1 National Roads, (ii) Area B : Residential area at western side of Nyando River, and (iii) Area C : Sediment source area.



Source: JICA Study Team (2008)

Figure 3.10 Priority Areas in the Nyando River Basin

Table 3.2 shows the possible adaptation measures applicable to the Nyando river basin against intense flooding due to global warming.

Table 3.2 Possible Adaptation Measure against Climate Change in the Lower Catchment

Structural Measure

1.	Retarding Basin	The magnitude of 10-yr flood event under present condition would be equivalent to about 5-yr flood event as heavy rainfall increases in the future. Possible adaptation measures are to allow flood inundation for short period in the river terrace as a buffer for retarding the incremental discharge.
2.	Road Raising	The flood inundation area does not change but the depth and frequency would be increased. The community road utilised as evacuation activities should be raised with freeboard. The priority for implementation is given to the road raising which is situated in parallel to the dike alignment along Nyando River. These road raisings are functioned as secondary and tertiary dikes when the extraordinary flood occurs and overflows into inland areas.
3.	Sediment Retention	Increased frequency of heavy rainfall would trigger the surface erosion and lateral erosion of river banks. Sediment transported to downstream causes riverbed aggradation and sediment plumes into Lake Victoria. Catchment conservation for reducing surface erosion would be more important.

Non-structural Measure

1	Strengthening of coordination activities among communities.	There are 550 communities in the flood prone area of the Nyando river basin. More frequent flooding forces community people to stay longer at the evacuation centre which are located by community. Repeated relief activities during frequent flood managed by the Disaster Management Committee (DMC) and/or NGOs may encounter financial and capacity constraint. Strengthening of community-based evacuation activities in close liaison among communities, such as the provision of relatively large-scale evacuation centre for several communities leads the effective relief activities.
2	Publicising by media	Publicising of the climate change to community people through media, i.e., TV and radio is one of effective methods to educate community people to the danger of frequent flooding.
3	Land use regulation	Buffer zones mainly comprise natural vegetation in riparian areas such as river banks and wetlands. Such lands have currently been allocated to individuals or converted to other public uses by the community. Loss or degradation of buffer zones is undesirable, since buffer strips are effective in retarding flood discharge and in trapping sediment under Kenyan environmental conditions. This is a trend that needs to be checked, more in the Nyando basin where the flood prone area is proportionately smaller and is surrounded by escarpments.
4	Diversification of Income generation	Most of the community people in the flood prone area are farmers. They are cultivating the limited crop, such as rice, sugarcane, maize, by communities. Frequent flooding causes the devastating damage in case that the community people depend only on the income from the limited crops. The diversification of income generation from the limited crops to livestock harvesting, fishery and handcrafting in addition might secure their incomes.

Source: JICA Study Team (2008)

4. Organisations related to Flood Management

Ministry of Water and Irrigation (MWI) and Water Resources Management Authority (WRMA) are the counterpart organization of the Study. MWI functions as policy maker / sector coordinator rather than implementer, while implementation functions are distributed among the new institutions. In this connection, the MWI prepared the National Water Resources Management Strategy (Draft), in which the strategies against flooding are depicted. According to hearing at MWI, so called Head of Donor Coordination (director class) has been assigned for the coordination and harmonisation with various donors' assistance for the water sector. The Water Act (2002) established the Water Resources Management Authority (WRMA) as the lead agency that oversees the management, use and development of water resources in Kenya. The present situation of WRMA organization is described below.

4.1 Present Situation of WRMA

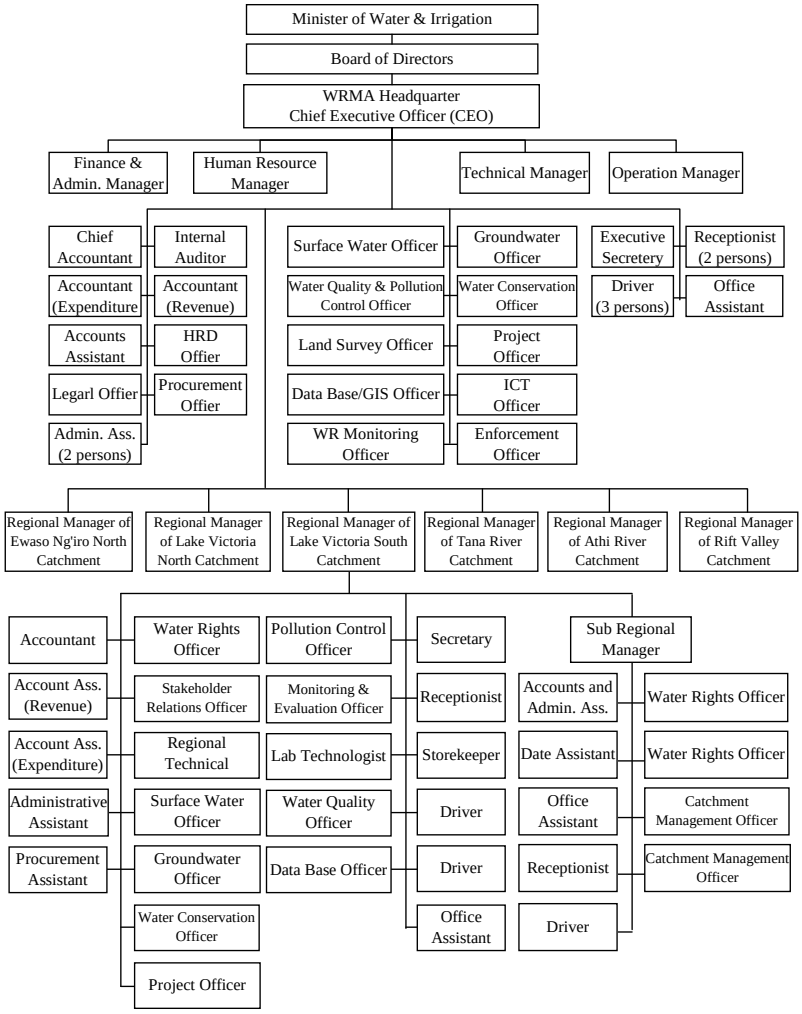
(1) Organisation of WRMA

WRMA has regional offices at catchment levels for decentralised decision making, quick response to management problems and for speedy water allocation processing. The designated powers and functions of WRMA are to:

1) Develop principles, guidelines and procedures for the allocation of water resources;
2) Monitor and assess implementation of the national water resources management strategy;
3) Receive and determine applications attached to permits for water use;
4) Monitor and enforce conditions attached to permits for water use;
5) Regulate and protect water resources quality from adverse impacts;
6) Manage and protect water catchments;
7) Determine charges to be imposed for the use of water from any water resource;
8) Gather and maintain information on water resources; and
9) Liaise with other bodies for the better regulation and management of water resources

There are six catchment areas managed by six WRMA regional offices. The six offices are headed by the Regional Managers for Lake Victoria North, Lake Victoria South, Rift Valley, Athi River, Tana River and Ewaso Ng'iro North River respectively. The study area is located under the jurisdiction of LVSC, which has three sub-regional offices located in Kisumu, Kericho and Kisii. As of December 2008, WRMA has a total occupancy of 34 number of staff at the headquarter and more than 460 staff nationwide including all regional offices.

It was agreed in the Inter-ministerial Steering Committee in December 2008, that flood management and climate change adaptation unit will be established within WRMA.



Source: Report on Operationalisation of the Water Act 2002 in Water Resources Management, Oct 2005, SID and Annual Report LVSC Regional Office Oct 2006
Organisational structure of the headquarter is based on hearing at human resource department in Dec.

Figure 4.1 Current Organisational Structure of WRMA Headquarter and LVSC Office

(2) Roles and Responsibilities of WRMA in Flood Management

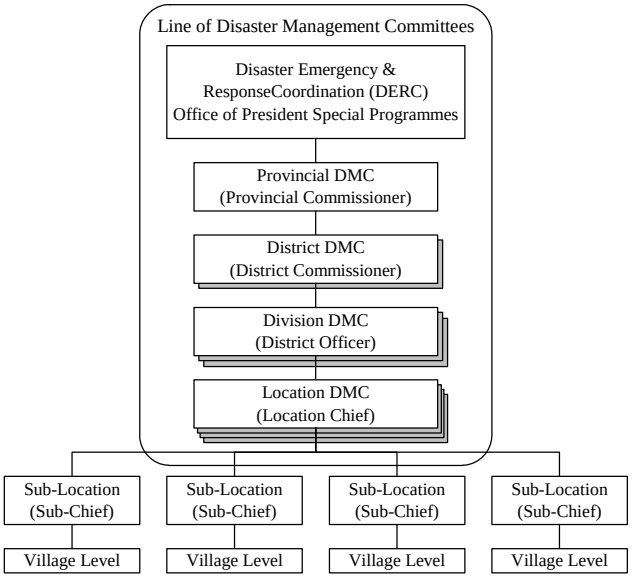
In the initial organisational design of WRMA, there was no explicit mandate to deal with the flood management and as a matter of fact that there is no clear statement regarding flood management in the Report "Operationalisation of the Water Act 2002 in Water Resources Management" that was prepared in assistance with SIDA/DANIDA. This can be considered as an operational guideline for WRMA.

The one of the major tasks for WRMA as specified in the report by SIDA is the preparation of a Catchment Management Strategy (CMS) within the framework of the National Water Resources Management Strategy (NWRMS). However, the SIDA report does not explicitly define the roles of WRMA as a lead agency in flood management, the WRMA's task in flood management can be included within the catchment management or catchment conservation. Therefore, the CMS in LVSC should define and include the clear tasks for WRMA in flood management.

4.2 Disaster Management Committee (DMC)

(1) Outline of the DMC

The coordination and management of disasters including floods, drought, landslides, earthquakes, terrorism, civil conflicts, disease epidemics, transport accidents, fires and so on are handled by the DMCs. The DMCs are in place from the national level to local (location) level. The Disaster Emergency and Response Coordination (DERC) is in charge of the DMC at the national level and it comes under the Office of President as mentioned earlier. DMCs exist at the division and location levels, and the series of DMCs thus formed are linked vertically with the administration units as shown in Figure 4.2.



Source: JICA Study Team 2006
*( ) bracket represents chairperson of the committee.

Figure 4.2 Existing Institutional Framework of DMC

(2) Constraints of the DMC

The following constraints can be observed in the current disaster management efforts, particularly for flood management.

a) Lack of well-trained personnel in flood management

b) Lack of coordination with related organisations and political interventions disrupt coordination

c) Lack of warehouses to store aid materials and items for disaster preparedness

d) Lack of appropriate tools for de-silting and water channels works

e) Difficulty of traditional flood forecasting due to the recent climatic changes

f) Lack of mitigation measures for harnessing water for irrigation use against high needs to utilise flood water.

With regard to item a) above, the Red Cross has extensive training activities at location level. The activities focus on getting the communities to build a disaster tolerant capacity by transferring basic knowledge about floods. However, they have a chronic financial shortage.

There was no presence of WRMA in DMC activities, while positive involvement of WRMA is expected in providing human resources of flood management, water sector coordination, flood forecasting and early warning. It is to be noted that the membership of WRMA in the District DMC was approved in consultative meeting between WRMA-LVSC and the existing key members of the DMC in October 2008. This will be elaborated further in the following sections.

5. Stakeholders Involvement

Table 5.1 shows the list of the stakeholders and their involvement and roles at international, national, regional and community levels in the formulation of the Master Plan.

Table 5.1 Key Stakeholders Involved in the Master Plan Formulation

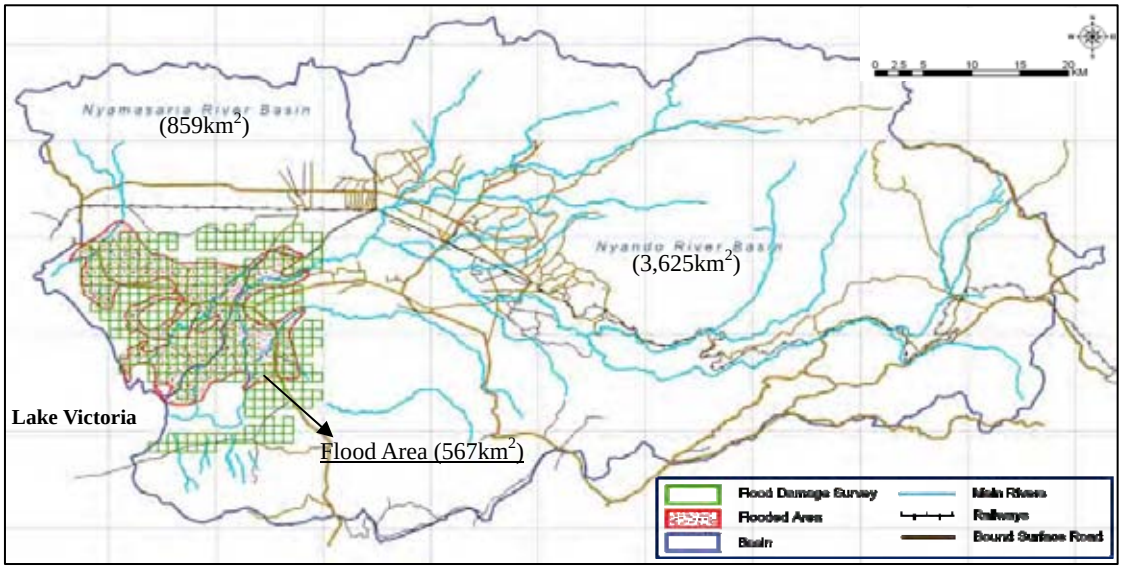
Organisation	Role in terms of Flood Management	Inputs to the Master Plan
International Level		
World Meteorological Organisation (WMO)	Strategy for flood management for Lake Victoria Basin was formulated in 2004.	Their comments were reflected in the Master Plan.
World Bank	Western Kenya Community Driven Development and Flood Mitigation Project (WKCDD/FM) in Nzoia Bain was formulated and is being financed.	Exchange of opinions between the Study Team and World Bank office were made from time to time.
SIDA	One consultant is attached to WRMA HQ to support institutional development of WRMA.	Institutional development of WRMA was discussed between the Consultant and the Study Team.
National Level		
Ministry of Water and Irrigation (MWI)	MWI is a policy maker and sector coordinator in the water sector.	PS of MWI is chairman of the steering committee. Various suggestions and discussions were made.
Office of President (OP)	OP is a policy maker and sector coordinator in disaster management.	PS of OP is a member of the steering committee. Discussions between the Study Team and Officers of OP were made.
WRMA	WRMA is a regulator of water resources.	CEO of WRMA is secretary of the steering committee and chairman of PWG. Various suggestions and discussions were made.
NWCPC	NWCPC has responsibility for formulation of structure measures to protect against flooding including dike construction and river de-siltation work.	Various discussions were made at central and regional levels to formulate the structural measures including dike construction.
Regional Level		
WRMA Lake Victoria South Catchment	WRMA regional office provides counterparts for the study	Collaborative works and day-to-day discussions for the Study were made. Regional office is secretary of the Forum.
Local Governments	Disaster management committees were formulated at provincial, district, division and location levels.	The concerned district departments are the members of the Forum. Various suggestions and discussions were made during the interviews and forum meetings.
NGOs	Regional and local NGOs carry out the flood mitigation and community development activities.	Some of the NGOs are member of the Forum. Various suggestions and discussions were made during the interviews and forum meetings.
Water Resource Users Association (WRUA)	WRUA is established cooperatively to share, manage and conserve common water resources.	Some WRUAs are the members of the Forum. Various suggestions and discussions were made during the forum meetings.
Site Level		
Community	Flooding is one of the key economic as well as social issues for the communities located in the study area.	Informal interviews, flood damage surveys, and public hearings were made.
CBO	CBOs carry out various activities for the improvement of economic and social conditions at community level.	Informal interviews and public hearings were made.

Source: JICA Study Team

6. The Study Area

6.1 Nyando River Basin

The Study Area lies mainly in Nyando river basin and partially in Nyamasaria river basin. The total area of Nyando river basin is 3,625 km^2 with a river course of 153 km and the total area of Nyamasaria river basin is 859 km^2 with a river course 40 km long. The altitude of the basins ranges from 1,130 m at the lakeshore to 3,100 m in the highland area.



Source: JICA Study Team

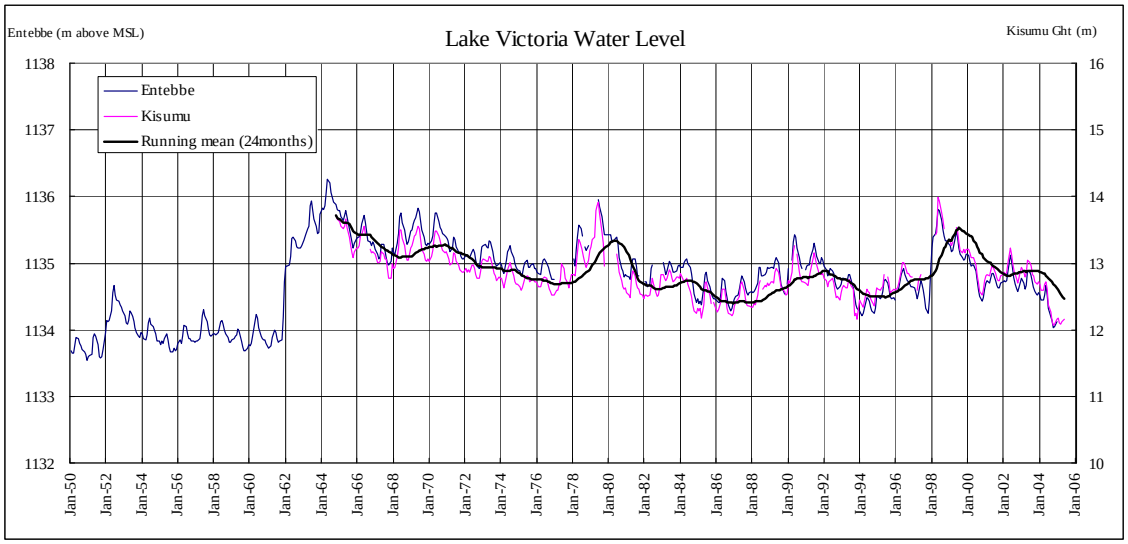
Figure 6.1 Study Area

The Nyando river basin lies in the western part of Kenya. The Nyando River originates from the Tinderet Forest, flows westward and pours into Lake Victoria. In comparison to other areas in Kenya, the river basin is characterised by relatively high average annual rainfall of 1,298 mm and high potential for agricultural production. However, a low-lying area called the Kano Plain suffers from frequent floods. The Nyamasaria river basin is situated adjacent to the Nyando river basin. Several small rivers originate from the Nandi Forest, flow into the Kano Plain, and pour into Lake Victoria. Flash floods are triggered frequently by torrential showers and its flow through these small rivers having steep riverbed gradients.

Most of the river basin administratively belongs to Nyando, Kisumu, Kericho and Nandi South Districts. As per 1999 Census, the population in the basin was 750,000 with an average growth rate of 3% per annum. Although the major industry is agriculture, the price of sugar cane has slumped recently. The impact was that many sugar factories went bankrupt and unemployment increased. Furthermore, rice production has declined. This is mainly because of the malfunction of irrigation systems that has been caused by siltation and frequent flooding. In comparison to the Kenyan average, the ratio of households categorised in absolute poverty in the Nandi South and Nyando districts is higher by 13%. This fact indicates that the northern part of the basin is rather poor, even by Kenyan standards.

6.2 Lake Victoria

The water levels of Kisumu Lake had been measured for the past five decades. The variation of monthly mean water level in the lake is illustrated in Figure 6.2.



Source: JICA Study Team, values in database of LVSWSB

Figure 6.2 Long-term Variation of Mean Water Levels of Lake Victoria

The lowest water level was recorded at El.1,133.19 m in 1923 and the water levels in lake sharply rose from 1961 to 1962 because of widespread rain in and around of Lake Victoria. The current water levels in the lake tend to drop and are at about 1,134 m in 2006. If the water level drops to as low as it was in 1923, the depth of water at Winam lake gulf into which the Nyando River pours, would be less than 2 m. This will lead to serious navigation problems in the Nyando and related rivers and could be experienced up to a distance of 30 km from the lakeshore. However, strictly looking at the viewpoint of flood control and drainage, it can be said that such fall in water level would be quite convenient for the lower Nyando and related rivers.

6.3 Sediment Discharge in Nyando River

Sediment transportation in the Nyando river basin was analysed in “the Pilot Study on Sedimentation and Sediment Characteristics on Nyando and Nzoia River Mouths and Winam Gulf of Lake Victoria”, December 2005, Lake Victoria Environmental Management Project (LVEMP). This study reported the three results of mean annual volume of sediment addressing suspended solids load transported by the flowing rivers to Lake Victoria. Nyando River includes the related Asawo and Awach Kano rivers. In comparison to the other two results, the volume estimated by the Pilot Study is high. However, the value estimated for LVEMP is quite small.

According to the above result, the specific sediment volume in the Nyando river basin has been estimated as 6.4 t/km^2/yr (by LVEMP), 43.8 t/km^2/yr (by Okungu) and 114 to 277 t/km^2/yr (by the Pilot Study). Judging from river characteristics of the Nyando river basin, the sediment volume in the Nyando river basin supposed to be in the order of 200 to 300 t/ km^2/year.

7. Flood Condition

7.1 Major Floods and Refugee

The climate in the Nyando river basin is controlled by the northward and southward movements of the Inter-tropical Convergence Zone (ITCZ). Above all, the climatic conditions from April to June are strongly influenced by the long duration of rainfall, which are brought by the southeast wind and south monsoon.

With such meteorological circumstances, the lower basin of the Nyando and Nyamasaria rivers has been suffering from serious flooding. According to the previous reports, major floods occurred during the period from 1940s to 1980s i.e. in 1937, 1947, 1951, 1957-58, 1961, 1964, 1978, 1985 and 1988. In recent years, serious floods occurred in 1997-98, 2002, 2003 and 2004.

Especially, the 1997-98 floods were the result of continuous rainfall, which was more than double of the rainfall in any normal year. This was caused by the El Nino phenomena. However, the quantitative information about the depth, duration, evacuation conditions, emergency food and medical care extended, etc., is quite limited for the lower basin of Nyando and Nyamasaria Rivers.

Flooding in the lower catchments of Nyando river basin is generally categorised into three types; 1) overflowing from the main channel of Nyando River, 2) flash floods in the Awach Kano and Nyamasaria rivers, and 3) spot flooding or inundation at depressions caused by local torrential rain.

Community people stay at evacuation centres during flooding. The length of a refugee's stay in an evacuation centre is 22 days on average with a 14 day median. In two evacuation centres located in Lower Nyakach, people stayed for six months supposedly waiting for the reconstruction or repair of their houses. More than 70 families on an average with a median of 30 families stayed at centre. Eight centres hosted more than 100 families each. Considering an average family size of four to five members, a median of more than 150 persons are estimated for stay in the centre. However, considering the limited space of a standard primary school, this number seems to be too large for their satisfactory accommodation. It is likely that this might have caused physical, health and psychological damages to both facilities as well as to refugees.

Source: JICA Study Team

Figure 7.1 Flood Condition in the Nyando River Basin

7.2 Flood Mitigation Project

(1) Government Effort for Flood Control

In order to reduce flood damage in the Nyando river basin, NWCPC implemented construction of dikes and de-silting work along the Nyando River. In addition to this, de-silting works were also undertaken for other rivers such as Ombei River, Miriu River and Awach River.

The dike construction was done in assistance with the construction machineries owned by NWCPC. It is planned that about 15 km of dike for each bank will be constructed in the near future. The de-silting works have been done using man-power through direct employment of labourers under NWCPC. The local people that live in the flood prone area along Nyando River appreciated the above effort made by NWCPC. However, NWCPC mentioned that due to the shortage of funds and construction machineries, the lifetime of the dike will be around 10 years only.

(a) Dike System along Nyando River

(b) Culvert at A1 National Road

Source: JICA Study Team

Figure 7.2 Current Condition of Flood Control Structure

(2) Food for Work

An NGO (Care Kenya) implemented the Flood Mitigation Food for Work Project in the early January 2004. The objective of the project was to reduce by 25% of the number of people that will displaced by flood in Nyando and Kisumu districts by September 2008. The project covered 11 locations in both Kisumu and Nyando districts, and formulated a flood control committee consisting of six members each at every target location. As per the works at specific location, the flood control committee discusses and finalises the schedule and the location of the works. Thus depending on the type and amount of work done by each participating individual, the food items such as beans and vegetable oils are distributed to the participants under the Flood Mitigation Food for Work Project .

The projects showed the good progress that the road rehabilitation works and de-silting works for canal and rivers have exceeded the planned annual targets. These works were undertaken in close collaboration with communities. This was quite different from the DMC system, which is organised according to regional administration lines. Although the scales of activities and works were small in nature but were very effective at the specific locations. The communities' appreciation for such undertaken work was high.

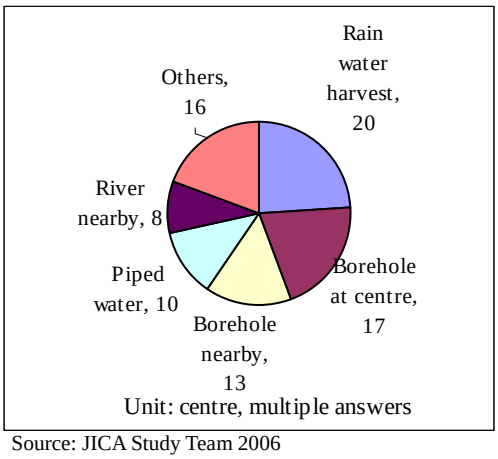
7.3 Evacuation Centre

Based on the interviews conducted with Chiefs, Assistant Chiefs and Village Elders during August 2006 and the public hearings held in the flood prone areas during November 2006, in total approximately 150 facilities were listed out as the evacuation centres. Out of this, 136 facilities were identified as actual evacuation centres. The 67 facilities that includes 33 in Kisumu District, and 34 in Nyando District, were interviewed for the available facilities, existing conditions and actual evacuation procedures. Primary schools are most frequently used as evacuation centres. The Churches and markets are also used. Of these 67 facilities, 39 facilities were formally recognized as evacuation centres, mainly by Provincial Governments while rest 28 facilities are not yet have been recognized.

The area where the facilities are used as evacuation centres is generally gets flooded during the rainy season. The 80% of the 67 interviewed centres are situated in those villages which often experience flooding and about more than two thirds of the village area gets flooded. Such conditions are more often found in Nyando District, especially in Nyando Division where all centres are situated in such villages whose more than one third of the area gets flooded.

It is difficult to assess the road conditions around the centres. During rainy seasons, 85 % of all centres can only be accessed by foot. Only 6 centres in Winam Division are accessible by vehicle, while no centres are accessible by vehicle in divisions of Kadibo, Lower Nyakach and Miwani. Many evacuation centres are at risk of inundation. Even though they are used as centres, more than 70% of them are partially (especially school grounds) flooded during the period of floods.

The most common water sources at the interviewed evacuation centres were boreholes in the centre or nearby. Piped water is not so common, while rain water harvesting measures such as catching of water by roof troughs and collecting in tanks was found in all five divisions of the flood prone areas. It seems this is regarded as a supplementary water source for the entire flood prone area (Figure 7.3). Temporary ponds or water pans made by rain or flood water is also used in some centres.



Source: JICA Study Team 2006

Figure 7.3 Water Sources for Evacuation Centres

Even though the centres are situated in rather water-rich areas, the supply of volume of water from these sources is not sufficient to meet the demand of 47 centres. As for the quality of water, water is reported being good by the staff of 22 centres while it is reported being bad by staff of 17 centres. Insufficiency of space, water and toilets causes unfavourable sanitary and health conditions in the centres, though the statistical data is not recorded. According to the staff of the centres, the most frequent disease that attacks refugees is malaria; the diseases of digestive organs such as diarrhoea and cholera or typhoid come second; and the third are other diseases.

7.4 Flood Disaster Map

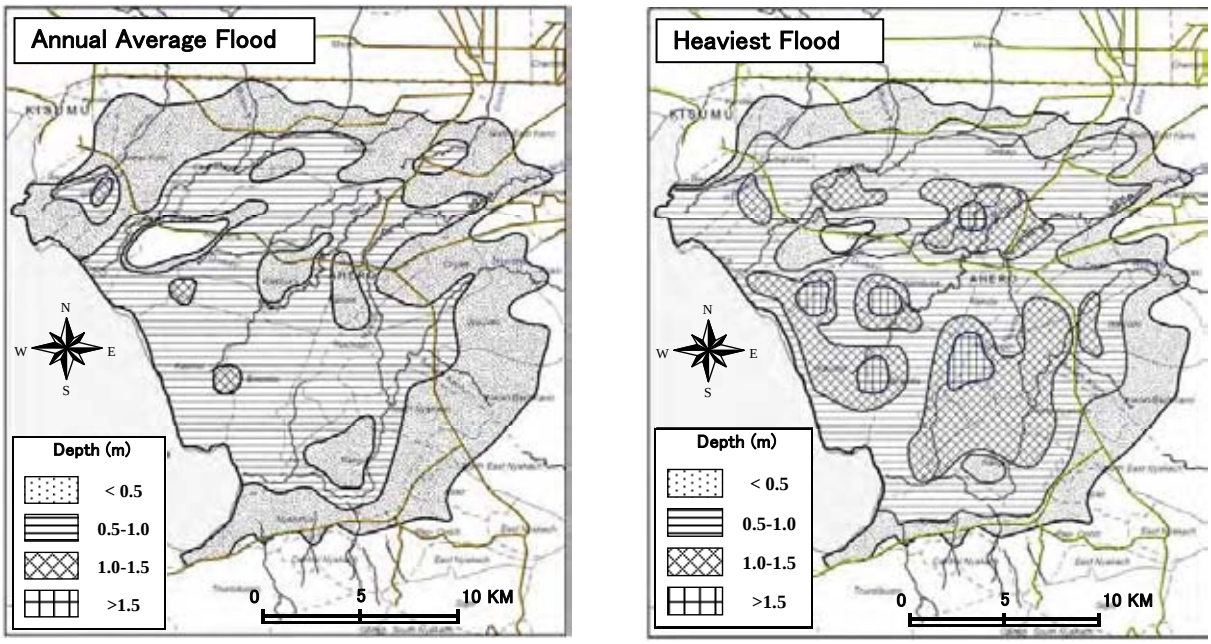
Due to shortage of the quantitative information on inundation, a flood damage survey was conducted at 350 spots in frequent inundation areas of 240 km^2 over the period from August to September 2006.

A new flood disaster map was developed for both annual inundation and maximum inundation in the past. For the purpose of verifying the accuracy of the map, public hearings were held three times with 340 participants in total from 6 to 8 November 2006 (Figure 7.4). he map was finalised. These maps would be available as a base map for preparing community-based flood hazard maps and specifying evacuation routes for the communities.

Source: JICA Study Team

Figure 7.4 Public Hearing at Rabour (November.07, 2006)

With due consideration of the suggestions and comments, the flood disaster map was considered as a draft. Also such comments were reflected again in the preparation of the detailed community hazard maps. The result is presented in Figure 7.5.



Source: JICA Study Team

Figure 7.5 Flood Disaster Maps of Annual Average Flood and Heaviest Flood

8. Hydrological Monitoring Condition

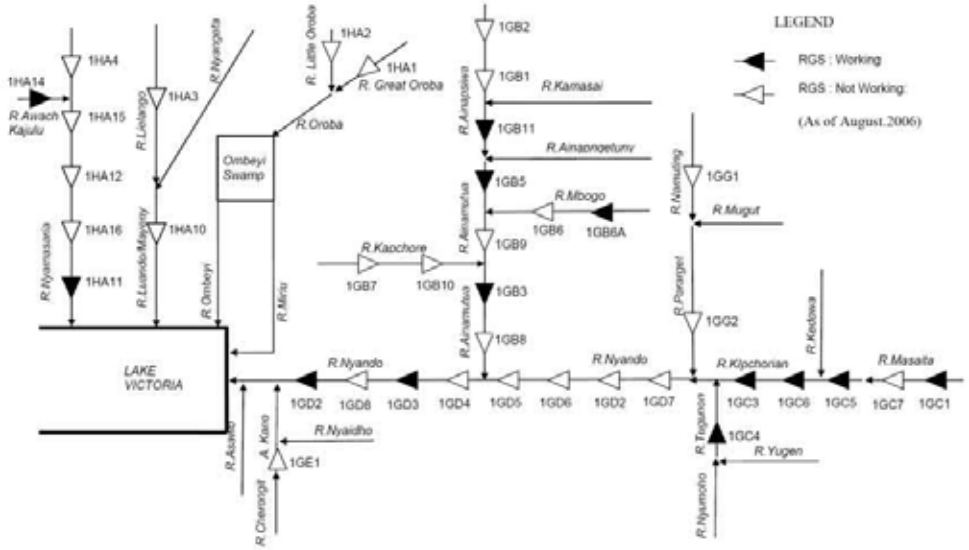
8.1 Meteo-Hydrological Monitoring Network

There exist 40 working rainfall stations including adjacent ones as shown in Figure 8.1.

Source: LVSWSB hydrological database

Figure 8.1 Location Map of Rainfall Stations

There exist water level stations at various locations on the main stream and several major tributaries. LVSWSB is responsible for water level, water quality and sediment measurements in the rivers flowing into Lake Victoria. However, the water level measurements has been terminated or abandoned at more than half of the stations due to financial constraints as shown in Figure 8.2.



Source: LVSWSB and WRMA

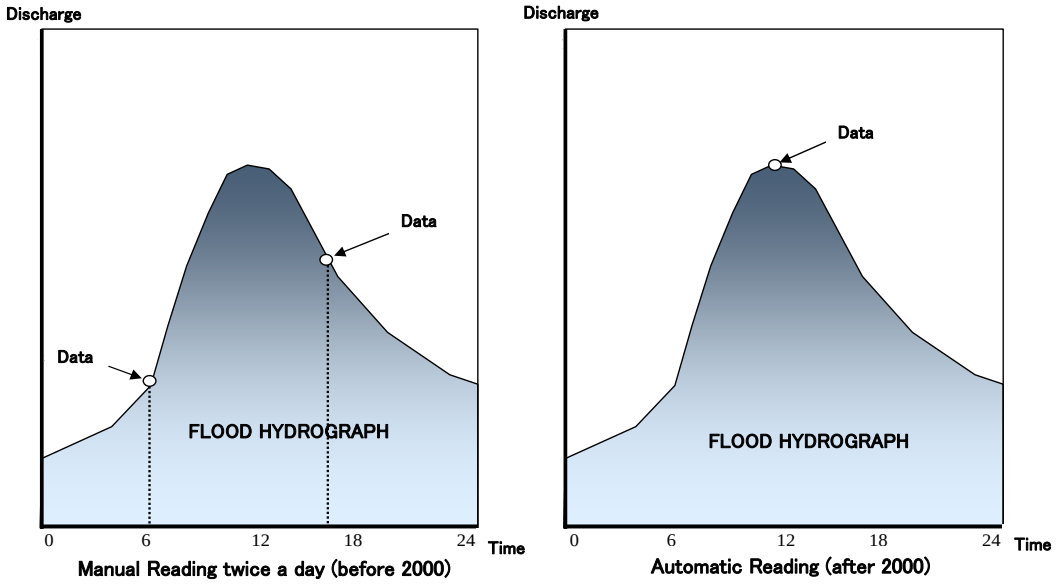
Figure 8.2 Schematic Diagram of Water Level Gauging Station

8.2 Water Level Measurement and Characteristics of Data

The water levels have been measured by means of reading water levels using staff gauges twice a day (morning and early evening) at stations in Kenya throughout the year without any additional measurements during flood. Hence, the maximum water level or peak discharge of large-scale floods has not been recorded at all stations. A rating curve between water level and discharge (H-Q curve) is available for almost all working stations by periodic reviewing of cross sectional changes occurred due to erosion or sedimentation; however it has not been reviewed at some stations.

In April 2000, in addition to the existing staff gauge, the automatic water level recording equipment were installed at the key station of 1GD03 (catchment area 2,625 km^2). Since then water level are recorded automatically at every 15 minutes. In the database at LVSWSB, water levels are recorded on an hourly basis and daily highest and lowest water levels are stored.

An increase in measured peak flood discharges for all return periods was reported due to the catchment degradation in the upper catchments. However, the increase was mainly due to a change in the water level measurement methods. Manual readings had been done twice a day before 1988 and automatic recording has been carried out since 2001. The peak discharges recorded by the automatic water level recorder are greater than those recorded by manual reading (Figure 8.3).



Source: JICA Study Team

Figure 8.3 Water Level Measurement at 1DG03

Probable flood peak discharges were re-examined (Table 8.1). The table shows that the design discharge with the probability of once in 25 years adopted by MWI for the current development scale of structural measures is equivalent to that of less than 10 years.

Table 8.1 Probable Flood Peak Discharge (unit: m^3/sec)

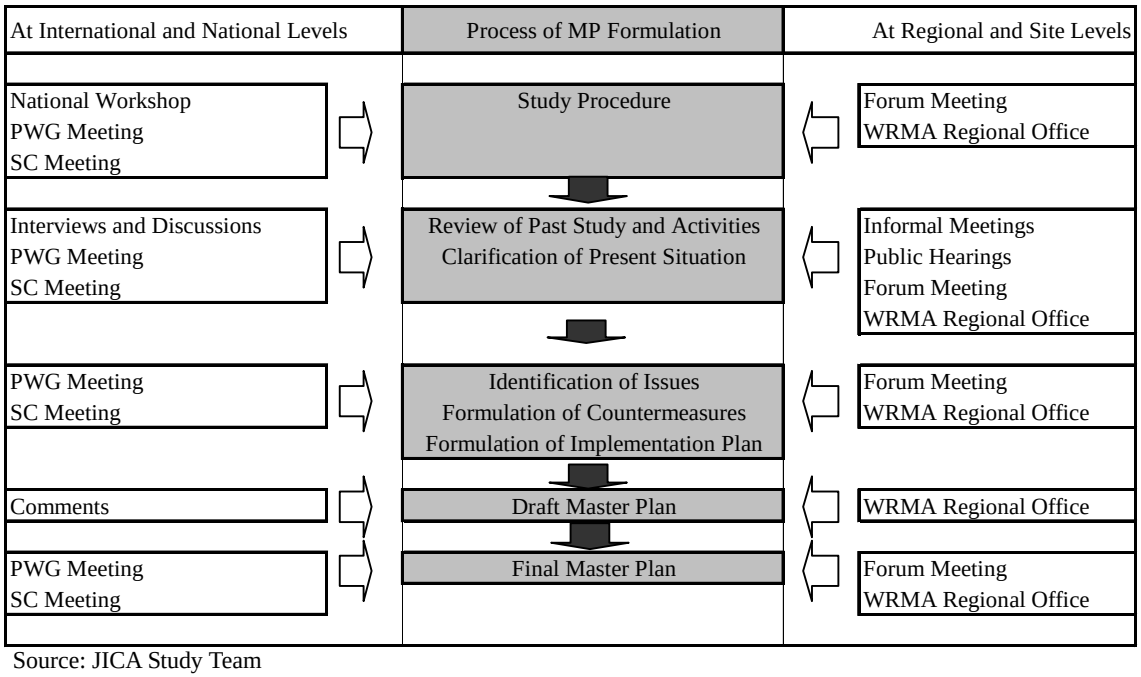
Return Period	5-yr	10-yr	25-yr	50-yr	100-yr
Master Plan (1983)	450	550	650	750	850
This Study (2006)	610	730	890	1,000	1,130

Source: JICA Study Team (2006)

9. Concept of the Master Plan

9.1 Formulation Process of Master Plan

The Master Plan formulation process was divided into five steps, namely: i) study procedure, ii) review of past activities and clarification of present condition, iii) formulation of countermeasures and implementation schedule, iv) preparation of draft Master Plan, and v) finalisation of Master Plan. The following inputs were provided by the concerned stakeholders for each step (Figure 9.1).



Source: JICA Study Team

Figure 9.1 Master Plan Formulation Process

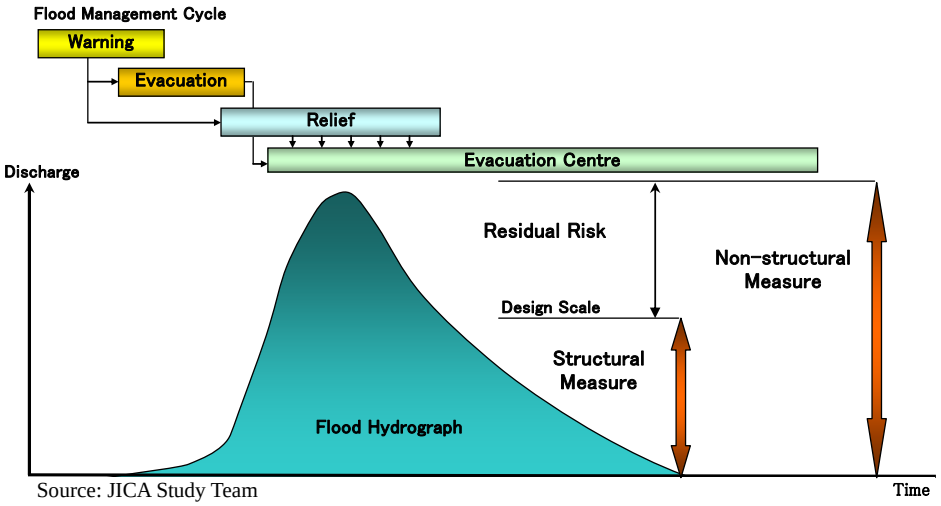
9.2 Target Year

Flood management is a long-term and ongoing process, beginning prior to the occurrence of a disaster, and is directed at reducing future flood damage to the community. The Master Plan was formulated with phased development of short, medium and long-term plans. However, one serious concern is the lack of available financial resources. The total development costs for nationwide water-related facilities were estimated at 1,947.5 million KShs for the fiscal year 2006/2007, of which KShs 45 million was allocated to flood control works in the Nyando River Basin. The accumulated total available budgetary resources to the year 2020 for the Nyando River Basin are estimated at KShs.630 million, although this assumes that the present budgetary resources would be increased in proportion to projected GDP growth.

Hence, the Action Plans to be developed for achievement of integrated flood management have been designed under the assumption that the short and medium-term plans would be achieved by the year 2020 as the intermediate target. The long-term plan has been formulated for future implementation after the year 2020.

9.3 Structural and Non-structural Measures against Residual Risk

Despite of protection measures at the planning and operational level, flood risk cannot be eliminated. This remaining risk is called residual risk and describes the amount of risk after the application of structural or non-structural flood mitigation measures as shown in Figure 9.2.



Source: JICA Study Team

Figure 9.2 Structural and Non-structural Measures against Residual Risk

People should be aware that structural mitigation measures do not exclude all kinds of risk. Reasons for this may have technical or financial aspects. Residual risks of flooding arise when the constructed flood control measures, control system, applied structures or systems are subjected to unquantifiable or extreme events. The events may exceed the design parameters and cause overtopping of the structures. This could also occur due to the structural failure or subsequent collapse of sections of the structures due to any large forces.

9.4 Design Peak Discharge

The 1GD3 water level gauging station is located at the upper point of the flood plain in the Nyando river basin after joining the largest tributary, the Ainamutua River. The flow at 1GD3 is completely confined by the hilly banks on both sides without any diffusion of flood flow.

By including the most recent data at the 1GD3 stations from 2000 to 2004 along with the previous recorded data, a probability analysis by return period of annual maximum flood discharges was made. The estimated probable discharges along with a comparison with the earlier values are summarised in Table 9.1

Table 9.1 Probable Discharges by Return Period

(Unit : m^3/sec)

Return Period (year)	This Study (2006)	Master Plan in the Past		
		WMO(2004)	JICA(1992)	M/P(1983)
5	610			450
10	730	863	437	550
25	890	1,044	564	650
50	1,000	1,178	659	750
100	1,130	1,310	752	850

Source : JICA Study Team

9.5 Optimum Development Scale

The net present value and economic index (B-C and B/C) are shown in Table 9.2. The variation of B-C and B/C are shown in Figure 9.3. The scale for 10 years indicates highest B/C.

Table 9.2 Summary of Cost and Damage

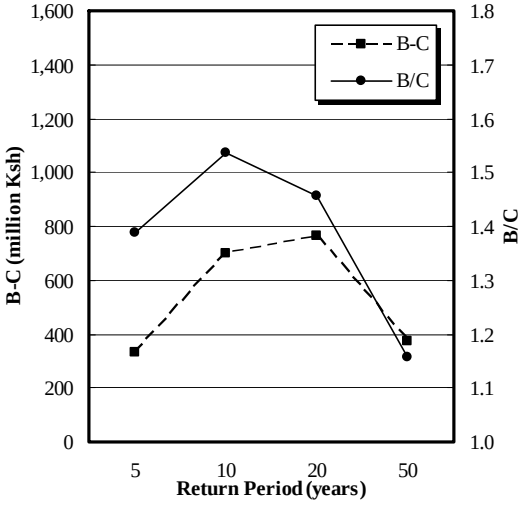
ITEM		Unit	Return Period (years)			
			5	10	20	50
I. Magnitude of Flood						
1) Peak Discharge		m^3/s	600	730	850	1,010
2) Inundation Volume		MCM	381.7	412.6	441.0	478.9
II. Cost : Dyke Construction						
1) Cross Sectional Area for Dyke		m^2	5.61	8.58	11.52	15.52
2) Construction Cost		M. Ksh.	1,355	2,074	2,785	3,752
III. Benefit : Flood Damage						
1) Agricultural Product		M. Ksh.	623.93	674.30	720.80	782.80
2) Repair Cost						
2.1) Road	Submerged	km	8.66	9.35	10.00	10.86
	Cost	M. Ksh.	67.52	72.97	78.00	84.71
2.2) House	Submerged	nos.	51,412	55,562	59,394	64,503
	Cost	M. Ksh.	682.72	737.84	788.72	856.56
3) Economic Stagnation due to Road Closing						
3.1) Detour	Period	days	18.00	24.00	30.00	37.00
	Cost	M. Ksh.	14.34	19.01	23.31	29.05
3.2) Economic Stagnation Cost		M. Ksh.	28.53	37.80	46.36	57.77
4) Relief Operation Cost		M. Ksh.	37.00	37.00	37.00	37.00
5) Total Flood Damage		M. Ksh.	1,454.04	1,578.92	1,694.19	1,847.89
IV. Economic Index						
1) Net Present Value with discount rate of 10%						
1.1) Cost		M. Ksh.	854.4	1,307.9	1,681.9	2,365.8
1.2) Annual Average Flood Damage		M. Ksh.	1,186.3	2,008.0	2,448.8	2,737.2
2) Cost and Benefit Index						
2.1) B/C			1.388	1.535	1.456	1.157
2.2) B-C		M. Ksh.	331.9	700.1	766.9	371.3

Note : M.Ksh. shows Million Kenya Shillings.

Source: JICA Study Team

The relationship between the annual flood damage and the development cost for flood mitigation measures was also evaluated.

From the economic viewpoint, the magnitude of a design flood once in 10 years, which is also almost equivalent to a 25-year event as per earlier study conducted, is the most viable development scale. Hence, the protection level of once in 10 years was adopted as the optimum development scale for the structural measures for the year 2020.



Source: JICA Study Team

Figure 9.3 Economic Index

9.6 Structural Measure

In line with the discussion held with government agencies, Nyando Forum, Water Resource Users Association (WRUA), and community people, the following recommendations were incorporated for the selection of structural measures.

1) Improvement of Lower Nyando River

   To protect against a 10-year probable flood, the lower Nyando River is to be improved by constructing new dikes and increasing the widths and heights of the existing dikes. During the construction of new dikes and increase of height of the existing dikes, drainage channels along the dikes are to be provided. This will improve the drainage system in the land area. In addition, ramps will be constructed to permit easy approach to the river channel.

2) River Channel Improvement of Awach Kano and Nyaidho Rivers

   The lower reaches of Awach Kano and Nyaidho rivers including Asawo are to be improved by a constructing dike system and de-siltation of the existing river channels. This will provide protection against 5-year probable floods.

3) Improvement of Nyamasaria and Other Rivers

   The Nyamasaria, Luando, Ombeyi and Miriu rivers are also need to be improved, mainly by constructing dike systems and de-siltation of the existing river channels. This will provide a protection against 5-year probable floods. For flash flood countermeasures, construction of slit type weirs in the channel and planting trees along the river banks are proposed. This will reduce the high flow velocity and serve as sediment traps.

4) Improvement of Drainage Condition along National Road A1 in Awach Kano Basin

   A new drainage channel is to be constructed along the National Road A1 to guide runoff towards adjacent rivers. In addition to this, additional culverts are also need to be constructed. Such improvement and construction will promptly drain out the water and prevent stagnation.

5) Improvement of Drainage Conditions along National Road A1 in the stretches from Nyamasaria to Nyando Rivers

   A new drainage channel is to be constructed along National Road A1 as a channel to guide the run off toward adjacent rivers and to promptly drain out the water and prevent stagnation. A culvert crossing over the channel also needs to be constructed.

6) Raising Local Roads

   During the earlier floods, almost all local roads were submerged. To cope with such situation, raising the levels of the local roads is one of solutions. Table 9.3 summarises the description of the local roads that needs to be raised.

Table 9.3 Road Raising Work

Item	Description	Remarks
Raising local roads		
1.Road from Ahero to Ombeyi	10 km	raising: 1 m
2.Road along Ombeyi swamp	12 km	raising: 1 m
3.Roads in lower basin	15 km in total	raising: 1 m

Source: JICA Study Team

7) Countermeasure for Climate Change

a) Development of Water Pan

Water pans are shallow natural or man-made depressions on the ground surface where water can be collected from surface runoff or directed from nearby streams. Water pans are most commonly used in flood prone areas of Nyando river basin for domestic, irrigation and livestock watering. Flood water is stored during wet season and the stored water is utilized during dry season.

There are two main types of water pan construction. The first is a simple excavated pit in flat areas or in existing depressions. Secondly embankment ponds can also be constructed to retain water within an earth embankment comprising impervious soils. The capacity of water pans ranges from a few hundred cubic metres for natural depressions and small man-made pans to 20,000m^3 for the MWI standard large capacity design.

b) Development of Reservoir

The flood control dam scheme is addressed in the structural measures. In this Study, three promising dams are proposed to be constructed to further raise the safety level during extraordinary flood events that could affect the whole basin. The detailed dam functions are either single purpose or multipurpose, and dam dimensions need to be studied in a future stage. Also, it is recommended that other dams be considered in the long term programme in a succeeding stage after completion of the said three dams.

Site reconnaissance was executed in March 2007 and the socio-economic condition for three dam sites was preliminarily inspected. Among the dam sites, the development of Nyando and Kibos dams is included in the Master Plan.

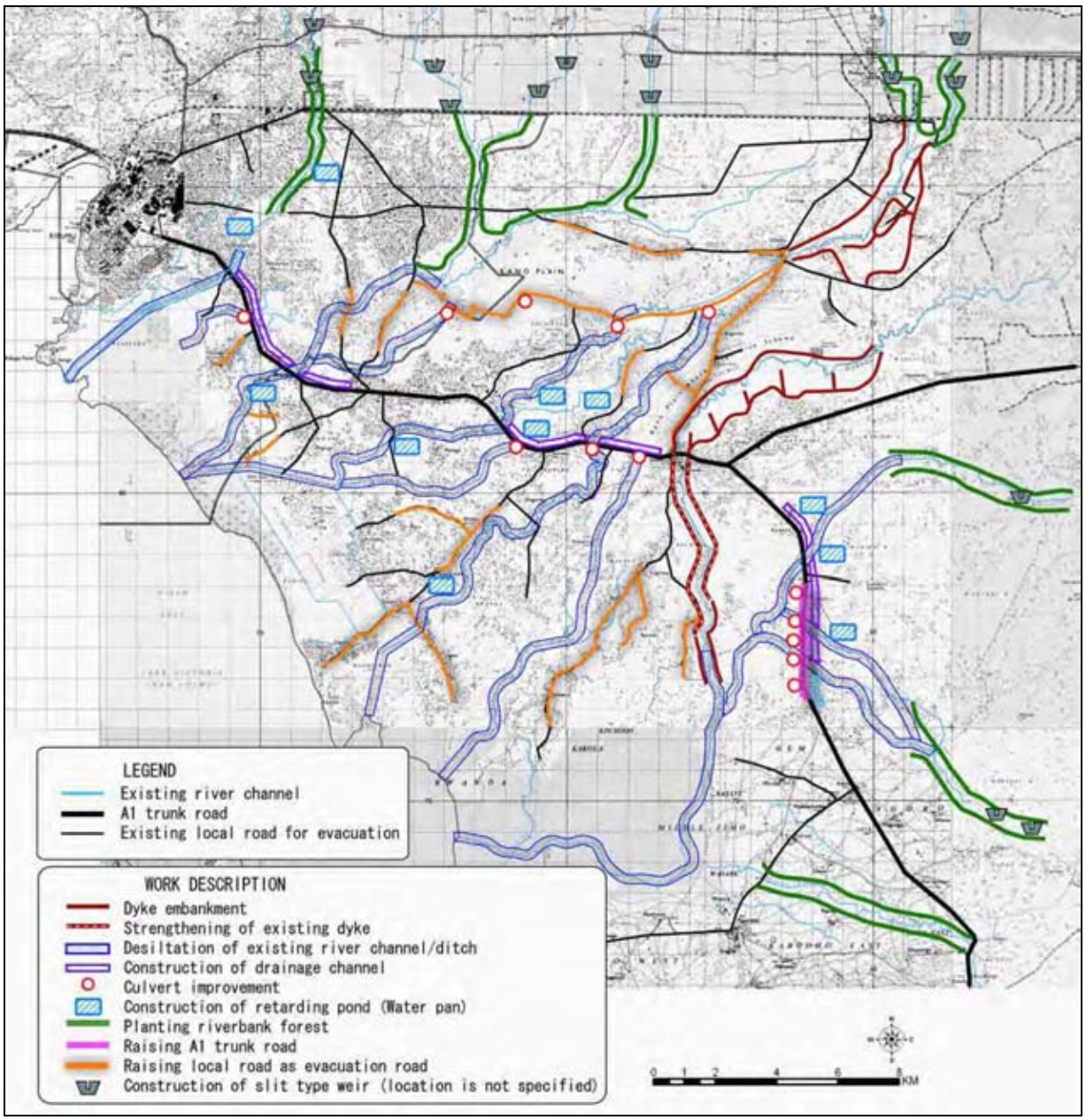
c) Restoring Hydrological Balance in the Nyando River Basin

The bulk of stream flow is produced in the upper and middle catchments of the Nyando river basin. However, the land's capacity to hold rainwater decreases due to encroachments on forest catchments, cultivation on steep slopes and prevalence of shallow soil areas.
Therefore, the land's capacity to hold rainwater should be restored so as to maximise infiltration in line with the principle of holding the rainwater where it falls.
The interventions, such as i) intervention in land use in the slope areas and ii) intervention to recreate hydrological buffer zones should be applied to restore hydrological balance in the basin.

(4) Arrangement of Structural Measure

Target is to strengthen the social mitigation capacity in the lower basin. This will assist in reducing the serious damage caused by frequent flooding and inundation in the lower Nyando and Nyamasaria rivers.

The structural measures proposed in this Study as illustrated in Figure 9.4 are divided into six categories; 1) raising evacuation roads, 2) dyke development, 3) river training, 4) de-silting, 5) retarding pond, and 6) catchment conservation for tributaries.



Source: JICA Study Team

Figure 9.4 Structure Measures Proposed in the Master Plan

(5) Implementation Plan

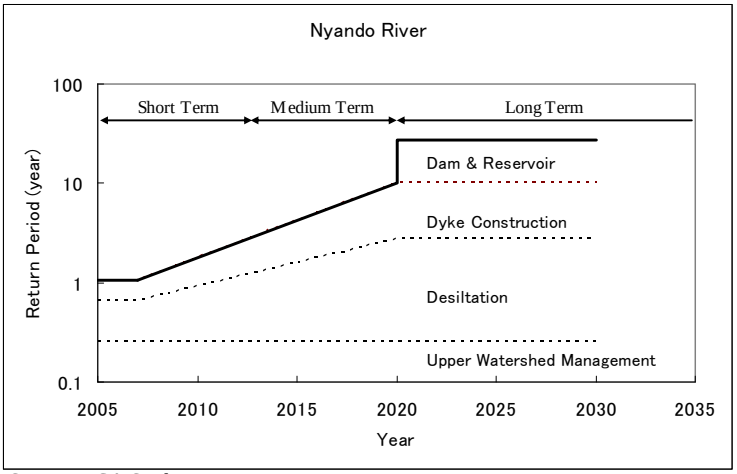
The targets for the implementation by phases are as follows.

Short Term : By the target year 2012, the lower catchment of the Nyando River Basin will be secured against flood from the main river channel of the Nyando River, provided the required financial resources are made available. In line with the concept of integrated flood management, the government assisted, community participatory works including non-structural measures will be carried out every year to manage residual risk for extraordinary floods beyond the flood magnitude of once in 10 years. The community initiated works will be executed by the community based organisations.

Medium Term : By the target year 2020, the de-siltation work and embankments along the downstream stretches of adjacent rivers will be completed. This will ensure the safety against floods of the magnitude of once in 5 years. In addition to the the development of dams and reservoirs on the Nyando and Kibos rivers, which increases the safety against the flood after the year 2021, the installation of telemetered flood forecasting and warning systems will also be done. Both community participatory works with government assistance and community initiated works will be continuously carried out.

Long Term : To maintain the condition accomplished by the target year 2020, the operation and maintenance works for structural and non-structural measures will be carried out. The community participatory works with government assistance will be carried out in line with the concept of the disaster management cycle and along with community initiated works.

The incremental levels of flood protection throughout the implementation of the phased development are illustrated in Figure 9.5.



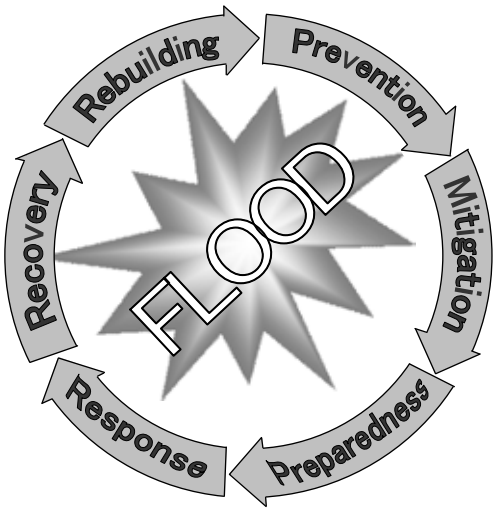
Source: JICA Study Team

Figure 9.5 Flood Protection Level in the Nyando River

9.7 Non-Structure Measures

(1) Continuous Process of Flood Management

Non-structural measures aim to reduce or avoid the potential losses from hazards, assure prompt and appropriate assistance to victims of disasters, and achieve rapid and effective recovery. The continuous process of the cycle as shown in Figure 9.6 illustrates the ongoing process which are planned by governments, businesses, and civil society. Such process facilitate in reducing the impact of disasters, quick reaction during and immediately following a disaster, and the steps for the early recovery after the occurrence of disaster. Appropriate actions at all points in the cycle lead to better preparedness, better warnings, reduced vulnerability or the prevention of disasters during the next iteration of the cycle. Furthermore, the complete integrated flood management cycle assist in formulating or modifying the public policies and plan to mitigate the effects of disaster on people, property, and infrastructure.



Source: Speightstown Community Disaster Management Plan, (JICA, 2006)

Figure 9.6 Flood Management Cycle

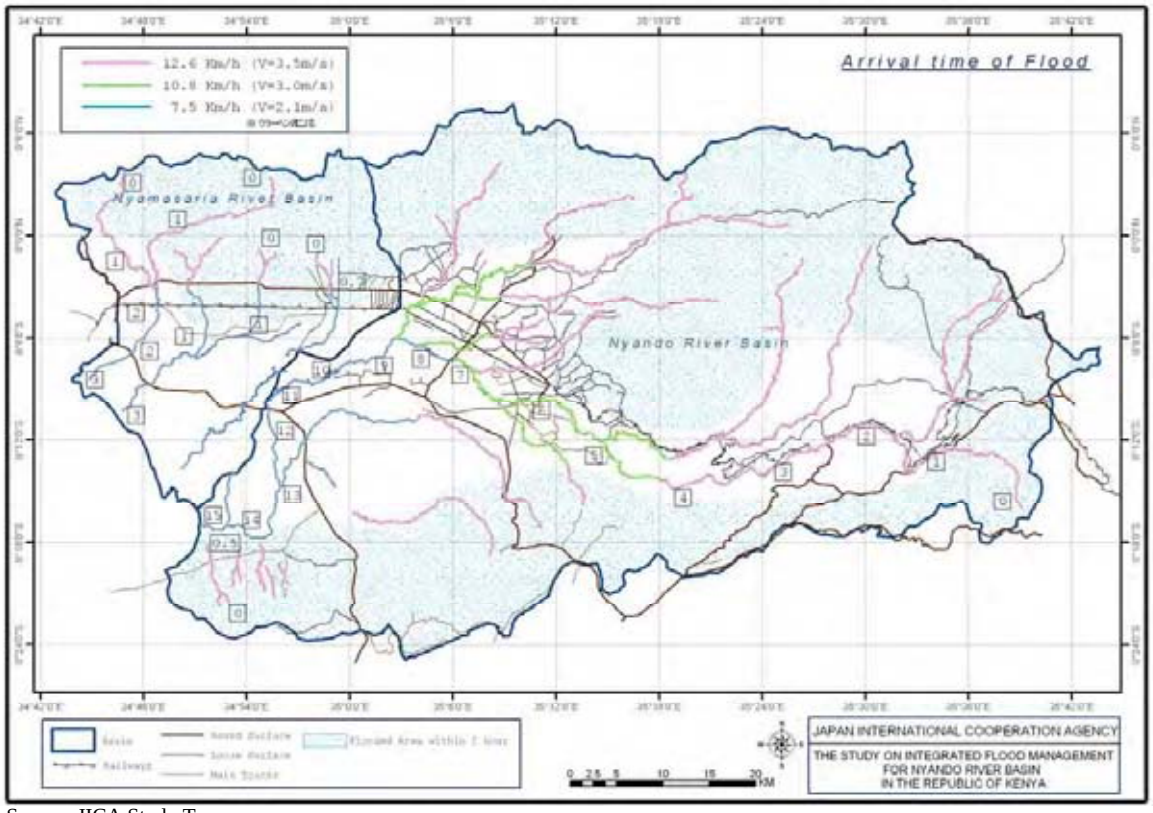
The mitigation and preparedness phases are meant for improvement of integrated flood management in anticipation of a flood. Developmental considerations play a key role in contributing to the mitigation and preparation of a community to confront a disaster in effective manner. As a disaster occurs, disaster management organisations gets involved in the immediate response and long-term recovery phases. The four disaster management phases, mitigation, preparedness, response and recovery, do not always, or even generally, occur in isolation or in this precise order for the sustainable development of non-structural measures. Phases of the cycle often overlap and the duration of each phase greatly depends on the severity of flooding.

- ***Prevention/Mitigation*** : Minimising the effects of disaster. (building codes and zoning, vulnerability analyses, public education)
- ***Preparedness*** : Planning how to respond. (preparedness plans; emergency exercises/training; warning systems)
- ***Response*** : Efforts to minimise the hazards created by a disaster. (search and rescue; emergency relief)
- ***Recovery*** : Returning the community to normal in the short-term. (temporary shelter, evacuation centre, grants; medical care)
- ***Rebuilding*** : Returning the community to normal in the long-term. (community infrastructure and houses)

(2) Flood Forecasting and Warning System

1) Travelling Time of Flood

Figure 9.7 shows estimated travel time of flood flows at various points. It has been estimated by assuming average velocity against riverbed gradient. The flooding conditions are characterised by the flood flow with fast velocity and short travel time. This level of flood flow reaches after the rainfall of 10 hours at Ahero in the Nyando main river, and 1 to 2 hours at A1 trunk road in the Awach Kano and Nyamasaria rivers.



Source: JICA Study Team

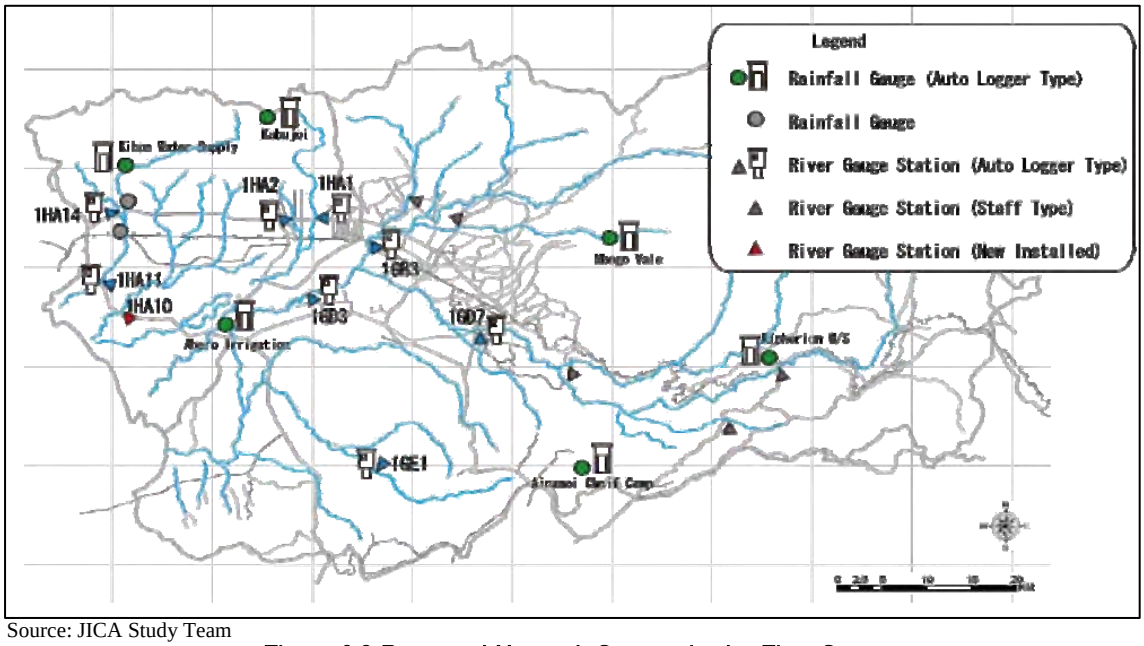
Figure 9.7 Travel Time of Flood Flows at Various Points

Accurate and prompt information regarding flooding is considerably important and necessary in the pre-flood time ahead of warnings and evacuation orders to the subject areas. The phased development plan for flood forecasting and warning system is proposed.

2) Short Term Plan

Figure 9.8 illustrates a proposed monitoring system as the first stage in the Nyando River Basin. As mentioned above, several key stations will be replaced with automatic recording type stations in addition to the existing three stations (1GD03, 1GB03 and 1GB07) and stations to be rehabilitated in the coming dry season by WRMA (as of November 2006).

The following services would be possible to achieve with the rehabilitated monitoring system after the first stage. 1) Accumulation of rainfall and water level data, 2) Clarification of relationship between rainfall and water level, 3) Simple forecasting of water levels at the lower key points through the above relationship, and 4) Data accumulation for flood forecasting and warning systems.

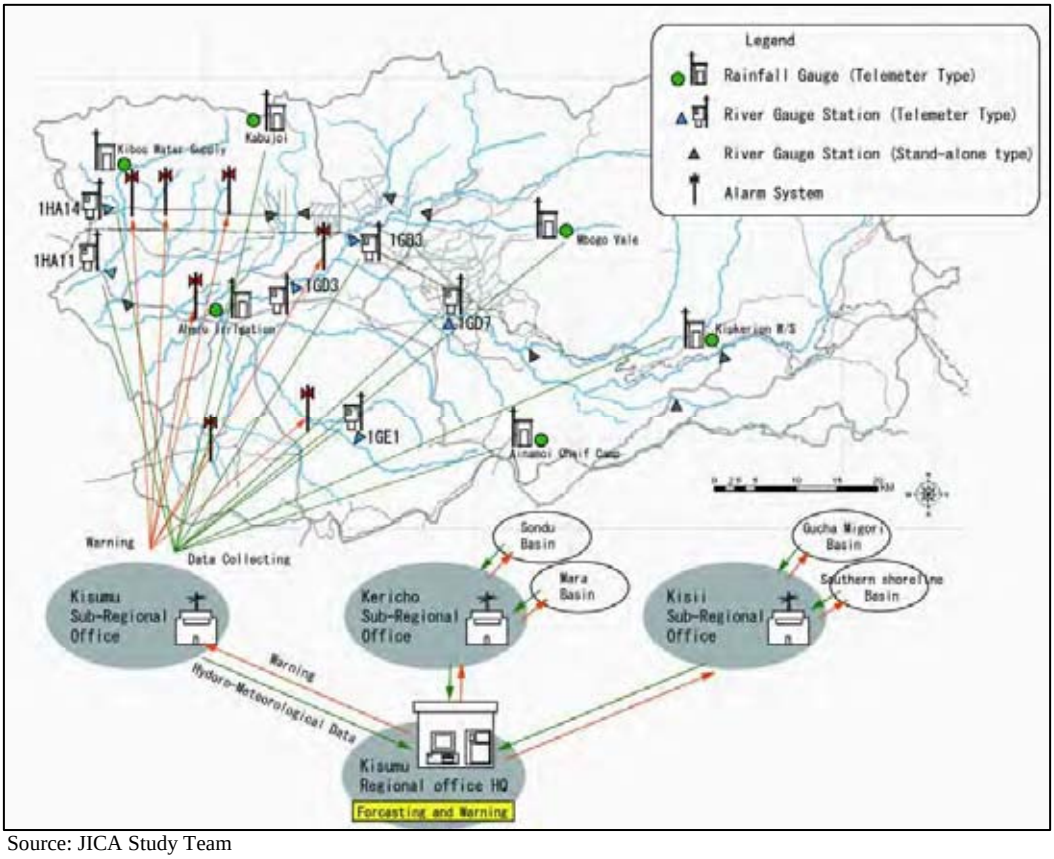


Source: JICA Study Team

Figure 9.8 Proposed Network System in the First Stage

3) Medium Term Plan

Figure 9.9 illustrates the proposed monitoring, forecasting and warning systems in the Nyando River Basin during the second stage. WRMA regional office will be the forecasting centre. Required data and information at the centre will be communicated through the sub regional offices. Notification of warnings and evacuation orders to the subject areas is to be made by the sub regional offices.

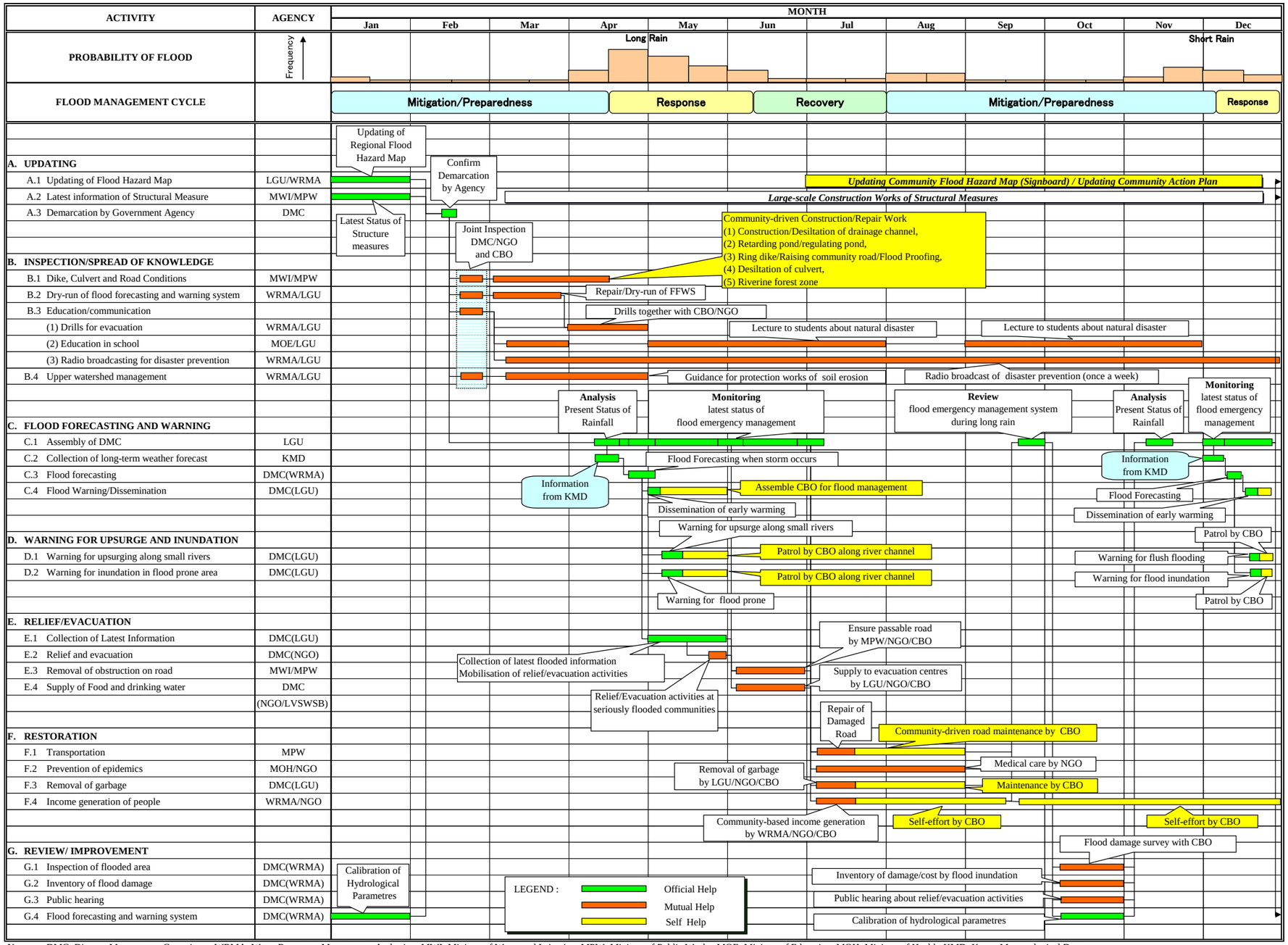


Source: JICA Study Team

Figure 9.9 Proposed Network System in the Second Stage

(3) Community-driven Integrated Flood Management based on Flood Management Cycle

Non-structural measures to manage flood inundation are to be incorporated in order to cope with extraordinary floods beyond the control of structural measures. Figure 9.10 shows flood emergency management that takes flood management cycle into consideration.



Note : DMC; Disaster Management Committee, WRMA; Water Resources Management Authority, MWI; Ministry of Water and Irrigation, MPW; Ministry of Public Works; MOE; Ministry of Education, MOH; Ministry of Health, KMD; Kenya Meteorological Department, LVSWSB; Lake Victoria South Water Services Board, LGU; Local Government Unit (Province & District), NGO; Non-Governmental Organisation, CBO; Community-based Organisation

Source: JICA Study Team (2006)

Figure 9.10 Schematic Diagram of Flood Emergency Management in Nyando River Basin


Updating Flood Hazard Map (Public Hearing)


DMC Meeting


Collection of the Latest River Structure Information


Collection of River Flow Conditions


River Monitoring


Evacuation Drill


Upper Watershed Management


Flood Management Education


Dissemination of Evacuation Order


Restoration Works

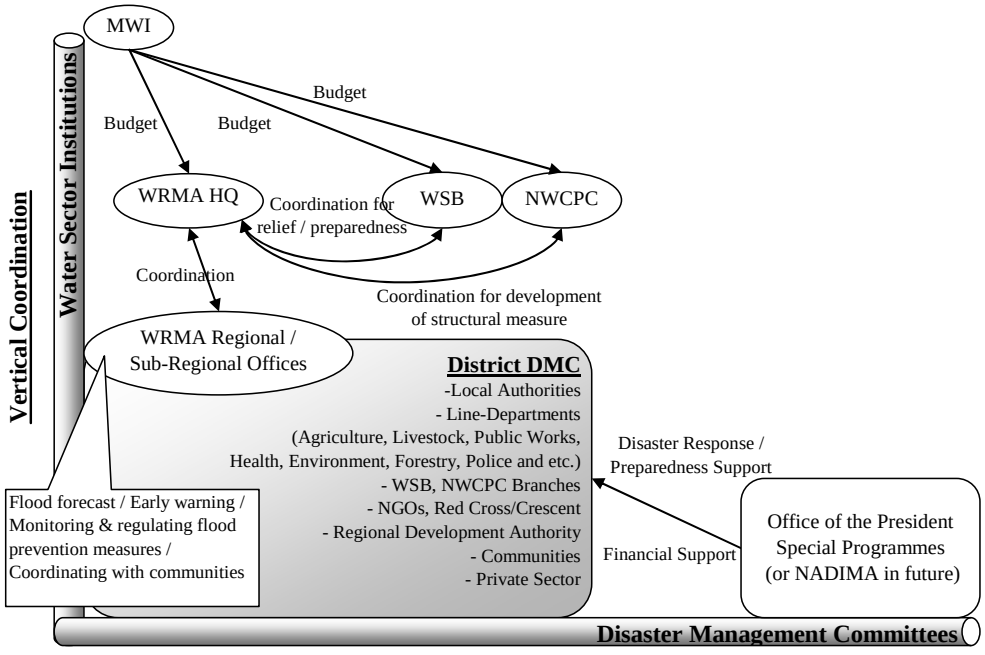
10. Institutional Framework in Master Plan

10.1 Institutional Roles and Responsibility in Structural Measures

Because of the water sector reform, the arrangement of roles and responsibilities among the institutions within the sector are still on-going, particularly in the area of water resources management. In level 1 and 2, WRMA will play a regulatory role in capacity building of the communities, water storage development including water pans, small dams, rainwater harvesting, and river bank / catchment protection. In level 3, WRMA will be a financier through MWI at the planning stage of the large-scale water storage and flood protection works. During implementation stage, again it will be playing a regulatory and inspection role for the construction works.

10.2 Institutional Setup in Integrated Flood Management

In the concept on institutional framework for flood management, the key is to integrate the water sector institutions (vertical axis) and the existing disaster management scheme framework under the Office of President, and establish the Disaster Management Centre as the core authority for regional disaster management. WRMA utilising its own data and information resources should become an important authority to connect the water sector institutions and disaster management committees, specifically in the area of flood forecasting and early warning systems. The aforementioned comprehensive approach can be conceptualised as in the following figure.



Source: JICA Study Team

Figure 10.1 Conceptual Institutional Framework for Flood Management

In the current framework of disaster management, there is no presence of WRMA as a water resources regulator. Thus, it is the necessity that WRMA become a key member of the committee and mainly be responsible for a) flood forecasting and early warning systems, b) coordination of river bank

protection and de-siltation of drainages in collaboration with communities and NWCPC, c) community mobilisation and capacity building.

In addition to the official help as mentioned above, mutual help with community and self-help of community are important in flood management. The pilot project as explained in Chapter 15-18 showed the importance and effectiveness of both mutual and self-helps through the capacity building programme for communities. These aspects were considered in the master plan as community participatory and community initiative works.

10.3 Capacity Building Plan

In parallel to setting the institutional framework, capacity building for flood management should also be conducted for the key players in the framework.

The table below presents the proposed capacity building plan for the key players.

Table 10.1 Capacity Development Plan

Key Players	Activities
WRMA	- Training on flood forecasting / early warning - Flood forecasting drills for testing and verification in collaboration with DMC and communities - Early warning drills for test and verification in collaboration with DMC and communities - Training on community relations / mobilisations - Appropriate staff recruitment - Procurement of necessary equipment
DMC	- Training on community sensitisation on disaster management in collaboration with NGO - Members training on disaster management / response / preparedness in collaboration with NGO - Drills on emergency response in collaboration with WRMA, line ministries and NGO - Training on disaster damage assessment and situation report in collaboration with WRMA - Deployment of appropriate supporting staff / technical staff - Procurement of necessary equipment
Communities	- Training on coordination with school, health centres and others as evacuation centres - Collective trainings for information dissemination and evacuation - Establishment and test of information channels and flows - Sharing roles among community members - Training on coordination with WRMA and DMC - Drills on disseminating early warning information within the community and evacuation - Search training for disaster victim and physical damage with WRMA and DMC

Source: JICA Study Team

11. Environmental Consideration in Master Plan

(1) EIA and Environmental Permits

The EIA reports have not been prepared so far for the Master Plan. According to Section 58 of the Environmental Law, EIA is required for all development activities, including proposed structures. Environmental management and monitoring plans will be required in accordance with the Environmental Management and Coordination Act (1999), which is regulated by the National Environmental Management Authority (NEMA).

(2) Public Consultation

Although the features of the project have been discussed with members of the Forum, no consultations have been held directly with the general public in the Project Area. In the EIA process, public consultation meetings and meetings with communities who will be affected by the proposed work must be conducted.

(3) Water Quality

Dredging work itself will have a positive impact on the water quality after implementation of the proposed works. However, it is to be noted that there may be a temporary deterioration of water quality during dredging works. Therefore, confirmation of the impacts and monitoring activities will be required.

(4) Ecosystem

The swamp area is located along the shores of Lake Victoria near the Nyando River. The area occupies an area of about 7,000 ha and extends for approximately 15 km towards the mouth of the Nyando River. Papyrus, bulrushes, and reeds are growing densely in the swamp area. The human population density is almost nil in the swamp area. According to NEMA Regional Office, there is limited existence of important animal species. There are no endemic, endangered or critically important plant species occurring in the flood prone area. In order to avoid negative impacts on the swamp area ecosystem, the dike along the Nyando River will be constructed ahead of the entrance to the swamp area.

(5) Resettlement

Construction of the dike will require some involuntary resettlement. Some houses located along the river bank falls in the area nominated for dike construction in the Nyando River. In addition, some houses are located between the Nyando River and the planned bank. By considering the situation of the Nyando River, a land acquisition and resettlement plan should be prepared as part of the EIA process.

12. Implementation Schedule

The following implementation schedule was prepared as phased development; namely, short (2007-2012), medium (2013-2020) and long-term (after 2021). The short-term plan aims to strengthen the currently existing dykes, establish a network of evacuation roads in flood prone areas, and de-silt currently clogged river channels. The medium-term plan aims to reduce flood peak discharge by structural measures including two dams and the non-structural measures such as establishment of flood forecasting and warning systems. The long-term plan is for expansion of the flood management system to all the communities situated in flood prone areas.

Table 12.1 Implementation Schedule

DESCRIPTION	Government Agency			Implementation Schedule		
	Coordi-nation	Executing	O&M	Short	Medium	Long
STRUCTURAL MEASURES						
A. NYANDO RIVER IMPROVEMENT	WRMA	NWCPC	WRMA			
a.1 Dike system in lower/middle reach				●		
a.2 Desiltation/Channelling in swamp area in downstream end					●	
B. AWACH KANO RIVER BASIN IMPROVEMENT	WRMA	NWCPC	WRMA			
b.1 Desiltation in Awach Kano river				●	●	
b.2 Desiltation in Tributary of Awach Kano				●	●	
b.3 Desiltation in Nyaidho river					●	
C. DRAINAGE IMPROVEMENT IN AWACH KANO BASIN						
c.1 Drainage improvement along A1 National Road	WRMA	NWCPC	WRMA		●	
c.2 Raising of A1 National Road (Ahero - Katito Section)	WRMA	MOPW	MOPW	●		
D. NYAMASARIA RIVER BASIN IMPROVEMENT	WRMA	NWCPC	WRMA			
d.1 Desiltation in Nyamasaria river and ditch					●	
d.2 Desiltation in Luando river					●	
d.3 Desiltation in Ombeyi river and ditch					●	
d.4 Desiltation in Miriu river and ditch					●	
d.5 Dyke construction in Oroba river					●	
E. DRAINAGE IMPROVEMENT IN NYAMASARIA BASIN	WRMA	NWCPC	WRMA			
e.1 Construction of drainage channel along A1 trunk road					●	
F. RAISING SECONDARY ROAD	WRMA	MOPW	WRMA			
f.1 Raising secondary road as evacuation road				●		
G. DAM AND RESERVOIR	WRMA	LBDA	LBDA			
g.1 Two dams, (Nyando and Kibos)					●	
H. SEDIMENT RETENTION AND EROSION PROTECTION	WRMA	NWCPC	WRMA			
h.1 Middle/Upstream catchment of small rivers					●	●
NON-STRUCTURAL MEASURE/COMMUNITY PARTICIPATORY WORKS WITH GOVERNMENT ASSISTANCE						
A. DISASTER MANAGEMENT CENTRE						
a.1 Main Building and Branch Office	OP/LA	OP	OP/LA	●	●	
B. FLOOD EMERGENCY MANAGEMENT						
b.1 Updating of Flood Preparedness	DMC	WRMA	WRMA	●	●	●
b.2 Inspection/Spread of Knowledge for Disaster Prevention	DMC	Cty/LA	Cty/LA	●	●	●
b.3 Relief/Evacuation	DMC	OP/LA	Cty/LA	●	●	●
b.4 Restoration	DMC	Cty/LA	Cty/LA	●	●	●
b.5 Review/Improvement	DMC	WRMA	WRMA	●	●	●
C. FLOOD FORECASTING AND WARNING SYSTEM						
c.1 Installation of Monitoring Station	WRMA	WRMA	WRMA	●		
c.2 Installation of Telemetering Station/Warning Station	WRMA	WRMA	WRMA	●	●	
c.3 Installation of Additional Station	WRMA	WRMA	WRMA	●	●	●
c.4 Operation and Maintenance	WRMA	WRMA	WRMA	●	●	●
D. UPPER WATERSHED MANAGEMENT						
d.1 Guidance for Restoring Hydrological Balance	WRMA	MOA	Cty	●	●	●
d.2 Guidance for Protection of Soil Erosion	WRMA	MOA	Cty	●	●	●
COMMUNITY INITIATIVE WORKS						
A. COMMUNITY SURVEY	WRMA	WRMA	Cty	●	●	
B. FLOOD MANAGEMENT TRAINING	WRMA	WRMA	Cty	●	●	
C. COMMUNITY-DRIVEN STRUCTURAL MEASURE (Including retarding pond)	WRMA	Cty	Cty	●	●	
D. O&M OF COMMUNITY-DRIVEN STRUCTURAL MEASURE	WRMA	Cty	Cty	●	●	●
E. MONITORING AND EVALUATION	WRMA	WRMA	Cty	●	●	●

Note : Short-term : 2007-2012, Medium-Term : 2013-2020, Long Term : after 2021

Legend: Cty: Communities MOPW: Ministry of Public Works OP: Office of the President MOA : Ministry of Agriculture
LA: Local Authority NWCPC: National Water Conservation and Pipeline Corporation
WRMA: Water Resources Management Authority DMC : Disaster Management Committee
LBDA: Lake Basin Development Authority

13. Preliminary Cost Estimate for Master Plan

The total cost of 11,810 million Ksh has been estimated. The total cost has been broken down into 7,532 million Ksh for structural measures, 1,590 million Ksh for community participatory works with government assistance and 2,688 million Ksh for community initiative works. The required costs by stages are shown in Table 13.1.

Table 13.1 Preliminary Cost Estimate for Master Plan

(Million Ksh)

DESCRIPTION	SHORT (2007-2012)	MEDIUM (2013-2020)	LONG (after 2021)	TOTAL
A. STRUCTURAL MEASURE				
1 Nyando River Improvement	1,362.94			1,362.94
2 Nyando River Improvement (Swamp Area)		192.00		192.00
3 Awach Kano River Improvement	33.06	140.08		173.14
4 Tributary of Awach Kano Improvement	24.40	152.03		176.43
5 Nyaido River Improvement		50.04		50.04
6 Drainage Improvement along A1 (Ahero-Katito)		33.54		33.54
7 Raising of A1 National Road	660.00			660.00
8 Nyamasaria River Improvement		70.35		70.35
9 Luando River Improvement		276.68		276.68
10 Ombeyi River Improvement		186.91		186.91
11 Miriu River Improvement		224.18		224.18
12 Oroba River Improvement		173.21		173.21
13 Drainage Improvement along A1 (Kisumu-Ahero)		52.38		52.38
14 Raising of Secondary Road	273.00			273.00
15 Dam Development (Nyando, Kibos)		3,300.00		3,300.00
16 Sediment retention/Flush flood countermeasure		93.56	233.93	327.49
Sub-total of Item A	2,353.40	4,944.96	233.93	7,532.29
B. COMMUNITY PARTICIPATORY WORKS WITH GOVERNMENT ASSISTANCE				
1 Disaster management centre	60.00	35.00		95.00
2 Flood emergency management	122.12	120.56	407.00	649.68
3 Flood forecasting and warning system	180.94	167.95	435.01	783.90
4 Upper watershed management	21.36	18.00	22.50	61.86
Sub-total of Item B	384.42	341.51	864.51	1,590.44
C. COMMUNITY INITIATIVE WORKS				
1 Community Survey	54.00	166.00		220.00
2 Flood Management Training	98.00	437.00		535.00
3 Community Structure (Including retarding pond)	294.00	1,311.00		1,605.00
4 O&M of Community Structure	7.00	42.00	55.00	104.00
5 Monitoring and Evaluation	27.00	173.00	24.00	224.00
Sub-total of Item C	480.00	2,129.00	79.00	2,688.00
TOTAL	3,217.82	7,415.47	1,177.44	11,810.73

Source : JICA Study Team

Remarks : Structural measures includes land acquisition cost of 60 million Ksh.
Dam cost in item A.15: from 2004 MWRMD Final Report.

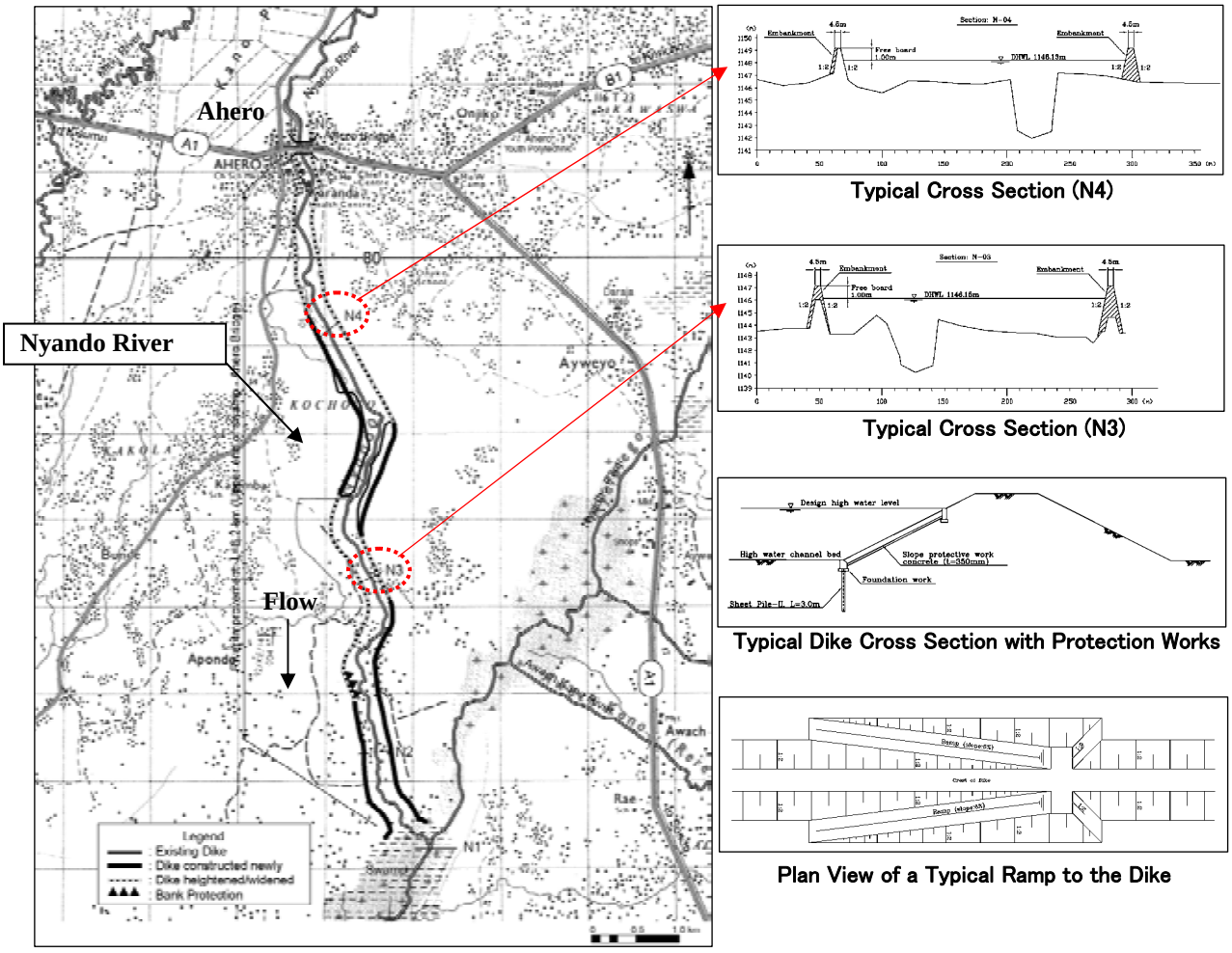
14. Outline of Priority Schemes

14.1 Selected Priority Projects

Among the proposed short-term measures, the highest priority schemes were scrutinised in line with the discussion held during Technical Workshop, Nyando River Basin Water Management Forum, and Technical Sub-committee Meeting. Finally, four priority schemes were confirmed by Steering Committee.

14.2 Strengthening of Existing Dikes (Total Cost: 663.3 Million Kshs)

Several stretches of the existing dikes along the Nyando River downstream from the Ahero Bridge have seriously deteriorated. This is mainly due to insufficient compaction during construction and lack of maintenance. Thus, the dikes should be strengthened using appropriate construction methods. Ramps with gentle slopes should be provided for crossing the dikes as illustrated below.

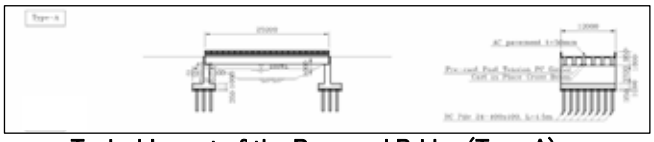


Source: JICA Study Team

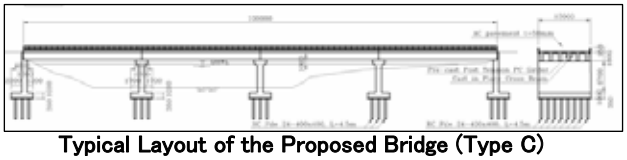
Figure 14.1 Proposed Priority Project for Strengthening of Existing Dikes

14.3 Network of Evacuation Roads Connecting Affected Communities (Total Cost: 933.0 Million Kshs)

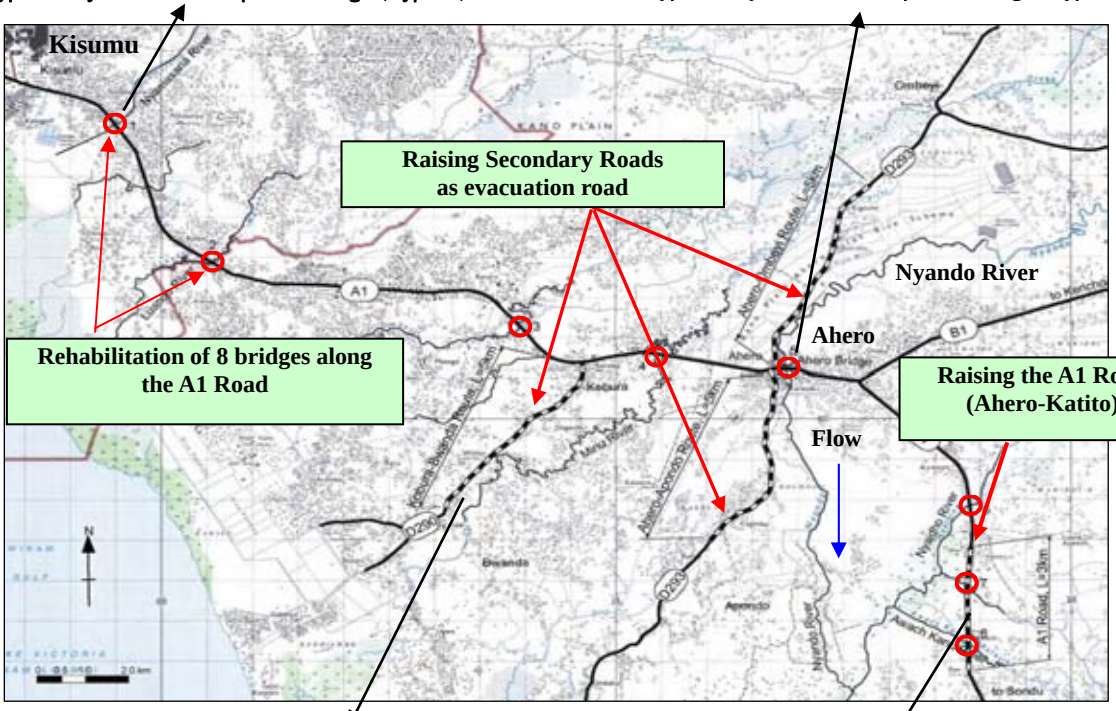
Frequently submerged sections of National Road A1 trunk road should be raised to ensure its role as the main trafficable road for relief and evacuation activities during any emergency. The levels of the road network of community roads connecting to A1 trunk road should also be raised for implementing the community-driven disaster management. In order to secure the traffic ability of the evacuation road and ensure efficient rescue operations, raising the road levels and improvement of bridges has been selected as priority schemes as illustrated below.

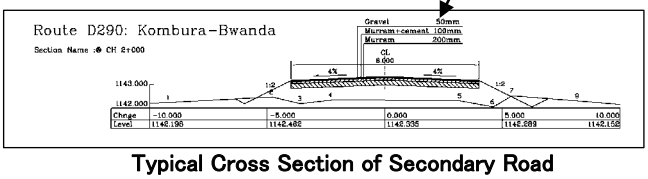


Typical Layout of the Proposed Bridge (Type A)

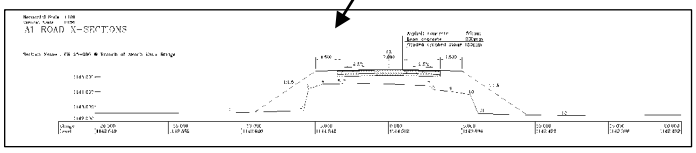


Typical Layout of the Proposed Bridge (Type C)





Typical Cross Section of Secondary Road



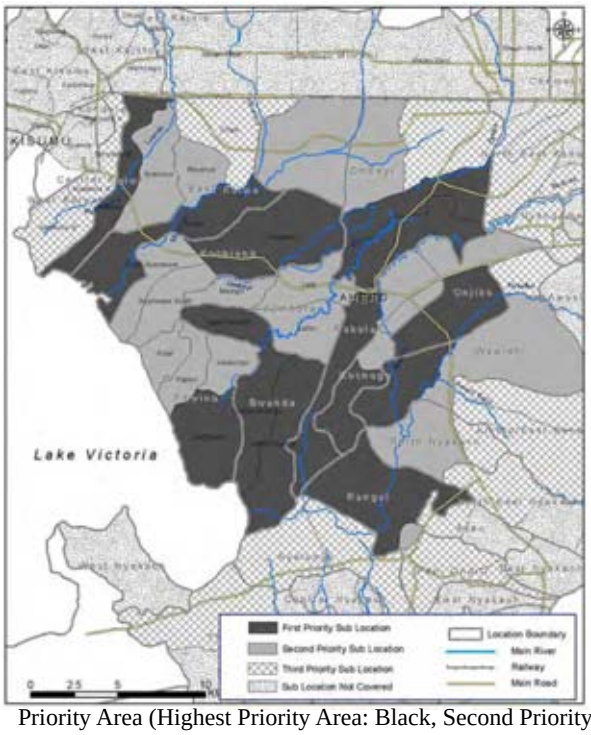
Typical Cross Section of National Road A1

Source: JICA Study Team

Figure 14.2 Proposed Priority Project for Network of Evacuation Roads

14.4 Capacity Development of Community-driven Flood management (Total Cost: 634.8 Million Kshs)

Capacity development for flood management in prioritised communities should be implemented as packaged programmes through: preparation of community flood hazard maps; establishment of community-driven flood management organisations; training in flood management, conducting evacuation drills; and construction of community-driven structural measures. The target communities are located in flood prone areas within the Study Area. The number of communities that requires flood management schemes has been estimated to be around 550, covering 55 sub-locations. The proposed major components and priority areas are shown in Figure 14.3.



Community Based Organisation (CBO) for Flood Management

1. Flood Hazard Mapping
2. Flood Management Planning
3. Community Driven Flood Structures
4. Flood Patrol and O&M
5. Emergency Communication
6. Flood Fighting
7. Community Development
8. Proposal Preparation

Source: JICA Study Team

Priority Area (Highest Priority Area: Black, Second Priority Area: Gray)

Figure 14.3 Proposed Priority Project for Capacity Development

14.5 Establishment of Hydrological Monitoring Network (Total Cost: 11.9 Million Kshs)

Water level gauging stations are located at various sites on the main stream and several major tributaries. However, due to financial constraints, the water level measurement at more than half of the stations has been terminated or abandoned. Thus, the hydrological monitoring network should urgently be refurbished and automatic recorders should be provided at the prioritised water level gauging stations. These efforts will increase the accuracy of flood forecasting and warning systems.

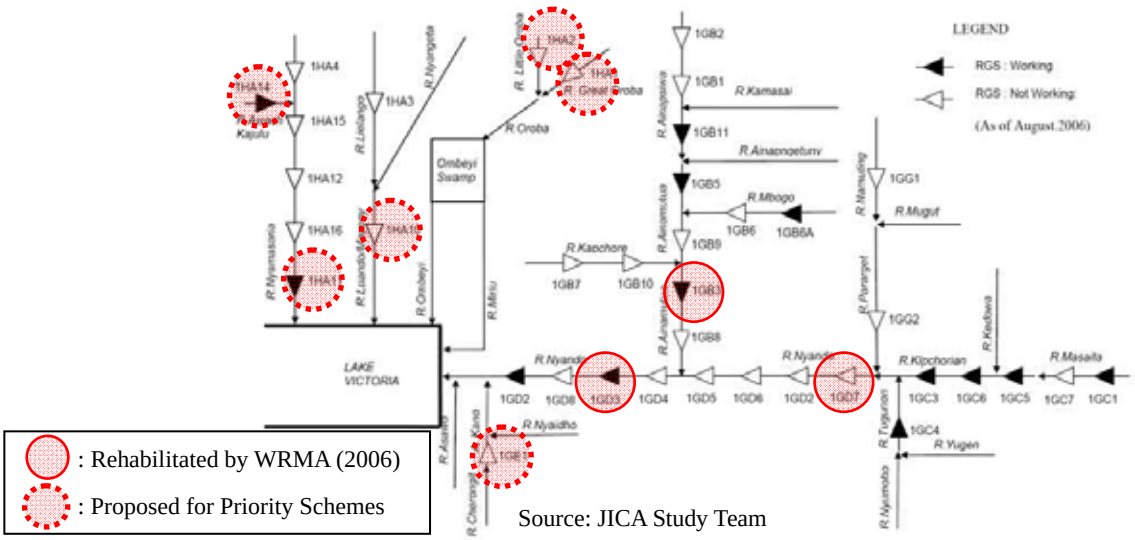


Figure 14.4 Proposed Priority Project for Establishment of Hydrological Monitoring Network

14.6 Preliminary Project Evaluation of Priority Schemes

Depending on the type of projects, the project benefits of the priority schemes can be either tangible, intangible or both. Economic evaluations were conducted for the projects of strengthening of dikes and network of evacuation roads, while qualitative evaluations were conducted for the projects of community capacity development and hydrological monitoring network. The results are shown below.

(1) Strengthening of Existing Dikes and Network of Evacuation Road

Table 14.1 Economic Evaluation of Priority Schemes

Item	1. Strengthening Dikes	2. Network of Evacuation Roads
NPV (Mil. KShs.)	152.3	-276.9
EIRR (%)	12.6	4.6
B/C	1.3	0.5
Switching values	35% increase of project costs	54% decrease of project costs or 115% increase of project benefits

Source: JICA Study Team

(2) Capacity Development of Community-driven Flood management

Community capacity development in flood management will raise awareness about flood disaster and enable to protect human and properties against flood. Furthermore, the Pilot Projects have proved that the community based structural measures within this scheme will have little negative environmental impacts.

(3) Establishment of Hydrological Monitoring Network

In short and long term, this priority scheme will provide a fundamental system for catchment management. The established network will enable in strengthening the WRMA's capacity for catchment management especially in data collection, management and analysis. The enhance evacuation drill activities by the communities will enable them to evacuate effectively when early warning information is dissipated.

(4) Integrated Approach for the Priority Schemes

The four proposed priority schemes are in fact mutually related and the combined results and impacts will facilitate in achieving the project benefits to its maximum. Thus, it is recommended that the four priority schemes should jointly be implemented for their synergistic effects for flood damage mitigation.

15. The Pilot Project: Selection of the Communities

Five pilot projects were implemented under the Study. The objectives was to: i) examine the effectiveness of community-driven flood management comparing both mutual and self help efforts, ii) develop flood management capacity through its implementation, and iii) learn lessons by finalising the priority projects as proposed in the master plan. The following section presents the selection procedure of the target communities.

15.1 Selection of Flood Damage Areas

The First Screening: Selection of Divisions

Based on the information regarding Flood Disaster in Western Kenya prepared by Kenya Flood Security Steering Group (May 2004), the divisions affected by flood in Nyando and Kisumu districts were selected. These divisions are Nyando, Miwani, Lower Nyakach, Winam, and Kadibo and are shown in Figure 15.1.

The Second Screening: Selection of Locations

For Nyando district, the needs assessment made by the JICA Study on Regional Development Programme in Nyando and Homa-Bay Districts was referred. The study results showed that Nyando and Miwani divisions have high priority needs for flood protection. Thus, the two divisions were selected. In addition to the above, the Flood Disaster in Western Kenya study (May 2004), the district disaster management plan, and the programme 'flood mitigation food for work' were reviewed. As a result seven locations (Kochogo, Kakola, Wawidhi, Onjiko, Ombeyi, Nyangoma, North East Kano) in Nyando district and seven locations (East Kolwa, Central Kolwa, West Kolwa, Bwanda, Kawino, Kombura, Kochieng) in Kisumu district were selected.

Source: JICA Study Team

Figure 15.1 Selection Process and Result for Priority Locations

The Third Screening: Selection of Location based on Flood Damage Surveys

Based on the flood damage surveys, the locations where damage levels were relatively high are selected. As a result, four locations in Nyando district, namely, Kochogo, Kakola, Ombeyi, and Nyangoma locations, and one location in Kisumu district, namely Kombura were selected and are shown in Figure 15.1.

Discussions with Nyando Forum and Project Working Group (PWG)

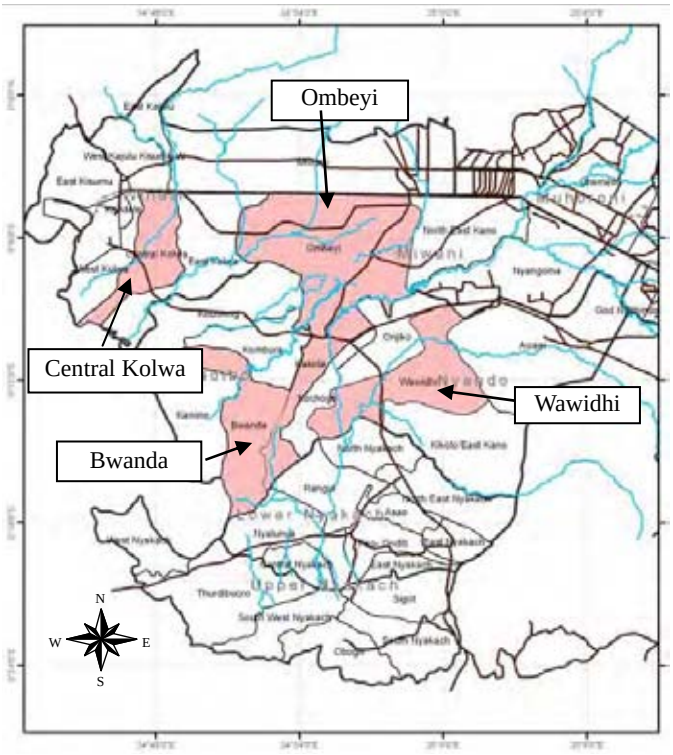
Based on the discussion between the members of PWG and the chairman of the Forum, the followings were suggested for selection in the priority locations.

(i) One Pilot Project should be implemented in the upper or middle catchments. The objective is to reduce the amount of soil sedimentation that is transported from the upper/middle catchments to the lower catchments. This will address one of the key issues for flood mitigation.

(ii) Regional balance of the location should be considered.

(iii) The Pilot Projects in the flood prone areas should be formulated considering the characteristics of the floods.

Based on the suggestions, the four locations presented in Figure 15.2 were selected for the lower catchment, while Chil Chila location was selected for the upper/middle catchment.



Source: JICA Study Team

Figure 15.2 Selection of Priority Locations for Pilot Projects

Discussion in the Steering Committee

The steering committee in December 2006 approved the selection of the four locations in the lower catchment and Chil Chila location in the upper/middle catchment. It was agreed that the target communities were selected after the result of community survey in the discussion.

15.2 Community Survey

In the community surveys conducted during December 2006-Feburary 2007, sub-location meetings were held in December 2006. During the survey, the following activities were exercised in each target village.

(i) Implementation of meetings for selection of five communities for Pilot Projects,

(ii) Facilitation of elaboration of community flood hazard map,

(iii) Implementation of questionnaire surveys,

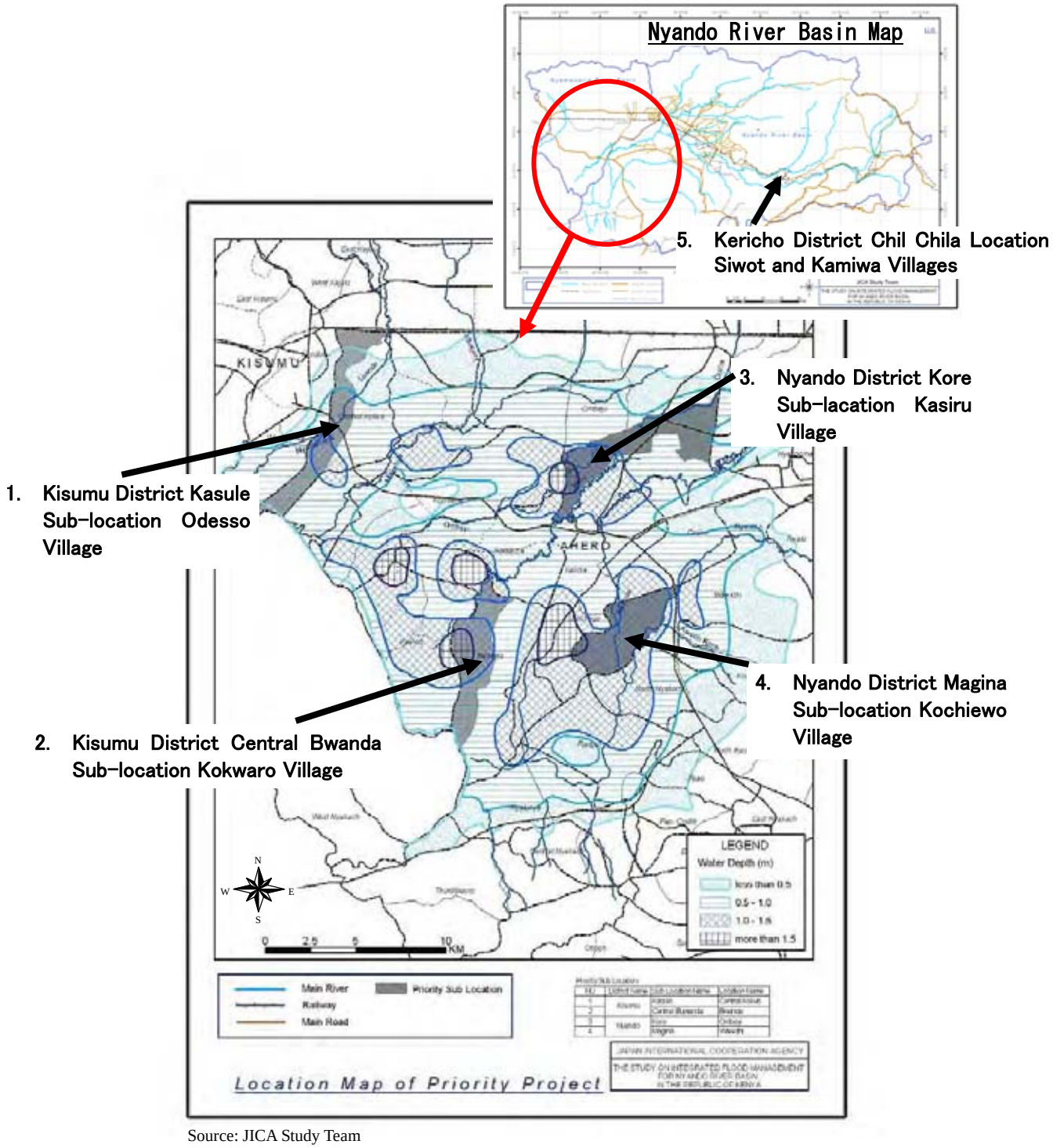
(iv) Assessment of community vulnerability through Participatory Rural Appraisal (PRA), and

Photo by JICA Study Team

Figure 15.3 Preparation of Community Hazard Map

(v) Facilitation and formulation of community action plan (CAP) indicating actions to be taken towards the major problems, roles and resources of actors, timing etc.

The locations of the selected communities are presented in Figure 15.4.



Source: JICA Study Team

Figure 15.4 Location Map of Pilot Project Sites

16. The Pilot Project : Outline

16.1 Outline of the Pilot Project

The Pilot Projects commenced in June 2007 and completed in November 2008. The project was delayed due to the unsecured situation after the presidential election in December 2007. During the implementation, the Forum and the PWG members conducted preliminary, mid-term and final evaluations for the Pilot Projects. This exercise contributed to enhance and strengthen institutional capacity. The general descriptions of the target villages and outlines of the project components are described in Table 16.1~16.5 below.

Table 16.1 Outline of the Odesso Village and Pilot Project

Item		Contents
Beneficiaries (Population)		Around 1,500 persons
Beneficiaries (Households)		Around 300 households
Characteristics of Flood		The village is located along the Nyamasaria river and national road. The water level of the river immediately increases after rainfall.
Characteristics of Socio-Economic Conditions		✓ There are many new comers who work in Kisumu city, since the village is located near Kisumu city. It is therefore pointed out difficulties of the communal works as village. ✓ It is observed relatively large damage caused by last December flood in the river bank at the downstream of the bridge. This is not mentioned in the CAP, since the flood occurred after CAP formulation. However, the need of the repair work is very high. ✓ The access to the village is very good, since it is located along the national road. ✓ Some of primary schools are utilized as evacuation centre. But, most villagers evacuate in higher elevation area of the national road or stay in relative's houses in Kisumu city. ✓ The main income sources are diversified, i.e. vegetable, sand collection, milk production, livestock, and casual labour.
Component		Outline
Structural Measures		River bank protection in the Nyamasaria river Length: 37m, Height of protection: 4m, Height of dike: 1m
Non-Structural Measures (common)	Establishment and Development of Community Based Flood Management Organisation	✓ Community sensitisation regarding the establishment of a Community Based Flood Management Organisation ✓ Selection of organisation members (Chairperson, Vice-Chairperson, Group Leaders, Secretary, Auditor), preparation of bylaws and registration, training in organisational operation, and monitoring and evaluation
	Training in Disaster Management	✓ Dissemination of disaster knowledge (Concept of disaster cycle (Preparedness / Response / Rehabilitation), introduction of structural measures that can be implemented by the community, and knowledge of equipment in evacuation centre ✓ Utilisation of the flood hazard map ✓ Emergency communication and key issues of evacuation ✓ Training on rescue and first aid
	Preparation of Community Flood Management Plan (manuals)	✓ Community flood management plan for disaster cycle ✓ Preparedness: confirmation of emergency communication network ✓ Response: confirmation of operational procedures for the emergency siren and communication network, coordination procedures with the disaster management committee, and roll call of evacuees ✓ Rehabilitation: how to assess flood damages, procedure for preparation of rehabilitation plan, procedures for request of relief goods, and procedures for request for cooperation in rehabilitation
	Implementation of evacuation training	✓ Production and installation of signboard for community flood hazard map indicating evacuation routes and dangerous areas ✓ Production, installation of signboards indicating dangerous areas, evacuation centre ✓ Implementation of evacuation training (drills) including information dissemination using emergency communication network, and feedback from the meeting

Source: JICA Study Team

Table 16.2 Outline of the Kokwaro Village and Pilot Project

Item		Contents
Beneficiaries (Population)		Around 1,200 persons
Beneficiaries (Households)		Around 250 households
Characteristics of Flood		The village is located between the Miriu and Nyando rives. The drainage of the village is very poor, since the river mouth faces to Lake Victoria with sedimentation.
Characteristics of Socio-Economic Conditions		✓ The swamp area occupies one third area of the village. The half of village boundary laps over the Mriu river line. Therefore, access to the village is very limited. ✓ A part of the road was rehabilitated under Food for Work program. ✓ There are evacuation centres for the village, namely: one primary school for the east area (out of village) and one church for the west area. ✓ The space of the church is not enough to stay, and accordingly, some people living in west area evacuate to the primary school using outer footpath. ✓ The local people are devoted to education, and donated to the primary school for improvement. ✓ People noted shortage of fire wood during flood. ✓ People also noted the shortage of food to feed the cattle and thus interested in learning how to preserve the feed. ✓ The main income sources are livestock, vegetable and rice.
Component		Outline
Structural Measures		✓ Raising local road as evacuation route: length: 600 m ✓ Construction of new evacuation centre: floor space: 180 m^2, with roof water catchments ✓ Installation of a toilet: 1 place
Non-Structural Measures (common)	Model disaster management education	✓ Training teachers (Necessity of disaster management education, sharing of disaster experience, selection of the training components, development of resident-participation type programme, teaching materials, and training skills) ✓ Implementation of model class by the trained teacher
	Establishment and Development of Community Based Flood Management Organisation	✓ Community sensitisation regarding the establishment of a Community Based Flood Management Organisation ✓ Selection of organisation members (Chairperson, Vice-Chairperson, Group Leaders, Secretary, and Auditor) ✓ Preparation of bylaws, and registration ✓ Training in organisational operation ✓ Monitoring and evaluation
	Training in the maintenance of the structures	✓ Maintenance training (training in operation) of evacuation centre, evacuation route and signboards installed in the Pilot Project.
	Preparation of Community Flood Management Plan (manuals)	✓ Community flood management plan for disaster cycle ✓ Preparedness: emergency communication network ✓ Response: confirmation of operational procedures of the emergency siren and communication network, coordination procedures with the disaster management committee, and roll call of evacuees ✓ Rehabilitation: how to assess flood damages, procedure for preparation of rehabilitation plan, procedures for request of relief goods, procedures for request for cooperation in rehabilitation
	Implementation of evacuation training	✓ Production and installation of signboard for community flood hazard map indicating evacuation route and dangerous areas ✓ Production and installation of signboard indicating dangerous areas and evacuation centre ✓ Implementation of evacuation training (drills) including information dissemination

Source: JICA Study Team

Table 16.3 Outline of Kasiru Village and Pilot Project

Item		Contents
Beneficiaries (Population)		Around 1,300 persons
Beneficiaries (Households)		Around 260 households
Characteristics of Flood		The village is located in Kano Plain. The flood water comes from the both Bacho and the Miriu rivers, as a result the period of submerged condition is long.
Characteristics of Socio-Economic Conditions		✓ The access to the village is limited, since the village is located between Bacho and the Miriu rivers. Therefore, it is difficult to evacuate out of village during flood. ✓ The village is divided into north and south parts, as the centre is intersected by paddy field ✓ There is no health facility. The village has a poor sanitary condition, since most of people use the river water for domestic use. ✓ There are two churches as evacuation centres located in south parts. There are no toilet and water supply facilities attached in those churches. ✓ Local people, who live in the north part, evacuate on foot to the south part through paddy field. ✓ The main income sources are sorghum, and maize.
Component		Outline
Structural Measures		✓ Raising evacuation road: length: 400m ✓ Installation of a well at existing evacuation centre: depth: minimum 50m and installation of a hand pump ✓ Installation of a toilet: 1 place
Non-Structure Measure (common)	Establishment and Development of Community Based Flood Management Organisation	✓ Community sensitisation regarding the establishment of a Community Based Flood Management Organisation ✓ Selection of organisation members (Chairperson, Vice-Chairperson, Group Leaders, Secretary, and Auditor) ✓ Preparation of bylaws and registration ✓ Training in organisational operation ✓ Monitoring and evaluation
	Training in the maintenance of the structures	✓ Maintenance training (training and operation) of evacuation centre, evacuation route and signboards installed in the Pilot Project.
	Preparation of Community Flood Management Plan (manuals)	✓ Community flood management plan for disaster cycle ✓ Preparedness: confirmation of emergency communication network ✓ Response: confirmation of operation procedures for the emergency siren and communication network, coordination procedures with the disaster management committee, and roll call of evacuees ✓ Rehabilitation: how to assess flood damages, procedures for preparation of a rehabilitation plan, procedures for request of relief goods, procedures for request for cooperation in rehabilitation
	Implementation of evacuation training	✓ Production and installation of signboard for community flood hazard map indicating evacuation route and dangerous areas ✓ Production and installation of signboard indicating dangerous areas and evacuation centre ✓ Implementation of evacuation training (drills) including information dissemination

Source: JICA Study Team

Table 16.4 Outline of Kochiewo Village and Pilot Project

Item		Contents
Beneficiaries (Population)		Around 3,120 persons
Beneficiaries (Households)		Around 620 households
Characteristics of Flood		The village is partially located along the Nyando river and the dike construction is on-going
Characteristics of Socio-Economic Conditions		✓ A part of the dike along the Nyando river has been damaged by the flood in last December. It was confirmed that rehabilitation need for the damage is high. ✓ In addition to the rehabilitation work, people would like to lean how to maintain the dike. ✓ Although the access to the village is limited, since the village is located in swamp area. However, need of road improvement is no so high. ✓ There are evacuation centres for the village, namely: one primary school (out of village) and four church. ✓ It is difficult to access safe water in the village. Therefore, local people proposed that well or rain water harvesting system should be considered in the evacuation centre. ✓ Local people need technology on how to preserve food or feed, since there are the shortages during flood. ✓ The main income sources are maize, milk, and livestock.
Component		Outline
Structural Measures		✓ Rehabilitation of existing dike: length: 100m
Non-Structure Measure (common)	Establishment and Development of Community Based Flood Management Organisation	✓ Community sensitisation regarding the establishment of a Community Based Flood Management Organisation ✓ Selection of organisation members (Chairperson, Vice-Chairperson, Group Leaders, Secretary, and Auditor) ✓ Preparation of bylaws, and registration ✓ Training in organisational operation ✓ Monitoring and evaluation
	Training in the maintenance of the structures	✓ Maintenance training (training in operation) of evacuation centre, evacuation route and signboards installed in the Pilot Project.
	Preparation of Community Flood Management Plan (manual)	✓ Community flood management plan for disaster cycle ✓ Preparedness: confirmation of emergency communication network ✓ Response: confirmation of operation procedures for the emergency siren and communication network, coordination procedures with the disaster management committee, and roll call of evacuees ✓ Rehabilitation: how to assess flood damages, procedures for preparation of a rehabilitation plan, procedures for request of relief goods, procedures for request for cooperation in rehabilitation
	Implementation of evacuation training	✓ Production and installation of signboard for community flood hazard map indicating evacuation route and dangerous areas ✓ Production and installation of signboard indicating dangerous areas and evacuation centre ✓ Implementation of evacuation training (drills) including information dissemination using emergency communication network, and feedback from the meeting

Source: JICA Study Team

Table 16.5 Outline of Siwot and Kamiwa Villages and Pilot Project

Item	Contents
Beneficiaries (Population)	Around 1,100 persons (including both villages)
Beneficiaries (Households)	Around 200 households (including both villages)
Characteristics of Flood	The villages are located in middle catchment of Nyando river basin, and along national road. The riverbank erosion is observed, although flood is not occurred due to V shape of the river.
Characteristics of Socio-Economic Conditions	✓ Although the communities have piped water supply system, most of local people collect domestic water from the Baraget river. ✓ Local people understand that riverbank erosion is one of the sedimentation source to downstream ✓ River water use by livestock is one of the reasons on water quality deterioration. This deterioration causes some disease to local people. ✓ Local people recommended that water point for livestock should be installed separately from water point for local people. In addition, structure for water quality improvement should be considered. ✓ The main income sources are labour wage of estate and agriculture.
Component	Outline
Structural Measures	✓ River bank protection upstream of bridge in the Bararget river: length: 17 m: height: 2m ✓ Construction of Ramp for cattle
Development of Existing Community Based Organisation	✓ Preparation of proposal for realisation of CAP
The non-structural measures such as i) development of a Community Based Flood Management Organisation, ii) preparation of a Community Flood Management Plan, and iii) implementation of Evacuation Training will not be implemented since flood is not serious problem in this area	

Source: JICA Study Team

16.2 Initial Environmental Examination for Pilot Projects

The Pilot Project was only be required to submit a project report to obtain an Environmental License. Since the project scale was limited to the community level, a full EIA process was not required. However, some of the environmental considerations were required: 1) social impacts should be taken care of, 2) discussions were required with Department of Public Works regarding riverbank protection works nearby the bridges at Odesso village, 3) WRMA's approval was required for drilling work, 4) community-based organizations must become project proponents for the environmental procedures.

The environmental project reports were submitted to NEMA on 8th May 2007. Headquarter of NEMA circulated the document to concerned local organizations. The reports were approved and approval documents were sent to the project proponents (each community-based organisation) in the beginning of July 2007.

17. The Pilot Project: Evaluation

The Pilot Project was evaluated through the mid-term / final evaluations by the selected members of Nyando River Water Management Forum and the staff of WRMA-LVSC, as well as the results from questionnaire survey at the five target communities. The following table presents the results of evaluation.

Table 17.1 Evaluation Results of the Pilot Projects

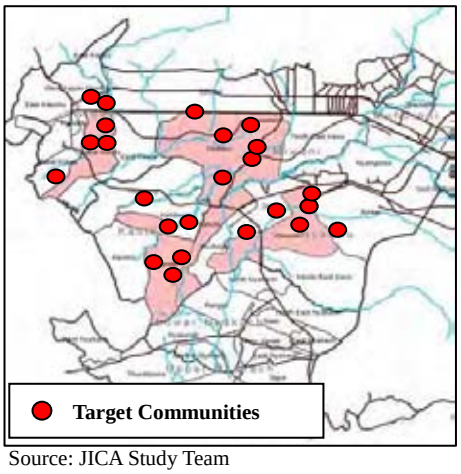
Item	Evaluation Result
Structural Measures	• Relatively high water levels due to torrential rain, resolution of land ownership and the contractor's poor management set the completion date back by 4 months, excluding the unsecured post-election period. • As of December 2008, all the work for building work, river protection, borehole drilling and raising road levels was completed and no damage was observed. • More than 80 % of beneficiaries, excluding Odesso, were satisfied with the structural measures. Only 50 % of beneficiaries were satisfied with the structural measures in Odesso because the community expected that the river protection work would be constructed at a larger scale.
Non-Structural Measures	• As non-structural measures, a series of trainings for organisation, O&M, flood management, and evacuation drills were executed successfully. Community people were satisfied with the training, but they expressed the need for more training. • More than 80 % of beneficiaries were satisfied with both the organisational and flood management training programmes. • Out of the four communities prioritised for flood management pilot projects, three CFMOs are capable of managing their organisations based on the knowledge acquired through the training, while the remaining CFMO has been operated poorly.
Education Programme	• The education programme, including the preparation of a textbook, was executed at Bwanda Primary School during October-November 2007. • The teachers and the pupils were satisfied with the knowledge acquired through the programme.
Institutional Strengthening	• WRMA is establishing a WRUA development cycle for water resources management. WRMA can provide more support to communities through a WRUA after completion of the project. • During the project implementation stage, WRMA explained to the CFMO about what joining a WRUA entails. As a result, four CFMOs have joined a WRUA and one community is considering joining a WRUA. • It is expected that community-driven flood management will be expanded through the WRUA development cycle.
Project Sustainability	• The members' of the Forum monitoring team raised some questions about the future financial sustainability aspect of CFMOs, even though the fund raising and proposal writing training have been done. In this regard, it is recommended that more intervention from WRMA should be done through WRUA's. Training in proposal writing for fundraising will be crucial for sustainability.

Source: JICA Study Team

18. The Pilot Project: Lessons Learnt

(1) Prioritisation of communities based on present and past flood damage.

In the pilot projects, the communities with serious flood damage were selected. Accordingly, all the community action plans indicated a very high need for flood protection and management. As a result, the communities expressed their high satisfaction with the structural and non-structural measures. This reinforces the need for selection of communities to be done carefully using the flood disaster map and the local people's knowledge about flood damage.



Source: JICA Study Team

Figure 18.1 Image of Community Selection Process

(2) Capacity development based on "learning by doing"

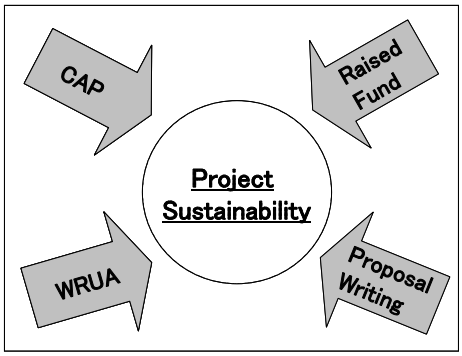
In the pilot projects, the CFMOs learned institutional development through participating in the actual activities, financial management through operation of a fund that was generated by means of labour wages, flood management concepts through evacuation drill exercises, and maintenance of structural measures through involvement in labour work. In addition, involvement of community in the structural measures provided a good incentive to establish and operate the CFMO. As a result, the CFMO has been strengthened. The concept of "learning by doing" should be emphasised in future community-driven flood management projects.

Source: JICA Study Team

Figure 18.2 Image of Learning by Doing

(3) Project Sustainability

The community had four tools for future development, namely: i) CAP as basis; ii) skill of proposal writing for fundraising; iii) operation of a fund financed by labour wages; and iv) linkage with WRMA and WRUA's. These tools will be utilised for future community development, including flood management. As a result, it is expected that the operation of the CFMO's will be organisationally and financially sustainable. Before project implementation, needs for the future operation of CFMO's should be carefully considered and necessary programmes should be included as project components.



Source: JICA Study Team

Figure 18.3 Image of Project Sustainability

19. Institutional Strengthening

19.1 Stakeholders' Workshops

During the study period, three stakeholders' workshops and an institutional strengthening-related workshop were held. The outline of the workshops is summarised in Table 19.1.

Table 19.1 Outline of Stakeholders' Workshops

Workshop	Major Participants	Objectives	Photo
National Workshop 3 Aug. 2006	MWI, WRMA, WMO, JICA, a group of donors, and line ministries (about 100 participants in total)	To discuss the opportunities and challenges for development, flood risks, methods for enabling community participation in the process, addressing needs and requirements, and proposed action.	
ID/OS (Institutional Development and Oraganisational Strengthening) Workshop 22-24 Aug. 2006	MWI, WRMA, OP, LVSWSB and others (37 participants in total)	To formulate an organisational framework for IFM and a capacity development plan for the WRMA to facilitate effective and efficient coordination with IFM.	
Regional Workshop 9 Oct. 2007	MWI, WRMA, JICA, officers related in WKCDD/FM project by World Bank, Nyando Forum members, WRUAs in the basin and others (about 100 participants in total)	To disseminate the information generated as the interim output of the Study, especially the Master Plan and progress of the Pilot Projects.	
Regional Workshop 11 Dec. 2008	MWI, WRMA, WRMA-LVN & Tana, WMO, JICA, Nyando Forum members, WRUA, and others (about 100 participants in total)	To widely share and exchange opinions on the study results as well as the emerging issue of global warming and activities of WMO, and flood situation in Tana Catchment among the participants.	

Source: JICA Study Team

19.2 ID/OS Workshop

The ID/OS Workshop was organised by the Study Team on 22-24 August 2006 in Kisumu. The total 37 participants were organised into four groups. Regarding the capacity development plan for WRMA, the superior target was common for all the groups: "WRMA will be able to effectively and efficiently coordinate the Integrated Flood Management in Nyando River Basin". Then, each group worked out an independent plan. The major targets of those plans included: strengthening linkages with other collaborating agencies, developing human resources, securing funds, developing and harmonising common approaches to community participation, developing flood forecasting systems and commitment to the WRMA mission. Table 19.2 presents the results of the workshop and the contributed activities by the Study Team during the study period.

Source: JICA Study Team

Figure 19.1 ID/OS Workshop

Table 19.2 Results of ID/OS Workshop: Capacity Development Plan

Group	Target	Results	Activities	Contributed Activities by the Study
Group 1	To establish flood forecasting systems based on the NWRMS	1) Early warning systems, 2) Evacuation systems	1) Develop monitoring network, 2) Develop communication strategy, 3) Capacity building, 4) Infrastructural development	Technical seminars on early warning or hydrological network systems and on–the-job training for evacuation planning
	To manage the Nyando catchment by using the clearly defined roles in the water sector	Catchment Management Plan	1) Soil & water conservation, 2) Riverbank protection, 3) Forestation, 4) Structural measures, 5) Capacity building & awareness creation	Technical seminars on Watershed Management Planning covering the entire Nyando River Basin
	To strengthen the linkage between WRMA, other agencies, and stakeholders, using good will from Development Partners	1) MoUs, 2) MoCs, 3) MoAs, 4) WRUAs	1) Consultative forums, 2) Formulation of roles and responsibilities; documentation, 3) WRUA establishment	Consultative discussions during Nyando River Management Forums addressing the agenda to develop consensus on roles and responsibilities of each stakeholder.
Group 2	To develop WRMA capacity in community participation	Resources utilised for enhanced community involvement and common issues	1) Determine available resources, 2) Prepare work plans procurement, 3) M&E plan	Counterpart involvement in planning and implementation of pilot projects on community-based flood management
	To develop human resources	Staff recruited, deployed and trained in community development approaches	1) Identify the required staff, 2) Recruit the staff, 3) Carry out training needs / skills assessment, 4) Capacity building/ training plan	Counterpart involvement in planning and implementation of pilot projects on community-based flood management
	To harmonise community participation approaches	Community based approaches harmonised by the WRUAs / CAACs	1) Community mobilisation/ formation of groups, 2) Capacity building/ creating awareness/ sensitisation, 3) Drawing up of MoUs with the relevant agencies, e.g. Red Cross	Counterpart involvement in planning and implementation for pilot projects on community-based flood management
Group 3	Commitment to WRMA mission	Achieve IFM goals and objectives	1) Strategic Plan, 2) Business Plan, 3) Capacity building: training in disaster management, GIS data and equipment	Technical seminars on flood hazard maps and traditional flood mitigation measures of Japan. On-the-job training on GIS data processing and handling
	Secure funds	Enhancement of Project implementation plans	1) Budgeting, 2) Develop financial management systems, 3) Expenditures	Counterpart involvement in formulation of the Master Plan and priority schemes.
	Appropriate services delivery mechanism	Adequate services delivered effectively/ efficiently	1) Carry out baseline surveys, 2) Stakeholder awareness & participation, 3) M&E and O&M	Under the counterparts' initiatives, On-the-job training for collection of socio-economic baseline data and organising community workshops.
Group 4	Make the necessary information accessible	Availability of information	1) Improvement of monitoring network, 2) Establishment of database from National, Regional, and Sub-regional levels, 3) Establishment and installation of Internet	On-the-job training on processing and handling of GIS data Technical meetings on the results of the river structure survey.
	To have skilled and well remunerated staffs	Skilled and motivated manpower	1) Capacity building, 2) Establish staff welfare institutions and well defined scheme of work, 3) Organise external exchange programmes between WRMA and development partners	Full-time stationing of counterpart staff in the Study Team Office.
	To have adequate finance	All the IFM activities and facilities will be achieved	1) Solicit funds from development partners, 2) Solicit funds from Exchanger, 3) Funds from relevant government departments	On-the-job training explaining how to prepare project proposals for funding purpose. .

Source: Result of ID/OS Workshop, JICA Study Team

19.3 Training Programmes for Staff of WRMA and LVSWSB

The various training programmes, based on seminars or field visits, were formulated and have been implemented. The objectives of the training programmes were to: i) develop the basic capacity of WRMA staff for flood management; and ii) learn from flood management experience in other countries. A total of seven topics were presented as seminars and several field inspections were implemented from August 2006 to October 2008.

Source: JICA Study Team

Figure 19.2 Technical Seminar held by the Study Team

Table 19.3 List of Technical Seminars

Month	Major Topics	Contents
Nov 2006	Preparation of Flood Disaster Map	• Basic concept on the flood disaster map. • Process of Preparing the flood disaster map • Sustainable use of flood disaster map
Jan and Feb 2007	Natural Disaster and Re-construction in Other Countries	• Earthquake occurred in Oct. 2006 in the northern part of Pakistan • Tsunami disaster occurred in Dec. 2005 in the Banda Aceh, North Sumatra, Indonesia • Volcanic disaster and mudflow due to the eruption of Mt.Pinatubo in Luzon, Philippines
June 2007	Various Structural Measures and Function for Flood Management	• Basic concept on flood management (mitigation and preparedness). • Introduction of various structural options and function.
June, 2007	GIS and Database Training for "The Study on Integrated Flood Management for the Nyando River Basin"	• Basic concepts of GIS and remote sensing. • Structure of the GIS Database established in the Study. • How to use basic GIS software functions including creating and editing GIS data.
June, 2007	Rivers in Japan and Mitigation Countermeasures against Flood and Riverbank Erosion	• Explanation of river features in Japan • Various structural measures for flood and riverbank erosion mitigation as well as various activities against flooding in Japan.
August, 2008	Introductory of Project Cycle Management (PCM)	• Concept of the method • How to conduct stakeholder analysis, problem analysis, prepare PDM • Monitoring and evaluation using the PDM
October, 2008	Flood Forecasting and Warning System	• Overall flood forecasting and warning system (equipment, organisation, etc)
Feb 2007-October 2008	Pilot Project (OJT basis)	• Concept, formulation and outline of pilot projects • Environmental issues to be considered in the pilot projects • Progress of pilot project (field visits) • Mid-term and final evaluation of the pilot project

Source: JICA Study Team

19.4 Counterpart Training Programme in Japan

In May 2007, four staff selected from WRMA and NWCPC participated in a training course on Community Disaster Management in Japan for about two weeks as follows.

Table 19.4 Outline of the Counterpart Training Programme in Japan

Title:	Community Disaster Management in Japan
Period:	May 13-27, 2007 (15 days)
Trainee:	Dr. Margaret A. Abira (WRMA), Mr. Edward S. Kelengwe(NWCPC), Mr. Willis O. Memo(WRMA) Mr. Peter M. Waithaka (WRMA)
Objectives:	✓ To learn traditional structure measure with low cost, community based flood management, administrative structure on flood management, ✓ To utilise above knowledge to develop community based flood management in Kenya, and ✓ To apply intervention method to the communities into the flood management planning in Kenya.

Schedule			
Date		Activity	Staying
2007/5/13	Sun	Leaving Kenya	Airplane
2007/5/14	Mon	Arriving Japan	Tokyo
2007/5/15	Tue	Programme Orientation Lecture by the Researcher of International Centre for Water Hazard and Risk Management	Tokyo
2007/5/16	Wed	Nippon Koei Research & Development Centre National Research Institute for Earth Science and Disaster Prevention (NIED)	Tokyo
2007/5/17	Thu	Lecture about Information Dissemination for Disaster Prevention Arakawa River Lower Reach Work Office	Tokyo
2007/5/18	Fri	Miyagase Dam	Tokyo
2007/5/19	Sat	Tokyo St.-Shin Fuji St.	Fuji
2007/5/20	Sun	Participating in Fujikawa River Flood Fighting Drill	Koufu
2007/5/21	Mon	Shingen Tsutsumi	Tokyo
2007/5/22	Tue	Kiso Sansen Ring Levee and traditional flood management facilities	Nagoya
2007/5/23	Wed	Lake Biwa Canal and facilities	Osaka
2007/5/24	Thu	Honganji Canal	Tokyo
2007/5/25	Fri	Evaluation Meeting	Tokyo
2007/5/26	Sat	Leaving Japan	Airplane
2007/5/27	Sun	Arriving Kenya	

Source: JICA Study Team

The results of the training were introduced in the Stakeholders' Workshop in October 2007, which successfully raised the awareness of the participants, shared important experiences about flood management in Japan.

19.5 Nyando River Water Resource Management Forum

As a result of discussions with MWI and WRMA, the Forum, consisting of 35 members, was officially established on the 18th of August 2006. The objectives of the Forum are to: i) monitor and review the progress and outputs of the Study; ii) prepare recommendations for WRMA on issues concerning flood management; iii) establish linkages between communities and WRMA for the purpose of the Study; and iv) propose post-study activities for the Forum, including soliciting funds from potential donors. By the end of December 2008, the Forum was held for 11 times. The following table presents the outlines of the forum meetings.

Source: JICA Study Team

Figure 19.3 The First Forum Meeting

Table 19.5 Outlines of the Forum Meetings

Date	Major Topics	Remarks
Aug 4, 2006	- Needs of the forum - Preliminary selection of forum members	- It was agreed to formulate the forum for Nyando River Basin Water Resources Management Forum. - The members of the forum were preliminarily selected. Involvement of females and balance between upper and lower catchments should be carefully considered.

Date	Major Topics	Remarks
Aug 18, 2006	- Background and outline of the Study - Draft operation guidelines for the Forum	- A Provincial Commissioner noted that the GOK will offer full support for the study team anytime they needed administrative assistance. He officially declared the Forum opened. - The objectives, members, and operation of the forum have been discussed. Various comments were reflected on the guidelines.
Sep 9, 2006	- Draft operation guidelines for the Forum - Election of chair person - Selection criteria for priority areas for the IFM	- Dr Okeyo Owuor (Director of VIRED) was elected as the chairperson and Mr Aloo Ogeka (opinion leader) was elected as vice- chairperson. - Preliminary selection of priority areas was explained and various comments were expressed. The members requested to formulate one pilot project in the upper catchment area.
Nov 16&17, 2006	- Present condition of upper catchment - Institutional aspect of watershed management	- Coordination amongst organisations concerned will be required for protection of the upper catchment in the future. - Soil erosion level is not very high in Nyado upper catchment. However, protection of gullies in some sub-catchments will be required in the future
Nov 30, 2006	- Draft Master Plan	- The draft master plan was accepted by the members of the Forum. - After the study, the master plan should be revised by WRMA through a capacity development programme to be created during the study.
Mar. 01, 2007	- Findings of Community Survey - Draft Plan for Pilot Projects - Environmental issues for the Pilot Projects	- The forum member should be involved in the evaluation of pilot projects. - The scale of the pilot projects should be re-considered if possible. WRMA explained that the pilot projects represent the first step and the efforts will be expanded after successful implementation.
Jun. 29, 2007	- Interim Results of the Study - IFM in Japan	- The final master plan was accepted by the Forum members. - The forum understood the importance of WRUA in expanding the efforts of the pilot projects. WRMA will arrange another meeting for explanation of WRUA for the forum.
Oct. 31, 2007	- Explanation of WRUA - Discussion on Mid-term evaluation of Pilot Projects by Forum Members	- WRMA explained the expected benefit being a member of WRUA and process to being a member. Explanation aimed at the WRUA and CBO representatives in the Forum to enhance mutual collaborations. - Forum members were selected as representatives for site reconnaissance at Pilot Project sites. Total 10 members from NGO, government, parastatal and WRUA were selected in addition to 4 members from WRMA.
Jun. 25, 2008	- Study Schedule - Progress of Pilot Project - Mid-Term Evaluation - New Community-Driven Flood Management Project for 24 Communities	- JICA Study Team explained time-frame work of the study in 2008 and the progress of five pilot projects. - Forum member reported the result of the first mid term evaluation for the pilot project. It was agreed that same members would implement the 2nd mid term evaluation in 8th-10th July. - JICA Study Team explained new community-driven flood management project for 24 communities. The concept of the project were discussed and agreed.
Sep. 19, 2008	- The results of Mid-Term Evaluation of Pilot Project - Final Evaluation of the Pilot Project - The results of Community Survey	- The Pilot Projects were recognised to be effective for the community in flood management by the Forum members - The issue was raised whether community should participate in contractual matters for the pilot project. - Members were selected for the Final Evaluation and method of evaluation and points to be looked into were discussed.
Nov. 3, 2008	- The results of the final evaluation for Pilot Projects - The 24 community-driven flood management projects - Discussion on the continuity and sustainability of the forum	- It was recognised that Pilot Projects were basically effective and useful for the target communities. More community involvement was recommended particularly at the implementation stage. - Preliminary designs for the 24 community-driven flood management projects were presented. Capacity of storage and evacuation centre was confirmed by the members. The future schedule for the projects was explained including EIA clearance procedure. - Continuity of the forum was discussed and agreed to voluntarily hold another meeting to discuss WRUA registration and future coordination of the forum

Source: JICA Study Team

19.6 Involvement of WRMA in Disaster Management Committee

At the regional level, strong concern has been expressed about the need for WRMA to become a member of the Disaster Management Committee (DMC). A consultation meeting was held on 16th October 2008 between WRMA, Provincial and District administrations, which are also chairs of the DMC at their respective levels. As a result, it was agreed and that WRMA would become a member of the DMC and act as the leading agency for flood management.

Source: JICA Study Team

Figure 19.4 Consultation Meeting with DMC

19.5 Guide for Community-Driven Flood Management

The Study produced a series of manuals for community-driven flood management, as listed in Table 19.6 below. These manuals were handed over to WRMA-LVSC for their utilisation.

Table 19.6 List of Integrated Flood Management Manuals

No.	Section	Manual Name	Contents
1	Community flood hazard mapping	How to conduct Community Flood Hazard Mapping (for the purpose of capacity development of WRMA)	Procedure for community flood hazard mapping using the Participatory Rural Appraisal (PRA) method.
2	Community flood management organisation	How to establish community-driven flood management organisations	Necessity for establishment of CFMO's and how to organise the people in the community.
3	Community flood management	How to develop community flood management	Community driven flood management for each CFMO to allow them to cope with flood management along with the flood management cycle.
4	Community-driven structure measures	How to design community-driven structural measures	As a part of integrated flood management, provision of basic knowledge about community-driven structural measures.
5	Operation and maintenance of community-driven structure measure	How to conduct operation and maintenance (O&M) for community-driven structural measures	Basic knowledge of O&M required for community-driven structural measures as a part of integrated flood management.
6	Evacuation drills	How to execute community-driven evacuation drills	Procedure of periodic evacuation drills as one of the major tasks of communities vulnerable to flooding.
7	Education for disaster management	How to conduct disaster management education	Teachers' training manual and disaster management education textbook for students.
8	Flood disaster maps	How to update flood disaster maps	Delivering of basic knowledge of how to create flood disaster map and update the existing flood disaster map.
9	GIS Database	How to utilise a Geographic Information System (GIS)	Effective use of GIS for integrated flood management.

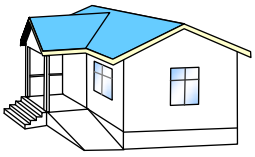
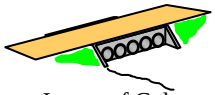
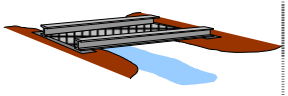
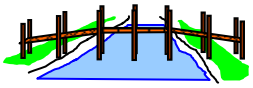
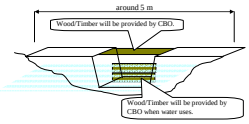
Source: JICA Study Team

20. Additional Projects for 24 Communities

The Government of Kenya (GOK) recognised: 1) Effectiveness of the Pilot Projects, which were based on community-driven approach against floods, 2) Recent increases of flood volume due to the global warming, and, 3) Necessity of community-based flood management activities. Based on this recognition, in June 2008 the GOK officially requested the Government of Japan to assist in implementing 24 Community-Driven Flood Management Projects followed by the completion of the Study. In response, JICA decided to implement an additional study to formulate a plan for the projects.

Through location meetings following the same steps as explained in Chapter 15, 24 communities were successfully selected to assess the present flood damage. For structural measures, the high priority structural measures proposed in the CAP were selected considering: i) related to flood management at a community level, ii) not an inter-community level; iii) unlikely to cause negative impacts for other communities; and iv) not in conflict with existing land arrangements. For non-structural measures, almost the same non-structural measures that were implemented in the Pilot Project were applied. In addition, public dissemination of information was proposed in order to establish an institutional framework for future flood management projects.

Table 20.1 Summary of Structural Measures

(1) Architecture Measure		
a) Borehole ■ Abstraction of groundwater per day is 20 m^3 for domestic use by the communities ■ Depth of borehole is up to 100m to get good quality groundwater ■ With a hand pomp and raised apron b) Evacuation Centre ■ The capacity is for around 120 of evacuee ■ With a kitchen and storage ■ The floor is raised. c) Toilet ■ 10 compartments for schools, 2 compartments for evacuation centre ■ The floor is raised. d) Storage ■ Designed for the possible use of dispensary in future ■ The floor is raised.	 Borehole in Pilot Project  Evacuation Centre in Pilot Project	 Toilet in Pilot Project  Image of Storage
(2) Infrastructure Measure		
a) Culvert ■ Main purpose is the evacuation use to evacuation centre ■ Pipe culvert is for relatively deep and wide stream and river. ■ Open ditch with RC cover is for small canal. b) Footbridge ■ Main purpose is the evacuation use to evacuation centre. ■ H-shaped steel with RC slab is proposed as main member ■ Wooden bridge is also proposed c) Weir ■ Impound water caused by flood is being utilised for horticulture ■ It is also utilised as footbridge for the evacuation	 Image of Culvert  Image of Footbridge (Steel Made)	 Image of Footbridge (Timber Made)  Image of Weir

Source: JICA Study Team

Table 20.2 Summary of Non-Structural Measures

(1) Development of Community Based Flood Management Organisations (CFMO)		
a) Management and operation training ■ Community sensitisation. ■ Organisational training. ■ Financial management training. b) Training in writing proposals for selected members of CFMO ■ Training in fundraising procedures. c) Production and installation of 3 kinds of signboards ■ Community hazard map and signboards directing the evacuation routes in each respective village.	 Community Sensitisation	 Community Flood Hazard Map
(2) Community Flood Management Training		
a) Community Flood Management Training ■ Training in flood disaster cycles (preparedness, emergency response, rehabilitation). ■ Training in first aid b) Community Flood Management Manual ■ Preparation of ready-to-use community flood management manual. c) Implementation of an Evacuation Drill ■ Evacuation drill implementation (300 participants).	 Evacuation Drill	 Preparation of the Manual
(3) Technical O&M Training for Structural Measures		
a) Both lectures and on-site training in O&M for the series of structures to be constructed by the Projects (evacuation centres, culverts, water pans, footbridges, toilets, boreholes, storage areas, etc.) b) Preparation of O&M manuals, including rules / manners for use of public facilities such as the evacuation centres, toilets, storage areas, water pans and boreholes.	 O&M Training	 O&M Training
(4) Education Programme for Disaster Prevention		
a) Targeting 16 primary schools identified within 24 communities. b) Teacher training in disaster prevention and flood management by using and modifying the teaching manual. c) Review and modification of the textbook by extended number of teachers, as well as the trained teachers using the new textbook to teach pupils. d) Mass printing (3,000 volumes) of the textbook.	 Teacher Training in Flood Management	 Teaching Pupils about Flood Management
(5) Radio Programmes on Flood Management		
a) The proposed long radio programmes will contain dialogues about issues related to flood management between the radio presenter and professionals for 60 minutes every week before the rainy season. b) In the proposed short spots, necessary actions to be taken by local people when evacuating will be broadcast for 60 seconds per spot, which will be aired four to five times per day for three months during the rainy season.	 Radio Station in Kisumu	 Radio Station Studio in Kisumu
(6) Awareness Campaign using Poster on Flood Management		
a) Posters covering 3 subjects will be produced: i) Storing water and food; ii) Useful goods for evacuation; iii) Attention when evacuating; and iv) Early warning. b) The posters will be distributed to local governments.	  Samples of Posters *Photo by UNDP and Swedish International Cooperation Agency	

Source: JICA Study Team

21. Conclusions and Recommendations

The Master Plan for Integrated Flood Management in the Nyando River Basin was prepared by incorporating the professional views of the JICA Study Team, fully considering actual flood conditions through flood damage surveys, preparation of flood disaster maps, and taking into account the stakeholders' opinions via the Nyando River Basin Water Management Forum. The JICA Study Team therefore recommends that the Government of Kenya should implement the Master Plan. The JICA Study Team is of the view that implementation of this Master Plan will ensure the protection of human life and property that would otherwise be lost or damaged by flooding, as well as the improvement of economic and social conditions in the flood prone area.

It is noted that the effectiveness of community-driven flood management programmes was confirmed through implementation of pilot projects in five communities. The JICA Study Team therefore recommends that community-driven flood management programmes should be realised as one of the components proposed in the Master Plan, with full involvement of the local communities. Doing this will increase effectiveness and sustainability of the Master Plan.

In addition, it is recommended the following actions be taken by Government of Kenya.

Table 21.1 Recommendations

Recommendation	Necessary Action
1. Consistency with the Catchment Management Strategy	The actions proposed in the Master Plan should reflect the Catchment Management Strategy of WRMA-LVSC and sub-catchment strategy of WRMA-Kisumu.
2. Implementation Capacity of WRMA	A coordination committee comprising MWI, Ministry of Roads, NWCPC, and WRMA for supervision of the project should be established.
3. Preparatory Work	The preparatory works should be done, namely: i) preparation of an Implementation Programme (IP) and ii) undertaking an EIA for the components proposed in the Master Plan.
4. Development of Institutional Framework	WRMA should continue to support the Nyando Forum as the Secretariat and coordinate with provincial and district administrations as a member of the Disaster Management Committee (DMC).
5. Transfer Technology on Integrated Flood Management to Other Regions	The technology transfer should be done to other regional offices of WRMA, namely, i) flood disaster maps; ii) community flood hazard maps; iii) development cycles for community-driven flood management projects; iv) disaster education programmes; and v) evacuation drills.
6. Updating of the Master Plan	The implementation schedule of the Master Plan should be revised from time to time by considering actual progress.

Source: JICA Study Team