ケニア共和国
環境・水・天然資源省
水資源管理庁

ケニア共和国
洪水に脆弱な地域における効果的な
洪水管理のための能力開発プロジェクト

プロジェクト業務完了報告書
第３巻　付属資料（1/2）

平成 26 年 9 月
（2014 年）

独立行政法人
国際協力機構（JICA）

株式会社　ニュージェック

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報告書の構成

第 1 巻　主報告書

第Ⅰ部　プロジェクトの背景と概要
第Ⅱ部　プロジェクト活動内容（成果 1）
第Ⅲ部　プロジェクト活動内容（成果 2）
第Ⅳ部　プロジェクト活動内容（全成果共通）
添付資料

第 2 巻　技術協力成果品

第 3 巻　付属資料（1/2）

第 4 巻　付属資料（2/2）

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2014 年 3 月

第 3 巻　付属資料 リスト（1/2）

第1部 プロジェクトの背景と概要

付属資料 1-1　WRMA 職員の洪水管理に係るキャパシティの変化

第2部 プロジェクト活動内容（成果 1）

付属資料 2-1　WRMA 洪水災害データベース（案）

付属資料 2-2　WRMA 職員の能力評価指標

付属資料 2-3　WRUA メンバーの能力評価指標

付属資料 2-4　WDC マニュアル洪水モジュール抜粋版

付属資料 2-5　本邦研修実施報告書

第3部 プロジェクト活動内容（成果 2）

付属資料 3-1　コミュニティベース洪水ハザードマップ作成活動報告書

付属資料 3-2　Isiolo 川流域洪水管理計画案

付属資料 3-3　Lumi 川流域洪水管理計画案

付属資料 3-4　Gucha Migori 川流域洪水管理計画案

第 4 巻　付属資料 リスト(2/2)

付属資料 3-5　Constitution of IFMC

付属資料 3-6　Isiolo 川流域における第 1 回 IFMC 会議議事録等

付属資料 3-7　Isiolo 川流域における第 2 回 IFMC 会議議事録等

付属資料 3-8　Isiolo 川流域における第 3 回 IFMC 会議議事録等

付属資料 3-9　Lumi 川流域における第 1 回 IFMC 会議議事録等

付属資料 3-10　Lumi 川流域における第 2 回 IFMC 会議議事録等

付属資料 3-11　Lumi 川流域における第 3 回 IFMC 会議議事録等

付属資料 3-12　Gucha Migori 川流域における第 1 回 IFMC 会議議事録等

付属資料 3-13　Gucha Migori 川流域における第 2 回 IFMC 会議議事録等

付属資料 3-14　Gucha Migori 川流域における第 3 回 IFMC 会議議事録等

付属資料 3-15　Gucha Migori 川流域における第 4 回 IFMC 会議議事録等

付属資料 3-16　Isiolo コミュニティ防災活動実施計画案

付属資料 3-17　MOU-Procurement-Com-Isiolo

付属資料 3-18　Minutes-Procurement-Com-Isiolo

付属資料 3-19　MOU-Riverbank protection works-Isiolo

付属資料 3-20　Isiolo パイロット事業契約報告

付属資料 3-21　Lumi コミュニティ防災活動実施計画案

付属資料 3-22　MOU-Procurement-Com-Lumi

付属資料 3-23　Minutes-Procurement-Com-Lumi

付属資料 3-24　MOU-Environmental improvement of evacuation camp-Lumi

付属資料 3-25　Lumi パイロット事業契約報告
付属資料 3-26　Exchange Visit to Nyando and LOGUMI
付属資料 3-27　FEWS フォーラム議事録等

第4部 プロジェクト活動内容（全成果共通）

付属資料 4-1　第 1 回ワーキンググループ会議議事録等
付属資料 4-2　第 2 回ワーキンググループ会議議事録等
付属資料 4-3　第 3 回ワーキンググループ会議議事録等
付属資料 4-4　第 4 回ワーキンググループ会議議事録等
付属資料 4-5　第 5 回ワーキンググループ会議議事録等
付属資料 4-6　ニューズレター

付属資料 1-1

WRMA 職員の洪水管理に係るキャパシティの変化

Pre-Project and Post-Project Capacity Assessment for WRMA

Project Purpose: In the Project target areas, institutional framework of flood management in the context of integrated water resource management is to be established for effective and sustainable implementation of community-based activities.

Output 1) At each level of WRMA (headquarters, regional offices and sub-regional offices), sustainable organizations in charge of flood management are to be strengthened.

Output 2) For promoting community-based activities with respect to flood management, WRMA staffs are to support WRUAs and communities are to be strengthened.

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
1. To Develop a System for Collecting and Analyzing Information/Data with respect to Flood Phenomena	[Personal aspects]				
	1-1 To collect and analyze information/data about rainfalls and river flows which may be the cause of floods	**Skills and expertise:** 1) Regarding collecting and analyzing information/data of rainfalls and river flows, which may be the cause of floods, staffs of WRMA-HQ, RO and SRO have skills and knowledge of low water, but they don' t have enough skills and knowledge (few staffs with skills) of high water(lack of equipment for high flow measurement). 2) Regarding the observation of rainfalls, WRMA staffs don't have enough knowledge and technique (few staffs with skills) for short-term interval rainfall observation. 3) Regarding the observation of water levels and river flows, they don't have enough knowledge and technique for one-hour interval water level observation and high water discharge observation. **Supplementary Notes:** 4) There are some opportunities for training the staffs of HQ, while there are few opportunities for training staffs of ROs and SROs. 5) No technical instruction books for hydro/meteorological observation exist. 6) WRMA stuffs can collect data but cannot analyze and bank information/data.	**SRO, RO, HQ**	**Improvements attributable to the Project** (To select "Very much improved", "Partially improved", and "Not improved yet") On collecting and analyzing information/data of rainfalls and river flows, which may be the cause of floods: ADCP available but other logistical (accessories) challenges in measuring high flows. **Partially Improved** On the observation of rainfalls, WRMA staffs don't have enough knowledge and technique for short-term interval rainfall observation. 1) Partially improved 2) Partially improved (Reason shall be described) 3) Partially improved **Challenges remaining** 1) Additional equipment are required. 2)Staff numbers are inadequate 3) Accessories to equipment (cable ways) 4) Vandalism to metallic installation 5) Capacity to analyze	■ Cable ways to capture high flows ■ On the job-training on the use of equipment ■ Installation of automated gauge stations (telemetric)
	1-2 To collect and analyze information/data on impacts and damages by floods	**Skills and expertise:** 1) WRMA-SRO staffs cannot collect and analyze information/data about the human damages, such as the number of missing persons and deaths, physical damages which constitute the number of destroyed houses and crops affected by floods, etc.	**SRO**	**On WRMA-SRO staffs cannot collect and analyze information/data about the human damages, Partially Improved** **Improvements attributable to the Project** 1) Partially improved: a. Trained WRMA staff designated as flood management officers **Challenges remaining** 1) Liason between WRMA and other stakeholders with crucial data 2) Capacity to collect and analyses the data in a timely manner	■ Enhancement of liason with KRCS, Agriculture, Transport and Education sectors ■ Strengthening of IFMC ■ Enhance the capacity of WRUA in collecting data ■ Establish/ enhance a system of data collection, analysis and dissemination ■ Establishing knowledge centre at various levels

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
	1-3 To collect and analyze both the characteristics of river basins and cause and effect of floods by using maps	**Skills and expertise:** 1) WRMA-SRO staffs usually don't use maps in their works. 2) It is common that flooded areas have not been identified and delineated on maps. 3) Records on river course changes have not been identified and shown on maps. 4) Only for Lumi River, such kind of records was listed on a hand writing map. 5) WRMA-SRO staffs don't have maps, which show the location of rainfall stations and water level gauging stations. 6) The use of GIS maps remains minimal in WRMA-HQ.	**SRO, RO**	**On WRMA-SRO staffs usually don't use maps in their works-Partially improved** **Improvements attributable to the Project** 1) Partially improved: a. Maps are being used in the three pilot project areas b. Maps are also being used in water rights permit processing and WDC application 2) Partially improved: a. It has been done at the three pilot areas b. Training has incorporated delineation of flooded areas skills 3) Partially improved: a. The change of GuchaMigori river course has been identified and documented and shown on the map 4) Not improved yet 5) Very much improved: a. Maps showing rainfall and water level stations 6) Partially improved: a. GIS maps are being used in the reports, presentations etc **Challenges remaining** 1) Bullet 5 Maps are yet to be displayed 2) Bullet 6 Inadequate capacity in the use of GIS at the Regional offices	■ Improve the use and display of maps ■ Capacity building in the use of GIS
	1-4 To summarize and report the status of floods and their damages	**Skills and expertise:** 1) WRMA-SRO staffs don't have enough skills and expertise to collect and analyze information/data of rainfalls, flow rates, geographical characteristics, flood affected areas, flood affected population, etc.	**SRO**	**Improvements attributable to the Project** 1) Partially improved: a) Data collection has improved as a result of some staff being trained, b) Some of the equipment have been distributed to the SROs c) Participation in the development of IFMP in the three pilot project areas, d) WRUA sensitization and training, e) Established CFMOs under the WRUA, f) Development of flood management module in the WDC manual g) Establishment of flood management department from the headquarters to the SROs h) Submitted flood disaster reports are available **Challenges remaining** ■ Inadequate equipment at the SRO, ■ Developing of IFMP for the remaining 13 flood prone areas ■ Inadequate system for flood data collection, analysis and dissemination	■ Procure and train staff on the use of the equipment, ■ Establish the system for flood reporting and dissemination, ■ To make a work plan and budget for the remaining 13 flood prone areas.
	[Organizational aspects]	(Human, physical, financial, knowledge, etc.)			
	1-5 To collect and arrange information/data systematically and appropriately with respect to rainfalls and high water discharges	**Organization:** 1) There are no common methods of installation, maintenance and calibration of hydro/meteorological observation equipment. 2) There is no particular system for installation, maintenance and calibration of hydro/meteorological observation equipment. 3) Although there are staffs in charge of data collection, there are no instruction manuals for guiding volunteer observers. 4) There are no officers in charge of checking and statistically processing	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved: a) There are staffs that have been trained, b) Standard procedures for installation, and operation 2) Not improved yet 3) Not improved yet 4) Partially improved: a. Staffs trained on data have been posted to the some of the	■ Develop observers' manual ■ Establishing of data analysis section ■ Establishment of instrument specialists office ■ Enhance data management capacity ■ Develop quality control manual for data management

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
		data. 5) Although staffs in charge of databases were stationed in SROs, ROs and HQ, there is no system to share the result of databases. **Standing instructions:** 6) There are no such regulatory documents of posts. **Budget Measures:** 7) Insufficient budget **Equipment:** 8) WRMA-ROs have Acoustic Doppler Current Profilers (ADCPs) and Acoustic Doppler Velocity-meters (ADVs). 9) WRMA-SROs have SEBA Current Flow Meters ready. 10) The number and the volume of hard disks of personal computers are not enough in WRMA-SROs. **Supplementary Notes:** 11) Poor accessibility to hydro/meteorological observation stations with the exception of a few stations		SRO 5) Partially improved: a. There is the year book available in the WRMA website b. There is feedback from the Headquarters to the Regional office on data analysis 6) Partially improved a) The schedule was developed and communicated b) Flood survey sheets developed 7) Partially improved a) There is budget line for Flood Management 8) Partially improved a) Two more ADPs added for Kiambu and Narok Sub regions b) 16 No. officers trained in use of ADCPs mainly from sub regions/regions 9) No improvement a) Non has been added and each sub region need SEBA current flow meters 10) No improvement 11) No improvement **Challenges remaining** ■ Bullet 1Calibration of equipment ■ Bullet 1Measuring the effectiveness on the use of procedures and manuals ■ Bullet 2 There is no section on instrumentation ■ Bullet 4 Inadequate staffs for data analysis ■ Bullet 5 Inadequate capacity ■ Bullet 7 Disbursement and voting of the fund ■ Bullet 9 Servicing and calibration	■ Assess the effectiveness of use of the schedule and flood data survey sheet ■ Work on work plan and come with clear budget ■ To procure ADPs and train other 14 flood prone sub regions ■ Improve on capacity of servers and number of computers at ROs and SROs ■ Improve on interconnectivity of WRMA offices ■ Automate hydromet stations with telemetric system
	1-6 To collect and analyze information/data about the effects and damages of floods	**Organization:** 1) There are no flood management staffs in ROs and SROs. **Standing instructions:** 2) noexistent **Budget Measures:** 3) Insufficient budget **Equipment:** 4) The number of personal computers and vehicles are not enough in ROs and SROs.	**SRO, RO**	**Improvements attributable to the Project** 1) Very much improved a) Staff trained and posted 2) Partially Improved a) Flood survey data sheet developed 3) Applies to above **Challenges remaining** ■ Bullet 1 inadequate trained staff ■ Bullet 1 no clear job description for FMOs	■ Training and deployment of FMOs ■ Assess the effectiveness in the use of the forms
	1-7 To collect and analyze the characteristics of river basins and cause and effect of floods by using maps	**Organization:** 1) It is very rare to use maps in SROs, ROs and HQ. 2) There are two staffs in HQ to be able to use GIS, whose skills are included to a medium or an upper class. 3) There are two staffs to be able to use GIS in RO, whose skills are included to a beginner class. 4) It is very hard for the staffs to use GIS for WRMA's works. **Standing instructions:** 5) Nonexistent **Budget Measures:** 6) insufficient budget **Equipment:**	**SRO,** RO, HQ	**Improvements attributable to the Project** 5) Partially improved a) There has been increase in use of maps in pilot areas b) There has been capacity building in use of maps in other 13 flood prone sub regions 6) Partially improved a) Some staff members have been trained in GIS 7) Ditto 8) Ditto 10) As above 11) As above 12) As above	■ Enhance capacity to use maps ■ Procure adequate GIS software licenses at SRO, RO and HQ ■ Enhance staff capacity on use of GIS software ■ Assess the effectiveness of the work instructions and the procedures

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
		7) The number of personal computers and vehicles are not enough in WRMA. **Supplementary Notes:** 8) Information/data are collected routinely, but not analyzed in graphs. 9) WRMA staffs don`t identify and instruct mistakes of volunteer observers.		13) As above 14) Partially improved a) Work instructions and procedures available at relevant functional levels **Challenges remaining** ■ Prohibitive cost of license	
	1-8 Reports for summarizing the situation of flood damages will be shared nationwide through HQ and ROs.	**Organization:** **1)** There are no Flood Management Officers in ROs and SROs. **Standing Instructions:** 2) nonexistent **Budget Measures**: 3) insufficient budget **Equipment:** 4) The number of personal computers and vehicles are not enough in WRMA. **Supplementary Notes:** 5) There are no flood disaster reports in WRMA.	**SRO,** RO, HQ	**Improvements attributable to the Project** ■ Covered above (1-4) 5) Partially Improved a) Regular reports have been submitted by SROs and ROs **Challenges remaining** ■	■ Include Flood management reports in the annual/quarterly water resources situation reports
	Institutional aspects]				
	1-9 An agreement or a system on sharing of observed data of rainfalls, water levels and flow rates with related organizations	1) There are no agreements for exchanging and sharing observed data between WRMA—which is conducting hydro/meteorological observation— and KMD—which is conducting meteorological observation—. 2) WRMA should provide rainfall data to KMD. 3) WRMA and KMD come away with no agreements with respect to data sharing from the effort. 4) However, there is a framework of KMD's data sharing to both ASAL Secretariat—a platform of countermeasures against drought— and NPDRR—a national platform for disaster risk reduction formulated by the Government of Kenya—.	**HQ**	**Improvements attributable to the Project** 1) Not improved a) Attempts have been made to bring in understanding between KMD and WRMA on data sharing, results awaited. 2) 2-3 as above 4) As above **Challenges remaining** ■ Bullet 1 Pegging data access to revenue collection	■ Lobby for increased use of data in decision making

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
2. To Analyze Cause and Effect of Floods by Using Related Information/Data	[Personal aspects]				
	2-1 Basic knowledge of topographic maps and mapping technique	**Skills and expertise:** 1) WRMA staffs are short on experience in reading topographic maps and mapping processes, because topographic maps are not common in Kenya. **Incentive:** 2) no incentive scheme **Supplementary Notes:** 3) WRMA staffs have no chances for attending training seminars of reading maps and mapping technique. 4) WRMA staffs have no technical reference materials.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partial improvement ➢ Development and transfer of flood hazard maps to the topographic maps ➢ Display of rainfall and RGS stations on the topographic maps ➢ Development of WRUA capacity ➢ Delineation of flood prone areas on the topographic maps 2) Partial improvement ➢ Transfer of flood hazard maps to the topographic maps ➢ Display of the hazard maps at strategic points ➢ Utilized in the installation of the Early Warning Systems ➢ Siting of intervention measures (structural measures 3) Partially Improved ➢ On-site training on the development and reading of flood hazard maps ➢ Participated in the development of flood hazard maps 4) Partially improved ➢ Development of the flood management module in the WDC manual ➢ Development of flood hazard map manual ➢ Evacuation drill guidebook ➢ Flood management textbook for primary school education ➢ Manual on evacuation centre ➢ Manual on the Flood early warning systems ➢ To include others in process of development **Challenges remaining** ▪ The current topographic maps does not portray real ground situations ▪ Inadequate number of trained staff in map reading ▪ Limited awareness and accessibility to technical reference materials	▪ Liaise with the Survey of Kenya to update the topographic map to portray water resources situation on the ground ▪ Capacity building on water resources map development and reading ▪ Dissemination of the technical reference materials
	2-2 Basic knowledge of high water discharge observation	**Skills and expertise:** 1) WRMA staffs are short on experience and understanding in high water discharge observation, although WRMA staffs understand the importance of low water discharge observation. **Incentive:** 2) no incentive scheme **Supplementary Notes:** 3) WRMA staffs have limited opportunities for attending training seminars of high water discharge observation. 4) WRMA staffs have no technical reference materials.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partial improvement ➢ A number of WRMA staff were trained in high flow discharge observations ➢ WRMA staff have become Trainers of Trainers ➢ More high water discharge observation equipment provided in the regions and sub regions and hence more experience by the staff. 2) Partial improvement ➢ With provision of more equipment and training there is increased motivation. ➢ Facilitation of staff 3) Partially improved ➢ A number of WRMA staff were trained in high flow discharge observations ➢ WRMA staff have become Trainers of Trainers ➢ Acquisition of more high flow measurement equipment ▪ 4) Partially improved ➢ Operational manuals have been provided with newly acquired	▪ Carry out staff training needs assessment and projection ▪ Purchase, provide high water observation equipment and train WRMA officers in the remaining 14 sub regions ▪ Keep the provided manuals at the knowledge centres

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
				equipment **Challenges remaining** ▪ Extremely rough flows are difficult to measure ▪ Limited high flow measurement equipment at the sub regional level ▪ Limited capacity to handle the equipment at the sub regional level ▪ Delayed facilitation	
	2-3 Basic knowledge of flood disaster databases	**Skills and expertise:** 1) WRMA staffs are short on experience in constructing a flood disaster database, although WRMA staffs understand the importance of it. **Incentive:** 2) no incentive scheme **Supplementary Notes:** 3) WRMA staffs have limited opportunities for attending training seminars for constructing and managing databases.	**SRO,** RO, HQ	**Improvements attributable to the Project** ▪ 1)Partially improved ➢Collected information on the floods in the 3 pilot project areas ➢Use of the information to develop the flood management plan in the 3 pilot areas ➢Development of systematic collection of flood information ▪ 2) Partially improved ➢Deployment of FMO obliges them to collect flood disaster information ▪ 3) partially improved ➢ WRMA Staff were trained in construction and management of data bases **Challenges remaining** ▪ Limited experience in data base construction	▪ Construction and management of the flood disaster data bases at the three pilot project areas and then the other thirteen flood prone areas ▪
	[Organizational aspects]	(Human, physical, financial, knowledge, etc.)			
	2-4 Framework for observing high water discharges	**Organization Framework:** 1) WRMA has no observation framework on high water discharges. 2) Each WRMA Office is in her own way of discharge observation. 3) For example, Kakamega RO is conducting a routine observation of discharges, while Kisumu RO has no observation of discharges. 4) No ROs have conducted any observation of high water discharges. **Standing Orders:** 5) nonexistent **Budget Measures:** 6) not enough **Equipment:** 7) ROs have deficient discharge observation instrument, although ROs have them. **Supplementary Notes:** 8) WRMA has unclear practice and procedure for observing high water discharges. 9) No manuals on discharge observation 10) Only WRMA LVSC has done discharge observation.	**SRO,** RO, HQ	**Improvements attributable to the Project** ▪ 1)Partially Improved ➢There is a monitoring schedule produced at the beginning of the Financial Year ▪ 2) Partially improved ➢Similar equipment supplied to the WRMA regions ➢There is coordination from the regional office ▪ 3)Partially improved ➢The 3 pilot regions now conduct regular observations of high discharges as per the monitoring schedule ▪ 4) Partially improved ➢All the 6 regions conduct regular high flow measurements ➢Two sub regions; Kiambu and Narok provided with high flow measurement equipment and conduct regular high flow measurements ▪ 5) Partially improved ➢ There is a monitoring schedule produced at the beginning of the Financial Year ▪ 6) Partially Improved ➢A budget line in the financial year ▪ 7) Partially improved ➢Two sub regions have been equipped (Kiambu and Narok) ▪ 8)Partially improved ➢There are documented instructions for high flow measurements ▪ 9) Not improved ➢No discharge observation manuals provided ▪ 10) Very much improved	▪ Purchase of high flow measurements equipment and training on the use(SRO) ▪ Develop the framework for high water discharge measurements ▪ Develop a manual for high water discharge measurements ▪ Adherence to the budget timelines ▪ Assess the effectiveness of the monitoring schedule

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
				All regions have been provided with high flow measurement equipment and are doing the discharge measurements. **Challenges remaining** ▪ Inadequate equipment for high flow measurements ▪ Inadequate capacity ▪ Irregular disbursement of funds to facilitate the teams to carry out high flow measurements ▪ Inconsistent high flow measurements ▪ Lack of discharge observation manuals ▪ no framework for high water discharge measurements	
	2-5 Framework for developing and administrating the flood disaster database in Kenya	**Organization Framework:** 1) WRMA has not developed the flood disaster database in Kenya, although it recognizes the importance of the flood disaster database in Kenya. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) available **Supplementary Notes:** 5) JICA Consulting Team has offered a prototype of the flood disaster database in Kenya, which was made by disaster data compiled by an existing database"CRED". 6) WRMA has no manuals for developing databases.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) A draft flood disaster database has been developed 2) Not improved 3) N/A 4) Partially improved b) Equipment available 5) Not improved 6) Not improved **Challenges remaining** ▪ Bullet1: Lack of awareness of the importance of the flood disaster database in WRMA ▪ Bullet 2 Lack of procedure for collecting flood disaster data ▪ Bullet 5 Non adoption of prototype ▪ Bullet 6 No flood disaster database manual	▪ Create awareness of the importance of the flood disaster database at all levels of WRMA ▪ Develop a procedure for collecting flood disaster data ▪ Review and adopt the prototype ▪ Develop a flood disaster database manual
	2-6 Framework for evaluating flood affected areas and flood damages	**Organization Framework:** 1) WRMA has no evaluation framework on flood affected areas and flood damages. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) nonexistent **Supplementary Notes:** 5) Overlooking the data on flood affected areas and flood damages. 6) WRMA has not gained one of important tools for appealing flood management.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Flood disaster assessment has been incorporated in the WDC flood management module b) Submission of flood situation report quarterly reports 2) Partially improved a) Documented instructions for submission of flood situation reports 3) Partially improved a) Existence of budget on flood management 4) Partially improved a) Procurement and disbursement of equipment including flood assessment eg GPS, Camera 5) Partially improved a) Flood management is now WRMA's mandate b) Flood situation reports prepared 6) Partially improved a) Flood management is now a WRMA mandate b) Flood damage data guidelines included in the WDC Manual c) Development of flood hazard maps **Challenges remaining** ▪ Bullet 1&6 Not all WRMA staffs are conversant with the revised WDC manual ▪ Bullet 1 Lack of clear evaluation framework of flood affected area	▪ Rollout the revised WDC manual ▪ Procure equipment for flood survey ▪ Build capacity in evaluation framework on flood affected areas and flood damages ▪ Develop evaluation framework on flood affected areas and flood damages

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
				and damage ▪ Bullet 5&6 inadequate capacity in evaluation of flood affected areas and damages ▪ Bullet 4Inadequate equipment for flood survey	
	[Institutional aspects]				
	2-7 Legal systems for assisting high water discharge observation	1) WRMA has no legal stipulation for making compulsory at high water discharge observation. **Supplementary Notes:** 2) Legal system should be set after the revised bill is passed. 3) The water bill doesn't mention about it, but the draft of the water bill mentions about it.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) No improvement 2) No improvement a. The bill has not been passed 3) No improvement a. The bill has not been passed **Challenges remaining** ▪ Water bill has not been discussed	▪ Review of water resources management rules after passing of water bill
	2-8 Legal systems for assisting to evaluate flood affected areas and flood damages	1) WRMA has no legal stipulation for making compulsory at evaluation of flood affected areas and flood damages, although since 2009 CRC has been collected disaster data, such as affected areas and damages by floods. **Supplementary Notes:** 2) Legal system should be set after the revised water bill is passed.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) No improvement 2) No improvement a. The bill has not been passed **Challenges remaining** ▪ Water bill has not been discussed	▪ Review of water resources management rules after passing of water bill
	2-9 Legal systems for assisting to develop and manage the flood disaster database in Kenya	1) WRMA has no legal stipulation for making compulsory at the flood disaster database in Kenya. **Supplementary Notes:** 2) Legal system should be set after the revised water bill is passed.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) No improvement 2) No improvement a. The bill has not been passed **Challenges remaining** ▪ Water bill has not been discussed	▪ Review of water resources management rules after passing of water bill

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
3. To Coordinate Relevant Stakeholders for Better Flood Management in Communities	[Personal aspects]				
	3-1 Basic knowledge on monitoring of rainfalls and water levels, and Early Warning System	**Skills and expertise:** 1) Both systems of monitoring of rainfalls and water levels, and Early Warning Systems have not been implemented. 2) However, WRMA staffs have basic understanding on these systems. **Incentive:** 3) no incentive scheme **Supplementary Notes:** 4) There are no reference materials available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Community based early warning systems in Pilot Project areas are operational b) Network for information sharing is in place in the Pilot areas 2) Much improved a) Trainings on manufacture and installation of FEWS b) Some number of FEWS have been manufactured, installed and stored 3) Partially improved 4) Partially improved a) Manuals developed **Challenges remaining** ■ Cost of maintaining the system in terms of power requirements and telephone ■ Bullet 3 to get a sustainable incentive scheme	■ Installation solar powered systems ■ Upscale FEWS in other identified areas within the pilot project sites ■ Replicate to other flood prone areas ■ Train more staff from other flood prone areas on manufacture and installation of FEWS ■ Develop and implement an incentive scheme (non monetary) ■ Improve on the developed manuals
	3-2 Basic knowledge on Hazard Mapping	**Skills and expertise:** **1)** Hazard Maps are not very common but WRMA staffs understand their importance in flood management. 2) There are few occasions to experience making of Hazard Maps. **3)** WRMA staffs have experience to make community flood Hazard Map with JICA Project team. **Incentive:** 4) no incentive scheme **Supplementary Notes:** 5) There are few chances of receiving trainings on Hazard Maps. 6) There are no reference materials available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Flood hazard maps developed for the three Pilot project areas b) Trainings of WRMA staff 2) Partially improved a) Staff in pilot areas participated in development of more flood hazard maps 3) As above 4) Job description for FMOs 5) Much improved a) ToTs has been undertaken hence there is internal capacity 6) Very much improved a) Manuals have been developed and are in use **Challenges remaining** ■	■ Develop hazard maps for all flood prone areas ■ Enhance capacity of WRMA staff in Flood hazard map development ■
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)				
	3-3 Methodologies and organizers for community-based flood responses (monitoring of rainfalls, water levels, flood damages, etc.)	**Organization Framework:** 1) WRMA is well aware of the importance of monitoring systems of water levels and flood damages, and Early Warning Systems and has an agreement on her intention to establish such systems in the near future. **Standing Instructions:** 2) onexistent **Budget Measures:**	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) WRMA with the community has established and operationalized FEWS in the three pilot areas 2) 2-5 as above **Challenges remaining** ■	■ Upscale to other areas

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
		3) N/A **Equipment:** 4) N/A **Supplementary Notes:** 5) No technical reference materials available to WRMA staffs.			
	3-4 Methodologies and organizers for preparing and utilizing Hazard Maps	**Organization Framework:** 1) WRMA has developed water resource maps, but they don't have experience, methodologies and organizations to draw flood Hazard Maps. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) There are no topographic maps and GIS software available. **Supplementary Notes:** 5) Some WRUAs are trying to make Hazard Maps on their own. 6) JICA Project team is preparing prototype base maps using GIS. 7) There is no technical standard available for mapping.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Manuals in place b) Trained staff and WRUA members 2) 2-3 as above 4) Partially improved a) Topo sheets procured for the Pilot areas 5) Partial improved a) WRUA members and WRMA staff have together developed Flood Hazard maps for the pilot areas 7) Partially improved a) Base maps for pilot areas to form the technical standard for mapping **Challenges remaining** ▪ Few number of staff and WRUA members have been trained	▪ Acquire topo sheets for other flood prone areas ▪ Enhance skills in WRUAs and WRMA staff to develop Flood hazard maps in other flood prone areas ▪ WRMA to develop base map for other Flood prone areas ▪ Review and adopt the standards in the base maps
	[Institutional aspects]				
	3-5 Legal systems for collecting and disseminating information of communities' flood responses (monitoring of rainfalls, water levels and flood damages)	1) WRMA has no legal stipulation for collecting and disseminating information of community-based flood responses, in particular, flood-related information.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Flood management is WRMA mandate **Challenges remaining** ▪ Pending water bill	▪ Full operationalization of flood management functions at all WRMA l levels

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
4. To Advice WRUAs Technically to Formulate SCMPs	[Personal aspects]				
	4-1 Basic knowledge on technical advices to community-based flood responses (evacuation, flood fighting, etc.)	**Skills and expertise:** 1) WRMA's current knowledge and skills on community-based flood responses (evacuation, flood fighting, etc.) is not very high. 2) It is difficult for WRMA staffs to technically advise communities on their flood responses. **Incentive:** 3) no incentive scheme **Supplementary Notes:** 4) There are no technical reference materials available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved: a) Capacity skills on community-based flood responses (evacuation, flood fighting, etc.)has been built for WRMA staff at all levels 2) Very much improved: a) Training materials on community based flood management have been developed (eg evacuation drill guidebook and community flood hazard map development manual) b) Trained WRMA staff have participated in the training of WRUA (WRMA staff executed community driven flood hazard mapping and evacuation drill) 3) Very much improved: a. Flood management is a mandate of WRMA b. Developed IFMP c. Inclusion of Flood management module in the revised CMS d. Incorporation of flood management module into the WDC manual e. Establishment of the IFMC f. WRMA staff working with the communities 4) Very much improved: a) Development of various flood management manuals b) Revised WDC Manual **Challenges remaining** ▪ Few number of staff have been trained ▪ Lack of flood management chapter in the existing SCMPs	▪ Capacity building of more WRMA staff on community-based flood responses (evacuation, flood fighting, etc.) ▪ Review the existing SCMPs with the aim of including flood management chapter
	4-2 Basic knowledge on technical advices for flood control works (structural measures against floods)	**Skills and expertise:** 1) WRMA staffs' current knowledge and skills on flood control works (structural measures) are limited. 2) It is difficult for WRMA staffs to technically advise communities on their efforts to design, implement and manage flood control works. **Incentive:** 3) no incentive scheme **Supplementary Notes:** 4) There are no technical reference materials available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved: a. Some WRMA staffs have been trained on flood countermeasures (structural measures) 2) Partially improved: a. There are technical materials that WRMA staffs can use to technically advise communities on their efforts to design, implement and manage flood control works 3) Very much improved a. Flood management is a mandate of WRMA b. Developed IFMP c. Inclusion of Flood management module in the revised CMS d. Incorporation of flood management module into the WDC manual e. WRMA staff working with the communities 4) Very much improved a) There are technical reference material for flood control works available **Challenges remaining** ▪ Few number of staff have been trained ▪ Inadequate awareness and access to technical reference materials	▪ Capacity building of more WRMA staff on flood countermeasures (structural measures) ▪ Create awareness and disseminate technical reference materials for flood control works

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
				for flood control works	
	4-3 Basic knowledge on technical advices to community level education for disaster prevention	**Skills and expertise:** 1) WRMA staffs' current knowledge and skills on community level education for disaster prevention are not prioritized. 2) It is difficult for WRMA staffs to technically advise communities on their efforts to educate community members. **Incentive:** 3) no incentive scheme **Supplementary Notes:** 4) There are no technical reference materials available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved: a. Flood management is a mandate of WRMA b. Developed IFMP c. Inclusion of Flood management module in the revised CMS d. Incorporation of flood management module into the WDC manual e. Establishment of the IFMC f. WRMA staff working with the communities 2) Very much improved a) WRMA staff have been trained and can technically advice the community on flood management 3) Very much improved a) The revised WDC manual b) Deployment of flood management officers 4) Very much improved a) There are technical reference material for flood disaster education are available **Challenges remaining** ■ Language barrier ■ Gender disparities	■ Collaborate with the local communities to interpret ■ Community sensitization on active participation for all community members in flood management
	4-4 Basic knowledge on technical advices to obtain funds for community-based activities	**Skills and expertise:** 1) WRMA staffs' current knowledge and skills on obtaining funds on flood management issue like WDC are not very high. 2) It is difficult for WRMA staffs to technically advise communities on their efforts to apply for funds. **Incentive:** 3) no incentive scheme **Supplementary Notes:** 4) There are no technical reference materials available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved: a. Flood management activities are now eligible for WDC funding 2) Very much improved a) There is a funding procedure 3) Not applicable 4) Very much improved a) There is funding procedure **Challenges remaining** ■ Limited number of sources of finances	■ Explore other additional sources of funding
	[Organizational aspects]	(Human, physical, financial, knowledge, etc.)			
	4-5 To establish methods and organizations to technically support WRUAs in their preparing SCMPs	**Organization Framework:** 1) WRMA staffs are currently not providing adequate technical support on flood management issues to WRUAs in their preparation of SCMPs. **Standing Orders:** 2) nonexistent **Budget Measures**: 3) N/A **Equipment:** 4) N/A **Supplementary Notes:**	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved: a) Flood Management has been incorporated in the WDC manual(the flood management chapter is yet to be incorporated in the existing SCMPs) 2) Very much improved: a) There is a WDC manual that has flood management training module 3) N/A 4) N/A **5)** Very much improved	■

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
		5) There is no technical standard or materials in WRMA for providing technical advices to WRUAs.		a) There is the WDC manual **Challenges remaining**	
	4-6 To establish methods and organizations to technically support WRUAs in their applying for funds	**Organization Framework:** 1) WRMA staffs are currently not providing adequate technical support to WRUAs under their application for funds. 2) WRMA is technically appraising the applications of WRUAs for funds. **Standing Orders:** 3) nonexistent **Budget Measures:** 4) N/A **Equipment:** 5) N/A **Supplementary Notes:** 6) There is no technical standard in WRMA for providing technical advices to WRUAs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Flood Management module included in the WDC manual 2) Not applicable 3) Very much improved a) Flood management module included in the WDC manual 4) N/A 5) N/A 6) Very much improved a) Flood management module included in the WDC manual **Challenges remaining** ■	■
	[Institutional aspects]				
	4-7 Legal systems for technical support to WRUAs under their preparing SCMPs	1) WRMA has a mandate to provide technical support to WRUAs under their preparing SCMPs.	-	**Improvements attributable to the Project** 1) Very much improved a) Inclusion of Flood management training module in the WDC manual **Challenges remaining** ■	

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
5. To Formulate and Update Training Manuals on Flood Management and Conduct Training Seminars to HQ/RO/SRO Staffs of WRMA	[Personal aspects]				
	—	—			
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)				
	5-1 To design WRMA's own technical development system	**Organization Framework:** 1) WRMA has not established her organization to design her own technical development system. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) N/A **Supplementary Notes:**	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) ToTs have been trained b) Training plan under implementation, 1st and 2nd stages have been implemented. The 3rd stage is under implementation 2) Partially improved a) Training plan in place **Challenges remaining** ■ Re-deployment of trained staff ■ No clear job description resulting to overlaps and conflicts	■ Continuous training of the ToTs and FMOs ■ Staff follow up assessment after training
	5-2 To prepare WRMA's technical reference materials	**Organization Framework:** 1) WRMA has not prepared technical reference materials for her technical development system. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) N/A **Supplementary Notes:** 5) There is no technical standard available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Partially improved a) Certain manuals have been developed and in process of finalization and publication (Manuals: High Flow measurements, Construction and maintenance of Flood management structures, manufacturing and installations of FEWS, monitoring of staff gauges, non- structural measures e.t.c) 2) Partially improved a) Catalogues of manuals and training materials distributed during training 5) Partially improved a) There is a technical standard material to be discussed for improvement by WRMA **Challenges remaining**	■ Publish and disseminate manuals ■ Continual improvement of manuals ■ Distribution of available manuals and training materials ■ Initiate discussion towards development of technical standards for flood management
	5-3 To raise lecturers for the WRMA technical training courses at the 2nd stage in Kenya	**Organization Framework:** 1) WRMA has not established a module to raise lecturers for her own technical development system. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) N/A **Supplementary Notes:**	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved a) ToTs have been trained and have undertaken training in the 2nd and 3rd stages 2) Partially improved a) The approach of using ToTs has been established **Challenges remaining**	■ Set a clear frame work to guide future operation
	5-4 To operationalize the WRMA technical training courses at the 2nd stage in Kenya	**Organization Framework:** 1) WRMA is not currently operating technical development system. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:**	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved a) Stage 1 and 2 completed, stage 3 ongoing b) Other trainings like IFAS have been conducted 5) Not improved a) No guidelines or standards formulated **Challenges remaining**	■ Develop guidelines/ standards for operation of technical development system

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
		4) N/A **Supplementary Notes:** 5) There is no standard for operation of the technical development system.		▪	
	[Institutional aspects]				
	5-5 Legal systems for the WRMA technical training courses at the 2nd stage in Kenya	1) WRMA has no legal stipulation for establishing her own technical development system at this moment, but it will be incorporated with the draft water bill.	**SRO,** RO, HQ	**Improvements attributable to the Project** Very much improved; a) The use of ToTs has been implemented in the 2nd stage training **Challenges remaining** ▪ WRMA technical development should not be legal issue, it should be formalized internally.	▪ To include training on flood management in the training policy and plan

WRMA Capacity to be Developed	Required Capacity Element	Pre-Project Assessment (*29th to 30th Nov. 2012*)	Target Group	Post-Project Assessment *(4th to 5th June 2014)*	Actions
6. To Introduce a Concept of "River Basin Flood Management Plan (RBFMP)", which should be Set between the CMS and the SCMPs	[Personal aspects]				
	6-1 Basic knowledge on Integrated Flood Management (IFM)	**Skills and expertise:** 1) WRMA staffs understand the necessity of IFM, but do not have acquired specific experiences to implement IFM and knowledge required. **Incentive:** 2) N/A **Supplementary Notes:** 3) There is no technical reference material available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved: ➢ Experience gained through the preparation of 3No Draft IFMPs and implementation of pilot projects ➢ Trainings carried out on IFM ➢ The revision of CMSs includes IFM 3) Very much improved a) Reference document such manuals and training materials are available **Challenges remaining** ■	■ Finalization of IFMPs ■ Revision of SCMPs to incorporate the IFM ■ Up scaling the development of the IFMP to other flood prone areas.
	[Organizational aspects]	(Human, physical, financial, knowledge, etc.)			
	6-2 To establish methods and organizations for making River Basin Flood Management Plans (RBFMPs)	**Organization Framework:** 1) WRMA understands the necessity of RBFMP but has not established organization to prepare RBFMPs. **Standing Orders:** 2) nonexistent **Budget Measures:** 3) N/A **Equipment:** 4) N/A **Supplementary Notes:** 5) There is no technical standard available to WRMA staffs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 1) Very much improved a) Flood management unit in HQ, RO and SROs b) IFMC operational in the pilot project areas 2) Partially improved a) The process is ongoing but there is need for documentation **Challenges remaining** ■ Trans-boundary issues in terms of participation in IFMCs and access to information/data. ■ Comprehensive mapping of flood prone areas has not been done	■ Map and document all the flood prone areas that require IFMP ■ Replicating the IFMP in the mapped out flood prone areas ■ Implement the relevant aspect of Kenya-Tanzania MoU on Trans boundary Water Resources Management. ■ Lobby the Ministry of EWNR for negotiation of MOUs on Trans boundary flood management ■ Preparation of manuals/guidelines for preparation of IFMPs
	[Institutional aspects]				
	6-3 Legal systems for River Basin Flood Management Plans (RBFMPs)	1) Each WRUA is mandated to prepare the SCMP for her sub-catchment, and WRMA prepare CMSs. 2) A RBFMP is a concept newly proposed in the Project and there is no legal provision to prepare RBFMPs.	**SRO,** RO, HQ	**Improvements attributable to the Project** 2) Partially improved a) Flood management is part of Water Resources Management functions **Challenges remaining** ■	■ The revision of the WRM rules to mainstream RBFMP

付属資料 2-1

WRMA 洪水災害データベース（案）

Water-Related Disaster Data in Kenya (1964 - 2011)

Source-1: CRED (Centre for Research on the Epidemiology of Disaster, Univ. Catholique de Louvain, Belgium)

Source-2: Flood Observatory of Univ. of Colorado **2013/3/12 17:08**

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
2010-9082		00/01/2010	00/00/2011	Drought	Marsabit District, Isiolo District, Moyale District			3,754,585			
	3646	08/05/2010	24/05/2010	Flood	Western Kenya, Amoni, Osuret,Asing'e, Among'ura, Kamolo and Osajai, Salabani location, Marigat District in Rift valley province		100	70,000	196,100		
2010-0285					(Western Kenya, Amoni location (Teso District))						
2010-0186		30/04/2010	30/04/2010	Landslide	Kitony village (Marakwet District)		10				
	3621	07/03/2010	03/05/2010	Flood	Marsabit North, Migori, and Urin Districts in South Nyanza, Mandera: North Rift, Pokot Central District		26	2,500	40,320		
2010-0094		01/03/2010	14/05/2010	Flood	Marsabit District, Turkana District, Moyale District		94	141,164			
	3589	21/12/2009	13/01/2010	Flood	Turkana East, Rarienda, Nairobi, Kajiado North, Narok, Rachuonyo, East Pokot, Mogotio, North Rift (Turkana East District, East and West Pokot Districts, Kenya-Ethiopia-Sudan roads cut.		21	30,000	176,700		
2009-0597		24/12/2009	12/01/2010		Nairobi province, Lake Turkana		40	91,350			
	3557	20/10/2009	28/10/2009	Flood	Tana Delta and Tana River, between Malindi and Garsen			2,000	197,700		Somalia Ethiopia
2009-0494		29/10/2009	04/11/2009	Flood	Mandera District, North eastern province		16	44,850			
2008-9302		00/07/2008	00/00/2009	Drought	Sacho township (Baringo District), Marigat District , Mukutani (East Pokot District)		4	3,800,000			
	3402	10/11/2008	12/11/2008	Flood	Western Kenya, Nzoia River			28,000	37,960		Uganda
2008-0513		08/11/2008	08/11/2008	Landslide	Chepkogoh village(Pokot District)		10	20			
2008-0483		10/11/2008	25/11/2008	Flood	Budalangi constituency (Busia District)		17	30,770			
2008-0483		04/10/2008	07/10/2008	Flood	Katilu location (Turkana District)		17	6,310			
	3394	14/10/2008	16/10/2008	Flood			3	10,000	45,130		Somalia
2008-0482				Flash flood	Mandera District			6,000			
	3321	13/06/2008	20/06/2008	Flood	Tana Delta District		16	8,658	40,030		
2008-0260											
	3294	20/04/2008	22/04/2008	Flood	Homa Bay-Asego Division-Wahambla and Got Kokech villages	River Rangwena		2,000	240		

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
	3291	28/03/2008	02/04/2008	Flood	Nyanza province-Lower Nyakach Division-Rang'ui, North Nyakach, Pap Onditi and Asalo. Nyando District. Kasai, Kisumu's Nyalenda slums	Nyando and Awach , Auji and Kibos	3	160	3,970		
2008-0129		20/03/2008			Chalbi District, Rachuonyo District		2	10,000			
	3290	17/03/2008	05/04/2008	Flood	Kenya-Coast province: Taita and Taveta Districts-Kimorigo, Eldoro and Marodo, Kimorigo, Mbogoni and Mahoo, Voi, Tanzania and Bondeni. Tanzania-Manyara region-Mirerani area Arusha	Voi, Lumi, Ruvu tributaries, Lake Jipe tributaries	1	9,600	50,220		Tanzania
2008-0127					Taita taveta District			700			
	3288	20/03/2008	02/04/2008	Flood	Rift valley province, Chalbi District, North Horr Constituency-Bubisa village, Mubisa area, Marsabit District, Meru Central District, Rachuonyo District-Naivasha area-Kodhoch, West Karachuonyo, Koyugi, Kawadhgone Nyongo and Wagwe, Onyege		2	10,000	21,280		
2007-0613		12/12/2007	15/12/2007	Flood	Taita taveta District		4	2,000	6,200		
	3240				Taita Taveta District, Voi, Wundanyi Division, Mwatate						
	3235	21/11/2007	16/12/2007	Flood	Tana River District-Garsen Division, Hweani , Mnazini, Bahati, Bura, Wenje, Garsen, Boji, Ozi and Kau, Tana Delta, Iskadeck	Tana	4	6,000	6,100		
2007-0408		15/08/2007	31/10/2007	Flood	Budalangi constituency (Busia District)		13	40,000			
2007-0356		10/08/2007	13/08/2007	Landslide	Kuvasali village (Lugari District)		20	6			
	3078	15/05/2007	14/06/2007	Flood	Coast province-Districts: Mombasa (Likoni, Kadongo, Moroto, Junda, Kadzonzo, Mushomoroni, Kisauni, Changamwe), Malindi, Kwale, Kilifi(Kikambala), Lamu (Witu, Mpeketoni, Soroko, Bomani), Kaloleni, Tana River District	Mwakuhenga, Mkuru	5	8,500	13,870		
2007-0177			11/06/2007		Mombasa District, Malindi District, Kwale District		2	651			
	3059	21/04/2007	30/04/2007	Flood	Busia District-Budalangi, Bwalwanga, Mukhunda, Sitiri	Nzoia	0	2,460	1,100		

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
	2979	23/10/2006	04/01/2007	Flood	Kenya-Coast, North- Eastern, Western and Rift valley provinces-Isiolo (Ngamara, Malkagala, Merti, Gafarsa). Garissa (Hagadera, Ahantabak, Alikune, Janirot, Amuma, Boralgi, Dadaab Ifo), Tana River District (Bula Bahati, Mnazini, Witu, Hola through Wenje to Garsen).Mandera (El Wak) , Wajir (Guarar, Dajabula, Kursin). Kilifi, Mombasa, Kwale, Lodwar, Moyale (Bori), Ijara, Merti division, Machakos, Modogashe, Mwingi, Nakuru, Nyando, Kisumu (Kajulu, Migori, Nyando) , Busia, (Budalangi, Maduma, South Bunyala). Lugari, Keiyo (Epke). Malindi, Kisumu, Nyanza area -South Somalia-Gedo region -Beledhawo, Garbaharey, Luq(Luuq), Barhere (Bardere), Jubba provinces-Kamsuma, Mugamba, Jilib, Buale, Jamame, Dobley, Afmadow and Marere -Tanzania-Shinyanga area, Mwanza area, Magu District, Nyakaboja, Nyamikoma, Lugeye, Shimanilwe and Kabita. Kigoma region, Tabora (Uyui) -Uganda-	Kenya- Ewaso Nyiro,Uaso Nyiro. Tana river and tributaries, Ramisi, Lak Dera, Lak Bor,Lagahar, Ndarugu, Sosiani, Ramisi, Nzoia, Ongoche, Kuja, Migori, Ongohe, Nyamasaria, Sabaki, Awach, Ragana Somalia-Jubba river, Lach Dera, Lach Bissigh - Tanzania-Wembere, Mwanza -Uganda-River	150	700,000	950,000		Somalia Tanzania Uganda
2006-0624		23/10/2006	19/12/2006	Flood	Dadaab District, Kwale District, Garissa District		114	723,000			
	2976	15/10/2006	26/10/2006	Flood	Coast province-Kilifi and Kwale Districts-Kaloleni, Mazeras, Ramisi, Kisauni Division, Mombasa District, Mishomoroni, Kiembeni, Malindi	Kombeni, Kilindini	6	2,000	12,730		
	2837	04/04/2006	22/05/2006	Flood	Districts-Malindi, Kilifi, Kwale,Nyando, Homa Bay, Migori, Siaya, Rachuonyo, Isiolo, Samburu, Laikipia, Wajir, Garissa, Mandera	Uaso Nyiro, Sabaki, Tana, Migori, Kuja, Nzoia, Nyando,	60	17,300	538,000		
2006-0587		15/10/2006	26/10/2006	Flood	Isiolo District, Garissa District, Lodwar town(Turkana District)		30	30,000			
2006-0234		25/04/2006	04/05/2006	Flood	Nyanza province, Mombasa District		8	13,000			
2006-0178		04/04/2006	22/05/2006	Flood	Isiolo District, Moyale District, Nairobi province		60	17,300			
2005-9719		00/12/2005	00/00/2006	Drought	Makueni District, Kitui District, Malindi District		27	3,500,000			
	2672	17/06/2005	20/06/2005	Flood	Western Kenya-Busia District-Bukhay, Walwasi		20	1,200	3,520		
2005-0526					Bukhay (Busia District), Walwasi ward (Busia distrct)						

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
	2652	03/05/2005	03/06/2005	Flood	Kenya-Nyanza, Western, -Rift Valley, Coast and parts of North eastern provinces-Districts: Nyando (Kabonyo, Kakola, Kochogo, Ongeche,), Rachuonyo (Kayitir, Kawadhgone, Koyugi), Nyatike (Kaden), Migori, Garissa (Dadaab), Isiolo (Merti, Gulesa and Malkagala), Karachuonyo, Homa Bay (Kochia, West Kagan, Rangwe), Ijara, Tana River, Kisumu (Buoye, Winam, Kolwa), Kochia, Naivasha, Nakuru -Uganda-Mbale District	Kenya-Nyando, Kibos, Awattende, Maugo, Ombeyi, Athi, Ewaso Nyiro, Oluch, Mango and Awach Kagan Nyamasaria and Mahenya - Uganda-Namatala	4	40,000	443,200		Uganda
2005-0260		18/05/2005	24/05/2005	Flash flood	Rift valley province, Western regions		5	10,000			
2005-0215		23/04/2005	26/04/2005	Flash flood			1	25,000		0.5	
2004-9288		00/07/2004	00/00/2004	Drought	Kitui District, Mbeere District, Mwingi District		80	2,300,000			
2004-0659		26/12/2004	26/12/2004	Tsunami	Mombasa District		1			100	
	2467	09/04/2004	11/05/2004	Flood	Nyanza province-Districts: Nyando, Rachuonyo, Kisumu, Migori, Homabay, South West Kano, Nyakach, Miwani, Ombeyi, Nyatike, Kisii, Muhoroni, Ahero, Rangwe, Aywey. Rift valley province-Ditriscts: Nakuru, Baringo, Turkana, Nyamira, Machakos, Marakwet. Towns: Rangwe, Karachuonyo, Kobuya, Nasigir, Naivasha, Eldoret, Laikipia. Budalangi-Busia District, Nairobi area.- Central- Thika, Murang'a, Nyeri, Kirinyaga Mt. Kenya region-Meru, Othaya, Kirinyaga- Western Kenya,-Ukambani- Coast province-Districts: Tana River, Taita Taveta, Homa Bay - Uganda-Mbale area	Kenya-Nyanza - Nyando, Mahenya, Sondu-Miriu, Sio, Awach, Ombeyi, Migori and Kuja, Tonde. Rift valley-Chemoron, Endao, Miriu, Athi Budalangi-Nzoia, Central-Thirikwa, Ndarugu, Thiriku, Mt. Kenya-Ruamuthambi, Nairobi area-Kirichwa, Ruaraka other rivers: Athi	50	15000	268,300		Uganda
2004-0194				Flood	Nairobi province, Tana river District			10,000			
2004-0152		09/04/2004	12/04/2004	Flash flood	Nyando District, Budalangi District		4	2,000			
	2334	26/08/2003	12/09/2003	Flood	Western Kenya-Busia,-Budalangi division of Siaya District, Ugenya and Alego-Usonga constituencies. Bunyala South villages neighbouring the Yala swamp	Nzoia, Yala	1	2,100	2,470		
	2331	24/08/2003	24/08/2003	Flood	Kerio valley-Chepsigot ward			400	2,920		

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
	2213	21/04/2003	04/06/2003	Flood	Kenya-Nyanza province -Districts; Nyando, Migori, Kisumu, Budalangi, Rift valley province-Districts: Nakuru, East Baringo, Kericho, Samburu, Koibatek, Nandi, West Pokot, Western province-Busia, Trans-Nzoia, Bungoma, Kakamega, Siaya, Sifuno, Eastern province-Districts: Turkana, Machakos, Yatta, Coast province-Ndera, Malindi, Garissa. -Eastern Uganda-Mbale District;Namalu area, Bugiri District, Bulidha sub-county, Kampala area	Kenya-Nyanza province-Nyando, Awach, Migori and Kuja. Rift valley province-Kositei, Cheptokwo, Nginyang, Iriri, Kimondi, Chesita, Murumi, Swam, Orwa. Western province-Nzoia, Ombeyi. Eastern province-Turkwel, Kerio, Tinganga. Coast province-Tana, Sabaki. North eastern-Lak Dara and tributaries Eastern Uganda-Amaler and	77	1,000,000	291,400		Uganda
	2118	04/01/2003	06/01/2003	Flood	Western Kenya-Kisumu, Manyatta, Dunga and Nyalenda Kisii	River Auji		300	390		
2003-0729					Kisumu region						
2003-0204		00/04/2003	00/05/2003	Flood	Nyando District, Kisumu District, Rachuonyo District		40	60,000			
	2108	21/12/2002	23/12/2002	Flood	Marigat division in Baringo District, Ng'ambo, Ng'arua,Eldume, Sintaan	Perkerra river	6	3,000	750		
2002-0800					Marigat division(Baringo District)						
	2088	17/11/2002	20/11/2002	Flood	Central Kenya-Kiambu District-River Riara from Kiambu town	Riara	12	2,000	920		
2002-0711				Flash flood	Kiambu District						
	2078	29/10/2002	04/11/2002	Flood	Eastern Kenya-Madogo division of Tana River District, Tana River, Marere River in Kinango area of Kwale District	Tana, Marere	14	20,000	77,900		
2002-0689					Madogo division (Tana River distrct)						
	2055	16/09/2002	19/09/2002	Flood	Mombasa, Matuga, Kipevu. Districts: Kwale, Kilifi, Mombasa, Taita Taveta				63,450		

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
	1917	26/04/2002	28/05/2002	Flood	Kenya– Budalangi area in Nyanza province. Central Meru and Muranga Districts near Mt. Kenya. Nairobi area. Western Districts of Kisumu and Busia. Rivers: Mara, Tana, Sabaki ––Uganda–Counties: Manjiya, Bubukwanga Districts: Mbale, Bundibugyo, Sironko. Towns: Kampala area, Kyambogo, Rwebisengo, Rwangara and Bweramole. Semliki river –Rwanda– Western and Central areas –Tanzania–Mbeya region, Geita District in Mwanza region	Kenya–Mara, Tana, Sabaki – Uganda–Semliki	160	168,000	1,019,000		Uganda, Tanzania, Rwanda
2002–0265					Migori District, Kisumu District, Nyando District		53	150,008			
2002–0248		30/04/2002	30/04/2002	Landslide	Meru District, Murang'a District		16				
	1915	29/04/2002	02/05/2002	Flood	Nairobi area. Nairobi river	Nairobi	2		3,830		
	1686	13/01/2001	14/01/2001	Flood	Nairobi and sorrounding areas–Dagoretti, Kibera		4		4,350	0.038	
2001–0032					Nairobi province						
1999–9388		00/12/1999	00/00/2002	Drought	Baringo District, Garissa District , Isiolo District		85	2,300,000			
	1374	27/05/1998	31/05/1998	Flood	Nairobi		19	800	106,200		
	1298	01/01/1998	20/01/1998	Flood	Kenya–Voi, Nairobi–Mombasa Highway, Tsavo National park, Garissa –Tanzania–Lakes Victoria and Tanganyika, North Zambia, Mwanga District, Kilimanjaro region	Tana, Mkondoa	86	346,000	386,400		
1998–0443		00/05/1998	00/05/1998	Flood	Lake Victoria		40	200			
	1287	30/11/1997	03/12/1997	Flood	Garissa	Tana	11	10,000	8,840		
	1271	15/10/1997	23/10/1997	Flood	Coastal areas–Mombasa	Bogolo	23		34,480		
1997–0255		00/09/1997	00/09/1997	Flood	Kwale District, Kilifi District, Mombasa District		86	900,000		11.8	
1996–9326		00/01/1997	00/00/1998	Drought	Garissa District, Isiolo District,Wajir District			1,600,000			
	1064	08/04/1996	11/04/1996	Flood	Nyanza province: Kano, Lower Nyakach, Karachuonyo, Kisumu District (West Nyakach), Homabay District (East Karachuonyo)		0	1,000	12,430		
1996–0474					Nyanza province						
1994–9422		00/03/1994	00/00/1995	Drought	North eastern regions			1,200,000			
1991–9224		00/00/1991	00/00/1992	Drought	North eastern regions			2,700,000			
1990–0352		14/04/1990	15/04/1990	Flood			44				
	177	10/04/1988	10/05/1988	Flood	Nairobi area, Districts–Kisumu, South Nyanza, Laikipia, Nyando division in Western Kenya. Rivers: Tana, Nyando		60	10,000	89,600		
1983–9060		00/00/1984	00/00/1982	Drought				600,000			
1982–0107		00/10/1982	00/10/1982	Flash flood	Near Lake Victoria		75	3,000			
1979–9177		00/00/1979	00/00/1980	Drought	Turkana District			40,000			

Register No.		Sart	End	Type	Location	River	Dead	Total Affected Residents	Affected Area (km^2)	Estimated Damage (US$ Million)	Other Nations Affected
CRED	Univ. of Colorado										
1977-0064		00/05/1977	00/05/1977	Flood			100	20,000		10	
1975-0008		00/00/1975	00/00/1975	Flood				16,000			
1971-9004		00/01/1971	00/00/1971	Drought	Country wide			150,000		1.5	
1968-0043		00/05/1968	00/05/1968	Flood	Nyanza province, Western province					0.05	
1965-9038		00/07/1965	00/00/1965	Drought				260,000			
1964-0025		00/05/1964	00/05/1964	Flood	Nyanza province, Western regions			15,000			

JICA Experts

付属資料 2-2

WRMA 職員の能力評価指標

Appendix B Capacity Assessment and Development Planning Matrix for WRMA

Project Purpose: In the Project target areas, institutional framework of flood management in the context of integrated water resource management is to be established for effective and sustainable implementation of community-based activities.
Output 1) At each level of WRMA (headquarters, regional offices and sub-regional offices), sustainable organizations in charge of flood management are to be strengthened.
Output 2) For promoting community-based activities with respect to flood management, WRMA staffs are to support WRUAs and communities are to be strengthened.

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
1. To Develop a System for Collecting and Analyzing Information/Data with respect to Flood Phenomena	[Personal aspects]							
	1-1 To collect and analyze information/data about rainfalls and river flows which may be the cause of floods	**Skills and expertise:** ■ Regarding collecting and analyzing information/data of rainfalls and river flows, which may be the cause of floods, staffs of WRMA-HQ, RO and SRO have skills and knowledge of low water, but they don' t have enough skills and knowledge of high water. ■ Regarding the observation of rainfalls, WRMA staffs don't have enough knowledge and technique for short-term interval rainfall observation. ■ Regarding the observation of water levels and river flows, they don't have enough knowledge and technique for one-hour interval water level observation and high water discharge observation. **Supplementary Notes:** ■ There are some opportunities for training the staffs of HQ, while there are few opportunities for training staffs of ROs and SROs. ■ No technical instruction books for hydro/meteorological observation exist. ■ WRMA stuffs can collect data but cannot analyze and bank information/data.	Staffs of WRMA-HQ, RO and SRO will utilize the basic knowledge of general meteorology, general hydrology, general river engineering, rainfall observation, water level gauging, river flow observation, river survey, river investigation, data processing and statistical processing in their flood management works. Some trained staffs of WRMA will be lecturers of the WRMA technical training courses at the 2nd stage in Kenya.	【 I 】	short-term	**[Training in Kenya]** Creating instruction book about basic knowledge of meteorology, hydrology, river engineering, rainfall observation, water level gauging, river flow observation, river survey, river investigation, data processing and statistical processing Training on the basic knowledge of meteorology, hydrology, river engineering, rainfall observation, water level gauging, river flow observation, river survey, river investigation, data processing and statistical processing	SRO,RO,HQ	■ Method of rainfall observation ■ Method of water level observation ■ Method of flow rate observation ■ Method for scrutinizing hydro-meteorological data ■ Hydro-meteorological statistics
	1-2 To collect and analyze information/data on impacts and damages by floods	**Skills and expertise:** ■ WRMA-SRO staffs cannot collect and analyze information/data about the human damages, such as the number of missing persons and deaths, physical damages which constitute the number of destroyed houses and crops affected by floods, etc.	From other related organizations and districts, WRMA-SRO staffs will obtain information/data related to flood damages.	【 I 】	short-term	**[Training in Kenya]** Technical training in Kenya to collect and analyze the human damages and physical damages by floods	SRO	■ Method for collecting flood damage data ■ Method for evaluating flood damage amounts
	1-3 To collect and analyze both the characteristics of river basins and cause and effect of floods by using maps	**Skills and expertise:** ■ WRMA-SRO staffs usually don't use maps in their works, because topographical maps have not been distributed in SRO offices. ■ It is common that flooded areas have not been identified and delineated on maps. ■ Records on river course changes have not been identified and shown on maps. ■ Only for Lumi River, such kind of records was listed on a hand writing map. ■ WRMA-SRO staffs don't have maps, which show the location of rainfall stations and water level gauging stations. ■ The use of GIS maps remains minimal in WRMA-HQ.	WRMA-SRO staffs will arrange the characteristics of river basins and the situation of river course changes by using topographic maps. WRMA-SRO staffs will indicate the locations of rainfall stations and water level gauging stations on a map.	【 I 】	short-term	**[Training in Kenya]** Technical training to analyze the characteristics of river basins, flood affected areas, river courses by maps	SRO,RO	■ Method for designating flooded areas in communities ■ Method for making a Hazard Map at community level ■ Method for utilizing a Hazard Map at community level ■ Method for making a Hazard Map at WRUA level ■ Method for utilizing a Hazard Map at WRUA level ■ Geographical Information System (GIS)

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
	1-4 To summarize and report the status of floods and their damages	**Skills and expertise:** ■ WRMA-SRO staffs don't have enough skills and expertise to collect and analyze information/data of rainfalls, flow rates, geographical characteristics, flood affected areas, flood affected population, etc.	WRMA-SRO staffs will collect and analyze information/data of rainfalls, flow rates and geographical characteristics as the causes of floods and to collect and analyze information/data of flood affected areas and affected population. WRMA-SRO staffs will formulate reports on the analyzed information/data.	【I】	short-term	**[Technical advice by JICA experts, training in Kenya & Japan]** Technical training of writing flood Disaster reports Technical training of formulating flood disaster reports	SRO	■ Method for making a flood damage database ■ Method for utilizing a flood damage database ■ Flood-prevention activities in Japan
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)							
	1-5 To collect and arrange information/data systematically and appropriately with respect to rainfalls and high water discharges	**Organization:** ■ There are no common methods of installation, maintenance and calibration of hydro/meteorological observation equipment. ■ There is no particular system for installation, maintenance and calibration of hydro/meteorological observation equipment. ■ Although there are staffs in charge of data collection, there are no instruction manuals for guiding volunteer observers. ■ There are no officers in charge of checking and statistically processing data. ■ Although staffs in charge of databases were stationed in SROs, ROs and HQ, there is no system to share the result of databases. **Standing Orders:** There are no such regulatory documents of posts. **Budget Measures:** Insufficient budget **Equipment:** ■ WRMA-ROs have Acoustic Doppler Current Profilers (ADCPs) and Acoustic Doppler Velocity-meters (ADVs). ■ WRMA-SROs have SEBA Current Flow Meters ready. ■ The number and the volume of hard disks of personal computers are not enough in WRMA-SROs. **Supplementary Notes:** ■ Poor accessibility to hydro/meteorological observation stations with the exception of a few stations	WRMA HQ will prepare regulatory documents on the installation, operation and maintenance, and calibration of rainfalls, water levels and water flows. WRMA-SROs will keep observation records without data missing and wrong typing. WRMA-SROs will check and correct missing and wrong typing data. WRMA-RO will conduct statistical analysis of observed data. WRMA-HQ will establish a hydro/meteorological database, which all RO and SRO staffs can use them. WRMA-HQ will prepare annual reports of observed data by using the hydro-meteorological database. WRMA-HQ will publish and share the annual report with RO and SRO.	【I】	short-term	**[Training in Kenya]** Technical training on how to install, maintain and calibrate observation equipment Technical advice on constructing a system of installation, maintenance and calibration of observation equipment Technical advice and training on collecting observed data of rainfalls, water levels and flow rates Technical advice and training on methods of checking and statistical analysis of rainfalls, water levels and flow rates Technical advice and training on constructing a system for checking and statistical analysis of rainfalls, water levels and flow rates Technical advice and training on a database of rainfalls, water levels and flow rates Technical advice and training on methods for sharing annual reports of observed data Technical advice and training on a system for publishing annual reports of observed data	SRO,RO,HQ	■ Method of rainfall observation ■ Method of water level observation ■ Method of flow rate observation ■ Method for scrutinizing hydro-meteorological data ■ Hydro-meteorological statistics ■ Method for managing the hydro-meteorological database
	1-6 To collect and analyze information/data about the effects and damages of floods	**Organization:** There are no flood management staffs in ROs and SROs. **Standing Orders:** nonexistent **Budget Measures:** Insufficient budget **Equipment:** The number of personal computers and vehicles are not enough in ROs and SROs.	Flood Management Officers will be stationed in ROs and SROs. To collect and analyze information/data about the effects and damage of floods will be listed in the mandate of WRMA.	【I】	short-term	**[Technical advice by JICA experts, training in Kenya]** Advice on organizational structures, human resources and budget	SRO,RO	■ Collecting method for flood damage data ■ Method for evaluating flood damage amounts ■ Method for designating flooded areas in communities

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
			Necessary equipment such as computers and vehicles will be deployed with an appropriate budget.			Technical training on the effect and damages of floods in Kenya		
	1-7 To collect and analyze the characteristics of river basins and cause and effect of floods by using maps	**Organization:** ■ It is very rate to use maps in SROs, ROs and HQ. ■ There are two staffs in HQ to be able to use GIS, whose skills are included to a medium or an upper class. ■ There are two staffs to be able to use GIS in RO, whose skills are included to a beginner class. ■ It is very hard for the staffs to use GIS for WRMA's works. ■ There are no staffs in WRMA to be able to use GIS. **Standing Orders:** nonexistent **Budget Measures:** insufficient budget **Equipment:** The number of personal computers and vehicles are not enough in WRMA. **Supplementary Notes:** ■ Information/data are collected routinely, but not analyzed in graphs. ■ WRMA stuffs can't identify and instruct mistakes of volunteer observers.	Flood Management Officers, who will be stationed in ROs and SROs, will use GIS in their daily works. To collect and analyze information/data about the effects and damage of floods will be listed in the mandate of WRMA. Necessary equipment such as computers and vehicles will be deployed with an appropriate budget.	【I】	short-term	**[Technical advice by JICA experts, training in Kenya & Japan]** Advice on organizational structures, human resources and budget Technical training on Hazard Maps	SRO,RO	■ Method for designating flooded areas in communities ■ Method for making a Hazard Map at community level ■ Method for utilizing a Hazard Map at community level ■ Method for making a Hazard Map at WRUA level ■ Method for utilizing a Hazard Map at WRUA level ■ Geographical Information System (GIS) ■ Method for utilizing flood Hazard Maps in Japan
	1-8 Reports for summarizing the situation of flood damages will be shared nationwide through HQ and ROs.	**Organization:** There are no Flood Management Officers in ROs and SROs. **Standing Orders:** nonexistent **Budget Measures**: insufficient budget **Equipment:** The number of personal computers and vehicles are not enough in WRMA. **Supplementary Notes:** There are no flood disaster reports in WRMA.	Flood Management Officers, who will be stationed in ROs and SROs, will prepare flood disaster reports. To collect and analyze information/data about the effects and damages of floods will be listed in the mandate of WRMA. Necessary equipment such as personal computers and vehicles will be deployed with an appropriate budget.	【I】	long-term	**[Technical advice by JICA experts, training in Kenya & Japan]** Advice on organizational structures, human resources and budget Technical training on how to disseminate information about flood damages in Kenya	SRO,RO	■ Method for designating flooded areas in communities ■ Method for making a flood damage database ■ Method for utilizing a flood damage database ■ Case examples for utilizing flood disaster databases in Japan ■ Case examples for utilizing knowledge management system in Japan
	[Institutional aspects]							
	1-10 An agreement or a system on sharing of observed data of rainfalls, water levels and flow rates with related organizations	■ There is no agreements for exchanging and sharing observed data between WRMA—which is conducting hydro/meteorological observation — and KMD—which is conducting meteorological observation—. ■ WRMA should provide rainfall data to KMD. ■ WRMA and KMD come away with no agreements with respect to data sharing from the effort. ■ However, there is a framework of KMD's data sharing to both ASAL Secretariat—a platform of countermeasures against drought— and NPDRR —a national platform for disaster risk reduction formulated by the Government of Kenya—.	WRMA will participate in NPDRR as an organization in charge of flood management.	【I】	long-term	**[Technical advice by JICA experts, training in Kenya]** Prior consultation with all the ministries/organizations concerned Fostering a common awareness of the relevant ministries/organizations through workshops Agreements with the relevant ministries in JCC	HQ	■ Characteristics of flood disasters in Kenya ■ Legal system for flood management in Kenya ■ Demarcation for flood management in Kenya ■ Flood management of WRMA
	[Personal aspects]							

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
2. To Analyze Cause and Effect of Floods by Using Related Information/Data	2-1 Basic knowledge of topographic maps and mapping technique	**Skills and expertise:** ▪ WRMA staffs are short on experience in reading topographic maps and mapping processes, because topographic maps are not common in Kenya. **Incentive:** no incentive scheme **Supplementary Notes:** ▪ WRMA staffs have no chances for attending training seminars of reading maps and mapping technique. ▪ WRMA staffs have no technical reference materials.	WRMA staffs are to apply the basic knowledge of topographic maps and mapping technique to flood management services. Lecturers for the WRMA technical training courses at the 2nd stage training in Kenya are to be selected out of WRMA staffs who have received the 1st stage training in Kenya.	【Ⅱ】	short-term	[**Training in Kenya**] Technical training on map literacy and mapping technique	SRO,RO,HQ	▪ Method for making a Hazard Map at community level ▪ Method for utilizing a Hazard Map at community level ▪ Method for making a Hazard Map at WRUA level ▪ Method for utilizing a Hazard Map at WRUA level ▪ Geographical Information System (GIS)
	2-2 Basic knowledge of high water discharge observation	**Skills and expertise:** ▪ WRMA staffs are short on experience and understanding in high water discharge observation, although WRMA staffs understand the importance of low water discharge observation. **Incentive:** no incentive scheme **Supplementary Notes:** ▪ WRMA staffs have limited opportunities for attending training seminars of high water discharge observation. ▪ WRMA staffs have no technical reference materials.	WRMA staffs are to apply the basic knowledge of high water discharge observation to flood management services. Lecturers for the WRMA technical training courses at the 2nd stage in Kenya are to be selected out of WRMA staffs who have received the 1st stage training in Kenya.	【Ⅱ】	short-term	[**Training in Kenya**] Technical training on high water discharge observation	SRO,RO,HQ	▪ Method of utilization of rating curves low water H-Q curves & high water H-Q curves ▪ Case example for utilization of rating curves low water H-Q curves & high water H-Q curves
	2-3 Basic knowledge of flood disaster databases	**Skills and expertise:** ▪ WRMA staffs are short on experience in constructing a flood disaster database, although WRMA staffs understand the importance of it. **Incentive:** no incentive scheme **Supplementary Notes:** ▪ WRMA staffs have limited opportunities for attending training seminars for constructing and managing databases.	WRMA staffs are to apply the basic knowledge of a flood disaster database to flood management services. ▪ Lecturers for the WRMA technical training courses at the 2nd stage in Kenya are to be selected out of WRMA staffs who have received the 1st stage training in Kenya.	【Ⅱ】	short-term	[**Training in Kenya & Japan**] Training on constructing a flood disaster database	SRO,RO,HQ	▪ Method for managing the hydro-meteorological database of WRMA ▪ Method for making a flood damage database ▪ Method for utilizing a flood damage database ▪ Case examples for utilizing flood disaster databases in Japan
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)							
	2-4 Framework for observing high water discharges	**Organization Framework:** ▪ WRMA has no observation framework on high water discharges. ▪ Each WRMA Office is in her own way of discharge observation. ▪ For example, Kakamega RO is conducting a routine observation of discharges, while Kisumu RO has no observation of discharges. ▪ No ROs have conducted any observation of high water discharges. **Standing Orders:** nonexistent **Budget Measures:** not enough **Equipment:** ▪ ROs have deficient discharge observation instrument, although ROs have them. **Supplementary Notes:** ▪ WRMA has unclear practice and procedure for observing high water discharges. ▪ No manuals on discharge observation	Framework for observing high water discharges is to be formed in WRMA. Framework for sharing discharge observation instruments between RO and SRO is to be formed in WRMA. ▪ Lecturers for the WRMA technical training courses at the 2nd stage in Kenya are to be selected out of WRMA staffs who have received the 1st stage training in Kenya.	【Ⅱ】	long-term	**[Technical advice by JICA experts, training in Kenya & Japan]** Technical advice and training on high water discharge observation ▪ Technical advice and training on constructing a high water discharge observation system	SRO,RO,HQ	▪ Flood management of WRMA ▪ Method for making a flood damage database ▪ Method for utilizing a flood damage database ▪ Case examples for utilizing flood disaster databases in Japan

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
		▪ Only WRMA LVSC has done discharge observation.						
	2-5 Framework for developing and administrating the flood disaster database in Kenya	**Organization Framework:** ▪ WRMA has not developed the flood disaster database in Kenya, although it recognizes the importance of the flood disaster database in Kenya. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** available **Supplementary Notes:** ▪ JICA Consulting Team has offered a prototype of the flood disaster database in Kenya, which was made by disaster data compiled by an existing database "CRED". ▪ WRMA has no manuals for developing databases.	▪ Framework for developing and administrating the flood disaster database in Kenya is to be formed in WRMA. ▪ The flood disaster database in Kenya is to be used as one of knowledge management tools for flood management. ▪ Lecturers for the WRMA technical training courses at the 2nd stage in Kenya are to be selected out of WRMA staffs who have received the 1st stage training in Kenya.	【Ⅱ】	long-term	**[Technical advice by JICA experts, training in Kenya & Japan]** ▪ Technical advice and training on developing the flood disaster database in Kenya ▪ Technical advice and training on administrating the flood disaster database in Kenya	SRO,RO,HQ	▪ Flood management of WRMA ▪ Method for managing hydro-meteorological database of WRMA ▪ Method for making a flood damage database ▪ Method for utilizing a flood damage database ▪ Case examples for utilizing flood disaster databases in Japan
	2-6 Framework for evaluating flood affected areas and flood damages	**Organization Framework:** ▪ WRMA has no evaluation framework on flood affected areas and flood damages. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** nonexistent **Supplementary Notes:** ▪ Overlooking the data on flood affected areas and flood damages. ▪ WRMA has not gained one of important tools for appealing flood management.	▪ Framework for evaluating flood affected areas and flood damages are to be formed in WRMA. ▪ Lecturers for the WRMA technical training courses at the 2nd stage in Kenya are to be selected out of WRMA staffs who have received the 1st stage training in Kenya.	【Ⅱ】	long-term	**[Technical advice by JICA experts, training in Kenya]** ▪ Technical advice and training on evaluating flood affected areas and flood damages ▪ Technical advice and training on framework for evaluating flood affected areas and flood damages	SRO,RO,HQ	▪ Flood management of WRMA ▪ Method for collecting flood damage data ▪ Method for evaluating flood damage amounts ▪ Method for designating flooded areas in communities
	[Institutional aspects]							
	2-7 Legal systems for assisting high water discharge observation	▪ WRMA has no legal stipulation for making compulsory at high water discharge observation. **Supplementary Notes:** ▪ Legal system should be set after the revised bill is passed. ▪ The water bill doesn't mention about it, but the draft of the water bill mentions about it.	▪ Compulsory observation on high water discharge is to be made in WRMA.	【Ⅱ】	long-term	[**Technical advice by JICA experts, workshop**] ▪ Proposal for legal stipulation on compulsory observation of high water discharges	SRO,RO,HQ	▪ Flood management of WRMA ▪ Method of utilization of rating curves : low water H-Q curves & high water H-Q curves ▪ Case example for utilization of rating curves : low water H-Q curves & high water H-Q curves
	2-8 Legal systems for assisting to evaluate flood affected areas and flood damages	▪ WRMA has no legal stipulation for making compulsory at evaluation of flood affected areas and flood damages, although since 2009 CRC has been collected disaster data, such as affected areas and damages by floods. **Supplementary Notes:** ▪ Legal system should be set after the revised water bill is passed.	▪ Compulsory evaluation for flood affected areas and flood damages are to be made in WRMA.	【Ⅱ】	long-term	[**Technical advice by JICA experts, workshop**] ▪ Proposal for legal stipulation on compulsory evaluation for flood affected areas and flood damages	SRO,RO,HQ	▪ Flood management of WRMA ▪ Method for collecting flood damage data ▪ Method for evaluating flood damage amounts ▪ Method for making flooded areas in communities
	2-9 Legal systems for assisting to develop and manage the flood disaster database in Kenya	▪ WRMA has no legal stipulation for making compulsory at the flood disaster database in Kenya. **Supplementary Notes:** ▪ Legal system should be set after the revised water bill is passed.	▪ Compulsory development and management and flood disaster database is to be made in WRMA.	【Ⅱ】	long-term	[**Technical advice by JICA experts, workshop**] ▪ Proposal for legal stipulation on compulsory development and management on the flood disaster database in	SRO,RO,HQ	▪ Flood management of WRMA ▪ Method for making a flood damage database ▪ Method for utilizing a flood damage database

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
						Kenya		
3. To Coordinate Relevant Stakeholders for Better Flood Management in Communities	[Personal aspects]							
	3-1 Basic knowledge on monitoring of rainfalls and water levels, and Early Warning System	**Skills and expertise:** ■ Both systems of monitoring of rainfalls and water levels, and Early Warning Systems have not been implemented. ■ However, WRMA staffs have basic understanding on these systems. **Incentive:** no incentive scheme **Supplementary Notes:** ■ There are no reference materials available to WRMA staffs.	■ WRMA staffs will apply their basic knowledge on monitoring systems of rainfalls and water levels, and Early Warning Systems to their flood management activities like provision of information. WRMA will consider implementing EWS by using automatic observation data. Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【VI】	short-term	**[Training in Kenya & Japan]** ■ To provide technical training on monitoring of rainfall and water level, and Early Warning	SRO,RO,HQ	■ Case examples for Early Warning Systems in Kenya ■ Case examples for Early Warning Systems at community levels in Kenya ■ Case example for distributing flood information via radios ■ Case examples for utilizing Early Warning Systems in Japan ■ Case examples for an Integrated Flood Warning System ■ Case example for distributing flood information via TV and SMS in Japan
	3-2 Basic knowledge on Hazard Mapping	**Skills and expertise:** ■ Hazard Maps are not very common but WRMA staffs understand their importance in flood management. ■ There are few occasions to experience making of Hazard Maps. ■ WRMA staffs have experience to make community flood Hazard Map with JICA Project team. **Incentive:** no incentive scheme **Supplementary Notes:** ■ There are few chances of receiving trainings on Hazard Maps. ■ There are no reference materials available to WRMA staffs.	■ WRMA staffs will apply their basic knowledge on Hazard Maps and technically advise WRUAs whenever WRUAs make their own Hazard Maps. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【VI】	short-term	**[Training in Kenya & Japan]** ■ To provide technical training on making Hazard Maps	SRO,RO,HQ	■ Method for making a Hazard Map at community level ■ Method for utilizing a Hazard Map at community level ■ Method for making a Hazard Map at WRUA level ■ Method for utilizing a Hazard Map at WRUA level ■ Geographical Information System (GIS) ■ Method for utilizing flood Hazard Maps in Japan
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)							
	3-3 Methodologies and organizers for community-based flood responses (monitoring of rainfalls, water levels, flood damages, etc.)	**Organization Framework:** ■ WRMA is well aware of the importance of monitoring systems of water levels and flood damages, and Early Warning Systems and has an agreement on her intention to establish such systems in the near future. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:** ■ No technical reference materials available to WRMA staffs.	■ WRMA will have established a network to collect and disseminate information on the results of rainfall and water level monitoring and other observations. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【VI】	short-term	**[Technical advice by JICA experts, training in Kenya & Japan]** ■ Technical training on monitoring systems for water levels and flood damages, and Early Warning	SRO,RO,HQ	■ Flood management of WRMA ■ Method of rainfall observation ■ Method of water level observation ■ Method of flow rate observation ■ Case examples for Early Warning Systems in Kenya ■ Case examples for Early Warning Systems at community levels in Kenya ■ Case example for distributing flood information via radios ■ Case examples for utilizing Early Warning Systems in Japan ■ Case examples for an Integrated Flood Warning System ■ Case example for distributing flood information via TV and SMS in Japan

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
	3-4 Methodologies and organizers for preparing and utilizing Hazard Maps	**Organization Framework:** ■ WRMA has developed water resource maps, but they don't have experience, methodologies and organizations to draw flood Hazard Maps. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** ■ There are no topographic maps and GIS software available. **Supplementary Notes:** ■ Some WRUAs are trying to make Hazard Maps on their own. ■ JICA Project team is preparing prototype base maps using GIS. ■ There is no technical standard available for mapping.	■ WRMA will establish organization to make, collect, update and manage Hazard Maps. ■ WRMA will provide WRUAs with Hazard Maps. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【VI】	long-term	**【Technical advice by JICA experts, training in Kenya & Japan】** ■ Technical training on organization for technically advising to communities in case of preparing Hazard Maps.	SRO,RO,HQ	■ Flood management of WRMA ■ Method for making a Hazard Map at community level ■ Method for utilizing a Hazard Map at community level ■ Method for making a Hazard Map at WRUA level ■ Method for utilizing a Hazard Map at WRUA level ■ Method for utilizing flood Hazard Maps in Japan
	[Institutional aspects]							
	3-5 Legal systems for collecting and disseminating information of communities' flood responses (monitoring of rainfalls, water levels and flood damages)	■ WRMA has no legal stipulation for collecting and disseminating information of community-based flood responses, in particular, flood-related information.	■ Establishment of WRMA's system to support community-based flood responses (collection and dissemination of flood-related information)	【VI】	long-term	**[Technical advice by JICA experts, training in Kenya]** ■ Proposal for legal stipulation on compulsory provision for supporting community-based flood responses (collection and dissemination of flood-related information)	SRO,RO,HQ	■ Flood management of WRMA ■ Method for designating flood damages in communities ■ Method for evacuation ■ Method for management of evacuation facilities
4. To Advice WRUAs Technically to Formulate SCMPs	[Personal aspects]							
	4-1 Basic knowledge on technical advices to community-based flood responses (evacuation, flood fighting, etc.)	**Skills and expertise:** ■ WRMA's current knowledge and skills on community-based flood responses (evacuation, flood fighting, etc.) is not very high. ■ It is difficult for WRMA staffs to technically advise communities on their flood responses. **Incentive:** no incentive scheme **Supplementary Notes:** ■ There are no technical reference materials available to WRMA staffs.	■ WRMA staffs will apply their knowledge on community-based flood responses (evacuation, flood fighting, etc.) and provide technical support to WRUAs when WRUAs are to execute flood response activities. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【V】	long-term	**[Training in Kenya & Japan]** ■ Technical training, in collaboration with CMDRR and KRCS, on community-based flood responses (evacuation, flood fighting, etc.)	SRO,RO,HQ	■ Method for designating flood damages in communities ■ Method for relieving flood disaster victims ■ Method for evacuation ■ Method for management of evacuation facilities ■ Practical training in Nyando Project site ■ Cooperation among central government, local government, donors, and NGOs ■ Case example for flood fighting activities in Japan
	4-2 Basic knowledge on technical advices for flood control works (structural measures against floods)	**Skills and expertise:** ■ WRMA staffs' current knowledge and skills on flood control works (structural measures) are limited. ■ It is difficult for WRMA staffs to technically advise communities on their efforts to design, implement and manage flood control works. **Incentive:** no incentive scheme **Supplementary Notes:** ■ There are no technical reference materials available to WRMA staffs.	■ WRMA staffs will apply their knowledge on flood control works (structural measures) and provide technical support to WRUAs when WRUAs are to implement flood control works. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【V】	long-term	**[Training in Kenya & Japan]** ■ Preparation of technical reference materials for designing, implementing and managing flood control works ■ Technical training on provision of technical support for designing, implementing and managing flood control works	SRO,RO,HQ	■ Case example for small scale structural measures against floods at community level ■ Case examples for constructing small scale structures against floods ■ Case examples for operation and management of small scale structures against floods ■ Practical training in Nyando Project site ■ Case example for traditional river engineering in Japan

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
	4-3 Basic knowledge on technical advices to community level education for disaster prevention	**Skills and expertise:** ■ WRMA staffs' current knowledge and skills on community level education for disaster prevention are not prioritized. ■ It is difficult for WRMA staffs to technically advise communities on their efforts to educate community members. **Incentive:** no incentive scheme **Supplementary Notes:** ■ There are no technical reference materials available to WRMA staffs.	■ WRMA staffs will apply his knowledge on community level education for disaster prevention and provide technical support to WRUAs when WRUAs are to carry out education activities. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【V】	short-term	**[Training in Kenya & Japan]** ■ Technical training on provision of technical support for community level education of disaster prevention	SRO,RO,HQ	■ Practical training in Nyando Project site ■ Case example for flood fighting activities in Japan ■ Case example for disaster education in Japan
	4-4 Basic knowledge on technical advices to obtain funds for community-based activities	**Skills and expertise:** ■ WRMA staffs' current knowledge and skills on obtaining funds on flood management issue like WDC are not very high. ■ It is difficult for WRMA staffs to technically advise communities on their efforts to apply for funds. **Incentive:** no incentive scheme **Supplementary Notes:** ■ There are no technical reference materials available to WRMA staffs.	■ WRMA staffs will apply their knowledge on funds and provide technical support to WRUAs when WRUAs are to apply for such funds. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【V】	short-term	**[Training in Kenya]** ■ Technical training on provision of technical support for WRUAs' application procedures for funds	SRO,RO,HQ	■ Knowledge for utilizing various funds for flood management ■ Case examples for utilizing funds for flood management ■ Case examples for utilizing WSTF to flood management
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)							
	4-5 To establish methods and organizations to technically support WRUAs in their preparing SCMPs	**Organization Framework:** ■ WRMA staffs are currently not providing adequate technical support on flood management issues to WRUAs in their preparation of SCMPs. **Standing Orders:** nonexistent **Budget Measures**: N/A **Equipment:** N/A **Supplementary Notes:** ■ There is no technical standard or materials in WRMA for providing technical advices to WRUAs.	■ WRMA will establish organization to apply her knowledge on flood management and provide technical support to WRUAs when WRUAs are preparing SCMPs. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【V】	long-term	**[Technical advice by JICA experts, training in Kenya & Japan, workshop]** ■ To providing advices and technical training to provide support to WRUAs under their preparing SCMPs	SRO,RO,HQ	■ Method for planning an Integrated River Basin Flood Management ■ Case examples for planning flood management in SCMPs ■ Overview for Considering Socio-Environmental Impact ■ Case Examples of Integrated River Basin Flood Management in Japan
	4-6 To establish methods and organizations to technically support WRUAs in their applying for funds	**Organization Framework:** ■ WRMA staffs are currently not providing adequate technical support to WRUAs under their application for funds. ■ WRMA is technically appraising the applications of WRUAs for funds. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:** ■ There is no technical standard in WRMA for providing technical advices to WRUAs.	■ WRMA will establish organization to apply her knowledge on funds and provide technical support to WRUAs when WRUAs are applying for funds. ■ Among WRMA staffs, who received the training in the Project, there will be a few staffs to lecture in the WRMA technical training courses at the 2nd stage in Kenya.	【V】	long-term	**[Technical advice by JICA experts , training in Kenya]** ■ To providing advices and technical training to provide support to WRUAs under their applying for funds	SRO,RO,HQ	■ Procedures for acquiring funds ■ Method for managing fund accounting
	[Institutional aspects]							
	4-7 Legal systems for technical support to WRUAs under their preparing SCMPs	■ WRMA has a mandate to provide technical support to WRUAs under their preparing SCMPs.	—	【V】	long-term	—	—	—

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
5. To Formulate and Update Training Manuals on Flood Management and Conduct Training Seminars to HQ/RO/SRO Staffs of WRMA	[Personal aspects]							
	—	—	—	—	—	—	—	—
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)							
	5-1 To design WRMA's own technical development system	**Organization Framework:** ■ WRMA has not established her organization to design her own technical development system. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:**	■ WRMA will establish her own technical development system to train staffs in regions other than pilot areas by lecturers who have been trained in the 1st stage training in Kenya and nominated as lecturers. ■ It is expected that in the WRMA technical training courses at the 2nd stage in Kenya lecturers are to be raised, reference materials are to be prepared, and training courses to be analyzed and executed.	【Ⅲ】	long-term	**[Technical advice by JICA experts , workshop]** ■ To providing advises and practices to WRMA's own technical development training ■ Both JICA and the Project team are expecting the WRMA technical development system to be self-sustaining in WRMA's own capacity.	SRO,RO,HQ	—
	5-2 To prepare WRMA's technical reference materials	**Organization Framework:** ■ WRMA has not prepared technical reference materials for her technical development system. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:** ■ There is no technical standard available to WRMA staffs.	■ WRMA will prepare and edit technical reference materials for her own technical development system.	【Ⅲ】	long-term	**[Technical advice by JICA experts , workshop]** ■ To providing support to make reference materials and programs for the WRMA technical development system	SRO,RO,HQ	—
	5-3 To raise lecturers for the WRMA technical training courses at the 2nd stage in Kenya	**Organization Framework:** ■ WRMA has not established a module to raise lecturers for her own technical development system. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:**	Lecturers for the WRMA technical development system will be selected from staffs who have received trainings in the 1st stage training in Kenya. WRMA will consider technical modules to be used in technical development. ■ Lecturers will understand the objectives of the technical development system in WRMA and its contents.	【Ⅲ】	long-term	**[Technical advice by JICA experts, workshop]** ■ To provide advices on WRMA's raising lecturers for the technical development system	SRO,RO,HQ	—
	5-4 To operationalize the WRMA technical training courses at the 2nd stage in Kenya	**Organization Framework:** ■ WRMA is not currently operating technical development system. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:** ■ There is no standard for operation of the technical development system.	■ WRMA will operate the WRMA's own technical development system to train staffs of regions other than pilot areas.	【Ⅲ】	long-term	**[Technical advice by JICA experts, workshop]** ■ To provide advices on WRMA's establishment of standards for operation of the technical development system ■ To provide advices on the WRMA technical development system	SRO,RO,HQ	—
	[Institutional aspects]							

Objective: WRMA Capacity to be Developed	Required Capacity Element	Assessment at Current Capacity Level (Consultant's Assessment with Additional Inputs from Discussions in 1st WG)	Capacity Development Needs (Consultant's Proposition with Additional Inputs from Discussions in 1st WG)	Priority	Time Scope	Specific Method for Capacity Development to be Adopted in the Project	Target Group	Detailed Content to be Included in the WRMA Training Courses
	5-5 Legal systems for the WRMA technical training courses at the 2nd stage in Kenya	■ WRMA has no legal stipulation for establishing her own technical development system at this moment, but it will be incorporated with the draft water bill.	■ WRMA will be mandated to operate her own technical development system.	【Ⅲ】	long-term	**[Technical advice by JICA experts, workshop]** ■ Proposal for legal stipulation on WRMA's establishment of the technical development system	SRO,RO,HQ	■ Flood management of WRMA
6. To Introduce a Concept of "River Basin Flood Management Plan (RBFMP)", which should be Set between the CMS and the SCMPs	[Personal aspects]							
	6-1 Basic knowledge on Integrated Flood Management (IFM)	**Skills and expertise:** ■ WRMA staffs understand the necessity of IFM, but do not have acquired specific experiences to implement IFM and knowledge required. **Incentive:** N/A **Supplementary Notes:** ■ There is no technical reference material available to WRMA staffs.	■ WRMA staffs will apply her basic knowledge on IFM and provide technical support to WRUAs under her preparing SCMPs.	【Ⅳ】	long-term	**[Training in Kenya & Japan]** ■ To provide training on IFM	SRO,RO,HQ	■ Method for planning an Integrated River Basin Flood Management ■ Case examples for planning flood management in SCMPs ■ Overview for Considering Socio-Environmental Impact ■ Case Examples of Integrated River Basin Flood Management in Japan
	[Organizational aspects] (Human, physical, financial, knowledge, etc.)							
	6-2 To establish methods and organizations for making River Basin Flood Management Plans (RBFMPs)	**Organization Framework:** ■ WRMA understands the necessity of RBFMP but has not established organization to prepare RBFMPs. **Standing Orders:** nonexistent **Budget Measures:** N/A **Equipment:** N/A **Supplementary Notes:** ■ There is no technical standard available to WRMA staffs.	■ WRMA will consider the necessity of RBFMPs and contents of plans for the river basins she manages.	【Ⅳ】	long-term	**[Technical advice by JICA experts , training in Kenya & Japan]** ■ To provide technical advices and training for establishing organization to formulate RBFMPs	SRO,RO,HQ	■ Flood management of WRMA ■ Method for planning an Integrated River Basin Flood Management ■ Case examples for planning flood management in SCMPs ■ Overview for Considering Socio-Environmental Impact ■ Case Examples of Integrated River Basin Flood Management in Japan
	[Institutional aspects]							
	6-3 Legal systems for River Basin Flood Management Plans (RBFMPs)	■ Each WRUA is mandated to prepare the SCMP for her sub-catchment, and WRMA prepare CMSs. ■ A RBFMP is a concept newly proposed in the Project and there is no legal provision to prepare RBFMPs.	■ WRMA will be mandated to prepare a RBFMP for each river basin she manages.	【Ⅳ】	long-term	**[Training in Kenya & Japan, workshop]** ■ Proposal for legal stipulation on preparation of RBFMPs	SRO,RO,HQ	■ Flood management of WRMA ■ Method for planning an Integrated River Basin Flood Management ■ Case examples for planning flood management in SCMPs ■ Overview for considering Socio-Environmental Impact ■ Case Examples of Integrated River Basin Flood Management in Japan

Priority Ranking:

Priority【Ⅰ】: Objective-1 To develop a system for collecting information/data with respect to flood phenomena

Priority【Ⅱ】: Objective-2 To analyze cause and effect of floods by using related information/data

Priority【Ⅲ】: Objective-5 To formulate and update a training manual on flood management and conduct training seminars to HQ/RO/SRO staffs of WRMA

Priority【Ⅳ】: Objective-6 To introduce a concept of "River Basin Flood Management Plan (RBFMP)", which should be set between the CMS and the SCMPs

Priority【Ⅴ】: Objective-4 To advice WRUAs technically to formulate SCMPs

Priority【Ⅵ】: Objective-3 To coordinate relevant stakeholders for better flood management in communities

付属資料 2-3

WRUA メンバーの能力評価指標

Appendix A　WRUA and Community Capacity Assessment and Capacity Development Planning Matrix for WRMA

Project Purpose: In the Project target areas, institutional framework of flood management in the context of integrated water resource management is to be established for effective and sustainable implementation of community based activities.

Output-1) At each level of WRMA (headquarters, regional offices and sub-regional offices), sustainable organizations in charge of flood management are to be strengthened.

Output-2) For promoting community based activities of flood management, capacity of WRMA staffs to support WRUAs and communities is strengthened. **"GM"= Lower Gucha Migori / "LL" =Lower Lumi / "IS"=Isiolo**

WRUA and Community Capacity that WRMA supports to be developed	Capacity Element to be required	Assessment of current Capacity Level of WRUA (Consultant Team's Assessment with additional Inputs from Discussions in 1st WG)	Development Needs of WRUA (Consultant Team's Proposition with additional Inputs from Discussions in 1st WG)	Development Needs of WRMA (Consultant Team's Proposition with additional Inputs from Discussions in 1st WG)	Priority	Time scope	Specific Method for Development adopted in the Project	Target Group	Content of Flood Management Module in WDC
1. To Establish Framework of Flood Fighting Activities	[Personal aspects]								
	1-1 Knowledge for community based flood activities	**"GM"** WRUA can read the value of water gauge and manage a simple flood warning system in their community. **"LL"** WRUA has been made for the protection levee temporary bridge and springs to ensure means of transportation, such as for the protection of agricultural land embankment. **"IS"** WRUA doesn't have any particular activities of flood.	WRUA needs to understand the outline of community based flood activities on flood disaster prevention	WRMA needs to explain the outline and role to play of community based activities on flood disaster prevention.	【V】	short -term	**[Lecture/site training]** Explanation of community disaster prevention technic Facilitation training	HQ,RO,SRO	
	[Organizational aspects] (human, physical, financial, knowledge)								
	1-2 to nurture leadership and ownership	**"GM, LL, IS"** WRUA have ownership in terms of water use, but their ownership for flood management has not been built yet.	WRUA needs to develop, create and engage in their awareness on self-help for flood management.	WRMA needs to understand and explain to WRUAs the idea of "Self-help/mutual support/public assistance" for flood.	【V】	short -term	**[Lecture, site training]** Explanation of the idea "self-help/mutual support/public assistance" with cases and experiences in Japan Facilitation training	HQ,RO,SRO	
	1-3 Establishing organizational structures for flood management activities (internal)	**"GM,LL,IS"** WRUA's constitution stipulate election of chairperson, secretary and treasurer, but internal group/committee is not organized in WRUA. **"GM"** WRUA has a flood management sub-committee. 1.	WRUA or flood management sub-committee in WRUA need to activate	WRMA needs to facilitate their activation.	【V】	short -term	**[Local training lectures]** Facilitation training to activate community groups	RO,SRO	
	[Institutional aspects]								

WRUA and Community Capacity that WRMA supports to be developed	Capacity Element to be required	Assessment of current Capacity Level of WRUA (Consultant Team's Assessment with additional Inputs from Discussions in 1st WG)	Development Needs of WRUA (Consultant Team's Proposition with additional Inputs from Discussions in 1st WG)	Development Needs of WRMA (Consultant Team's Proposition with additional Inputs from Discussions in 1st WG)	Priority	Time scope	Specific Method for Development adopted in the Project	Target Group	Content of Flood Management Module in WDC
	1-4 Establishing organizational structures for activities (external)	☒ Prevention against floods is insufficient in **"GM, LL, IS"** WRUA. There is a cooperative relationship between WRUA, district office, NGO, schools and Ministry of Water and Irrigation during floods. **"GM, LL, IS"** WRUA	WRUA needs the strong and cooperative relationship with authorities such as WRMA and district office at the time of emergency.	WRMA needs to coordinate to strengthen such kind of cooperation.	【V】	short -term	**【WG・OJT】** To propose cooperation with related organizations	RO,SRO	
2. To Analyse and Evaluate Flood Risks	[Personal aspects]								
	2-1 Understanding community's knowledge and perception of flood events	**"GM"** WRUA members share information each other about latest flood, using panel with photos and comments. **"GM"** WRUA members can make graph that shows the relation between river water level and inundation level. **"IS"** WRUA has already recognized the importance to observe rainfall level in upstream of Mt. Kenya and water level in upstream of Isiolo river. **"LL"** WRUA members understand that rainfall at Mt. Kilimanjaro is cause of flood and they can predict floods based on observing the rains.	WRUA needs to know the level of knowledge and awareness on flood issue of local residents.	WRMA needs to study the level of knowledge and awareness of local resident to share with WRUA.	【I】	short -term	**【WS・Discussion】** Training on WRMA's understanding for risks by area based on field study and information collecting	SRO	
	2-2 Understanding vulnerabilities against floods	The elders of the community hand down verbally about flood damage of their community in **"GM,LL,IS"** WRUA, but it is not documented.	WRUA needs knowledge about the risk of each community. WRUA needs to understand the problems that are caused by long inundation such as sanitary deterioration and loss of agricultural products.	WRMA needs to collect and organize flood records and information. WRMA needs to explain to WRUA about vulnerability of the area from above information.	【I】	short -term	**【WS・Discussion】** Training on WRMA's understanding for vulnerability by area based on field study and information collecting	SRO	
	[Organizational aspects] (human, physical, financial, knowledge)								
	2-3 Accumulating information and utilising analyses on community's experiences, respondences in flood events	**"GM"** WRUA shares their experiences each other by using photos and panels and drawing hazard map. There is no particular activities in "LL, IS" WRUA	WRUA members need to manage the flood information by time series to share correct one.	WRMA needs to manage and collect information to upgrade and provide it for WRUA.	【I】	short -term	**【WG・OJT】** Guidance to record information	RO,SRO	
	2-4 Keeping and updating knowledge on vulnerabilities against floods	**"GM, LL, IS"** WRUA members shares past flood damage information. They recognize the vulnerability of flood in the area.	WRUA needs to accumulate and manage to consider their flood management plan.	WRMA needs to evaluate vulnerability of the sub catchment area. WRMA needs to guide WRUA to put priority for countermeasures.	【I】	short -term	**【WG・OJT】** Presentation to take priorities of measures for vulnerability	RO,SRO	

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	2-5 Understanding of responding capacity of community in flood events	**"GM, LL, IS"** WRUA hold a meeting to consider flood management after disaster.	WRUA needs to understand the current responding capacity of community.	WRMA needs to share good practices of self-help activities with WRUA.	【Ⅰ】	short -term	**【WG, site visit, discussion】** Presentation of good practices	HQ	
	2-6 Understanding of possible damages of flood events	**"GM"** WRUA make and share hazard map that shows the damage situation in the past (lost crops, livestock, destruction of infrastructure, human life, etc.) There is no particular activities in **"LL,IS"** WRUA	WRUA needs to improve accuracy in the updating the map and information. WRUA needs to understand the outline of flood damage mechanism.	WRMA needs to give WRUA information to improve their understanding of possible damage. WRMA needs to explain the outline of flood damage mechanism to WRUA.	【Ⅰ】	short -term	**[WG, case study, site visit]** Guidance of information collection and its improvement	HQ,RO,SRO	
	[Institutional aspects]								
	[Personal aspects]								
3. To Establish Organizations against Floods Disasters	3-1 Establishing ownership and sense of responsibilities	WRUAs that are in high risk area have strong responsibility. **"GM"** WRUA has strong responsibility for flood management, but **"LL,IS"** WRUA have for water use, not for flood management.	WRUA needs to strengthen a sense of responsibility and foster will for flood management.	WRMA needs to make WRUAs understand the seriousness of flood damage. WRMA needs to explain the importance of self-help to reduce flood damage.	【Ⅲ】	short -term	**【WG,OJT, site visit】** Explanation of disadvantage due to flood and importance to avoid spiral of poverty from flood disaster	HQ,RO,SRO	
	[Organizational aspects] (human, physical, financial, knowledge)								
	3-2 Understanding regional issues related to disaster prevention	**"GM, LL, IS"** WRUA hold a meeting about the flood disaster issue.	WRUA needs to understand characteristics of flood and measures to be taken in their communities. WRUA needs to recognize the importance of "mutual support" in their community.	WRMA needs to explain the importance of "mutual support" according to characteristics of each community.	【Ⅲ】	short -term	**[Lecture, site training]** Guidance from the cases and experiences in Japan	HQ,RO,SRO	
	3-3 Nurturing sub-catchment leadership	WRUA leaders (especially in **"GM"** WRUA) have leadership within the WRUA. They lead to collect flood damage information at emergency by residents.	WRUA needs to maintain the current structure of leadership sustainably	WRMA needs to facilitate to maintain WRUA's leadership.	【Ⅲ】	short -term	**[Lecture, site visit, training in Japan]** Guidance from the cases and experiences in Japan	RO,SRO	
	3-4 Executing sub-catchment leadership nurturing activities	**"GM,LL,IS"** WRUA's constitution determine to assign chairperson and Secretary. The constitution of WRUA gives room for election of leadership.	WRUA constitution should define the role of leaders to lead during the flood disaster including evacuation and also have by-laws that addresses disaster emergency.	WRMA/SRO CMO needs to guide WRUA.	【Ⅲ】	short -term	**[Case study WG, site visit]** Training for CMO of WRMA SRO to lead WRUA	RO,SRO	

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	3-5 Organizing community, establishing voluntary disaster prevention group	**"GM,LL,IS"** WRUA have already established voluntary groups, but those groups are not for flood, but for water use. **"GM"** WRUA has flood management sub-committee.	WRUA needs to indicate and educate the role of those established groups.	WRMA needs to support and promote WRUA by disaster prevention issue.	【Ⅲ】	short -term	**[Research challenges WG ·, OJT]** The project facilitates to cooperate with KRCS and other organization. ·	RO,SRO	
	[Institutional aspects]								
	3-6 Position of WRUA in community based activities.	WRUAs correspond to realize community based activities on flood issues. WDC manual determine that WRUA can operate flood prevention activities using WSTF.	WRUA needs to sensitized a flood chapter in SCMP and be able to carry our flood prevention activities based on SCMP	WRMA needs to guide and support WRUA's community based flood management activities.	【Ⅲ】	short -term	**[Lecture WG · OJT]** To show know-how of the method of community based activities through pilot projects.	RO,SRO	
4. To Enlighten Community Members and Oorganizations	[Personal aspects]								
	[Organizational aspects] (human, physical, financial, knowledge)								
	4-1 Risk Communication among WRUA members	The current risk communication in WRUA is mainly between executives, not between all WRUA members. **"GM, LL, IS"** WRUA	WRUA needs to have risk communication with all WRUA members.	WRMA needs to support WRUA's risk communication. To cooperate with NGO is an option.	【Ⅱ】	short -term	**[Lecture, local training, training in japan]** To guide risk communication with cases in Japan and cooperation with NGO	HQ,RO,SRO	
	4-2 Training community leaders for flood fighting activities	**"GM"** WRUA have flood management sub- committee. They discuss and consider flood damage and its measures. **"LL,IS"** WRUA doesn't have any leader on disaster prevention.	WRUA needs to be able to select leaders and encourage them.	WRMA needs to offer necessary information and support on leaders' training to WRUA.	【Ⅱ】	short -term	**[Lecture, local training, training in Japan]** To introduce cases in Japan and good examples from NGOs and other donors.	RO,SRO	
	4-3 Preparing materials for disaster prevention enlightenment activities	WRUA records the past flood damage with photograph and etc. WRUA draws and shares maps that show flood phenomenon (inundation, river channel change, etc.) and situation of damage (loss of crops, livestock, destruction of infrastructure, human life, etc.) There is also a disaster educational materials provided by the KRCS.	WRUA needs to have capacity to develop hazard map based on their "flood sketch map" WRUA needs to know about educational materials and tools for disaster prevention.(such as for example CMDRR)	WRMA needs to advise WRUA on necessary information.	【Ⅱ】	short -term	**[Training in Japan, site visit, lecture]** To introduce cases and experience in Japan	HQ,RO,SRO	

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	4-4 Executing disaster prevention enlightenment activities	There is no particular activities in **"GM, LL, IS"** WRUA.	WRUA needs to have capacity to familiarize and carry out disaster prevention enlightenment activities in community.	WRMA needs to share and guide WRUA to familiarize and carry out disaster prevention enlightenment activities in community.	【Ⅱ】	short -term	**[Training in Japan, site visit and lecture]** To guide disaster prevention enlightenment activities with cases in Japan and cooperation with NGO Guidance from the NGO with the cooperation of the cases and cases of Japan and other donors	HQ,RO,SRO	
	4-5 Consideration of vulnerable segment of community in activities	There is no particular activities in **"GM, LL, IS"** WRUA.	-WRUA needs to response to aid community people in emergency.	WRMA needs to provide WRUA with necessary information about necessity and measures of emergency response.	【Ⅱ】	short -term	**[Training in Japan, site visit and lecture]** To guide based on cases and experiences in japan.	HQ,RO,SRO	
	[Institutional aspects]								
	[Institutional aspects]								
5. To Plan Flood Disaster Mitigation and Flood Control Measures	5-1 To include flood disaster preventing activities in "SCMPs".	In Gucha Migori and Lower Lumi, it have been already included. **"GM, LL"** WRUA, In **"IS"** WRUA, it will be included in the future.	WRUA needs to understand that it is not only targeted measures for flood measures and understandings of "SCMP" WRUA needs to have a knowledge of how to describe a plan for flood measures to "SCMP" -Flood management activities should be incorporated in the SCMP.	It can be explained how to describe an overview of "SCMP" and flood measures to WRUA members. WRMA needs to train WRUA in developing SCMP that mainstream flood management.	【Ⅳ】	short -term	**[WG ･Discussion, site visit, OJT]** A suggestion for the section related to the flooding description and "SCMP" in "WDC manual"	RO, SRO	
	[Organizational aspects] (human, physical, financial, knowledge)								
	5-2 To establish operating plans of community based disaster prevention activities	The flood disaster management plan has been included in "SCMP" **"GM, LL "** The plan has not been included in "SCMP" **" IS"**	WRUA needs to incorporate the plan into "SCMP". WRUA needs to educate its members about the crisis management and the guidelines for the development manual	-WRMA needs to make a technical instruction to the WRUA concerning the activities of disaster prevention. WRMA needs to Coordinate and ask the cooperation with various organizations.	【Ⅳ】	short -term	**[Training in Kenya･Lecture, site visit]** Guidance from the case of NGO and Case of Japan and other donors	RO, SRO	
	[Institutional aspects]								

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	5-3 Legislatory framework for community disaster prevention plans	The plan has been included in "SCMP" **"GM, LL "** The plan is not included in "SCMP" **" IS"**	WRUA needs to have the ability to incorporate in "SCMP" and to carry out	WRMA needs to educate so that the WRUA can plan the contents of the draft or description of matter in "SCMP" WRMA needs to have the ability to stakeholder coordination in the planning and more upper level planning.	【Ⅳ】	short -term	**[WG ·Discussion , Site visit, OJT]** Guidance from the case of NGO and case of Japan and other donors	RO, SRO,HQ	
	5-4 To secure communication channels in flood management plans	It has not been secured yet at present. **"GM, LL, IS"**	WRUA needs to be able to incorporate aspect of lobbying from WRUA to the Flood Management Plan through the Basin Committee, etc	WRMA needs to educate the WRUA can incorporate their aspect of lobbying into the Flood Management Plan	【Ⅳ】	short -term	**[Training in Kenya·Lecture, OJT]** Teaching so that the WRMA can establish the description matters and draft of the Flood Management Plan	RO, SRO,HQ	
6. To implement flood countermeasures	[Personal aspects]								
	6-1 Basic understanding for structural measures against floods	Someone have the knowledge of embankment, culvert, but it is just limited.	WRUA needs to have the knowledge about the example list of structural measures	WRMA needs to have the ability of planning and designing. WRMA should supervise.	【Ⅸ】	middle -term	**[Training in Kenya·Lecture, OJT]** Teaching so that the description of matter into the Flood Management Plan, the contents of the draft may be planning. Instill a sense of ownership of an existing project to design WRMA	RO, SRO	
	6-2 To understand Hazard Maps, and disseminating information	With the help of PT, core facility inundation area, such as shelter, livestock and agricultural damage mapping, of human suffering is **"GM "** being made by the WRUA on the map in the hands of residents**"GM "** The trial of making hazard map have been started by referring the example of "Gucha Migori" **"LL, IS"**	WRUA needs to have the ability to disseminate the technique of hazard map making, WRUA needs to have the ability to practice in a pilot area non "Gucha Migori"	-WRMA needs to be familiar with the information should be provided and usefulness of hazard map -WRMA needs to have capacity to assist WRUA to develop flood hazard map.	【Ⅸ】	middle -term	**[Training in Kenya·Lecture, OJT]** Introduced WRMA examples of Japan, to understand the effect of the hazard map	RO, SRO,HQ	
	6-3 To establish knowledge management system	Enlightenment is done by using the warning display in the office of WRUA and comments to the panel photo of the floods in the past **"GM "** It has not been implemented **" LL, IS"**	WRUA needs to have a competence that can be formed by integrating a mechanism to share and measures of damage in each community, such as the performance of its reflection (Knowledge Management)	WRMA needs to have an ability to support information organization and integration of WRUA based on a implementation of Knowledge Management System	【Ⅸ】	middle -term	**[WS · Discussion, research]** Advise on the draft of the proposed WRMA Knowledge Management System	RO, SRO,HQ	
	[Organizational aspects] (human, physical, financial, knowledge)								

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	6-4 To implement structural measures against floods	Not implemented in the GuchaMigori and Isiolo basin **"GM, IS"** Gabion works are implemented in the Lumi basin**" LL "**	WRUA needs to have an ability to do the project management of the life cycle for the order materials and services for carrying out	WRMA needs to have an ability to provide know-how for ordering procedures, the procurement and such as construction management concerning the project management of WRUA	【Ⅸ】	middle -term	**[WG・site visit OJT]** Implement an OJT with the manual	RO, SRO	
	6-5 To establish Hazard Maps and disseminating information	Enlightenments for establishing hazard maps have been done **"GM "** It has started to establishing hazard maps **" LL, IS"**	WRUA needs to have an ability to plot and gather various information on paper and to distribute to residents	WRMA needs to provide a topographical map to WRUA. WRMA needs an ability to do an explanation of how to fill in systematically and present complete sample to WRUA..	【Ⅸ】	middle -term	**[Training in Kenya・Lecture, practical guidance]** Guidance for creating a base map, getting information, how to maintenance and completion.	RO, SRO,HQ	
	6-6 To secure budget (WSTF) for implementing structural/non-structural measures	Dredging of drainage, Gabion works for protection of water source have been done by applying the fund for water utilization. **" LL "** The item for flood management has been established in “SCMP”, and a new trial is planed. **"GM "** Nothing has done. **" IS"**	WRUA needs to have an ability to make an application for funds in flood control	WRMA needs to make an instruction to be able to apply for funds to WRUA. WRMA needs to provide some completed examples or standard formats .etc	【Ⅸ】	middle -term	**[WS・Discussion, research]** Pointing out the problems and barriers on the application of funds, guidance on improvement measures WRMA	SRO,HQ	
	6-7 Planning of structural measures	Any structural measures have not been done **"GM "** There is a gabion work in Lumi There are some implementation examples conducted by “KRCS” **" IS"** [IS] (strictly speaking is not a subject WRUA)	WRUA needs to have basic understandings for river structures (such as knowledge of the features and strengths of each type and structure)	WRMA needs to have understandings throughout the life cycle of river structures and having implementation management capacity (investigation, design, construction, maintenance)	【Ⅸ】	middle -term	**[WS-research]** Introduces the fact that through the case in Japan. Monitoring and advice.	RO, SRO	
	[Institutional aspects]								
7. To Train Community Members for Flood Responses	[Personal aspects]								
	[Organizational aspects] (human, physical, financial, knowledge)								
	7-1 Planning flood fighting/evacuation drills	There is no implementation of flood drill by WRMA**"GM, LL, IS"**	WRUA needs to have an ability to make/request NGO trainings for flood fighting drills upon implementation of the decision of the planning and implementation of a system for flood prevention training	To be required consultation of WRMA	【Ⅷ】	middle -term	Should be discussed		

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	7-2 Evaluating and revising flood fighting/evacuation drills	There is no concrete implementation **"GM, LL, IS"**	WRUA needs to be able to establish a framework for the implementation results being evaluated. WRUA needs to be able to build a framework for reflection based on the evaluation and the lesson it. WRUA should be trained in flood fighting and evacuation drill skills.	WRMA needs to facilitate to support WRUA.	【Ⅷ】	middle -term	Should be discussed		
	7-3 Drill for flood fighting / evacuation among various organizations	There is no concrete implementation **"GM, LL, IS"**	WRUA needs to have ability to publicity, scenario creation, adjustment related organizations (establishing the way for spiral up).	WRMA needs to facilitate to support WRUA.	【Ⅷ】	middle -term	Should be discussed		
	[Institutional aspects]								
8. To Respond to Emergency Events	[Personal aspects]								
	[Organizational aspects] (human, physical, financial, knowledge)								
	8-1 Leading evacuation, providing care	Partly implemented but it cannot be said to be organized **"GM, LL, IS"**	WRUA needs to have an ability to be able to build a evacuation centre or route that can support the implementation of evacuation during flood	WRMA needs to facilitate to support WRUA.	【Ⅵ】	middle -term	Should be discussed		
	8-2 Flood fighting	There is no concrete implementation **"GM, LL, IS"**	WRUA needs to have an ability to decide upon implementation the roles and activities of members of planning and flood prevention	WRMA needs to identify materials for flood fighting	【Ⅵ】	middle -term	Should be discussed		
	8-3 Observation of flood event	They observe and record the water level[GM] They put photos and status at the time of flood on sketch map**"GM "** They provide the necessary information to DC on the line **"GM, LL, IS"**	WRUA needs to have an ability to understand what is to be monitored in real time during the flood, to determine the response.	WRMA needs to have an ability to provide instruction about implementation of real-time observation procedure during floods to WRUA	【Ⅵ】	middle -term	**[Training in Kenya・Lecture, site visit]** Showing the details a instruction and monitoring during flood case being implemented in Japan to WRMA	RO, SRO,HQ	
	8-4 Making a local decision of (early) warning and notification	Standards and rules reported to DC are unknown **"GM, LL, IS"**	WRUA needs to establish the documentation and reaffirmation of the agreement with the DC. WRUA needs to complete the flow of information-communication system	WRMA needs to be able to teach WRUA the determination of the information-communication flow system	【Ⅵ】	middle -term	**[Training in Kenya・Lecture]** Advise to check the local rules on the basis the case of local	RO, SRO,HQ	

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	8-5 Executing emergency rescue operation	Unknown They are left to the DDMC and NGO etc.? **"GM, LL, IS"**	WRUA needs to be able to prepare for disaster response. WRUA needs to have knowledge of medicine distribution.	WRMA needs to share information and communication channel with donors and stakeholders.	【Ⅵ】	middle -term	Should be discussed		
	[Institutional aspects]								
	8-6 Emergency information exchange structure and rules among organizations	They report and consult DC, WRMA / SRO, **"GM, LL "**	WRUA needs to be able to act according to the manual along the procedure for transmission of information with relevant agencies in the event of emergency.	WRMA needs to develop manual. It will enhance communication and flow of information during disaster.	【Ⅵ】	middle -term	Should be discussed		
9. To Restore and Reconstruct Livelihood, Daily Lives (Limited to the part pertaining to the flood management of WRMA such as Recovery and reconstruction)	[Personal aspects]								
	[Organizational aspects] (human, physical, financial, knowledge)								
	9-1 Understanding of community needs	Discussion and confirmation in meetings. **〝GM, LL, IS〞**	WRUA needs to be able to request to relevant agency by collecting needs from the community.	To be required consultation of WRMA	【Ⅶ】	middle -term	Should be discussed		
	9-2 Executing works for restoration of infrastructures, housing and livelihood etc.	They are doing recovery works of roads/bridges destruction, culverts obstruction, dykes broken and waterways occluded (repair by sandbags and gabions)	WRUA needs to be able to reach out to relevant organizations. WRUA needs to have an ability to raise the competence of such materials.	To be required consultation of WRMA	【Ⅶ】	middle -term	Should be discussed		
	[Institutional aspects]								
	9-3 Allocation of budget for restoration works	Unknown			【Ⅶ】	middle -term			
	9-4 Organizing relevant parties for reconstruction	WDC activities			【Ⅶ】	middle -term			

Priority Ranking

Priority 【Ⅰ】: objective 2 To analyze and evaluate risks
Priority 【Ⅱ】: objective 4 To enlighten community members and organizations
Priority 【Ⅲ】: objective 3 To establish organizations
Priority 【Ⅳ】: objective 5 To plan disaster reduction
Priority 【Ⅴ】: objective 1 To establish framework of activities
Priority 【Ⅵ】: objective 8 To respond to emergency
Priority 【Ⅶ】: objective 9 To restore and reconstruction livelihood, daily lives and under recovery
Priority 【Ⅷ】: objective 7 To train people
Priority 【Ⅸ】: objective 6 To implement countermeasures

付属資料 2-4

WDC マニュアル洪水モジュール

WRUA DEVELOPMENT CYCLE

(WDC)

VERSION TWO

APRIL 2014

PREFACE

The decision to revise the WRUA Development Cycle (WDC) version I of 2008 arose from the lessons learnt during the implementation of the manual. This among others, was the need to include flood management, climate change and livelihood components. The framework follows the provisions in the Constitution of Kenya 2010 and the principles of Integrated Water Resources Management, both of which lay emphasis on the involvement, public participation and collaboration with local community.

The framework defines the arrangements between Water Resources Management Authority (WRMA) and Water Services Trust Fund (WSTF) regarding funding of water resource management activities through the Water Resource Users Association (WRUAs). It also provides adequate guidelines for other potential development partners with interest in WRUA activities.

It is worth noting that this document was revised before the enactment of the water Bill 2014 into law, and has therefore been based on the provisions of the Water Act 2002. We also note that the document has three complementary parts arranged in three different volumes covering the framework, operational guidelines and toolkit. It is advisable that the separate volumes be referred to as complementary parts and not in isolation.

I wish to acknowledge the participation of the steering committee comprising of members of staff from WRMA and WSTF who spearheaded the development of the revised version. We firmly believe that this WRUA DEVELOPMENT CYCLE VERSION 2 of 2014 will continue to provide useful guidelines in supporting water resource management at the local level in collaboration with WRUAs.

Eng. Phillip Olum, HSC,
Chief Executive Officer
Water Resources Management Authority

Eng . Jacqueline Musyoki OGW
Chief Executive Officer
Water Services Trust Fund

WDC LIST OF ABBREVIATIONS

AGM	Annual general meeting
CAAC	Catchment Area Advisory Committee
CBOs	Community Based Organizations
CDF	Constituency Development Fund
COP	Codes of Practice
CPC	Community Project Cycle
HR	Human Resource
HRD	Human Resource Development
HQ	Head Quarter
IGA	Income Generating Activities
IWRM	Integrated Water Resources management
M&E	Monitoring and Evaluation
MEWNR	Ministry of Environment, Water and Natural Resources
MWI	Ministry of Water and Irrigation currently MEWNR
NWCPC	National Water Conservation and Pipeline Cooperation
NSIS	National Security Intelligence Service
QCA	Quality Control Agent
RO	Regional Office
SHGs	Self Help Groups
SCMP	Sub Catchment Management Plan
SO	Support organisation
SRO	Sub Regional office
WDC	WRUA development cycle
WRM	Water Resource Management
WRMA	Water Resources Management Authority
WRUA	Water Resource Users Association
WSB	Water Service Boards
WSP	Water Service Providers
WSTF	Water Services Trust Fund
UPC	Urban Project Cycle
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
LMG	Livelihood Micro Grant

WDC DOCUMENT OVERVIEW

Vol.	Title	Content	Reference	Details
1	**WDC FRAMEWORK**	• Introduction to WDC • Policy and Legislative Framework • Overview of WDC Approach • WRUAs		
			Appendix	
2	**WDC OPERATIONAL GUIDELINES**	Eligible areas and activities	A1	WSTF – WRMA Memorandum of Agreement
		WDC Funding Process		
		WDC Financial Guidelines		
			A2	WRMA-Other Development Partners Memorandum of Agreement
			A3	WRMA-WRUA Memorandum of Understanding
			B	Categorisation of sub-catchments according to status
			C	WDC Standard Rates for WRUA
			D1	WDC Request for Funds (RFF)
			D2	WDC Fund Request Forwarding Form WRMA-WSTF
			E	Sub-Catchment Management Plan (outline)
			F	WDC Desk Appraisal
			G	WDC Field Appraisal
			H	WDC Activity Contract
			I	WDC Progress Report (outline)
			J	WRUA – SO contract (sample)
			K	Criteria for WRUA Registration with WRMA
			L	Implementation Plan (Excel Format)
			M	WDC Projects Monitoring Tool (Annexes A-E)
			N	Activity Monitoring Reporting Template
			Module	
3	**WDC TOOLKIT**	Instructions to WDC Toolkit		
			1	Water Sector Reforms
			2	WDC Overview
			3	Catchment Characteristics
			4	SCMP Development
			5	Water Balance & Water Demand Management

			6	Water Allocation and Use
			7	Water Resource Protection
			8	Catchment and Riparian Conservation
			9	Flood Management
			10	Climate Change
			11	Infrastructure Development
			12	Alternative Livelihood
			13	Rights Based Approach and Poverty Eradication
			14	Institutional Development
			15	Monitoring and Information
			16	Financial Management
			17	Training Module Vol 2 Operational Guidelines

MODULE 9:

FLOOD MANAGEMENT

Target Group WRUA committee members,
WRUA members,
Stakeholders

Sessions

1: Flood Disaster And Flood Management
2: Integrated River Basin Flood Management
3: Rainfall and Flood Observation
4: Community-Based Flood Hazard Map
5: Flood Early Warning
6: Flood Disaster Evacuation Programme
7: Communication, Public Awareness Raising and Disaster Education

8: Planning, Design, Construction, Operation, and Maintenance Of Flood Mitigation Facilities
9: Co-Operation between Upstream and Downstream Stakeholders And Co-Ordination

Overview

This module addresses the need for WRUAs to understand aspects related to flood disaster and management, Integrated River Basin Flood Management. Rainfall and Flood Observation, community-Based Flood Hazard Map, flood Early Warning and flood Disaster Evacuation Programme. It also highlights in details communication, Public Awareness Raising and Disaster Education, planning, Design, Construction, Operation, and Maintenance of Flood Mitigation Facilities and co-Operation between Upstream and Downstream Stakeholders and Co-Ordination

SESSION 1: FLOOD DISASTER AND FLOOD MANAGEMENT

Topics:

1: Introduction to the Causes and Effects of Floods
2: Understanding Flood Management
3:Flood Disaster Management

Overview

This session introduces flood disaster and flood management with focuses on the causes and effects of floods, understanding flood management, and flood disaster management.

Figure-1Relation between Cause and Effect

Table-1 Example of Relation between Cause and Effect

Cause	State of Function	Effect
Mosquitoes	Human Immunity Resistance	Malaria Disease
Spreading Flood Water	State of Sanitary Facilities	Water-borne Diseases
	Drainage Capacity of Roads	Traffic Congestion
Heavy Rainfall Amount	Channel Capacity	Flood

This session, therefore aims to enhance the understanding of Water Resources Users Association (WRUA) members and leaders, communities as well as the other stakeholders on:

- What is a flood?
- Where does a flood occur?
- What are the causes of floods? and
- Flood preparedness concept at the community level, etc.

The aim of this session is to have the participants gain the understanding that a community can minimize the impact of flood damages, even though it is difficult to control or reduce the flood itself.

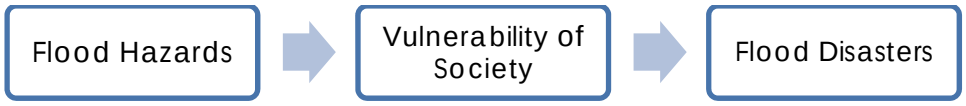


Figure-2Relation between Flood Hazard and Flood Disaster

This session also seeks to impart skills to WRUA leaders and other stakeholders regarding how to collaborate with similar groups and/or organizations within their respective sub-catchments in participating in the development of Flood Management System.

The four(4) phases of the Flood Disaster Management, i.e., Preparation, Response, Recovery, and Mitigation, are required for actions against flood disasters, which are shown in Figure-3.

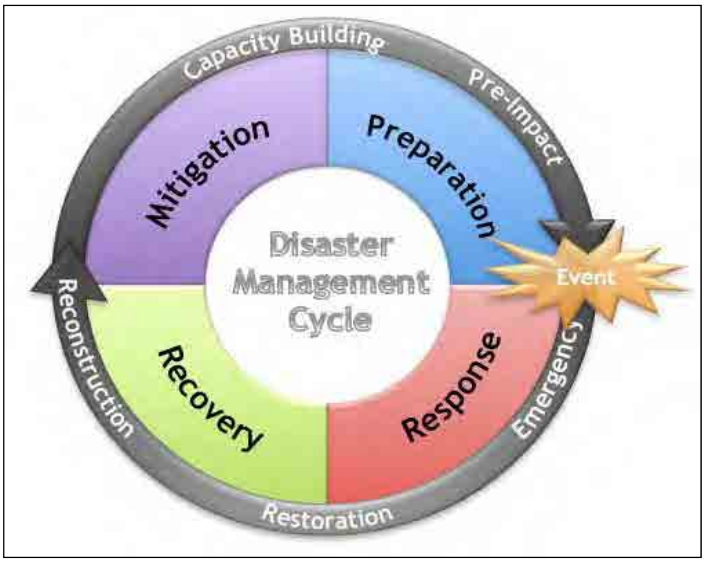


Figure-3Disaster Management Cycle (DMC)

By the end of this training session, the participants will be able to develop Flood Management Plans (FMP) by themselves.

1:Causes and Effectsof Floods

Introduction	How to understand a Flood? A flood is a situation in which the water of a river, a stream, and/ora channel overflows its banks and covers large areas of dry land. The temporary water-covering of land, which is not normally covered with water, may include floods from rivers, from mountain areas, and from the sea in coastal areas. This session introduces general notions of 'Hazard', 'Risk', 'Disaster' and 'Flood Management'.
Purpose of the topic	WRUA committee leaders/members and other stakeholders are required toclearly understand what a flood is, the causes and effects of floods, where they occur, and how best the community should be prepared in the event of a flood to prevent the occurrence of a disaster. The overall goal is that the participants will be able to mobilize and raise the required awareness of the importance of flood preparedness in the catchment areas.
Objectives	By the end of this session, the participants will have an understanding of: 1) The definition of a flood; 2) The occurrence of floods, their causes and effects; 3) The definition of a flood disaster; 4) Mobilizing and sensitizing a community and the WRUA members

	on flood preparedness; and 5) How to manage a flood disaster in their operation areas.
Time period	- 1hour
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions
Materials/Tools	- Illustrations shall be provided by the instructor. - Flip Charts. - Kenya Flood Safety Manual.
Content/Message	**Step-I: Understanding of a flood** The participants will try to share their ideas and thoughts on their understanding of what a flood is. This entails: Illustration of water levels in a river; • Understanding of the river bank characteristics; • Rainfall patterns in the catchment area; • Population characteristics; • Land use characteristics---settlement patterns, farming practices, deforestation, and reforestation; • Water resources in the catchment area; and • Soil erosion and sediment deposition in ariver. The facilitator will define what a flood is.
	Step-II: The causes of a flood Guide /note: The facilitator to ask the participants to differentiate between natural and human causes of floods below: • Increased rainfall amounts; • Catchment characteristics such as soil types, shape, slope angle, land use, etc.; • River channel siltation and sediment deposition; • Reservoir or dam embankment collapse causing downstream flooding; and • Human activities interfering with natural flows leading to the overflow on dry lands amongst others

	Step-III: Where do floods occur? **The facilitator to probe the discussion which entails:** • Land areas adjacent to the river channel (riparian areas); • Low lying areas in downstream catchments; • Flood plains; and lake • Deltas.
	Step-IV: The effects of a flood **The facilitator to probe the discussion which entails:** Floods have good and bad effects. Bad effects to a society and human resources are designated as disaster. **The bad effects are:** • Increased soil erosion and environmental degradation; • Damages to property and crops; • Loss of human life and livestock; • Damages to physical facilities such as roads, houses, churches, hospitals, schools, bridges. • Disruption of communication and transport networks; and • Health problems by means of mosquito breeding causing malaria, pollution of both surface and ground water. **The good effects are:** • To promote breeding, nesting and feeding of fish, birds and wildlife; • To improve soil fertility(in the plains) • To be used for storage for future irrigation; • To recharge groundwater.
Review of knowledge of flood Impacts and how to prepare for disasters	The facilitator will ask the participants to identify the areas mainly affected by floods , the impacts and how to prepare for disasters in Kenya and in the respective rivers/streams in their sub catchment At this stage the WRUA members/leaders and other stakeholders are ready to be inducted on the flood disaster management contents and disaster preparedness mechanisms.
Conclusion	At this stage the WRUA members/leaders and other stakeholders are ready to be inducted on the flood disaster management contents and

	disaster preparedness mechanisms.

2:Understanding Flood Management

Introduction	Flood management differs widely (before (pre), during, and after (post) floods) based on the following actions; At the National level, the flood management would be structural measures and/or non-structural measures. At the sub catchment level the flood management would aim at preserving lives and/or assets and/or infrastructures for the community members; and At the house hold level the flood management would aim at self-preservation actions and/or daily preparations for floods. Flood management plan includes structural (dykes, dams, drainage systems, evacuation structures) and non-structural (planning, community education and raising awareness, flood modeling and mapping, early warning systems).
Objectives	By the end of the session, the participants will be able to understand the meaning of the steps involved in the flood management activities within their specific catchment areas.
Time Period	- 1 hour
Methodology	- Discussions. - Questions and Answers. - Brainstorming.
Materials/Tools	- Papers. - Pens. - Cards. - Flip charts. - Examples of flood management regimes in Kenya
Session Guide: Discussionand Brainstorming	This session aims at understanding detailed flood management schemes. The discussion should build on existent community flood management strategies. The role of the group leader in this session will be to guide the discussions. The participants will be required to share with the others their understandings of flood management plans, importance of flood management plans, and how they are developed. The participants will be divided into groups of equal membership and sit in a roundtable for the discussion.

	Each group shall appoint the Chair and the Rapporteur.
Content/Message	**Step-I: Flood management regimes** **The facilitator introduces the** Flood management regime components The participants will identify the regimes in their sub catchment in each group Flood management regime is premised on four components: • Magnitude; • Duration; • Timing; and • Frequency. Flood types are defined by differentiating similar flood events based on their magnitude (i.e., peak flow), duration, timing, and frequency.
	Step-II: Importance of flood management plans The facilitator to ask the participants to plot the regime components (Magnitude, Duration, Timing, and Frequency)for the specified record(e.g. 20 years) Flood management regimes are used for flood risk assessment and planning purposes. Once the flood regimes are identified, the frequency of each type is calculated for the entire record.
	Step-III: How to develop flood management plans Flood management plan outlines the roles and responsibilities and describes flood management planning and management activities.
Outputs	The rapporteurs will write on a flip chart the discussion results and stick up them on walls. Each group will share and discuss the reports of other groups. The session should result in sharing the notion of theflood management mechanism by all the participants.
Session review	Check the attainment of the objectives of this session by asking the participants to explain what they came up with the use of the flood management plan they have just formulated.

3:Flood Disaster Management

Introduction	A disaster is a sudden or gradual event that causes damages to and/or disruption of economic activities and patterns of life. Floods become disasters only when they seriously affect human life, livelihoods, and property and would require internal and external help. Disaster management is, therefore, a body of policy, administration

	decisions, and operational activities, which govern various phases of a disaster at all levels. Disaster management usually consists of a multi-disciplinary team and requires complex co-ordination and management of a wide variety of activities. Disaster Management Cycle (DMC: see Figure-3) involves Monitoring, Assessment, Preparedness, Response, Restoration, and Rehabilitation (MAPRRR).
Objectives	By the end of the session, the participants will be able to: 1) Understand the four (4) phases in sustainable and effective flood disaster management cycle; and 2) Understand the importance of the MAPRRR in minimizing the impacts of flood disasters.
Phases in sustainable and effective Flood Disaster Management Cycle (FDMC)	1) **Flood Preparation**: Flood preparation involves hazard and vulnerability identification, frequency and consequence analysis, and disaster assessment according to the given criterion for designating a disaster. Flood preparation also involves planning how to respond to the flood; • Examples: Preparing plans, emergency exercises/training/drills, flood early warning systems, etc. 2) **Response**: Efforts to minimize the hazard caused by a disaster. • Examples: search and rescue, emergency relief, etc. 3) **Post Flood Recovery/Rebuild**: Restoring the community to normal living conditions. • Examples: Temporary housing, grants, medical care, as well as repairing and reconstruction, damage compensation, review and suggestions for future management, etc. 4) **Flood Mitigation**: Minimizing the effects of a disaster. • Examples: Building codes and zoning, vulnerability analyses, public education,etc., using structural and non-structural measures.
Time period	- 1 hour
Methodology	- Lecture. - Guided discussions. - Sharing experiences.
Materials/Tools	- Papers. - Pens. - Flip charts. - Open space.
Session guide	This session aims at enhancing participants' knowledge of flood preparedness concept to mitigate the effects of a flood disaster.
Outputs	This session should result in identifying the knowledge gaps between the participants on flood disaster management and ways they can address

	them.
Review	Check the attainment of the objectives of this session by asking the participants to share their knowledge of flood disaster management plans. Allow the participants to list them up on a sheet of paper and discuss them as a group.

SESSION2: INTERGRATED RIVER BASIN FLOOD MANAGEMENT

Topics:

1:Integrated River Basin Flood Management (IRBFM)
2: Introduction to Community Managed Flood Disaster Risk Reduction (CMFDRR)
3: Vulnerability Assessment
4:Flood Mitigation Non-Structural Measures including Community-based Measures

Overview

In general, the Integrated Flood Management (IFM) comprises relevant laws, strategies, plans, and institutions.

This session introduces the Integrated River Basin Flood Management (IRBFM). IRBFM means integration of flood and water resource management within a river basin using a combination of measures that involve beneficial use of floods, concurrently with reducing the risks that floods can cause to humans and their activities.

The reason for introducing the Integrated River Basin Flood Management is to ensure that all the externalities can be taken care of. Among these externalities is the pollution that can occur during floods.

Non-structural measures should be taken to control pollution or contaminated deposits, because it is necessary to ensure that natural ecosystem that should be left intact with no interference by any mitigation measures in case of recurrence of flood disasters.

This session further introduces the use of non-structural measures against floods. It seeks to explore the applicability of these non-structural measures to a flood risk management plan.

Figure-9 below shows how IRBFM may be an integral part of flood management (IFM) under Integrated Water Resources Management (IWRM).

Presently our interest is basically to show the unity of a river basin planning regime.

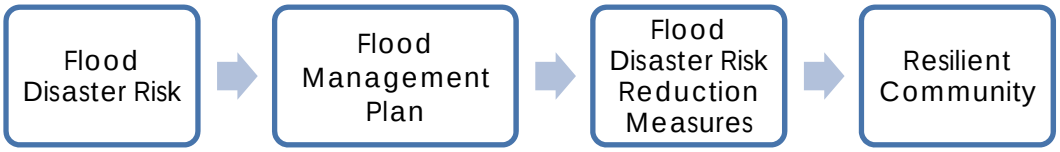


Figure-6Roles of Flood Management Plan for Reducing Flood Disaster Risk

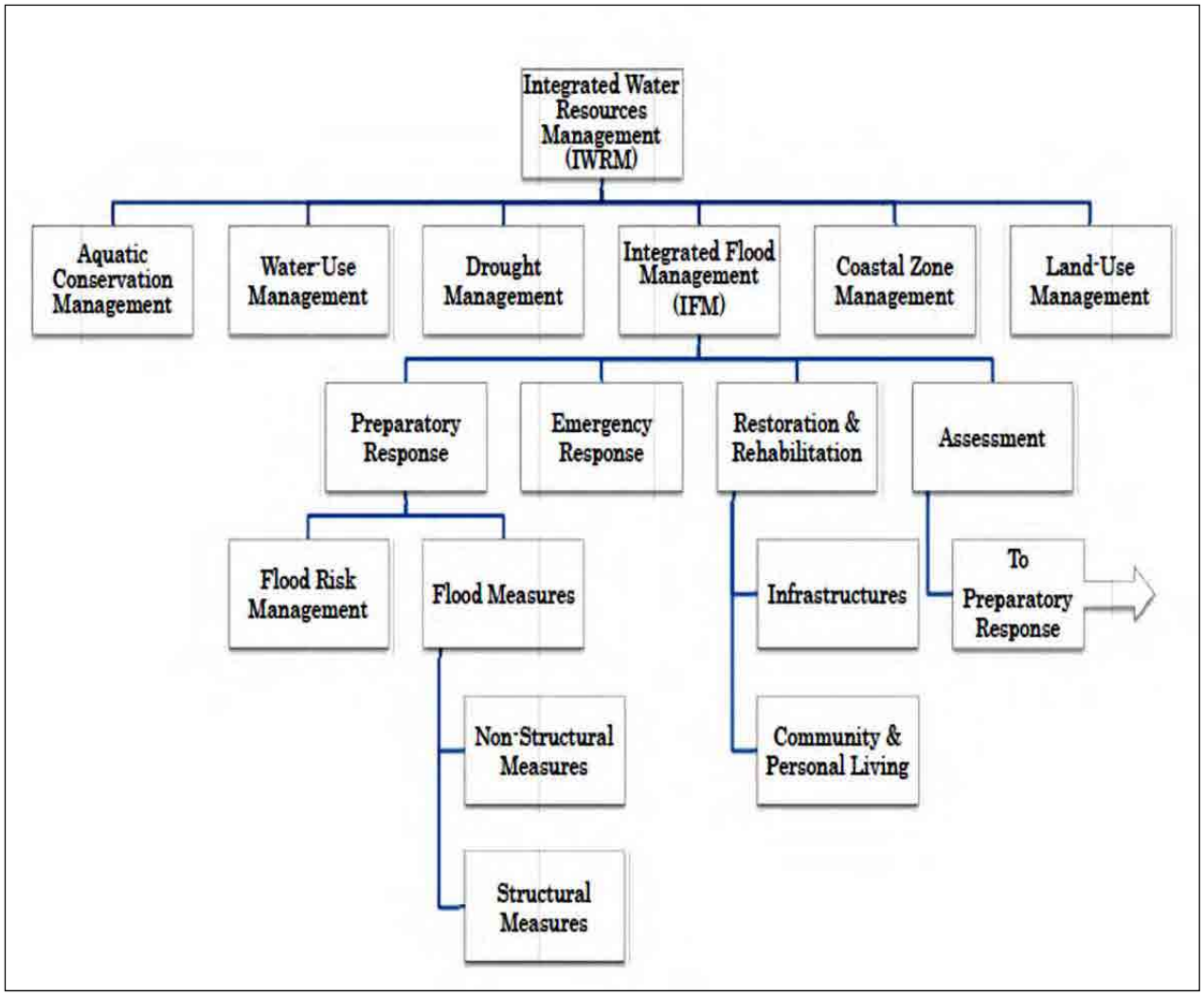


Figure-7Proposed Framework of Integrated Flood Management in Kenya
(Source: JICA Project Team)

Table-2Flood Management Project Effects on Flood Management

Flood Management Project Effects	Facility Effects	Direct Impact	Alleviation Effects on Direct Damages		Damage Abatement for Human Life
					Damage Abatement for Personal Property
					Damage Abatement for Agriculture, Forestry, and Fisheries Industry
					Damage Abatement for Public Utility Enterprises
					Damage Abatement for Lifeline Utilities
					Damage Abatement for other Utilities
		Indirect Impact	Alleviation Effects on Indirect Damages		Mitigation of Suspension/Stagnation in Production
					Abatement of Outgoings for Emergency Countermeasures
					Abatement of Blocking Life Function
					Abatement of Psychic Influence
			Regional Development	Land Development	Upgrading Land-Use
					Expanding Utilizable Land
				Economic Expansion	Trigger for Production
					Promotion for Distribution including Roads and Channels
					Raising Income Levels
					Expansion of Job Opportunities
				Social System Improvement	Growth of Population
					Promotion of Facilities Improvement
					Fiscal Soundness
			Ripple Effect for Flood Management Facilities		Enhancement of Residents' Life Quality
					Conservation of Natural Environment
					Improvement of Hygienic Environment
					Enhancement of Amenity
					Development for Tourism Resources
	Investment Effects				Effect on Production Activities
					Effect on Income Increase
					Effect on Consumption Growth
					Effect on Employment Increase

Table-3 List of Structural and Non-Structural Measures for Flood Management

Structural Measures	Measures for Flood Risk Reduction (FRR)	Measures to Improve Water Flows in River Channels, which are focused on Rivers	Excavation of River Channels
			Levee and Embankment
			Discharge Channels and Cut-Off Channels
			Floodgate
			Inland Water Drainage
			Riverbank Protection
			Spur Dike, etc.
		Measures to Control Run-off into Rivers, which are focused on River Basins	Dam
			Flood Control Facilities
			Effective Utilization of existent Facilities, etc.
		Measures to Control Flood Flows	Secondary Levees
			Open Levees
			Ring Levees, etc.
		Measures to Control Sediment Flows (Sabo Works)	Erosion Control Dam or Check Dam
			Channel Works
			Training Levees
			Groundsill, etc.
	Measures for Rehabilitation and Reconstruction		Disaster Prevention Facilities
			Transportation Network
			Disaster Prevention Operation Plan
			Business Continuity Plan
			Disposal of Flood-generated Waste, etc.
Non-Structural Measures	Measures of Evacuation		Evacuation and its Guidance
			Forecasting and Warning
			Evacuation Facilities
	Measures against Emergency		Flood Fighting
			Cofferdam
			Drainage Measures
			Sandbag
			Evacuation Drill
			Training
			Disaster Education, etc.
	Measures to Reduce Damages in Floodplains		Raising Floors of Buildings
			Installing Electric and Machinery Equipment on higher places
			Regulation of Land-Use, etc.

1:Integrated River Basin Flood Management (IRBFM)

Introduction	This session seeks to discuss the rationale and importance of a plan for Integrated River Basin Flood Management(IRBFM) in terms of flood risks and to clearly understand flood measures in an integrated way.
Objectives	The objectives are to enable the participants to understand: 1) Integrated River Basin Flood Management (IRBFM); 2) Community Managed Disaster Risk Reduction (CMDRR); 3) Vulnerability Assessment process; and 4) Non-structural flood mitigation measures including community-based measures.
Time period	- 1 hour.
Methodology	- Short presentation. - Questions and Answers. -Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Marking pens.
Content/Message	**Step-I: Integrated River Basin Flood Management (IRBFM)** The Integrated Flood Management (IFM) is related to the central government, county government, communities, and the individual stakeholders. IFM integrates land and water resources development in a river basin and aims at maximizing the net benefits from the use of floodplains as well as aiming at minimizing the loss of lives and the property damages due to flooding (see Figure-7).
	Step-II: Flood Mitigation using Non-Structural Measures The facilitator will introduce the participants to the Non-Structural Measures to mitigate flood damages. The measures include: • Spatial planning; • Early warning; • Evacuation plan; • Preparedness for disaster relief and flood proofing; • Emergency response; • Knowledge sharing; and • Community participation or Public Involvement (PI)
	Step-III: Use of Forecasting and Warning System

	This entails: • Establishing an efficient Early Warning System (EWS); • Data gathering system involving rainfall intensity and distribution on a real-time scale; • Means of translating this information into a hydrograph and a possible flood event; • Quick and clear method of communicating the information from the relevant authorities to the areas and communities likely to be affected; and • Preparation for evacuation, relief efforts, and restoration mechanisms.

2:Community Managed Flood Disaster Risk Reduction (CMFDRR)

Introduction	A risk refers to the possibility for a specific hazard to occur and its probable effectson people, property, and environment. In the present discussion, a risk means that there is a chance that a disaster can occur. A hazard refers to a situation that poses threat to human life, public health, property, or environment. Floods and droughts are regarded as climatic hazards. On the other hand, vulnerability is the lack of ability for a person, a community or an infrastructure to protect him/her/itself against the damage, injury, or harm inflicted by a hazard. The facilitator will define and give other examples of risk hazard and vulnerability and briefly explain the concept of Community Managed Disaster Risk Reduction (CMDRR).
Objectives	By the end of this session participants will: 1) Understand the concept of Disaster Risk Reduction (DRR); 2) Have their understanding of CMDRR enhanced; 3) Explore the factors that influence adoption of CMDRR within catchment areas; 4) Identify the main stakeholders in a CMDRR process; and 5) Have their skills enhanced to assess risks in a humanitarian context in which they work.
Time period	- 1 hour
Methodology	- Lecture. - Group Discussions. - Information Sharing
Materials/Tools	- Marking pens.

	- Flip charts and sheets of paper. - Outline of groups to be involved.
Session Guide	Explore the role of the community and other stakeholders in the reduction of flood disaster risks. This session will involve group discussions among the participants and knowledge sharing.
Output	The participants will acquire skills of the community management of Flood Disaster Risk Reduction (CMFDRR) mechanisms. They will also understand the roles of key players in the process.
Description	Community Managed Disaster Risk Reduction (CMDRR) approach cultivates people's capacities to prevent and mitigate the impact of hazards on communities at risk. Disaster Risk Reduction (DRR) is achieved by enhancing individual survivability and community readiness. Building resilient communities means to strengthen the foundation of safety and enhance Disaster Risk Reduction measures.
Content/Message	**Step-I: Understanding of CMFDRR** The participants will be inducted into understanding the key issues involved in a CMFDRR process. The process entails: • Facilitating, documenting, and sharing of CMFDRR experiences as a part of policy advocacy; • Community resource mobilization; • Networking; • Monitoring and evaluation; and • Organizational learning. The participants will understand how to link community organizations with other actors who are active in Disaster Risk Reduction and how to access resources for CMFDRR.
	Step-II: Factors that influence Adoption of CMFDRR within Catchment Areas This entails: • Livelihoods development; • Natural resources management; • Health systems development; • Disaster education; and • Community disaster resilience. Integrating DRR in the wider community development programmes ensures the sustainability of DRR practices and principles.

	Step-III: Main Stakeholders in a CMFDRR Process and their Capabilities: What can the following stakeholder do? • Community members; • NGOs; • Government; and • Private sectors, etc.
	Step-IV: Knowledge Sharing At this stage the WRUA members, WRUA committee members, and other stakeholders are ready to deepen their insight into the concept of CMFDRR and disaster preparedness mechanisms within their catchment areas.

3: Vulnerability Assessment

Introduction	Vulnerability is the degree to which people, property, resources, systems, and cultural, economic, environmental and social activities (communities) are susceptible to harm, degradation, or destruction when exposed to a hostile agent or factor. Vulnerability Assessment is the process of identifying, quantifying, and prioritizing (or ranking) the vulnerabilities in a system or a community. Exposure is normally a factor of vulnerability but a distinction is usually made between exposure and vulnerability. Flood risk can be reduced not only by decreasing the magnitude of hazards but also by reducing exposure of people and their activities against flooding and by diminishing the vulnerability of flood-prone society. Vulnerability from the perspective of disaster management can be evaluated by assessing the threats from potential hazards on the population and infrastructures. Vulnerability Assessment may be conducted in the political, social, economic or environmental fields. It has a common meaning with Risk Assessment. The goal is mitigating or eliminating the most serious vulnerabilities for the most valuable resources.
Objectives	By the end of this session the participants will: 1) Enhance their understanding of vulnerability; 2)Explore the factors that influence vulnerability within the catchment areas; and 3) Enhance their ability to assess vulnerability and risks in the

	humanitarian context in which they work.
Time period	- 1 hour
Methodology	- Lecture. - Discussions. - Information sharing.
Materials/Tools	- Marking pens. - Flip charts and sheets of paper. - Outline of groups to be involved
Session Guide	Explore the role of the community and other stakeholders in Vulnerability Assessment. The facilitator will involve stakeholders in group discussions and knowledge sharing.
Content/Message	The stakeholders will have catalogued their assets and capabilities in a ranking order and identified their potential levels of threats to floods.
	Step-I: Vulnerability Assessment Vulnerability Assessment is typically performed based on the following steps: • Cataloging assets and capabilities (resources) in a system; • Assigning quantifiable values (or rank order, at least) and importance to those resources; and • Identifying the vulnerabilities or potential threats to each resource.
	Step-II: Disaster Control Planning Disaster control planning refers to assessing the options for reducing flood risks such as non-structural measures/actions by individuals such as flood proofing, land-use regulations, flood emergency measures (flood warning and evacuation). The basic options include reduction of risk, exposure, and vulnerability. The participants should be able to know the various options for reducing flood risks as summarized in the Table-4 below.
Conclusion	Participants now understand the importance of disaster control measures within their WRUAs and communities. They may not have considered other options here. Let them list them.
Discussion Questions	Discuss what and where Flood Vulnerabilities are in your community, referring to the discussion example in Figure-8.

Table-4Disaster Control Planning for Non-Structural Measures

Hazard Reduction	Exposure Reduction	Vulnerability Reduction

• Retaining water where it falls (increasing infiltration, rooftop storage) • Retention basins (natural wet lands or manmade depressions e.g., school grounds, household underground tanks) • Land-use management (e.g. house building codes in urban areas, appropriate spatial planning)	• Structural and non-structural measures and actions by individuals (flood proofing) • Land-use regulations • Flood emergency measures (flood warning and evacuation)	• Physical: improving the infrastructure, well-being, job opportunities, and living environment. • Constitutional: facilitating equal participation opportunities, disaster education and awareness, providing adequate skills and social support • Motivational: raising awareness and facilitating self-organization

Figure-8 Community Repairing a Culvert to reduce Vulnerability

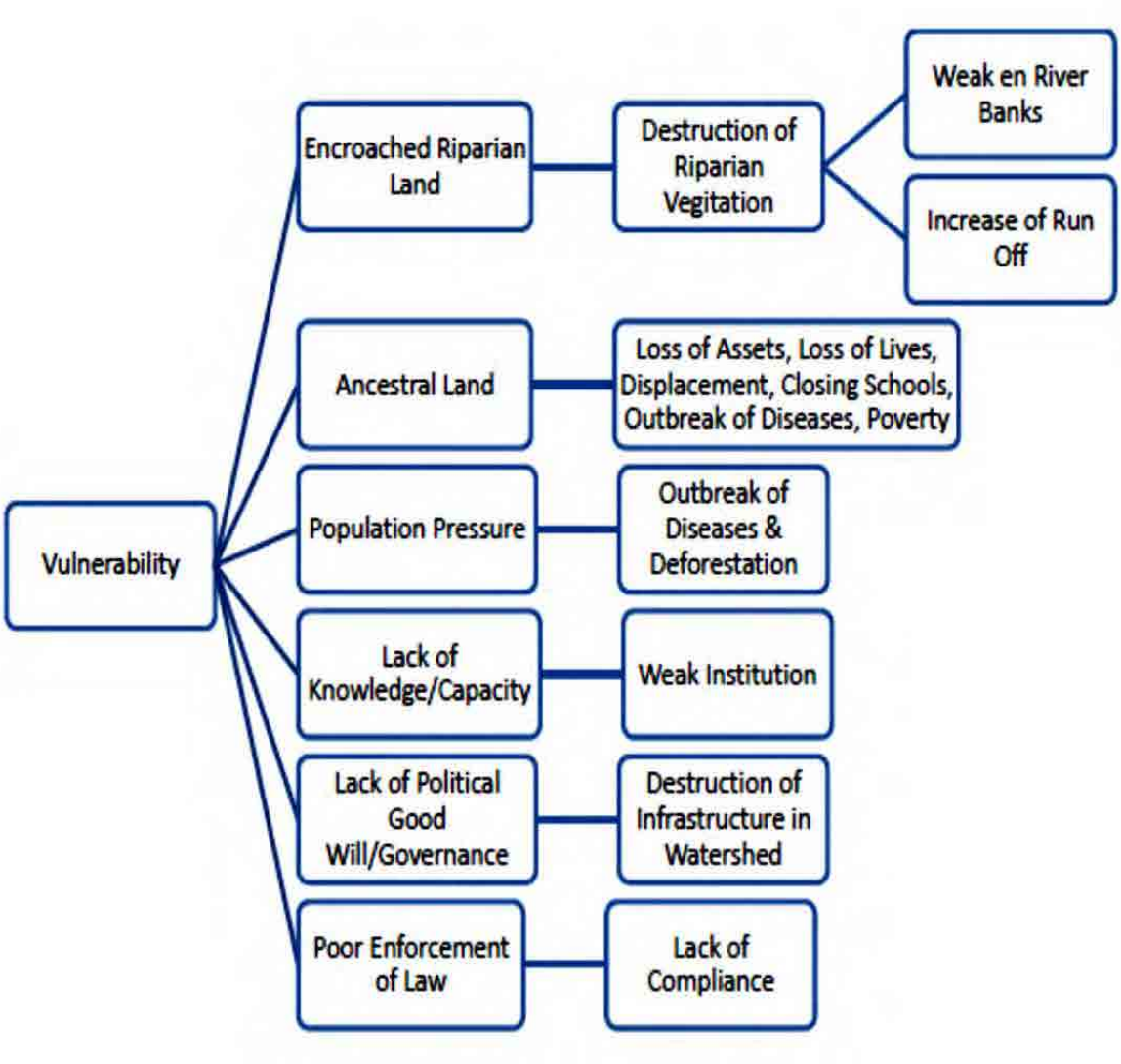


Figure-9Example of Problem Trees discussed on Flood Vulnerability
(1st Stage WRMA Training held on 14 October 2013)

4: Non-Structural Measures for Flood Mitigation Including Community-based Measures

Introduction	Non-Structural Measures are summarized in Table-3 for future reference. Non-structural techniques include relocation; flood proofing, acquisition, and flood preparedness (see Table-3). Participants will discuss and share experiences regarding each of these Non-Structural Measures.
Objectives	At the end of the session, the participants will be able to: 1) Understand measures or activities that reduce hazard, reduce exposure, and/or reduce vulnerability; and 2) Understand process of Vulnerability Assessment in disaster management.
Time period	- 1 hour
Methodology	- Discussions. - Questions and answers. - Information sharing.
Materials/Tools	- Sheets of paper. - Pens. - Flip charts. - Vulnerability assessment map
Buy-Outs	A buy-out, also known as acquisition or relocation, means that the local government purchases the flood-prone houses and assists the homeowners in locating new houses out of the floodplain. The local government then returns the flood-prone area to a natural floodplain. Although this can be costly, it does eliminate the risk of flood damages to infrastructures and the risk to damage of human life and safety.
Flood warning	The flood warning system is also a non-structural measures for reducing damages and protecting lives. A Flood Early Warning System (FEWS) is important to convey important emergency alerts, notifications and updates during an emergency, such as flooding to the community residents.

SESSION 3: RAINFALL AND FLOOD OBSERVATION

Topics:

1: Rainfall Observation
2: Data and Statistical Processing of Rainfall
3: Flood Discharge Observation

Overview

This session presents various ways of making rainfall observations, collecting and statistical processing of rainfall data, and measuring discharge or flood water.

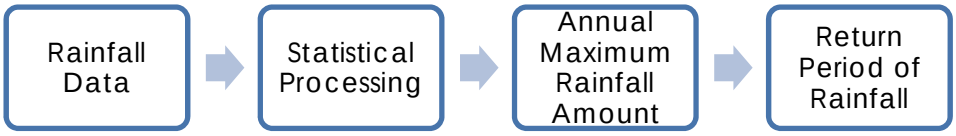


Figure-10 Relation between Rainfall Data and Statistical Processing

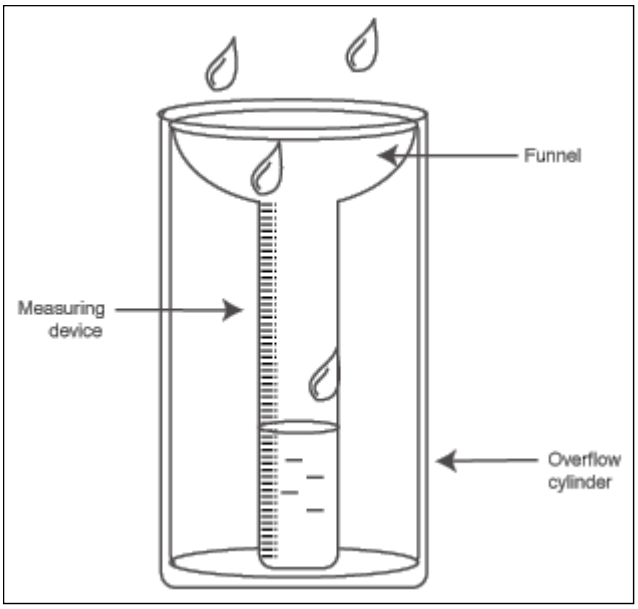
Figure-11 Relation between Rainfall Data and Calculated Discharge

This session also seeks to strengthen the capacity of the community, WRUAs and other stakeholders in the best practice methods of both rainfall observation and flood measurements.

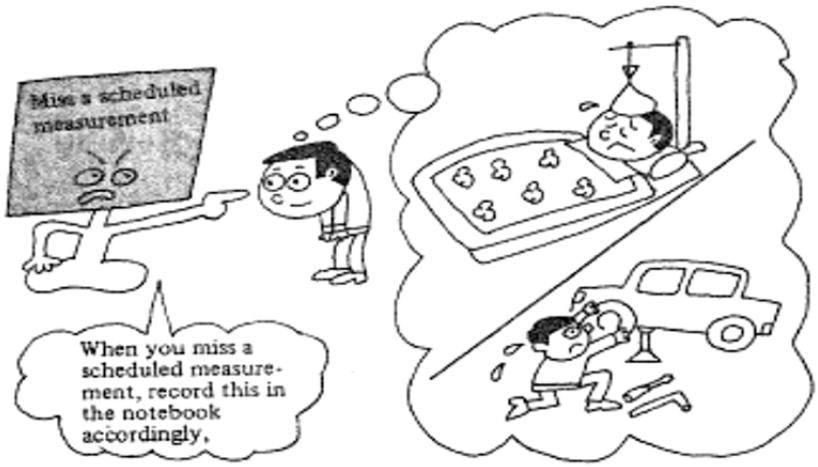
Relationship between rainfall data and run-off discharge may be translated into floods (Figure-12 and -13).

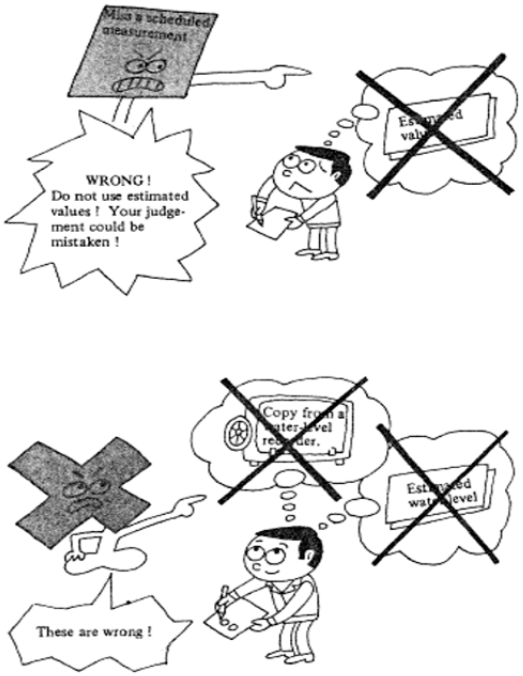
1: Rainfall Observation

Introduction	The participants will be introduced to simple rainfall observation techniques and tools that are applicable to their catchment areas. The participants will also be introduced to the measurement of rainfall observation with accuracy.
Objectives	The objectives of this session are to enable the participants to understand: a) Methods of measuring daily rainfall amounts by using manual rain gauges; b) Methods of measuring hourly rainfall amounts by using automatic rain gauges; and

	c) Techniques for translating rainfall amounts into hyetographs.
Time period	- 1 hour
Methodology	- Short presentation. - Question and Answers. - Visit to a Rain Gauge and River Gauging Station (RGS).
Materials/Tools	- Illustrations. - Flip charts. - Information sharing. - Discussions.
Rainfall Observation	The facilitator in consultation with the participants will decide the possible procedures that can be used for rainfall observation: 1) Distinction between daily rainfall amounts measured by manual measurement and hourly rainfall amount measured by automatic measurement; 2) Distribution of rain gauges in the area; 3) Measurement skills shared among the WRUA members and the community; 4) Accuracy of the measurements; 5) Causes of missing data; and 6) Dissemination of the data gathered.  Figure-12 Rain Gauge—Manual Rainfall Measurement
Conclusion	Rainfall may be measured continuously by using manual rain gauges and/or automatic rain gauges. This may be calculated as mm/day or mm/hr.

2: Data and Statistical Processing of Rainfall

Introduction	Participants will be introduced to methods of simple rainfall data analysis and statistical data processing.
Objectives	The objectives of this session are to enable the participants to understand: • Various methods of rainfall data analysis and statistical data processing; • Techniques for displaying and sharing rainfall data; • Techniques for calculating the average value with missing data; and • Meaning of Return Period of heavy rainfall.
Time period	- 1 hour
Methodology	- Short presentation. - Questions and Answers.
Materials/Tools	- Sheets of graph paper. - Pencils.
Content/Message	**Step-I: Rainfall Data Processing** Types of rainfall data include: • Automatic hourly rainfall data; • Daily rainfall data; • Monthly rainfall data; • Yearly mean rainfall data; and • Return period for yearly maximum rainfall data.
	Step-II: Missing Data  Figure-13 Ways of coping with missing data Source: 'Hydrological Observation Explained in Pictures', Ministry of Construction, PP128, 1999 WRMA and relevant organizations should be responsible for rainfall data

	collection and their analysis in the basin. WRUAs should also collect rainfall information. Discuss how such data may be collected and shared by means of mobile phones, community radios, etc.
	Step-III: Illustrations of Data Analysis • Calculations of 24-hour rainfall, monthly and/or yearly average rainfall. • Rainfall hyetograph and cumulative rainfall amounts at a specific rainfall station.
	Step-IV: Return Period In case of planning a structural measure against floods, it is common to introduce a concept of Return Period as a statistical quantity. A Return Period is usually to be calculated statistically by time series data of yearly maximum rainfall amounts. It is, therefore, important to make correct rainfall observation and accumulate accurate long-term data, for the sake of making a proper plan for structural measures against floods.
Conclusion	Rainfall data is the basis of flood run-off analysis and flood early warning.
Discussion Questions	 Figure-14 Prohibited matters in Rainfall Observation Source: 'Hydrological Observation Explained in Pictures', Ministry of Construction, PP128, 1999 Discuss what attitudes toward measuring rainfall amounts and recording data are to be prohibited.

3: Flood Discharge Observation

Introduction	Over-all goal of these sessions to enable the participants to be able to measure or approximate flood water level or discharge in their particular river basins. The facilitator will mention to other methods of indirect discharge measurements such as the use of weir or flume in small streams, which are not covered here.
Objectives	The objective of this session are to enable the participants to understand: a) Definition of discharge. b) Procedure of discharge measurements. c) Techniques for analyzing and displaying discharge data.
Time period	- 1 hour
Methodology	- Short presentation. - Questions and answers.
Content/Message (1)	**Step-I: Discharge Measurement Procedures** The participants will be introduced to discharge measurement procedures which entails: • Determination of left and right river banks; • Cross-sectional distance across the river channel, channel width, measured in meters; • Depth (surface water level) measurements, taken in meters; • Use of a staff gauge in measuring water level, in meters; • Current meter and its use to determine the flow rate of the water (velocity), measured in meters/second (m/s); and • Discharge is obtained by multiply cross section width, by depth and by velocity, usually given in cubic meters per second (m^3/s). The facilitator is to introduce the participants into the normal process of measuring flood or run-off discharge in a specific cross section of a river.
	Step-II: Field Visit to River Gauging Station (RGS) The participants will: 1) Understand what is meant by Regular Gauging Station (RGS); 2) Understand the various components of RGS; and 3) Be able to estimate flood discharge.

Standing on one of the river banks, how do you determine the **Right** and **Left** river bank?

- What is the direction of the river flow?
- What are you able to identify?
- Staff gauge – how is it calibrated?
- Current meter - how is it calibrated?

The participants will list up the various components in a River Gauging Station in a table and mention to them their functions.

Table-5 Elements of a River Gauging Station

Step	Identified Element	Functions
1	Staff gauge	On one site of the river bank-measures water surface elevation
2	Measuring rod	Part of the current meter-used to measure the depth of water
3		
4		
5		

Figure-15 Gucha-Migori River
The river water level and velocity was high.

Figure-16 Water Level Gauge (unit: mm)

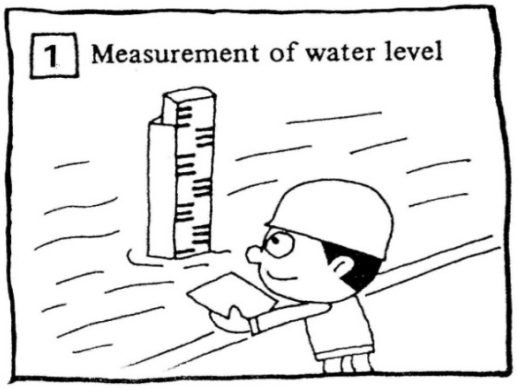
Content/Message (2)	**Step-III: Discharge Calculation**

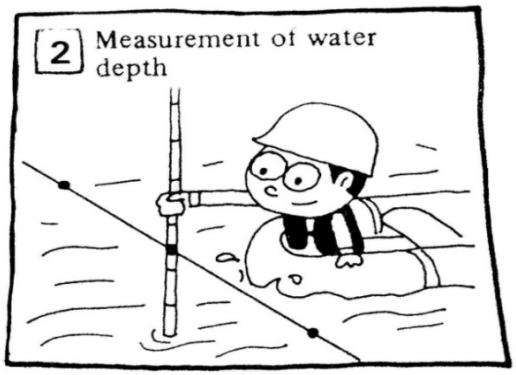
Discharge {Q (m^3/s)} = Cross-Section Area (m^2) x Velocity (m/s)

Cross-Section Area (m^2) = Water Depth x Water Width

Discharge is calculated by three (3) elements, i.e. River Depth, River Width, and River Velocity.

This gives the volume of water flowing at that particular site of the river.





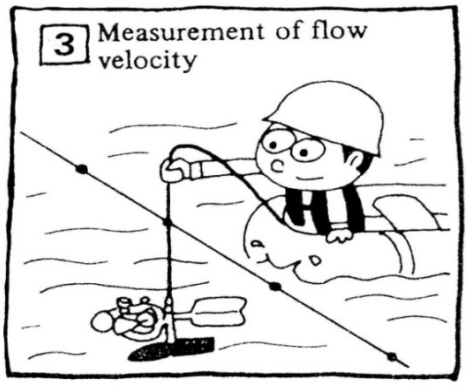


Figure-17 Three (3) Measuring Elements to determine Discharge (Q)
Source: 'Hydrological Observation Explained in Pictures',

	Ministry of Construction, PP128, 1999
Content/Message (3)	**Step-IV: H-Q Rating Curve** This idea is for the participants to understand the relation between the water level, gauge height, and discharge in plotting a Discharge Rating Curve.

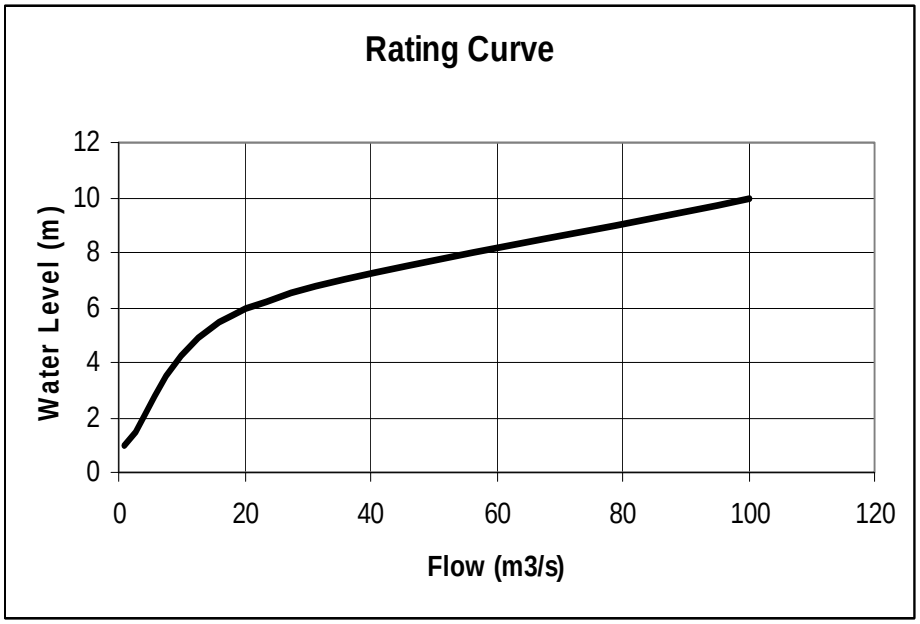


Figure-18 Relationship between Water Level and Discharge (Example of H-Q Rating Curve)

Content/Message (4)	**Step-V: Importance of Rainfall Observation and Water Level/Flood Discharge Measurements** The participants will well understand the importance of rainfall observation and water level/flood discharge measurements. The participants will: • Enable WRUA members to know the available water resources in their catchments mainly from rainfall; • Develop water harvesting mechanisms in case of water shortage; and • Plan for Flood Disaster Risk Management, rescue, evacuation and recovering strategies.
Conclusion	The participants will gain enough basic knowledge of how to measure rainfall amounts, water levels and flood discharges. The information would be necessary to help/assist the community in coping with a disaster.
Discussion Questions	1) Discuss why the H-Q Rating Curve is necessary for flood management. 2) Discuss what merits will be gained in setting a threshold on the data of rainfall amounts, water levels, and flood discharges.

SESSION 4: COMMUNITY-BASED FLOOD HAZARD MAP

Topics:

1: Meaning and Purpose of Flood Hazard Map (FHM)
2: Community-based Flood Hazard Map (CFHM)
3: Preparations for Developing Community-based Flood Hazard Map

Overview

This session introduces the participants to the need of the development and application of a Community-based Flood Hazard Map (CFHM).

1: Meaning and Purpose of Flood Hazard Map

Introduction	Developing a flood map in a target area is a central challenge for the flood management. The participants will be introduced to simple flood hazard mapping techniques and tools that are applicable to their catchment areas. This session is composed of the three (3) following steps: 1) To invite all the stakeholders from the ecological zone river basin. The stakeholders are: • WRUA committee members; • WRUA members; • GOK officials; • Community groups; and • Organizations within the community that have programmes of flood management. 2) To discuss why the Flood Hazard Map (FHM) is necessary. 3) To outline the steps necessary for a flood hazard mapping process.
Meaning and Purpose of Flood Hazard Map	The facilitator will explain briefly that Flood Hazard Map is a tool for communicating the impact of a specific flood event in a particular community. It provides information on spatial distribution of inundation areas and its associated depths during the heaviest and annual average flooding. Flood Hazard Map, in general, is a tool for the presentation and dissemination of information on flood hazard (intensity, spatial range, inundation depth, duration time, frequency, etc.) and evacuation options (location of evacuation centers, evacuation routes, dangerous spots, etc.) in aid of quick and safe evacuation in the event of flood.
Nature and Distribution of a Flood Hazard Map	The community members should know the nature of the flood in extent and how it is distributed within the catchment area. This will be of help in planning the evacuation and rescue centers. Community participation in information dissemination and sharing

	information to avert a flood hazard in the basin is essential.
Flood Information input in to Flood Hazard Map	Table-6 below shows types of flood hazard information, evacuation information and general remarks to take into consideration during evacuation. The participants may add any other relevant information in their localities.

Table-6 Flood Hazard and Evacuation Information

Flood Hazard Information	Evacuation Information	Remarks
- Flood inundation area - Flood inundation depth - Flood duration time	- Evacuation centers - Evacuation path routes - Dangerous spots - Healthcare centers, etc.	- Addition of the information on the building used as residents' land mark - Setting to the scale range that can have a common view - Consider of gender, age, health, etc. (the most vulnerable groups in the community: children, elderly/disable/sick people, and women)

2: Community-based Flood Hazard Map (CFHM)

Introduction	WRUA committee members and WRUA members will develop the skills to map out flood hazard zones within their catchment areas. Flood Hazard Map includes areas along with other variables of interest in the areas of operation between the flood hazard prone areas and evacuation centers and other existent health facilities, which should be covered by the community resource map. The participants will be sensitized on how to develop a Community-based Flood Hazard Map (CFHM). The mapping process is as important as the map itself. The goals of a community-based flood hazard mapping process are to: • Have the community members learn flood characteristics in their areas; • Assist flood-affected community members to know the important points like evacuation routes, evacuation centers, and other hotspot areas; • Assist the WRUA to interpret the real flood features on the ground and open up discussion among the community members and thereby raise flood awareness and sensitization within the community; • Assist the Government and other donor agencies to access the affected communities with ease; and

	• Facilitate the transfer of experiences of historical flood incidences both past and present to the younger generation.
Purpose of the session	Information sharing, discussion and planning
Objective	By the end of the session, the participants will have learned the process of developing a Community-based Flood Hazard Map.
Time period	- 1 hour
Methodology	- Activity. - Guided discussions. - Brainstorming.
Materials/Tools	- Sheets of paper. - Pens. - Drawing Manila papers.
Session guide	This session aims at supporting the participants to develop a Community-based Flood Hazard Map and encourage the WRUA members work together to ensure that the flood hazard map they develop will reflect their thoughts and address the flood risk management issues in their catchment areas.
Content/Message	**Step-I: Prerequisite Conditions for Community-based Flood Hazard Map** Divide the participants into three thematic groups in order to work out a plan for each issue, which entails: • Flood inundation area, depth and time; • Evacuation centers, routes, and hotspots; and • Consideration of the most vulnerable groups; children, elderly/disabled/sick people, and women. Be sure to stick to high priority issues that are linked to the main issues within the sub-catchment. Each group should be able to draw a draft of a Flood Hazard Map.
	Step-II: Flood Inundation Area, Depth and Time Review the problems/factors identified in resultant flood hazard: • Rainfall distribution; • High Water characteristics; • Groundwater; and • Time and duration of High Water and rainfall intensity.
	Step-III: Evacuation Centers, Routes, Hotspots and Response Make clear main components of Flood Hazard Mapping: • To establish evacuation centers, routes, hotpots and healthcare facilities;

	• To establish the role of the WRUA committee members, the WRUA members, and other stakeholders in ensuring proper workings of the established Flood Hazard Map; and • To establish how the data for drawing the map are collected.
	Step-IV: Consideration of the most Vulnerable Areas a) Review Session 3 in Session 2. b) Identify which people in the community are vulnerable as you try to map out the flood risk zones in order to make the necessary precautionary steps. Consider the following area characteristics: • Degraded areas; • Erosion gullies; • Settlement in swamps and/or flood plains; • Road drainage; • Settlement on steep slopes; and • Number of children, elderly, disabled, sick people and women. c) Detect how these groups may be affected by flood risks within their areas of settlement.
	Step-V: Activity Planning Matrix For each issue, develop an approach and activities. Translate the approach into a specific output and activities to realize that output as per the matrix in Table-7 below. Flood Hazard Map provides information on spatial distribution of inundation areas and its associated depths during the heaviest and annual average flooding.

Table-7 Output and Activities Analysis for Planning Matrix

Step	Output	Activity	Time Frame
1			
2			
3			
4			
5			

3: Preparations for Developing Community-based Flood Hazard Map

Introduction:	The training facilitator will introduce the participants into the main steps involved in the development of a Community-based Flood Hazard Map (CFHM).
Important Considerations in Preparation of Hazard Map	This entails: • Gender representation, which considers children, elderly/disabled/sick people, women, etc.; • Community members identify key flood-related landmarks; • Setting up of an open ground for easy interactions among community members in the process of developing a Flood Hazard Map that takes into consideration the view of the community; • Establish consensus on the language, symbols, signs, legend, colors, etc. to be used on the Flood Hazard Map, that must be easy to understand by all community members for its effective and efficient use, bearing in mind that the map is a communication tool with its message; • For village-based Flood Hazard Map, it is advisable for transect walk to be carried out to verify the various points and locations indicated on the draft Community-based Flood Hazard Map; • Explanation of the purpose of the Flood Hazard Map to the community; • Choose or identify one member of the community to lead in drawing the Community-based Flood Hazard Map; and • Last but not least, transfer the sketch from the ground to the Manila paper as the first draft, thereafter community members discuss the draft and come to a consensus on it and adopt the draft as it is or they review it based on the areas agreed upon.
Importance of the Community-based Flood Hazard Map	**1) To WRMA, GOK Staff, and Other Stakeholders:** A Flood Hazard Map can be utilized for the formulation of regional planning that includes: • Planning of structural measures against floods; • Road maintenance and improvement; • Planning for evacuation; • Drainage improvement; • Selection of sites for new evacuation facilities; and • Prioritization of communities to be strengthened against and prepared for flooding, etc. **2) To the Community (WRUA Committee Members and WRUAMembers)** A Flood Hazard Map can be utilized for evacuation information at the flooding and as a disaster prevention learning information.

Figure-19Community Members Draw a Flood Hazard Map inWasiese Village on July 15, 2010

Figure-20 Example of a community Flood Hazard Map

On 18th June 2012 made by LOGUMI WRUA
for Kabuto and Nyora Villages in Lower Gucha Migori Sub-Catchment

SESSION5: FLOOD EARLY WARNING

Topics:

1: Flood Early Warning System (FEWS)
2: Community-based Flood Early Warning (CFEW)

Overview

This session introduces the participants to the need for the development and application of community-based Flood Early Warning System (CFEWS).

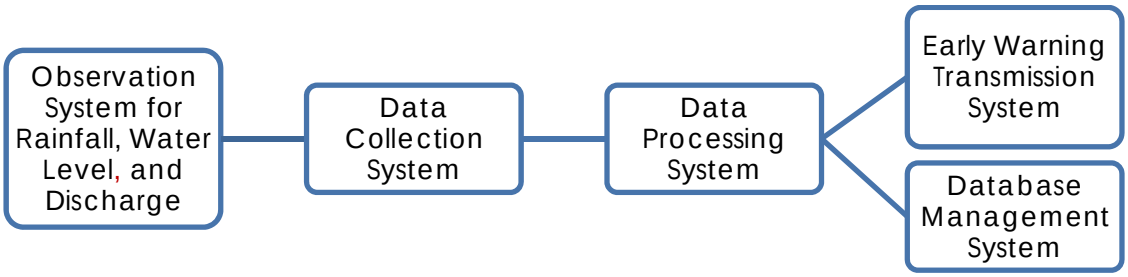
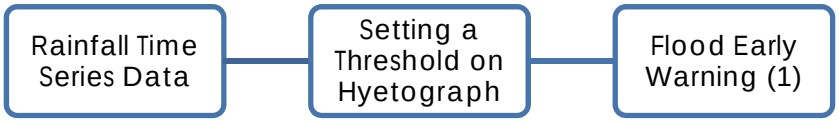


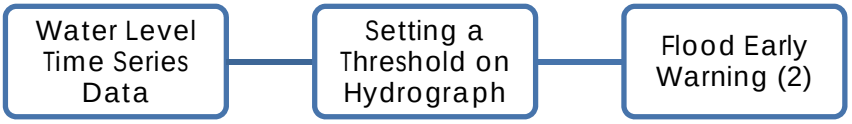
Figure-21 Framework of Flood Early Warning System (FEWS)

A Community-based Flood Early Warning System helps the community to identify the problem, brainstorm together, and share the proposed solutions.

1) Rainfall



2) Water Level



3) Discharge

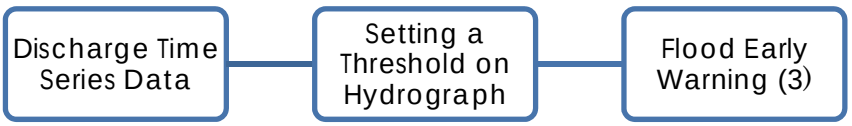


Figure-22 Methods for Issuing Flood Early Warning

1: Flood Early Warning System (FEWS)

Introduction	The participants will be mobilized and sensitized on the need of and developing a workable Flood Early Warning System (FEWS). It is important to introduce the followings: • Early Warning System developed along Nzoia River Basin by World Bank and KMD; and • Rainfall gauge at a primary school as community-based action for Early Warning System.
Objectives	The objectives of this session are to enable the participants to understand: 1) Elements of an Early Warning System; and 2) Importance of Early Warning System in flood disaster mitigation.
Time period	-1 hour
Methodology	- Short presentation. - Questions and Answers. -Information sharing. - Discussions.
Materials	- Illustrations. - Flip charts. - Pens.
Content/Message	**Step-I: Elements of Flood Early Warning System (FEWS)** The facilitator will introduce the participants into the process of flood early Warning System and its main components. This entails: • Rainfall (Precipitation) forecast for a particular period of time; • Travel time from where the rain is falling to where participants are settled; • Rate of river water level rise; • River flood forecast (flood area and depth, arrival time of flood water); and • Optimum operation timing of river management facilities. Community-based Flood Early Warning System (CFEWS) is based on their experience in many cases.
	Step-II: Importance of Flood Early Warning System (FEWS) The Flood Early Warning System is to: • Allow the information of flood risks to be transmitted at the real time ; • Allow the flood mitigation managers to plan in advance on responses required, evacuation and evacuation routes (if needed), healthcare centers, identification of hotspots, evacuation centers, etc.; and • Timely disseminate forecast and warning information to relevant stakeholders and communities.

Conclusion	It is important to note that one crucial purpose behind flood forecasting and warning is to change people's behavior to increase adaptations, save lives, and reduce damage to property and loss of human life.

Session 2: Community-based Flood Early Warning (CFEW)

Introduction	The participants will be mobilized and sensitized on the need of and developing a workable Flood early Warning System. The focus will be on Community-based Flood Early Warning System (CFEWS). Besides the earlier discussed topics on rainfall measurements, the magnitude and frequency of floods remains a vital component of the Community-based Flood Early Warning System.
Objective	By the end of this session, the participants will be aware of the requirements for setting up a Community-based Flood Early Warning System.
Time period	- 1 hour
Methodology	- Short presentation. - Questions and Answers. -Information sharing. - Discussions.
Content/Message	**Step-I: Meaning of Flood Hydrograph** What is a hydrograph? The facilitator will demonstrate graphical examples of monthly river discharges: 1)Discuss why the community requires a flood hydrograph; • Identify the flood peaks and time-scale. • Brainstorm and develop mechanism of disseminating information regarding rise and fall of water levels clearly and quickly to the other community members. 2) Discuss response actions when a flood event occurs.
	Step-II: Requirement for Development of a Community-based Flood Early Warning System This entails: • Establishing a proactive Flood Management Committee (FMC); • Establishing a working rapport with RGS meter reader assigned by the WRMA; • Establishing a coordination mechanism between various Flood Management Committee (FMC) members;

	• Assigning one of FMC members to regularly monitor the river levels by reading and recording the levels at RGS; • Flood management committee to hold meetings to discuss the river water levels vis-a-vis, the flood coverage areas, and flood depths in various parts of the affected areas; • Secretary to harmonize the collected information; • Secretary to develop a graph that takes into consideration the relationship between the two variables (river levels for each day and the expected flood depth) experienced in various places and areas affected; • WRUA and the community to hold a meeting to discuss and approve the graph; and • Adoption of the graph as a hydrograph for Flood Early Warning that can be used by the WRUA Flood Management Committee in preparation and response in case of flood occurrence after the warning is issued; the problem is how far and wide the mobile phones are used.
	Step-III: Importance of Community-based Flood Early Warning System The facilitator will try to elaborate on the merits of a Community-based Flood Early Warning System (see Figure-27 below). These merits include: • To make the community more proactive rather than reactive in flood management; • To make use of traditional knowledge of floods and indigenous adaptation methods; • To trigger early evacuation that can minimize the human suffering experienced during turbulent evacuation in the flood occurrence; • To assist the WRUA and the community to negotiate with relevant evacuation places that can minimize the disruptions of day to day business; • The WRUA and the community members can effectively discuss with relevant agencies and organizations in the preparation phase prior to floods; and • Effective planning that enables easy zoning and dispatching of flood management committee members to various flood-affected sites.
	Step-IV: Actual Cases for Community-based Flood Early Warning System **1) Community-based Flood Early Warning System using Rain Gauge** If it rains in mountain area, lower area will have a flash flood within some

hours.

People who live in mountain area can make alert to lower stream residents in case of a heavy rainfall using convenient rain gauge data (See Figure-25).

- **Community-based Flood Early Warning System using River Gauge**

Convenient River Gauge shown in Figure-24 can alert the flood. The cost is approximately 2-300USD, and local people can maintain it by themselves.

For example, the National Coordination for Disaster Reduction of Guatemala (CONRED) makes the convenient River Gauges with automatic radio transmission by them, and distributes them to many points along the river basin.

The volunteers, who have been given mobile phones and handy radios by CONRED, have been reporting the current situation to CONRED in case of heavy rain and river level rises.

Figure-23 Installation of Convenient Rain Gauge

Figure-24 Convenient Rain Gauge and its Monitoring Instrument

Conclusion	WRUA committee members and the community members are more equipped and prepared to cope with the flood risks that may arise when flooding occurs.

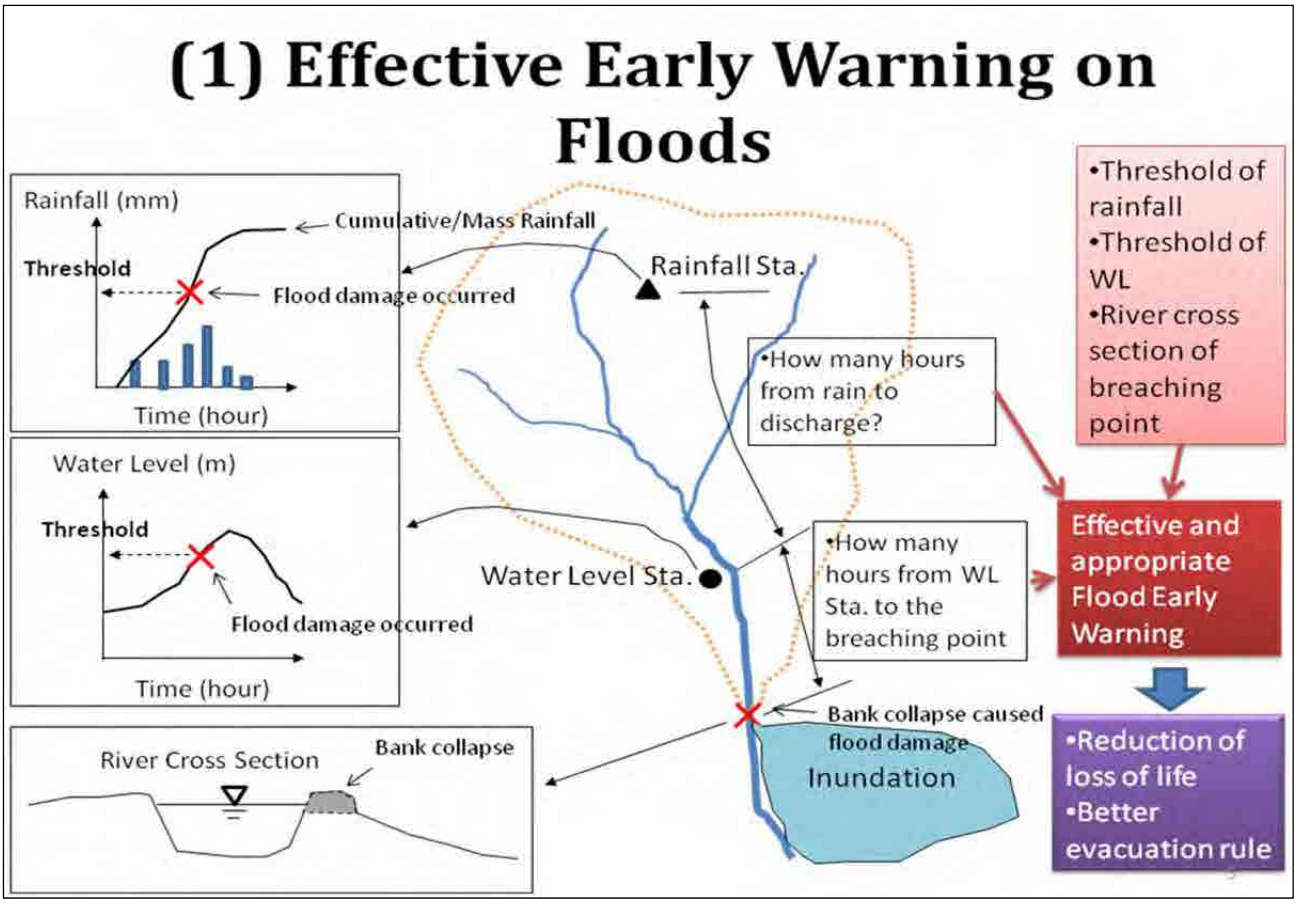


Figure-25 Effective Early Warning on Floods

SESSION6: FLOOD DISASTER EVACUATION PROGRAMME

Topics:

1: Evacuation Planning
2: Evacuation Centre Management

Overview

This session presents the process and management of Flood Disaster Evacuation programme.

The key pillar of the programme is the development of a more responsive evacuation programme and process and management of evacuation centres.

Evacuation is the process in which affected persons move from their homes to a safer place to settle temporarily because of an impending disaster or the disaster that has just occurred.

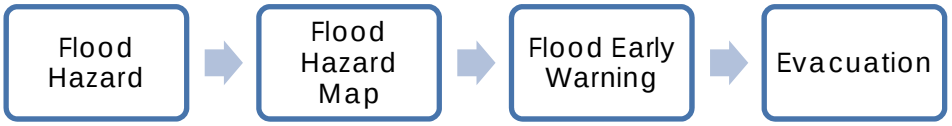


Figure-26 Scheme of supposed Evacuation on a Flood Event

1: Evacuation Planning

Introduction	The facilitator will highlight the key issues needed for a proper working evacuation programme.
Objectives	The objectives of this session are to enable the participants to understand: 1) Steps necessary for a disaster evacuation planning; and 2) Execution of a Flood Evacuation Plan.
Time period	- 1 hour
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Marking pens.
Content/Message	**Step-I: Disaster Evacuation Plan** The facilitator elaborates on the key steps necessary for a Flood Evacuation Plan, which entails: • Identification of the flood-prone areas or zones; • Marking the affected areas; • Sending alarms to the affected people and directions on what is

	required to them; • Formulation of traffic diversion with a minimum impact on the regional transport system; • Regional population movement plan to deal with mass evacuation, displacement, or influx; • A compressive review and update of all preparedness plans currently in use to make them conform to the current crisis; • Marking of the evacuation routes and centers of stoppage; • Preparation of health care facilities; • Disaster education and post disaster counseling to allow the evacuees to cope with the situation; and • Post disaster recovery programme involving resettlement plans, relief transportation, and supply chains.
	Step-II: Evacuation Drills and Mock Experience 1) Invite all the stakeholders from the flood hazard zone of the river basin. The stakeholders will include: • Water Service Boards (WSBs); • Water service providers(WSPs) • Water Resources Users' Associations (WRUAs). • Schools, colleges, and other educational institutions; • County government and • GOK staff • Other CBOs, NGOs operating in the catchment and key organizations operating programmes on disaster management: 2) Discuss why the Evacuation Drills are necessary. 3) Agree with the way to conduct Evacuation Drills and mock experiences. 4) The use of community sirens/whistles/drums for evacuation purposes.
	Step-III: Evacuation Drills Rules 1) Discuss what is needed in conducting the drills: • Whistles/sirens/drums; • Assembling points; • Participants; and • Other necessary materials like tents for healthcare, mobile phones, chargers, etc. 2) Discuss and develop the rules that govern the conduct of the Evacuation Drills: • Who manages the drills; and • The time to start and end, etc.

	• Who organizes the Evacuation Drills?
	Step-IV: Mock Experience At this stage the participants will give a feedback on their experiences during the evacuation.
Conclusion	Community mobilization at this stage is essential, because it can give the required motivation and instill some sense of responsibility in carrying out evacuation in case of flood disasters.
Exercise	The participants will completely discuss the result of Table-8 depending on their experiences of floods in their areas.

Figure-27 Group Discussion on Flood Mitigation and Response in Kamuga Village on Aug. 20, 2010

Figure-29 Group Presentation on Evacuation in Kamuga Village on Aug. 20, 2010

Figure-28 CFMO organizes Community Members during Evacuation drillingWasiese Village on Dec. 3, 2010

Figure-30 Community Members assist an injured Evacuee during Evacuation Drilling Mombasa Wangaya Village on Dec. 6, 2010

Table-8Disaster Evacuation Plan

Activity	Content/Input	Actor	Items to be confirmed
Identification of the flood-prone areas or zones	Flood hazard maps	WRUA/CBO/NGO in charge of flood disasters	Maps available for dissemination to all stakeholders
Marking the affected areas	Identified affected areas	Chairman of CBO/WRUA, NGO charged with flood disaster management	All affected areas are identified
Sending alarms to the affected people and directions on what is required to them	Megaphone, Siren	Assistant chief, village elder, WRUA and Chairman CBO/ NGO charged with flood disaster management	Availability of battery for megaphone, siren and identified escape route
Formulation of traffic diversion with a minimum impact on the regional transport system	Integrated Flood Management Plan (IFMP)	WRMA staffs (Flood Management Officers Regional and Sub-regional),WRUA	IFMP available for dissemination to all stakeholders
Regional population movement plan dealing with mass evacuation, displacement or influx	Integrated Flood Management Plan	WRMA staffs (Flood Management Officers Regional and Sub-regional),WRUA	IFMP available for dissemination to all stakeholders
A compressive review and update of all preparedness plans currently in use to make them conform to the current crisis	Integrated Flood Management Plan	WRMA staffs (Flood Management Officers Regional and Sub-regional),WRUA	IFMP available for dissemination to all stakeholders
Marking of the evacuation routes and centers of stoppage	Evacuation guidebook	Assistant chief, village elder, WRUA and Chairman CBO/ NGO charged with flood disaster management	Evacuation guidebook is beneficial for dissemination to all stakeholders
Preparation of health care facilities	Community Flood management Manual	District Public Health Officer, WRUA and Chairman of CBO/ NGO charged with flood disaster management	Community Flood Management Manual is beneficial for dissemination to all stakeholders
Disaster education and post disaster counseling to allow the evacuees to cope with the situation	Community Flood management Manual	District Education Officer, WRUA, Head teacher and Chairman of CBO/ NGO charged with flood disaster management	Community Flood Management Manual is beneficial for dissemination to all stakeholders
Post disaster recovery programme involving resettlement plans and relief transportation and supply chains	Community Flood management Manual	WRMA staffs (Flood Management Officers Regional and Sub-regional) and WRUA	Community Flood Management Manual is beneficial for dissemination to all stakeholders

2: Evacuation Centre Management

Objectives	By the end of this session, the participants will be able to: 1) Understand what is required in an evacuation center; 2) Understand the personnel needed in the evacuation center; and 3) Know the rules in the management of an evacuation center.
Time period	- 1 hour
Methodology	- Discussions. - Questions and Answers. - Brainstorming.
Materials/Tools	- Sheets of paper. - Pens. - Flip charts.
Session guide	This session aims at making use of the experience of the participants. The activity will stimulate discussion on the need for coordinated Evacuation Centre Management.
Activity	• What is an evacuation center? • Where are evacuation places?
Content/Message	**Step-I: Procedure** This entails: • Ask participants to identify where they move when they evacuate; • Identify the gaps in therein in Evacuation Centre Management through group discussion and presentation; • Discuss how the gaps can be bridged; • Explain what can make a place a good evacuation center in the context of safety, accessibility, security, food security and hospitality; and • Pair ranking of safety, accessibility, security, food security and hospitality to prioritize the variables and identify which variable is to be given the highest priority.
	Step-II: What is needed for a successful Flood Evacuation Programme? The following simple items may be available in any evacuation programme: • A cell-phone charger to afford communication among the evacuees; • A rope;

- A life jacket;
- A life ring;
- A detachable ladder;
- Assembly point; and
- Motor boats, etc.

Step-III: Pre-requisite for Management of an Evacuation Centre

To be able to easily manage an evacuation center, the following would be necessary:

- Specifically identified evacuation center or place;
- Proper designated routes to the center that are free from traffic congestion;
- Accessibility would be necessary;
- Adequate staff to take care of the evacuees; and
- Enough boat/vehicle ambulances and facilities.

Figure-31 Evacuation Activities during Dec. 2011 Floods
Source: Kenya Red Cross Migori Branch

Step-IV: Prerequisite Knowledge required for effective Management of an Evacuation Centre

This entails:

- Determine resources needed, mobilize and secure them;
- Maintaining the evacuation center structure and equipment;
- Preparing the evacuation center for use;
- Operate the evacuation center with available resources;
- Establish and maintain effective channels of communication with relevant agencies and support groups; and
- Completing all tasks at closure.

Step-V: Evacuation Centre Management Strategies

This entails:

	• Make strategic alliances with other stakeholders on how to manage the center; • Avoid conflict in the management of the Centre with the help of designated staff in the center; • Proper communication to deal with real-time issues; • Engage all the stakeholders in more integrative approach; • Allow the various stakeholders to participate in their more specialized areas of undertaking; • Avail all the required equipment and materials for the evacuation exercise; • Use mobile clinic when necessary to take care of the most vulnerable group in the community; • Create confidence in the evacuees that everything is under control; and • Allow minimum movement among the evacuees and other stakeholders to reduce congestion and allow easy movement during the exercise.
Conclusion: Importance of well-managed Evacuation Centre	This affords the followings: • To serve and save life; • To allow quick evacuation; • To provide the evacuees with the necessary facilities during the time of the disaster; and • To avoid massive destruction and disruption of livelihoods.  Figure-32Community Members evacuating into the Evacuation Centre due to the real Flood during the drill in Komwaga Village on Nov. 23, 2010

SESSION7: COMMUNICATION, PUBLIC AWARENESS RAISING AND DISASTER EDUCATION

Topic

1: Capacity of Transmitting and Communication Skills
2: Communication of Desired Information to Schools
3: Effective Public Awareness Raising on Floods
4: Roles of Effective Communication Channels between the Government and Community in Mitigating Flood Risks

Overview

This session provides the community, WRUA committee members, and WRUA members with the most effective communication method using simple community tools.

This session seeks to strengthen the communication skills and systems of WRUAs and communities to be able to communicate more effectively, clearly, and quickly.

1: Capacity of Transmitting and Communication Skills

Introduction	The facilitator will assess the community's capacity in communication skills and transmission of information related to flood hazards.
Objectives	The objectives of this session are to enable the participants to understand: a) Effective ways of communication; b) Methods of information transmission; c) Nature and regional characteristics of flood hazards; and d) How to estimate the distances between the flood-prone areas and evacuation centers and other existent health facilities by means of mapping of flood hazard areas.
Time period	- 45 minutes.
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Marking pens. - Map of the catchment basin.
Content/Message	**Step-I: Effective Ways of Communication** The participants will be inducted into the effective ways of communication in relation to flood hazards, which entails: • An understanding of what is communication and what makes a good communication;

	• Roles of the sender of the message and the receiver of the message; and • Clarity/conciseness elements in communication.
	Step-II: Methods of Information Transmission The participants will be inducted into the best methods of communication in relation to flood hazards, which entails: • The use of mobile phones; • Monitoring of cloud movements to predict impending weather variation; • Organized community groups; • The use of barazas to relay the message; and • The use of local FM radios to broadcast short-time forecast on an oncoming flood event.
	Step-III: Understanding Flood Hazards The participants will be inducted on flood hazards including the affected areas and the places of rescue, which thus entails: • Mapping of flood-prone areas and warning people there; and • Sharing information on the places where community members can reach in case of flood occurrence.

2: Communication of Desired Information to Schools

Introduction	This session intends to introduce the participants to ways and methods of creating flood disaster awareness in schools. This is expected to have a wider coverage and to reach many people by using the school going children.
Objectives	The objectives of this session are to enable the participants to understand: 1) Need of using schools as centers to relay messages on flood disasters; and 2) Use of school curriculum to disseminate information on floods within their WRUAs and communities.
Time period	- 1 hour
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts.
Content/Message	**Step-I: Teaching of Flood Disaster in Schools**

The participants will be inducted to the best methods of teaching flood disaster issues in schools, which entails:

- Development of the subject contents on Flood Management;
- School Curriculum development by identifying the necessary topics to be covered;
- Decision making on the level at which the Disaster Prevention Course can be introduced (primary or secondary school level); and
- Development of materials that can be used with ease in communities.

Figure-33 School Pupils dramatize to target Audience of Community Members in R. Nyando Basin.

The narrative entitled Koth Uhuru: a story of the heavy rainfall in 1961-1963 that led to heavy floods in the country during handover of Nyando Project (2009-2011) to the community on Nov. 21, 2011.

Figure-34School Pupils keenly study a Community Flood Hazard Map put up on a signboard in Odesso Village.

Step-II: Teaching Methods/Materials regarding Disaster Education

This entails:

- The use of lectures, demonstrations, video tapes, etc.;

	• Allow the students to experience on-site trainings in those areas already inundated by floods; • The facilitator will hold a demonstration on the available methods; • Preparation of pamphlets for distribution among the young school children, which are written in simple language and with pictures on best practices for Disaster Prevention; and • The use of a flood disaster map.
	Step-III: Expected Outcomes This entails: • A wide coverage of affected communities; • New knowledge imparted into the young minds; • Development of a more robust method of flood disaster communication network; and • Development of a specific method of response to flood disasters; plan for evacuation and recovery measures.
	Step-IV: New Type of Disaster Drill New type Disaster Drill, which makes children feel enjoyment in it. (See Figure-39: Iza! Kaeru Caravan) Children are learning in an enjoyable format; a new type disaster reduction training programme for children involving their parents.
Conclusion	The participants have been equipped with the necessary knowledge and will be prepared to share the knowledge and information gained at WRUA level in local and regional areas.

Figure-35Iza! Kaeru Caravan 1(Japan)

Figure-37Iza! Kaeru Caravan 3(Japan)

Figure-36Iza! Kaeru Caravan 2(Japan)

Figure-38Iza! Kaeru Caravan 4

(Japan)

3: Effective Public Awareness Raising on Floods

Introduction	This session introduces the participants to the role that Public Awareness of floods and Flood Disaster Education in schools plays an important part in Integrated Flood Management (IFM): • Communication should improve local awareness so as to reduce and minimize flood damages; • Provide information on risks and evacuation; • Facilitate communication according to the level of understanding and existing knowledge on flood disasters; • Incorporate local stories on historical floods and traditional measures against flooding; • Understand the roles of Structural and Non-Structural Measures such as levees, dams, natural basin storage, etc.; • Incorporate knowledge on Flood Management into the School Curriculum; • Facilitate understanding of the roles of National Government, County Government, local communities and individuals (Public Assistance, Mutual-Help and Self-Help); and • Understand the roles of citizen groups and volunteers.
Objectives	By the end of this session, the participants will be able to: 1) Raise public awareness on floods; and 2) Inculcate best methods of message transmission about floods.
Time period	- 1 hour
Methodology	- Discussions. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Papers. - Pens - Cards.

	- Flip charts
Discussion and Brainstorming	This session aims at bringing out detailed ways of raising public awareness of flood disasters. The discussions should build on existent indigenous knowledge of flood disasters and how the communities have developed coping mechanisms over time. The role of the group leader in this session is to guide the discussion and encourage active participation of the members. The participants will: • Discuss their understanding of flood disasters and how to create and raise awareness among the community members and the WRUAs; • Be divided into groups of eight (8) representing the entire proportionate participants, and each member in the group is required to list up and write down his/her understanding of Public Awareness Raising among the community members; and • Be expected to draw Table-9 below and mark their methods of Public Awareness Raising within their communities. Several activities may be carried out at the village level, which includes: • Visiting villages to hold Flood Disaster Awareness meetings; • Putting up flood preparedness posters and Flood Hazard Maps at a local baraza meeting place; • Joining the community during the weekly meeting with their local chief; and • Sensitizing teachers and pupils during parents meetings in schools within the catchment. Other activities include planned series of activities that are well coordinated, such as having evacuation drills, broadcasting radio programmes on floods, and carrying out a disaster education programme in schools. Less frequent and yet useful activities could be done in the annual community event like culture day that integrates Community-based Disaster Activities (CDA) and is therefore able to reach many community members who interact and attend the popular culture day event.
Exercise	Work in groups and complete Table-9 below. Each member in each group will be expected to include as many variables as possible that can be used to raise public awareness. The facilitator will elaborate on the need to promote community awareness

	and to strengthen community resilience in the following ways in efforts to reduce the flood risks: 4) Well-designed public communication campaigns have contributed enormously to educating the public; and 5) Conveying the intended message over a large geographical area to a vast and diversified audience.

Table-9Various Methods of Public Awareness Raising

Major Flood Disaster Issue	Public Awareness Raising Method	Mark indicating Means used
Increased water levels	The use of radio, phones,etc. to send messages	
Increased rainfall intensities	The use of mobile phones, emails	
Community flood hazard map	The use of billboards, etc.	

4: Roles of Effective Communication Channels between the Government and Community in Mitigating Flood Risks

Introduction	As already shown in Session 1, flood risks can be seen as a combination of the magnitude of the flood hazard expressed in terms of frequency, the severity with respect to the exposure of the elements to flooding, and the vulnerability of the community at risk. The participants will be inducted into understanding the importance of effective communication in coping with flood risks. A hierarchy of communication channels will be established within the community and the respective WRUAs in order to sensitize them about the need and the roles of good communication systems in disaster risk management. Communication flow channels with respect to information dissemination and activities of stakeholders are shown in detail in (see figure 39 below) in cases of Pre-Flood, In-Flood, and Post-Flood, respectively. This will focus on the causes and effects of floods on the community, catchment area, and the environment in general. This mobilization will create the required public awareness of the roles and importance of Flood Risk Communication (FRC).
Objectives	The objectives of this session are to enable the participants to understand: 1) The roles of communication in Flood Risk Management (FRM); 2) The importance and meaning of communication in flood risks; 3) The causes and effects of floods and their impacts on the community;

	4) The concept, principles, and channels of disaster communication; 5) How to familiarize with some communication participatory techniques/skills and tools for community members; 6) How to distinguish between methods and levels of disaster communication in different situations and with different stakeholders and the government; and 7) How to conduct effective disaster communication for community members in avoiding flood risk.
Time period	-1 hour
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip Charts. - Pens.
Discussion and Brainstorming: **Roles of Communication in Flood Risk Management**	The participants will brainstorm on the roles of flood risk communication, which entails: • Evidence of an impending flood risks; • Identification and the use of the best communication channel to reach as many people as possible (see table 9 above) Discussion on why communication between the WRUA committee members, stakeholders, and the government is necessary; and • Agreement with the way forward.

Figure-39 Posters showing (a) Evacuation Tips and (b) Early Warning Awareness

SESSION8: PLANNING, DESIGN, CONSTRUCTION, OPERATION,AND MAINTENANCE OF FLOOD MITIGATION FACILITIES

Topics:

1:Planning and Designing of Flood Mitigation Measures
2:Flood Mitigation Structural Measures including Community-based Measures
3:Operation and Maintenance of Flood Mitigation Structural Measures

Overview

This session provides the participants with the overall planning, designing, operation, and maintenance of Flood Mitigation measures.

It also seeks to impart skills to the WRUA leaders and the community members regarding the best practices to plan, design, maintain and operate simple Flood Mitigation facilities within their respective sub-catchments.

1: Planning and Designing of Flood Mitigation Measures

Introduction	The facilitator discusses the available flood mitigation measures and their implication in minimizing the flood damage impacts on the community and their properties.
Objectives	The objectives of this session are to enable the participants to understand: 1. The types of flood mitigation measures. 2. The use of flood mitigation measures.
Time period	- 1 hour.
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Pens.
Content/Message	**Step-I: Types of Flood Mitigation Structures** The facilitator will induct the participants to the various methods of flood mitigation. Flood damage reduction consists of two basic techniques, i.e. structural and non-structural techniques. Structural methods modify the flood and “take the flood away from people” by measures such as levees, floodwalls, dams, dredging, and channelization. Non-structural flood damage reduction techniques basically “take the people away from the floods” leaving the flood to pass unmodified by means of training and sensitization of community members.

	Both structural and non-structural techniques consist of the measures listed in Table-3 above. The facilitator will explain what these measures entail.
	Step-II: Planning of Flood Mitigation Measures The existent common process of flood risk management includes the following aspects: 1) Risk Assessment: hazard and vulnerability identification, frequency and consequence analysis, and risk assessment according to given criteria for risk acceptance. 2) Protection: structural and non-structural measures. 3) Preparedness and Response to Emergency: planning for disaster relief, flood forecasting warning, evacuation, rescue, and humanitarian assistance. 4) Post-Recovery: repairing and reconstruction, damage compensation, review of and suggestions for future management. 5) It should also include the following steps: • To organize to prepare the plan; • Public Involvement (PI); • To coordinate with other agencies; • To assess the hazard; • To set goals; • To evaluate the problem; • To draft an Action Plan; and • To adopt the plan.
	Step-III: Design of Flood Mitigation Measures: • Flood mitigation measures are designed to alter the behaviour of the flood itself by reducing flood levels and/or velocities, or by excluding flood water from the areas of risks. • They are made to confine the water within the river channel or to temporary store the flood water for some time before being released to recover the necessary river flow volume downstream the structure. • Afford the necessary protection against the flood water to the buildings, property, and loss of human life.

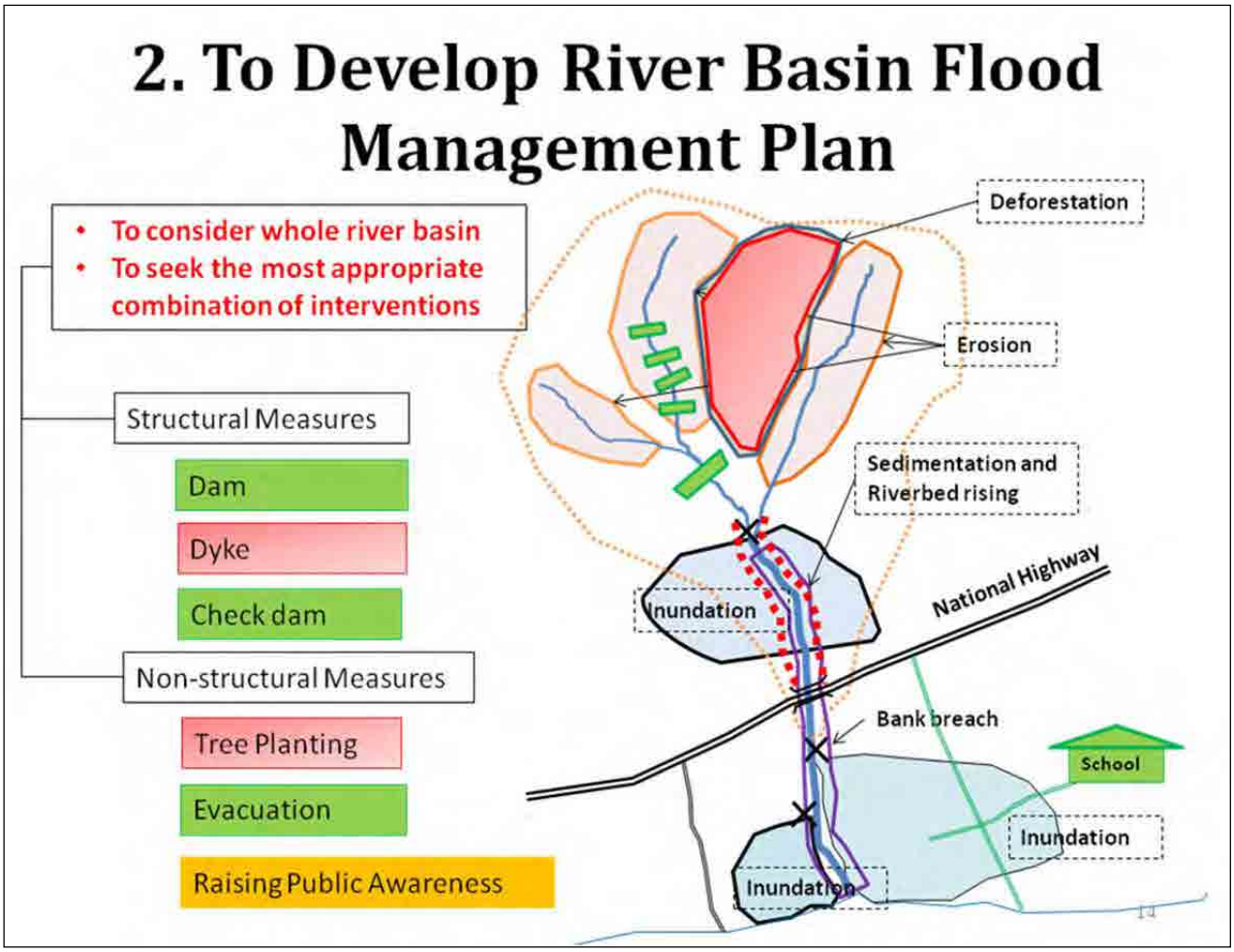


Figure-40 Elements of the River Basin Flood Management Plan

2:Flood Mitigation Structural Measures Including Community-based Measures

Introduction	The facilitator discusses the available flood mitigation measures and their implication in minimizing the flood damage impacts on the community and their properties. The types of structural measures examined in this session include levees, floodwalls, and dredging. Levees and floodwalls are freestanding structures located adjacent to or away from the buildings that can prevent the encroachment of floodwaters. Dredging the flood-prone waterway may allow the waterway to carry more floodwater, reducing the depth of floodwaters.
Objectives	The objectives of this session are to enable the participants to understand: 1)The types of flood mitigation measures; and 2) The use of flood mitigation measures.

Time period	- 1 hour.
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Pens.
Content /message	To familiarize the participants with these flood damage reduction measures. General descriptions are presented below.
Levees	Typically, levees are constructed of compacted fill taken from the impervious soil locally available. Depending upon the availability of suitable local soil, levees can be one of the least expensive flood damage reduction measures. Levees have the advantage of being compatible with the landscape since they are easy to shape and are covered with grass as demonstrated in the Figure-41below.  Figure-41A Typical Levee Unlike other flood proofing measures, a well-designed and well-constructed levee results in no water pressure on its structures themselves. Consequently, as long as the levee holds or is not overtopped, the building should not be exposed to damaging hydrostatic or hydrodynamic force. Another advantage of this technique is that there is no need to make major structural alterations on the flood-prone buildings.
Floodwalls	These are similar to levees; floodwalls also keep water away from the building. However, floodwalls are constructed of stronger materials, are thinner, take less space, and generally require less maintenance than levees. Floodwalls can be constructed by using a variety of designs and materials,

	such as steel sheet piles and concrete. However, flood walls are typically more expensive than levees, and they require closure structures to access to the waterway.  Figure-42A Typical Floodwall
Excavation	Excavation faces the problem of maintenance in many cases. It should sometimes be filled with sediments very fast. Excavation should be done by using machines.
Dredging	Waterways change over time, sometimes they are aggraded (filled with sediments), and sometimes they are eroded. Dredging deeper and/or wider waterways can provide more capacity for floodwaters, lowering the flood water level; however, the dredging must be done on a regular basis. A site to place the dredged materials must also be identified.
Flood Proofing	Dry flood proofing typically involves sealing the exterior building walls with waterproofing compounds, impermeable sheets, or other materials. It also uses shields for covering and protecting openings against floodwaters. Shields can be used on doors, windows, vents, and other openings. Sewer lines need to be fitted with check valves that shut when flood water rises in the sewer to prevent backup and flooding inside the building. In evaluating the feasibility of flood-proofing techniques, important analysis/design criteria must be considered such as flood characteristics (level, duration, and velocity); elevation of the first habitable floor, the type and condition of construction, lot size, the location and type of utilities, accessibility, etc.; building codes, zoning/site restrictions, flood insurance guidelines, etc.; and owner/community input and reasonable aesthetics. Generally, dry flood proofing should only be employed in buildings

	constructed of concrete blocks or brick veneer on a wood frame. Weaker construction materials may fail at much lower water depths by the hydrostatic pressure. The brick or concrete block walls may not proof a flood above a height of approximately three feet, due to the danger of structural failure by hydrostatic force, unless a structural engineer has confirmed that the building is designed to cope with the force.
Elevation	Elevation involves raising the flood-prone buildings in place so that the lowest floor is above the flood level, for which flood proofing protection is required. The buildings are jacked up and set on the new or extended foundations above the level of protection. For houses that include basements, the basements can be filled in, the house should be raised, and a new living space can be added to compensate for the lost basement space.
Channelization	Channelization or channel modification (also called Conveyance Improvements) typically means modifying a stream by activities such as straightening, widening, narrowing, and/or lining with concrete. Narrowing the channel would reduce its flood capacity. In very narrow areas, the only channelization activity that could possibly be effective would be to line the channel with concrete to speed up the flow and possibly reduce water surface elevations.  Figure-43 Channel Widening to accommodate Flood Water Channel modification is an artificial change of the characteristics of a channel, typically for the purpose of reducing flood damages by increasing its overall conveyancecapacity. This can be accomplished by widening and/or deepening the channel, reducing the friction by removing woody vegetation, or by occasionally adding a concrete lining.

Importance of Structures	Flood mitigation structures are designed to alter the behaviour of the flood itself by reducing flood levels and/or velocities, or by excluding flood waters from areas of risks to afford reduced flood damages to the communities, their properties, and human lives.

3:Operation and Maintenance of Flood Mitigation Structural Measures

Introduction	The participants will be introduced to the process of Operation and Maintenance (O&M) of flood mitigation structures and their importance in minimizing the flood disaster impacts on the community.
Objectives	The objectives of this session are to enable the participants to learn: 1) Operation of flood mitigation structures; and 2) Maintenance of flood mitigation structures.
Time period	- 1 hour.
Methodology	- Short presentation. - Questions and Answers. - Demonstrations.
Materials/Tools	- Illustrations. - Flip charts. - Pens.
Content/Message	**Operation and Maintenance of Flood Mitigation Structures:** • Flood mitigation structures require constant checks involving maintenance and repairs, though this may be done after a flood event; • Civil engineers should be involved both in the Construction and Operation and Maintenance (O&M) of the structures; • Community members need also to know the basic repair and maintenance of some of the structures like dykes and levees through labour provision to stabilize the structures after a flood event; • Removal of debris, logs and other materials need to be done immediately so that the flood water can recede and the next flood water can pass without causing floods. In such mutual assistance tasks, community members should be involved; and • Sandbags are beneficial materials for Operation and Maintenance (O&M). Sandbags could reinforce river banks, gabions around springs, house foundations, etc.in case of a low level flooding (see Figure-44, Figure 45 and Figure-546).

Conclusion	Mobilization at this stage is essential because it will give the required motivation and instill some sense of ownership to the WRUA members.

Figure-44Vetiver System

Figure-45 Putting Sand/Soil into Sandbags

Figure-46 Setting Sandbags in front of Door

SESSION9: CO-OPERATION BETWEEN UPSTREAM AND DOWNSTREAM STAKEHOLDERS AND CO-ORDINATION

Topics:

1:Co-operation and Co-ordination between Upstream and Downstream WRUAs in a River Basin

2:Roles of Co-operation and Co-ordination

3: Co-operation with County Government, WRUA and Sub County Disaster Management Committee (SCDMC)

Overview

This session, first, presents modalities for the upstream and downstream WRUA co-operation.

It also seeks to impart skills to the participants, WRUA committee leaders, and its members how to work in collaboration with upstream and downstream WRUAs within a river basin.

Second, it presents co-operation and co-ordination process among the WRUA members and other stakeholders in dealing with flood disaster risks.

Finally, it seeks to impart skills to the WRUA leaders to work in collaboration with other groups with similar objectives within their respective sub-catchments.

1: Co-operation and Co-ordination between Upstream and Downstream WRUAs in a River Basin

Introduction	This session tries to examine the areas of co-operation and co-ordination between different WRUAs in the upstream and downstream scale or left bank and right bank within a river basin.
Objectives	The objectives of this session are to enable the participants to understand: 1) Why it is important to co-operate; and 2) How to identify the areas of co-operation and co-ordination by WRUAs within a river basin.
Time period	- 1 hour.
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Marking pens.
Content/Message	**Step-I: Areas of Co-operation and Co-ordination** The facilitator will guide the participants in identifying the areas necessary for co-operation and co-ordination in trying to mitigate flood disaster risks.

	This covers the following areas and aspects. 1) Identifying the areas of co-operation and information sharing such as: • Hydro-meteorological monitoring network to record and predict rainfall patterns and flood event; • Establishing Community-based Flood Early Warning System (CFEWS); • Mapping flood-prone areas and ensuring that all the WRUAs are informed accordingly; • Establishing focal committee members for easy communication; and • Networking among the WRUA members in both the upstream and downstream areas in the river basin. 2) This allows for real-time flood mitigation planning, co-ordination, evacuation, response and rescue operation in order to: • Avoid damages to downstream flood mitigation structures; • Reduce flood risks in the downstream areas; • Prepare for evacuation; and • Provide flood early warning to the downstream sections of the river, etc.
	Step-II: Importance of Co-operation and Co-ordination of Activities in River Basin among WRUAs and Community Members The participants are expected to take part in a brainstorming session among them to generate ideas about the areas of co-operation and co-ordination within their river basin. These areas should focus on: • Water use demands among the users; • Equitable sharing of the water resources and sustainability; • Networking and knowledge sharing among the WRUAs; • Communication networks on flood disaster risks; • Collaboration with other stakeholders; and • Active community participation and ownership.
	Step-III: WRUA and Community Participation This should focus on the need for all the stakeholders to be involved in decision making through the following ways: • Initial community and WRUA meetings for identifying the areas of co-operation and co-ordination; • Drawing the areas that need to be addressed; and • Making a Plan of Action for implementation of the purposes.

	Step-IV: Outcomes At this stage the WRUA members and community members are ready to share the knowledge gained with other stakeholders.
Conclusion	The participants have enough understanding of the importance of networking, co-operation and co-ordination among the affected communities and the WRUAs.

2:Roles of Co-operation and Co-ordination

Introduction	This session aims at coming up with detailed framework that can be used to achieve a well-structured co-operation and co-ordination to cope with a flood in the effort of the Flood Disaster Risk Reduction Programme. The discussions should be based on existent known areas of co-operation and co-ordination among the affected WRUAs. The participants will discuss the development of a Plan of Action amongst others.
Objectives	By the end of the session, the participants will be able to: • Understand the necessity of co-operation in Flood Risk Management (FRM); and • Understand the importance of co-ordination.
Time period	- 1 hour
Methodology	- Discussions. - Questions and Answers. - Brainstorming.
Materials/Tools	- Sheets of paper. - Pens. - Flip charts
Development of a Plan of Action for Co-operation and Co-ordination	The participants will select a group leader to lead the discussionfrom among them. In the group discussion the participants should strive to answer the following questions to review the necessary issues in their proposed Plan of Action: • What are the existentflood risk mitigation measures in your area? • What issues would you like the WRUA committee to address (here some objectives will be developed)? • Which stakeholder should take the leading role within the catchment? • What are the roles of the community in the Plan of Action? • Who will execute the Plan of Action? • What is the time frame for the implementation of the Flood Risk Reduction Plan of Action?

	Once all the participantshave answered these questions, the leader will provide them with the expected Plan of Action with some blanks and let them fill in it in groups. After this all the participants will report and agree with the Plan of Action to be adopted.
Conclusion	This session should result in the development of a flood risk reduction plan of action involving the upstream and downstream WRUA members. In order to check the attainment of the objectives of the session, the participants will be asked to explain a Flood Risk Reduction Plan of Action that they have come up with for implementation.

3: Co-operation with County Government, WRUA, and Sub County Disaster Management Committee (SCDMC)

Introduction	The participants will be introduced into the need for both co-operation and co-ordination of a Flood Disaster Risk Reduction programme.
Objectives	The objectives of this session are to enable the participants understand: 1) Clear understanding of basin linkages --- upstream/downstream, actors, institutions, planning levels; 2) Administrative arrangements for disaster management --- national to local levels; 3) Water resources management at the national government level; and 4) Roles of key institutions in flood management --- data and information gathering and dissemination, early warning, planning, rescue operations and recovery.
Time period	- 1 hour
Methodology	- Short presentation. - Questions and Answers. - Information sharing. - Discussions.
Materials/Tools	- Illustrations. - Flip charts. - Pens. - Sheets of Paper.
Content/Message	**Step-I: Power and function of the Cabinet Secretary and Water Resources Institutions** The facilitator will explain the power and function of the Cabinet Secretary. This involves Mechanisms of co-operation and co-ordination (shown in Figure-47) , Water Resources Institutions such as Water Resources Management Authority, Catchment Area Advisory Committees(CAACs), Water Resource Users Association, National

	Water Conservation and Pipeline Corporation(NWCPC) , and Water Service Trust Fund (WSTF), and functions and responsibilities of National Disaster Operation Centre (NDOC).
	Step-II: Roles and functions of the County Government The facilitator will explain the roles and functions of the County Government. National/County Governments institutional flow chart is shown in Figure48.
	Step-III: Roles and Responsibility of CDMC and SCDMC The facilitator will explain the roles and functions of Community Disaster Management Committee (CDMC), Sub County Disaster Management Committee (SCDMC).
	Step-IV: Roles and Functions of WRUA, Community, and Other Actors The facilitator will explain the roles and functions of WRUA and community during pre-flood disaster phase, during flood, and post flood disaster. Community first to despondence, importance of local information, WRUA's assessment of the flood depth, WRUAs collaboration, and CFMOs at village level will be explained. Private sector participation and media in flood management will be explained.
Output	At this stage the participants will learn the importance of a smooth chain of co-operation and co-ordination among the key players in the development of flood disaster risk reduction and management programme. Furthermore, following results of cooperation and coordination will be understood by the participants: • Real-time flood mitigation planning, co-ordination, evacuation, response and rescue operation Avoid damage to downstream flood mitigation structures; • Reduce flood risks in the downstream areas; • Prepare for evacuation; and • Provide early warning to the downstream sections of the river.
Conclusion	This process is likely to instill some sense of the need for all the stakeholders to co-operate and co-ordinate the activities geared towards disaster risk reduction by the various methods adopted within their catchment areas.

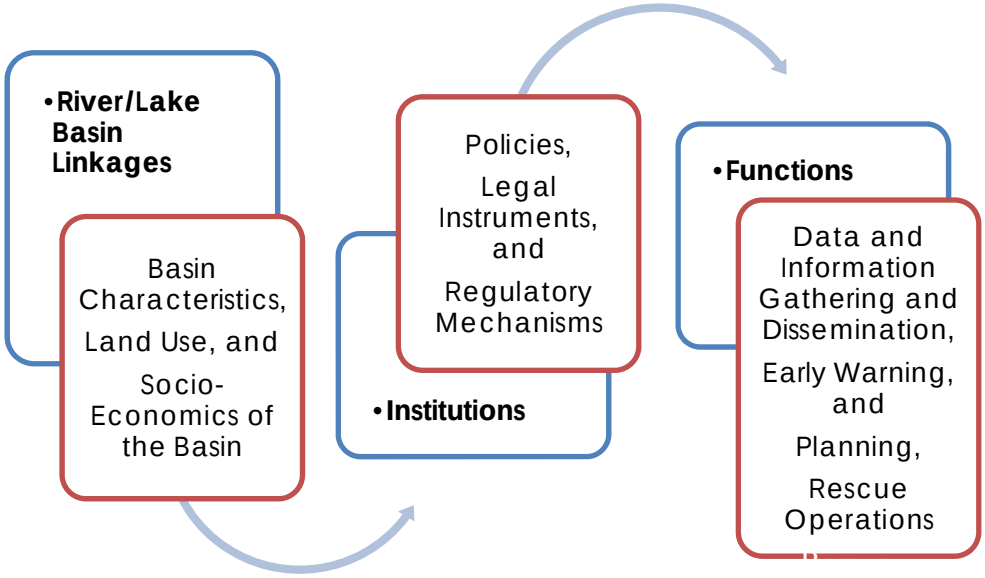


Figure 47 Mechanisms of Co-operation and Co-ordination

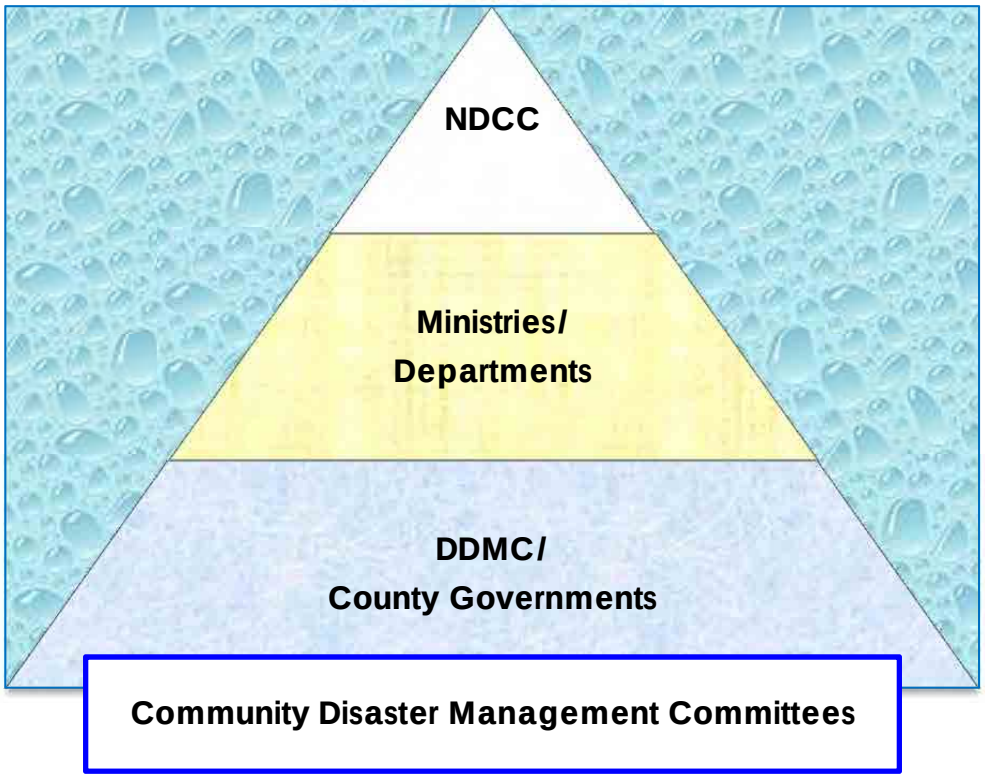


Figure 48 National/County Governments Institutional Flow Chart

付属資料 2-5

本邦研修実施報告書

（株）ニュージェック
2013 年 12 月 10 日

ケニア国
洪水に脆弱な地域における効果的な洪水管理のための能力開発プロジェクト（第 2 年次）
研修実施報告書

1. 本邦研修概要

(1) コース概要

(a) コースの名称

和文：洪水管理能力とコミュニティ防災活動支援能力の向上プログラム

英文：Effective Community Based Flood Management

(b) 研修期間

平成 25 年 11 月 11 日から同年 11 月 26 日（16 日間）

(c) 研修生人数

15 名

(2) 研修内容

(a) 研修全体概念図

ケニア国における研修を含む、研修計画の全体概念図を以下に示す。

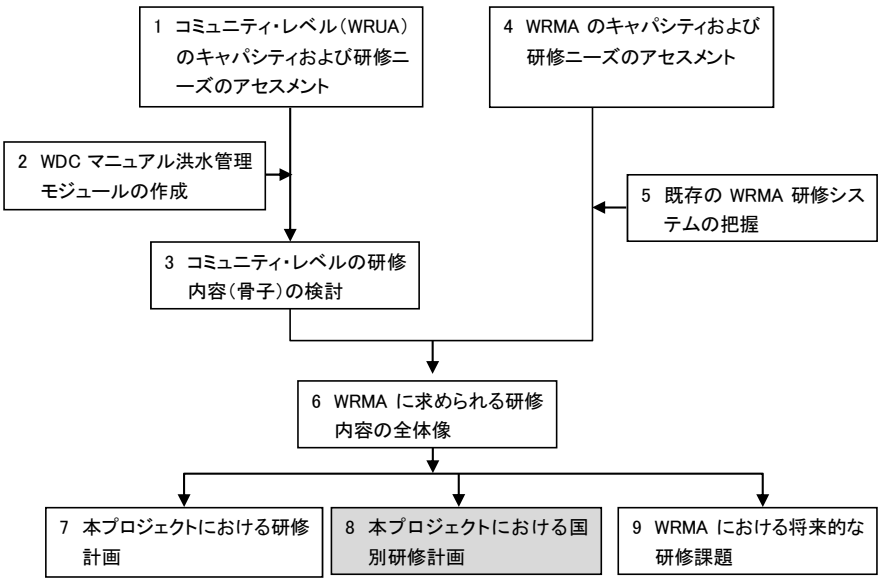


図 1　研修計画の全体概念図

(b) 日程表

研修日程表案は以下のとおりである。

表 1 研修日程

No.	年月日	曜日	活動内容	受入先/見学先	宿泊地
-	2013/11/9	土	空路移動（ナイロビードバイ）	-	機中泊
-	2013/11/10	日	空路移動（ドバイ－成田） 陸路移動（成田空港－JICA 東京）	JICA 東京	JICA 東京
1	2013/11/11	月	ブリーフィング 現地視察（荒川知水資料館）	JICA 東京、 国土交通省 関東地方整備局 荒川下流河川事務所、 NEWJEC 東京本社	JICA 東京
2	2013/11/12	火	講義/実習	JICA 東京	JICA 東京
3	2013/11/13	水	講義/実習	JICA 東京	JICA 東京
4	2013/11/14	木	講義/実習	JICA 東京	JICA 東京
5	2013/11/15	金	陸路移動（東京－山梨） 現地視察（富士川水系） 陸路移動（山梨－東京）	国土交通省 関東地方整備局 甲府河川国道事務所	JICA 東京
6	2013/11/16	土	休日	JICA 東京	JICA 東京
7	2013/11/17	日	休日	JICA 東京	JICA 東京
8	2013/11/18	月	陸路移動（東京－大阪） 講義/実習	NEWJEC 大阪本社	大阪市内
9	2013/11/19	火	現地視察（淀川中下流域）	国土交通省 近畿地方整備局 淀川ダム統合管理事務所、淀川河川事務所	大阪市内
10	2013/11/20	水	現地視察（淀川上流域）	国土交通省 近畿地方整備局 琵琶湖河川事務所 NEWJEC 大阪本社	大阪市内
11	2013/11/21	木	現地視察（損保川、加古川）	国土交通省 近畿地方整備局 姫路河川国道事務所	大阪市内
12	2013/11/22	金	講義/実習	NEWJEC 大阪本社	大阪市内
13	2013/11/23	土	現地視察（淀川水系支川桂川） 陸路移動（京都－東京）	桂川渡月橋周辺洪水氾濫跡	JICA 東京
14	2013/11/24	日	休日	JICA 東京	JICA 東京
15	2013/11/25	月	講義/実習	JICA 東京	JICA 東京
16	2013/11/26	火	APR 発表会、評価会、修了証授与 空路移動（成田－ドバイ）	JICA 本社	機中泊
-	2013/11/27	水	空路移動（ドバイーナイロビ）	-	-

(c) シラバス

1）研修目的

本プロジェクトのプロジェクト・デザイン・マトリックス（PDM）において、以下のとおりプロジェクト目標及び成果が設定されている。

> **プロジェクト目標：**プロジェクト対象地域において、コミュニティによる洪水対策を普及するためのWRMAの実施体制が確立される。
>
> **成果 1：**WRMA の各層（本局、地域事務所、サブ地域事務所）の洪水管理全般に関する基礎的な能力向上と組織強化が図られる。
>
> **成果 2：**コミュニティ防災活動を支援するための、WRMA の体制及び能力が向上する。

本邦研修は、成果 1 及び成果 2 における特に「WRMA 各層の洪水管理能力全般に関する基礎的な能力とコミュニティ防災を支援するための能力の向上」に寄与する活動であり、ケニア国内では十分な説明が難しく、かつ日本に参考となる事例の存在する内容（具体的には水系一貫した洪水・河川管理の組織体制、関連する組織の洪水災害緊急対応の方法、洪水管理施設や伝統工法、防災教育・洪水ハザードマップの利用、水防工法など）についての知識・ノウハウを得ることにより、研修参加者の今後の洪水管理活動に具体的イメージを与えて、その促進を図ることを本邦研修の目的とした。

2）研修到達目標

上述した本邦研修の目的を踏まえて、本邦研修の到達目標を次に示すとおり設定した。

1. MEWNR 職員と WRMA 職員が、日本における行政やコミュニティによる洪水管理に関する事例を学び、洪水管理に関する基礎的な能力向上を図る。
2. コミュニティ防災活動を支援するための、WRMA 職員の能力向上を図る。
3. WRUA のリーダーが、コミュニティ防災活動を実施する上で、有効な知識・ノウハウを身に付ける。
4. 日本で習得した知見やノウハウをケニア国内で活かすためのレポートが作成される。

※研修対象者所属組織の補足説明
本プロジェクトの C/P である WRMA は、流域単位での水資源管理を促進するために、旧 MWI によって、2005 年に新設された。WRMA は本局のほか、地域事務所（6 箇所）、サブ地域事務所（27 箇所）で構成され、洪水管理・水資源管理のコミュニティ活動の実施主体となる WRUA を技術的に支援する役割をもっている。
しかし、WRMA のこれまでの活動は水資源管理（利水）を中心としてきたものであり、洪水管理全般に関する知識・ノウハウや実施体制を有しておらず、コミュニティレベルにおける洪水管理活動を支援する能力やその体制も十分でないことが課題となっている。
MEWNR：Ministry of Environment, Water and Natural Resources 環境・水・天然資源省
（旧 MWI：Ministry of Water Irrigation 水・灌漑省）→洪水管理の政策・法律策定を所管
WRMA：Water Resource Management Authority 水資源管理庁→河川管理者及びコミュニティ防災活動の支援の役割を担う
WRUA：Water Resources Users Association 水資源利用者組合→コミュニティ活動の実施主体

なお、研修生による研修コース評価結果を示した「添付資料(c) クエスチョネア集計」によれば、設定された到達目標とニーズの適合について、12 人が最高評価 5 を、3 人が次に高い評価 4 を付けていることから、設定した到達目標が研修生のニーズと合致していることがわかる。

(3) 研修コースに対する所見

研修到達目標を達成するために、以下に示す講義、討論・実習・演習・発表、見学にて、研修コースを構成した。

(a) 講義

ケニアでは十分な説明が難しく、かつ日本に参考となる事例の存在する内容を中心に、次に示す講義を設けた。

- 河川管理/洪水管理概論（洪水対策及び水資源管理の歴史と総覧、洪水対策手法とその展開等）
- 自助・共助を活発化するための地域防災向上方策について
- コミュニティ防災活動の事例と教訓
- コミュニティベースドハザードマップ

また、現地視察の前に視察対象の河川ならびに視察施設について理解を深めてもらう目的で、下記の講義も設けた。

- 荒川水系及び富士川水系、淀川水系、揖保川水系視察事前講義及びフォローアップ

(b) 討論・実習・演習・発表：

- ケニアの洪水管理体制について（法制度と組織体制）
- 我が国の河川管理及び洪水管理の法制度と組織体制
- 合理式による流出計算演習
- 河川改修案の比較演習
- ケニアにおける防災教育の実施案検討演習
- パイロット事業の振り返り
- アクションプラン・レポート作成実習及び発表

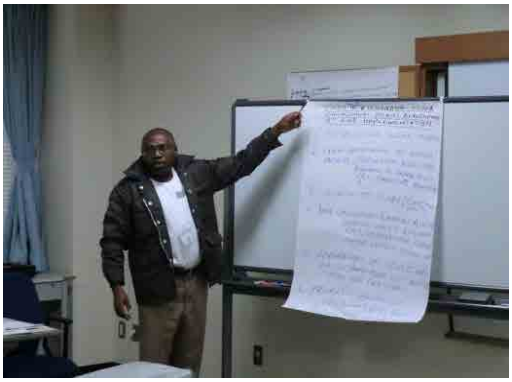



写真　講義及び演習、発表の様子

(c) 見学：

洪水管理を含む河川管理や河川構造物、並びに先人の知恵の結晶である種々の伝統工法による治水対策に接してもらうため、見学対象を吟味し、関係各所と協議を重ねた結果、次に示す 5 水系を見学することとなった。

- **荒川水系（国土交通省 関東地方整備局 荒川下流河川事務所）**

荒川下流域は人口や資産、社会経済活動の中枢機能も極度に集中しており、堤防が決壊し荒川が氾濫した場合、首都圏の壊滅的な被害の発生が想定される。そのため、首都圏の壊滅的な被害の防止・軽減に向けて実施されている先端的な防災情報システムの仕組み、並びに堤防等の河川構造物による治水対策、国家事業レベルの大規模河川改修事業、中枢都市における河川管理の在り方について学んだ。

【主要視察地点/説明内容】

- 災害対策室 / 荒川下流域における防災情報システム、水門の操作についての説明
- 災害対策支援船の乗車 / 堤防強化対策等についての現地説明


写真　防災情報システムについての説明、写真　災害対策支援船に搭乗

- **富士川水系（国土交通省 関東地方整備局 甲府河川国道事務所）**

富士川は日本三大急流河川の一つに数えられるわが国でも有数の急流河川であるため、洪水によるエネルギーが大きく、局所洗掘に起因する洪水被害が発生している。また、富士川の治水の特色として、古くから治水事業に地元住民の協力や地元で調達

可能な材料を用いるなどして、地域に根付いた伝統的な治水事業が実施されてきたことが指摘されている。

富士川の治水事業の歴史とともに河川伝統工法を学ぶことは、コミュニティ防災を実施していく上で大いに参考となり、また、本プロジェクト対象地点である Isiolo 川も同様に急流河川であり、急流河川における洪水管理を学ぶ上でも、富士川の視察は大変有益であるため、研修地点として本地点を選定した。

具体的には、富士川の地形と洪水特性について、高台から流域を望みながら説明し、河川伝統工法の一つである信玄堤、万力林を中心に治水施設を視察し、先人の治水の知恵と現在に至る富士川水系の河川管理への取り組みについて学んだ。

【主要視察地点】

- 信玄堤、中聖牛、霞堤
- 万力林（水害防備林）

写真　中聖牛の視察、

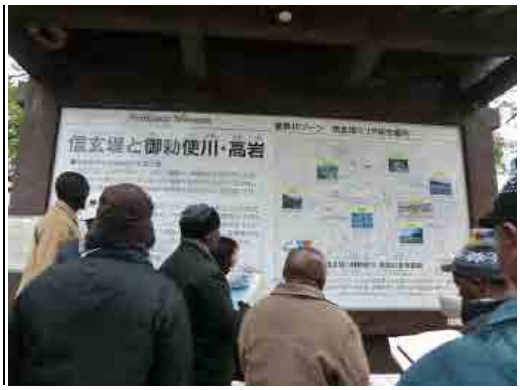


写真　信玄堤の説明

- **淀川水系（国土交通省 近畿地方整備局 淀川ダム統合管理事務所、淀川河川事務所、琵琶湖河川事務所）**

ケニアでは、水系一貫の河川管理が行われておらず、水系一貫の河川管理の具体のイメージを抱きにくいため、水系一貫の河川管理がなぜ必要であるのかということが理解しにくい。そこで、日本が水系一貫の河川管理に至った過去の経緯を踏まえた講義及び上流から下流に渡る現場視察により、洪水管理を含む河川管理についての具体のイメージを抱いてもらい、理解を深めた。

また、平成 25 年台風 18 号の影響により近畿地方を中心に広い範囲で長時間に渡り激しい降雨となり、淀川水系の沿川の住民に避難指示、避難勧告が発令された台風 18 号の災害状況及び対応について学んだ。

【主要視察地点】

- レーダー雨量計
- 淀川資料館
- 淀川三川（桂川、宇治川、木津川）合流地点
- 淀川大堰
- 瀬田川洗堰

・　天ヶ瀬ダム
・　渡月橋（桂川、嵐山地区）


写真　レーダー雨量観測システムについての説明、写真　淀川資料館での淀川概要説明


写真　淀川大堰の操作に関する説明、写真　淀川大堰の視察


写真　瀬田川洗堰の操作に関する説明、写真　天ヶ瀬ダムの視察

➢ **揖保川水系、加古川水系（国土交通省　近畿地方整備局 姫路河川国道事務所）**

ケニアの現状では、地図（紙・電子媒体）による洪水ハザードマップが普及されるまでには時間を要することを踏まえ、地図（紙・電子媒体）による洪水ハザードマップに限らず、浸水実績や避難経路等の洪水関連情報を居住地域に標示した「まるごとまちごとハザードマップ」実施地域を視察した。

また、洪水氾濫常襲地域の自治区単位の地元住民を中心に作成され、わが国におけるコミュニティレベルのハザードマップといえる「マイ防災マップ」を活用しながら、洪水時危険個所を含む避難所までの避難経路を歩くことで、コミュニティレベルでのハザードマップ作成方法並びに多様な洪水情報の伝達手段について学んだ。

揖保川における治水対策の特色として、緊急時の防災対策として地元住民の意見を

反映して作られた特殊堤防「畳堤」がある。平常時は河川景観を考慮し、堤防の隙間から河川を眺めることができるが、洪水時には地域住民の協力により堤防に畳を差し込むことで堤防として機能させる畳堤が構築されている。地域住民の意見を反映して作られた畳堤とその水防活動について学ぶことで、地域住民と一体となった防災活動についての理解を深めた。

- 龍野武家屋敷資料館
- 揖保川下流域（龍野橋）「畳堤」実施地点
- 揖保川中流域（安積橋）「まるごとまちごとハザードマップ」実施地点
- 滝野地区築堤等事業個所


写真　畳堤の視察


写真　まるごとまちごとハザードマップ実施地点の視察

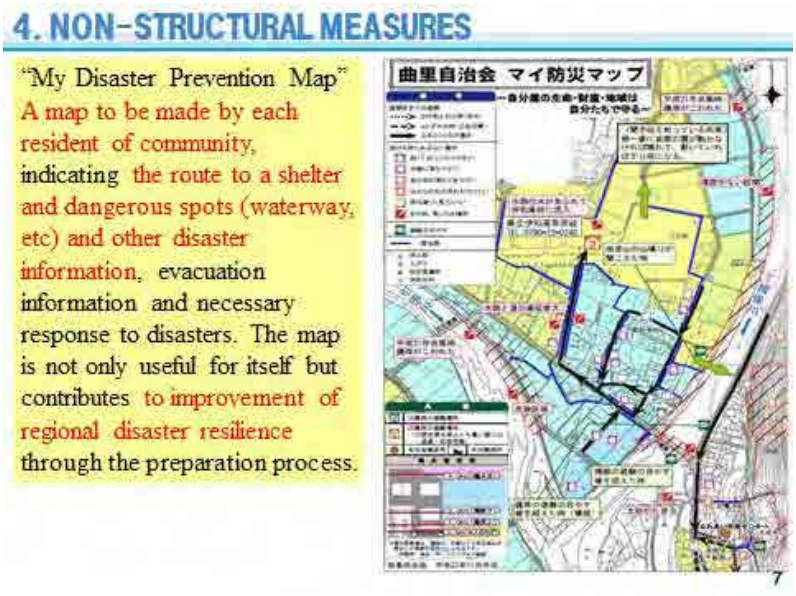


図 2　マイ防災マップの説明図

(d) 研修期間・配列・密度

研修生の自国における本来業務に支障のでない期間で、研修到達目標を達成するためのカリキュラムを効率的かつ効果的にこなすため、研修期間を 16 日間とした。配列及び密度についても講義、討論、実習、演習、見学のそれぞれが偏ることないように全体のバランスを考慮し、適切に配置した。

また、研修生による研修コース評価結果を示した「添付資料(c) クエスチョネア集計」によれば、研修期間の適切性について、研修生 15 名中、5 名が最高評価 5 を、8 名が次に高い評価 4 を付けていることから、研修生全体の 8 割以上が研修期間について適切であると評価していることがわかる。

(e) テキスト・機材・施設

研修テキストは研修生の理解促進を図るため、出来る限り視覚的な内容となるよう配慮した。講義、演習等の座学実施場所である研修施設については、施設への移動に伴う時間のロス及び、研修生への負担軽減を図るため、東京滞在時は JICA 東京セミナールーム、大阪滞在時は当社の会議室を使用した。機材についても同様に、JICA 東京セミナールーム、当社会議室の機材を使用した。

また、研修生による研修コース評価結果を示した「添付資料(c) クエスチョネア集計」によれば、下記の表に示すとおり、研修機材、研修施設について、11 名が最高評価 5 を、3 名が評価 4 を、テキストについては 8 名が最高評価 5 を、6 名が評価 4 を付けていることから、研修生から高い評価を得ていることがわかる。

表 2　テキスト、研修機材、講義施設についての研修生による評価

	← good				poor →	X
	5	4	3	2	1	
テキスト/ textbooks	8	6				1
研修機材/ training equipment	11	3				1
講義施設/ lecture facilities	11	3				1

×は未回答を示しており、研修生の記入忘れによるものである。

(4) 研修生

(a) 資格要件

本邦研修対象者は、C/P 機関であり河川管理者である WRMA を中心としながら、その上位組織に当たり、洪水管理の政策・法律策定を所管する MEWNR やコミュニティ防災活動の中心を担う WRUA を対象とした。

コミュニティ防災活動を実施する上では、WRMA と WRUA、関連ステークホルダー間の連携が不可欠であることから、本研修では、洪水管理に関わる組織及び立場・役割が異なるものが協働で学び、議論することで、研修実施後のそれぞれの活動がより円滑かつ効果的となることを狙った。

なお、WRUA メンバーを本邦研修の候補対象としたのは WRMA からの要望によるものである。コミュニティの代表である WRUA リーダーが洪水管理/防災活動について知見・深い理解を得ることで、地域と密着した、より効果的な洪水管理・コミュニティ防災の実現を目指した。

研修生の資格要件としては、WRMA の各層（本部、地域事務所、サブ地域事務所)、または WRMA とともに洪水管理に関する活動を実施する組織から、組織において洪水管理分野を主導する重要なポジションに従事すると思われる者、かつ本プロジェクトを今後進めていく上で重要な役割を担う者である。なお、英語等の最低限の語学力は有することを前提とした。

(b) 研修参加への意欲・受講態度

病欠によるやむ得ない事情を除き、欠席者はおらず、全研修生ともに、講師及び研修受け入れ先にて、熱心にメモを取り、時間ぎりぎりまで質問し、理解に努めるなど、終始意欲的な姿勢で研修に取り組んでいた。


写真　研修生　受講の様子

(5) 研修成果の活用

研修で得ようとする知識や情報は多岐にわたり、ボリュームも少なくない。そこで研修をより効率的かつ効果的なものとするため、フォーカスをあてる重点別にグループを編成し、次に示す研修実施体制を構築した。

MEWNR 職員と WRMA 本部職員で構成されるグループを 1 つ、Lumi、Isiolo、Gucha Migori 川の 3 つの流域毎に、当該流域の WRMA 地域事務所、サブ地域事務所職員及び WRUA メンバーの各 1 名に加え、WRMA 本部職員 1 名で構成されるパイロット流域グループ 3 つを編成し計 4 グループとした。

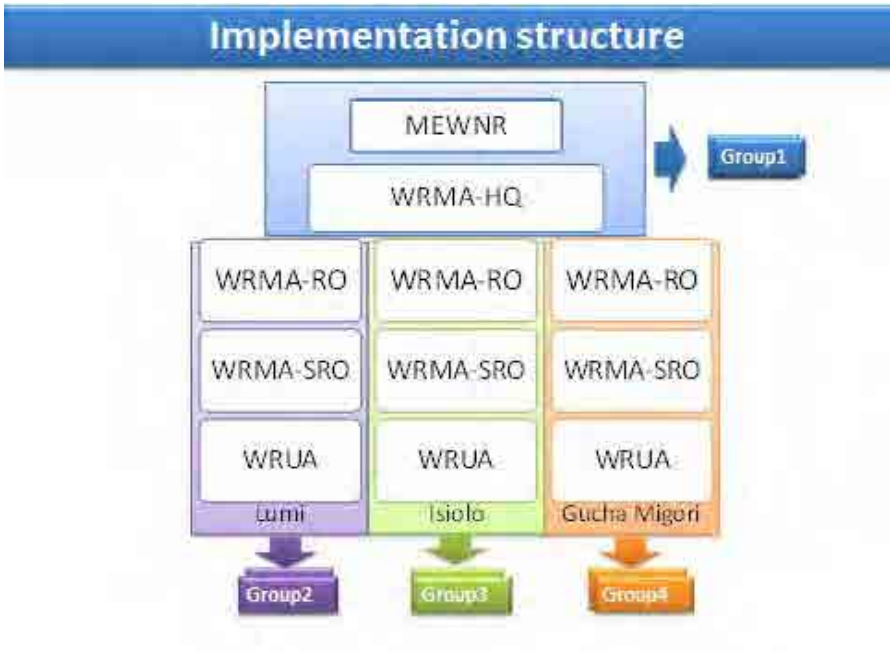


図 3　研修グループ

(a) 研修で得られた成果について

本邦研修において、研修生への研修課題としてアクションプラン・レポートの作成を求めた。研修生はアクションプラン・レポートにて、ケニア国及びプロジェクト対象地域の現状、課題を踏まえて、まず参考となった事例等をもとに本研修で得た知見を整理した。そして、その知見を今後のケニア国内での洪水管理及び本プロジェクトに応用することを検討した。その結果、研修生から今後の WRMA の取組みについて以下のような提案がなされた。

1)　グループ 1（MEWNR と WRMA 本部職員から構成）のテーマ：

「WRMA の将来的な洪水管理体制の在り方とそれを実現可能なものとするための政策案の提案」

本邦研修で得た知見や講義、演習、討論等並びに、ケニアの洪水管理体制の現状分析をもとに、WRMA の洪水管理のあるべき姿について検討し、それを実現可能なものとするために必要な事項を含んだ具体的な政策案を提案した。

2)　グループ 2,3,4（河川流域毎に構成）のテーマ：

「各流域における今後実施していきたい洪水管理及びコミュニティ防災活動に関する方策案の提案」

本邦研修で得た知見や講義、演習、討論等をもとに、各流域の SCMP 等に将来的に組み込み、今後事業として実施していきたい洪水管理及びコミュニティ防災活動に関する方策を提案した。

わが国では河川流域（水系）ごとに、河川計画を定めており、河川整備基本方針にて、長期的な整備の方針を示し、河川整備計画にて、当面（数十年先）の実施目標、具体的整備内容を示している。また、河川管理者である国土交通省のみで全河川を管理しているわけではなく、重要区間を国（国土交通省）が管理し、残りの区間を都道府県、市町村に委任している。

一方、ケニアでは河川の重要度区分やその管理区分はなされておらず、人材、予算ともに WRMA 単体で全河川を管理していくことは困難であるため、地方行政である County とともに今後の河川管理体制・制度を築いていくべきであるという意見が提案された。この提案は、我が国の河川管理（洪水管理を含む）に関する講義並び視察等から、研修生が日本の河川管理について理解し、ケニア国に適用すべく、研修生自ら導き出したものであり、今後のケニアの河川管理上、大変有益となる研修成果である。

これらの事例に留まらず、約 2 週間の日本滞在での経験、またそこで得られた知見に基づく応用検討は、今後ケニアの洪水管理・河川管理を見直していく上で大変有益なものとなると思われる。

写真　研修生によるアクションプラン・レポートの発表

(b) 成果の活用方法について

本邦研修終了後、本プロジェクトにて実施されるケニアでの現地研修第 2 ステージが予定されており、今回の本邦研修に参加した研修生の内、現地研修第 1 ステージ受講者である数名が講師となって、WRMA 内での研修を実施することとなる。本邦研修にて使用した講義／実習テキストがケニア国内のさらに多くの河川技術者の能力向上のために活用されることが期待される。

また、アクションプランにて提案された河川管理（洪水管理を含む）事業を研修生が自らの手で積極的に推進されていくことを期待したい。

(6) 研修環境

宿泊施設については､東京において JICA 研修施設での快適な住環境が提供されるとともに、大阪では民間のホテルにて JICA 施設と同程度の住環境が研修生に提供された。

但し、研修を実施した 11 月は冬の季節にあたり、河川の現地視察など室外にいる時間も多いため､研修生の中には慣れない日本の冬の寒さの影響等で体調を崩したものもいた。このため、研修実施時期を冬の季節に実施したことを反省点としたい。

(7) その他特記事項

本邦研修実施にあたり、以下の点を工夫した。

- 研修生が本邦研修で学んだことを帰国後、自国にて活かしてもらうために、講義及び視察において、ケニア国の現状・課題に照らし合わせて考えるように促し、研修生自らが考えるための演習・討論、発表の時間を多く設けた。研修生の選定においても、C/P である WRMA の各層のみならず、MEWNR 職員や WRUA を交えた河川管理、洪水管理にかかる主要セクターから構成されるグループとすることで、研修生が本研修で得た経験や研修成果がより有益に機能するようにした。
- 日本側による一方通行の講義・情報提供とならないように、討論及び質疑応答の時間を多く設けて、研修生と講師の双方が意見交換することにより、講義内容の理解を深めた。
- また、講師及び視察受入先に対しても、研修生のニーズと合致した講義内容とすべく、事前にケニア国の現状や抱える課題等について、十分な説明を行うことで講師及び視察受入先のケニア国への河川管理、洪水管理への理解を深め、講義の質を高めた。

2. 添付資料

(a) 研修工程実績表

(b) 研修員リスト

(c) クエスチョネア集計

(d) 研修員によるアクションプラン・レポート

(e) 荒川下流河川事務所 HP における研修視察受入の紹介

添付資料（a）研修工程実績表

研修工程実績表

1. 技術研修

年/月/日	受入先/見学先 項目	講師名 役職名	格付	単価	時間数	金額	受入先・見学先 場所	講師在住・在勤地	移動手段	宿泊地	同行者の有無	備考
2013/11/9	空路移動 ナイロビ→ドバイ	－	－	－	－	－	－	－	航空便	機中泊	－	
2013/11/10	JICA東京 来日：空路移動 ドバイ→成田、陸路移動 成田→JICA東京	－	－	－	－	－	JICA東京	－	電車	JICA東京	無	
2013/11/11	JICA東京 JICA規定ブリーフィング	－	－	－	－	－	JICA東京	－	－		有 （三雲）	
	(株)ニュージェック プログラムオリエンテーション	大川 尚範 (株)ニュージェック 国際事業本部 土木グループ土木チーム	6 （従業者）	13,100	1.0	13,100	JICA東京	(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ	－			
	国土交通省 関東地方整備局 荒川下流河川事務所 / 荒川知水資料館 講義：荒川下流域における河川管理（仮） 現地視察：荒川下流域、災害対策室	波多野 真樹 国土交通省 関東地方整備局 荒川下流河川事務所 / 事務所長	－	－	2.0	－	国土交通省 関東地方整備局 荒川下流河川事務所 / 荒川水系下流域	国土交通省 関東地方整備局 荒川下流河川事務所 〒115-0042 東京都北区志茂 5-41-1	JICAバス			言語：日本語
2013/11/12	研修生 発表：ケニアの洪水管理体制について（法制度と組織体制）	－	－	－	0.5	－	JICA東京	－	－		有 （三雲）	
	国土交通省 国土技術政策総合研究所 総合技術政策研究センター 建設マネジメント技術研究室 講義：わが国の河川管理及び洪水管理に関する法制度と組織体制	小林 肇 国土交通省 国土技術政策総合研究所 総合技術政策研究センター 建設マネジメント技術研究室 / 主任研究員	－	－	2.0	－		国土交通省 国土技術政策総合研究所 総合技術政策研究センター 建設マネジメント技術研究室 〒305-0804 茨城県つくば市旭1 旭庁舎	－			
	山口大学大学院・理工学研究科 講義：自助・共助を活発化するための地域防災向上方策について	朝位 孝二 山口大学大学院・理工学研究科 システム設計工学専攻 / 准教授	1 （民間）	26,200	2.0	52,400		山口大学大学院 理工学研究科 システム設計工学専攻 〒755-8611 山口県宇部市常盤台2-16-1				
	アジア防災センター 講義：コミュニティ防災活動の事例と教訓	荒木田 勝 アジア防災センター / 主任研究員	3 （従業者）	16,800	2.0	33,600		アジア防災センター 〒651-0073 神戸市中央区脇浜海岸通 1-5-2 東館5				
2013/11/13	(株)ニュージェック 復習及びフォローアップ対応 アクションプラン・レポートの作成実習	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	1.0	13,100	JICA東京	(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20	－	JICA東京	有 （三雲）	
	NPO法人プラス・アーツ 講義：途上国での防災教育実施の経験に基づく実施・支援のノウハウの伝授 実習：防災教育の実技体験 演習：ケニアにける防災教育の実施案検討演習	永田 宏和 NPO法人プラス・アーツ / 理事長	1 （民間）	17,500	5.5	96,250		NPO法人プラス・アーツ 〒651-0082 兵庫県神戸市中央区小野浜町 1-4 デザイン・クリエイティブセンター神戸 307				言語：日本語
2013/11/14	(株)ニュージェック 講義：河川計画概論1（洪水対策、水資源管理の歴史）	濱口 達男 (株)ニュージェック / 副社長執行役員	1 （民間）	26,200	2.0	52,400	JICA東京	(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ	－		有 （三雲）	
	(株)ニュージェック 講義：河川計画概論2（ハードを中心とした洪水対策手法）	松永 雄紀 (株)ニュージェック 国際事業本部 土木グループ土木チーム / 主任	3 （従業者）	16,800	1.5	25,200		(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ				
	(株)ニュージェック 演習：河川計画概論3（河川改修案の比較検討演習）	松永 雄紀 (株)ニュージェック 国際事業本部 土木グループ土木チーム / 主任	3 （従業者）	16,800	1.0	16,800		(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ				
	(株)ニュージェック 演習：河川計画概論4（流出解析演習）	大川 尚範 (株)ニュージェック 国際事業本部 土木グループ土木チーム	6 （従業者）	13,100	1.0	13,100		(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ				
	(株)ニュージェック 講義：河川伝統校及び富士川水系の概要ならびに現地視察場所について	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	1.0	13,100		(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
	(株)ニュージェック 復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	0.5	6,550		(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
2013/11/15	国土交通省 関東地方整備局 甲府河川国道事務所 / 富士川水系（釜無川、笛吹川） 現地視察：河川伝統工法を中心とする富士川の治水システム（信玄堤、中聖牛、霞堤、万力林）	小池 栄史 国土交通省 関東地方整備局 甲府河川国道事務所 / 副所長	－	見学謝金	4.0	2,100	国土交通省 関東地方整備局 甲府河川国道事務所 / 富士川水系	国土交通省 関東地方整備局 甲府河川国道事務所 〒400-8578 山梨県甲府市緑が丘1-10-1	借上げバス		有 （三雲）	言語：日本語
2013/11/16	休日	－	－	－	－	－	－	－	－		－	
2013/11/17	休日	－	－	－	－	－	－	－	－		－	
2013/11/18	(株)ニュージェック 講義：河川計画（洪水対策の展開）	濱口 達男 (株)ニュージェック / 副社長執行役員	1 （民間）	26,200	2.0	52,400	(株)ニュージェック大阪本社	(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ	JICAバス、新幹線、電車	大阪市内ホテル	有 （大川）	
	(株)ニュージェック 講義：淀川水系揖保川水系の概要ならびに現地視察場所について	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	2.0	26,200		(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
	(株)ニュージェック 復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	0.5	6,550		(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
2013/11/19	国土交通省 近畿地方整備局 淀川ダム統合管理事務所 講義：平成24年台風18号時の対応について（仮） 現地視察：淀川ダム統合管理事務所	志鹿 浩幸 国土交通省 近畿地方整備局 淀川ダム統合管理事務所 / 防災情報課長	－	見学謝金	2.0	2,100	国土交通省 近畿地方整備局 淀川ダム統合管理事務所 / 淀川水系中流域	国土交通省近 畿地方整備局 淀川ダム統合管理事務所 〒573-0166 大阪府枚方市山田池北町10番1号	借上げバス		有 （大川）	言語：日本語
	国土交通省 近畿地方整備局 淀川河川事務所 講義：淀川水系の河川管理（中下流域を中心として）（仮） 現地視察：淀川下流域、淀川大堰	河元 隆利 国土交通省 近畿地方整備局 淀川河川事務所 / 調査課長	－	見学謝金	3.5	2,100	国土交通省 近畿地方整備局 淀川河川事務所 / 淀川水系中下流域	国土交通省近 畿地方整備局 淀川河川事務所 〒573-1191 大阪府枚方市新町2丁目2-10				言語：日本語
2013/11/20	国土交通省 近畿地方整備局 琵琶湖河川事務所 講義：淀川水系の河川管理（上流域を中心として）（仮） 視察：瀬田川洗堰	北野 正朗 国土交通省 近畿地方整備局 琵琶湖河川事務所 / 副所長	－	見学謝金	2.5	2,100	国土交通省 近畿地方整備局 琵琶湖河川事務所 / 淀川水系上流	国土交通省近 畿地方整備局 琵琶湖河川事務所 〒520-2279 滋賀県大津市黒津4丁目5-1	借上げバス		有 （大川）	言語：日本語
	(株)ニュージェック 現地視察：天ヶ瀬ダム	大川 尚範 (株)ニュージェック 国際事業本部 土木グループ土木チーム	6 （従業者）	13,100	0.5	6,550	(株)ニュージェック大阪本社 / 淀川水系天ヶ瀬ダム	(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ				
	(株)ニュージェック 復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習（中間報告）	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	1.5	19,650	(株)ニュージェック大阪本社	(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
2013/11/21	国土交通省 近畿地方整備局 姫路河川国道事務所 講義：揖保川、加古川における洪水管理（仮） 現地視察：まるごとまちごとハザードマップ、マイ防災マップ実施地、水防活動（量	奥野 真章 国土交通省 近畿地方整備局 姫路河川国道事務所 / 調査第一課長	－	見学謝金	6.0	2,100	国土交通省 近畿地方整備局 姫路河川国道事務所 / 揖保川水系	国土交通省 近畿地方整備局 姫路河川国道事務所 〒670-0947 兵庫県姫路市北条1-250	借上げバス		有 （大川）	言語：日本語
2013/11/22	(株)ニュージェック 視察フォローアップ対応（淀川水系の河川管理）	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	2.0	26,200	(株)ニュージェック大阪本社	(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20	電車		有 （大川）	
	(株)ニュージェック 講義：コミュニティベースドハザードマップ	大川 尚範 (株)ニュージェック 国際事業本部 土木グループ土木チーム	6 （従業者）	13,100	1.5	19,650		(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ				
	(株)ニュージェック 復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	3.0	39,300		(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
2013/11/23	(株)ニュージェック 現地視察：淀川水系桂川（渡月橋周辺の台風18号による洪水氾濫被害地）	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	2.0	26,200	(株)ニュージェック大阪本社 / 淀川水系桂川	(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20	借上げバス、新幹線、JICAバス		有 （大川）	
2013/11/24	休日	－	－	－	－	－	－	－	－		－	
2013/11/25	(株)ニュージェック 演習：パイロット工事の振り返り	西田 雅 (株)ニュージェック 国際事業本部 土木グループ / グループマネジャー	3 （従業者）	16,800	2.5	42,000	JICA東京	(株)ニュージェック東京本社 〒136-0071 東京都江東区亀戸1-5-7（日鐵ND タ	－	JICA東京	有 （三雲）	
	(株)ニュージェック 演習：アクションプラン・レポートの作成実習	三雲 是宏 (株)ニュージェック 国際事業本部 土木グループ土木チーム / マネジャー	4 （従業者）	13,100	3.5	45,850		(株)ニュージェック大阪本社 〒531-0074 大阪府大阪市北区本庄東2-3-20				
2013/11/26	JICA本部 発表会・アクションプラン・レポート発表会及び評価会、授与式	－	－		3.0	0	JICA本部	－	JICAバス	機内泊	有 （三雲）	
	離日：陸路移動 JICA東京→成田、空路移動 成田→ドバイ	－		－	－	－	－	－	－			
2013/11/27	空路移動 ドバイ→ナイロビ	－	－	－	－	－	－	－	－	－	－	

研修工程実績表

2. 検討会等の開催

（2/2）

年/月/日	件名	参加者名	役職名	格付	単価	時間数	金額	実施場所	移動手段	備考
2012/7/30	研修報告会	西田　雅	(株)ﾆｭｰｼﾞｪｯｸ 国際事業本部　土木ｸﾞﾙｰﾌﾟ　/　グループマネジャー	3号(従事者)	¥0	3時間(英語)	¥0	JICA本部 〒102-8012 東京都千代田区二番町5-2 5 二番町センタービル	電車	受注企業・団体所属のため、謝金対象外
		三雲　是宏	(株)ﾆｭｰｼﾞｪｯｸ 国際事業本部　土木ｸﾞﾙｰﾌﾟ　土木ﾁｰﾑ　/ マネジャー	4号(従事者)	¥0	3時間(英語)	¥0		電車	受注企業・団体所属のため、謝金対象外
		大川　尚範	(株)ﾆｭｰｼﾞｪｯｸ 国際事業本部　土木ｸﾞﾙｰﾌﾟ　土木ﾁｰﾑ	6号(従事者)	¥0	3時間(英語)	¥0		電車	受注企業・団体所属のため、謝金対象外
		井上　雅之	(株)ガイア技術士事務所	3号(従事者)	¥0	3時間(英語)	¥0		電車	受注企業・団体所属のため、謝金対象外
						検討会等参加謝金　計	¥0			

3. 原稿執筆

件名		執筆者名	使用言語	原稿枚数	単価	金額	備考
プログラムオリエンテーション	2013/11/11	大川　尚範 / (株)ニュージェック　国際事業本部土木グループ土木チーム	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
荒川下流域における河川管理(仮)	2013/11/11	波多野　真樹 / 国土交通省 関東地方整備局 荒川下流河川事務所　/ 事務所長	日本語	－	－	－	原稿謝金の受け取りをご辞退されるとのこと
ケニアの洪水管理体制について(法制度と組織体制)	2013/11/12	研修生	英語	－	－	－	研修業務の一貫のため、原稿謝金対象外
わが国の河川管理及び洪水管理に関する法制度と組織体制	2013/11/12	小林 肇 / 国土技術政策総合研究所 総合技術政策研究センター 建設マネジメント技術研究室 /主任研究員	英語	－	－	－	原稿謝金の受け取りをご辞退されるとのこと
自助・共助を活発化するための地域防災向上方策について	2013/11/12	朝位　孝二 / 山口大学大学院・理工学研究科 システム設計工学専攻 /　准教授	英語	9	¥4,000	¥36,000	パワーポイントスライドのため、230語あたり1枚、4,000円/枚にて計算。
コミュニティ防災活動の事例と教訓	2013/11/12	荒木田　勝 / アジア防災センター / 主任研究員	英語	－			受注企業・団体所属のため、原稿謝金対象外
途上国での防災教育実施の経験に基づく実施・支援のノウハウの伝授	2013/11/13	永田　宏和 / NPO法人プラス・アーツ / 理事長	日本語	16	¥4,000	¥64,000	パワーポイントスライドのため、230語あたり1枚、4,000円/枚にて計算。
復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	2013/11/13	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
河川計画概論1(洪水対策、水資源管理の歴史)	2013/11/14	濱口　達男 / (株)ニュージェック / 副社長執行役員	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
河川計画概論2(ハードを中心とした洪水対策手法)	2013/11/14	澤　秀樹 / (株)ニュージェック　国際事業本部土木グループ土木チーム / チームマネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
河川計画概論3(河川改修案の比較検討演習)	2013/11/14	大川　尚範 / (株)ニュージェック　国際事業本部土木グループ土木チーム	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
河川計画概論4(流出解析演習)	2013/11/14	大川　尚範 / (株)ニュージェック　国際事業本部土木グループ土木チーム	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
河川伝統校及び富士川水系の概要ならびに現地視察場所について	2013/11/14	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	2013/11/14	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
河川伝統工法を中心とする富士川の治水システム(信玄堤、中聖牛、霞堤、万力林)	2013/11/15	小池 栄史　/ 国土交通省 関東地方整備局 甲府河川国道事務所 / 副所長	日本語	－	－	－	現場説明のため、原則としてテキストは用いない予定
河川計画(洪水対策の展開)	2013/11/18	濱口　達男 / (株)ニュージェック / 副社長執行役員	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
淀川水系、揖保川水系の概要ならびに現地視察場所について	2013/11/18	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	2013/11/18	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
平成24年台風18号時の対応について(仮)	2013/11/19	志能　浩幸　/ 国土交通省近畿地方整備局淀川ダム統合管理事務所 / 防災情報課長	日本語	－	－	－	原稿謝金の受け取りをご辞退されるとのこと
淀川水系の河川管理(中下流域を中心として)(仮)	2013/11/19	河元 隆利 / 国土交通省近畿地方整備局淀川河川事務所 / 調査課長	日本語	－	－	－	原稿謝金の受け取りをご辞退されるとのこと
淀川水系の河川管理(上流域を中心として)(仮)	2013/11/20	北野 正朗　/ 国土交通省　近畿地方整備局 琵琶湖河川事務所　/ 副所長	日本語	－	－	－	原稿謝金の受け取りをご辞退されるとのこと
天ヶ瀬ダムの視察	2013/11/20	大川　尚範 / (株)ニュージェック　国際事業本部土木グループ土木チーム	日本補	－	－	－	現場説明のため、原則としてテキストは用いない予定
復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習(中間報告)	2013/11/20	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	日本補	－	－	－	現場説明のため、原則としてテキストは用いない予定
揖保川、加古川における洪水管理(仮)	2013/11/21	国土交通省　近畿地方整備局 姫路河川国道事務所 / 調査第一課長	日本語	－	－	－	原稿謝金の受け取りをご辞退されるとのこと
視察フォローアップ対応(淀川水系の河川管理)	2013/11/22	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
コミュニティベースドハザードマップ	2013/11/22	大川　尚範 / (株)ニュージェック　国際事業本部土木グループ土木チーム	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	2013/11/22	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
淀川水系桂川(渡月橋をはじめとする台風18号による洪水氾濫被害地)	2013/11/23	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	英語	－	－	－	現場説明のため、原則としてテキストは用いない予定
パイロット工事の振り返り	2013/11/25	西田　雅 / (株)ニュージェック　国際事業本部土木グループ /　グループマネジャー	英語	－	－	－	受注企業・団体所属のため、原稿謝金対象外
復習及びフォローアップ対応 演習：アクションプラン・レポートの作成実習	2013/11/25	三雲　是宏 / (株)ニュージェック　国際事業本部土木グループ土木チーム / マネジャー	日本補	－	－	－	現場説明のため、原則としてテキストは用いない予定
					原稿謝金　計	¥100,000	

添付資料(b)　研修員リスト

November 11, 2013

Name	Position and Institution	Group
ナンシーさん Ms. Nancy Cherono Koech	環境・水・天然資源省 / 水文担当官 Hydrologist, MEWNR	1
マタガロさん Mr. Wilfred Ochenge Matagaro	水資源管理庁　洪水管理ユニット / 副技術部長 Dep. Tech. Cord. Manager, WRMA	1
ローズさん Ms. Rose Akinyi Nyamori	水資源管理庁　洪水管理ユニット / 技術部長補佐 Ass. Tech. Cord. Manager, WRMA	1
ズーコさん Mr. Alexander Nzyuko	水資源管理庁　洪水管理ユニット / 副技術部長 Dep. Tech. Cord. Manager, WRMA	2
ガオさん Mr. Stephen Ngao	水資源管理庁　アティ流域地域事務所 / 技術部長補佐 Ass. Tech. Cord. Manager, WRMA	2
マイナさん Mr. Joseph Maina	水資源管理庁　ロイトキトクサブ地域事務所 / 流域管理担当官 Catchment Man. Officer, WRMA	2
フレディーさん Mr. Fredy Emanuel Reuna	ルミ川下流域　水利用者組合 / 事務局長 Secretary, Lower Lumi WRUA	2
ジルさん Mr. Peterson Njiru	水資源管理庁　洪水管理ユニット / 技術部長補佐 Ass. Tech. Cord. Manager , WRMA	3
ムティエさん Mr. Timothy Mutie	水資源管理庁　エワソ・ンギロ・ノース流域地域事務所 / 技術部長補佐 Ass. Tech. Cord. Manager, WRMA	3
ギトンガさん Mr. Abraham Gitonga	水資源管理庁　イシオロサブ地域事務所 / 流域管理担当官 Catchment Man. Officer, WRMA	3
デビッドさん Mr. David Nabea Mwiti	イシオロ川流域　水利用者組合 / 事務局長 Secretary, Isiolo WRUA	3
エリザベスさん Ms. Elizabeth Akinyi Diego	水資源管理庁　洪水管理ユニット / 技術部長補佐 Ass. Tech. Cord. Manager, WRMA	4
ボイトさん Mr. Joseph Boit	水資源管理庁　ヴィクトリア湖南部流域地域事務所 / 流域管理担当官 Catchment Man. Officer, WRMA	4
ジヒアさん Mr. Samuel Njihia	水資源管理庁　キシイサブ地域事務所 / 流域管理担当官 Catchment Man. Officer, WRMA	4
ジョシュアさん Mr. Joshua Ouma Ojwang	グチャ・ミゴリ川下流域　水利用者組合 / 事務局長 Secretary, Lower Gucha Migori WRUA	4

添付資料(c)　クエスチョネア集計

集計年月日：　2013/11/25

クエスチョネア集計/Questionnaire

研修コース名	ケニア「洪水管理」
受入期間	2013.11.10/～2013.11.26
対象人数	15名

Ⅰ．研修コース評価　Evaluation of the training course

1．設定された到達目標とニーズの適合について

Did you find the course objectives appropriate according to the needs of your country or organization?

← appropriate				inappropriate →	X
5	4	3	2	1	
12	3				

回答が1、2の場合、改善を要す点　If your answer is 1 or 2, what kind of improvement should be made?

2．カリキュラム評価　Evaluation of the curriculum

(1)　研修プログラムで最も有益であった研修項目

Please name the most beneficial subject in the training program.

*Flood Hazard Maps, structural and non structurral measures (River basin management)(マタガロ)
*River Basin Management　（ズーコ）
*Community based activities, Tatami dyke, Community flood hazard map.（エリザベス）
River basin management visits.　（ジル）
*Flood management system and flood hazard maps in Japan.（ローズ）
*Flood Hazard Map　（ガオ）
*River Law in Japan and River basin management.（ムティエ）
*River basin management in Japan.（ボイート）
*River basin management in Japan.（マイナ）
*Disaster Information system and flood mitigation structural measures for the flood prone areas.(ギトンガ)
*Legal system and organizational structure of river management and flood management in Japan.（ジヒア）
*Site visits to observe flood management activities in various river basins in Japan.　（ナンシー）
*Community Hazard Map, Triangle traditional wooden block. The use of ICT in river flood management.　（ジョシュア）

*The use of traditional methods in flood management i.e. use of tatami mats and use of skeleton works. （フレディ） *Flood management. （デビッド）

(2) 今後追加すべき研修項目

Please write the subject that should be added to the training program.

*Flood forecasting using analyzed data collected. （エリザベス） *Introduction to general mapping of flood prone areas to act as a guide to subbasins, who will make a detailed map. （ジル） *Classification of rivers, Enforcement of river laws to achieve good quality water in rivers,（ローズ） *Involvement of relevant institutional researchers in flood management.(ボイート) *Involvement of private and non government organization in flood management. （マイナ） *Community participation and involvement on flood management. (ギトンガ) *Policy formulation process for flood management in Kenya.（ジヒア） *The training given so far was very comprehensive and I think more site visits should be added to have wider perspective of Japan flood management. （ナンシー） *Sustainability of projects by the local people. （フレディ）

(3) 今後削除すべき研修項目

Please write the subject that should be eliminated from the training program.

None

３．研修期間について Did you find the duration of the program appropriate?

← **appropriate**				**inappropriate** →	**X**
5	**4**	**3**	**2**	**1**	
5	8	2			

回答が 1、2 の場合、その理由 If your answer is 1 or 2, please describe the reasons.

４．講師の講義プレゼンテーションについて

What is your evaluation of the presentation by the lecturers in the program?

← **good**				**poor** →	**X**
5	**4**	**3**	**2**	**1**	
8	7				

回答が 1、2 の場合、その理由 If your answer is 1 or 2, please describe the reasons.

５．テキスト、研修機材、講義施設について

What is your evaluation of the textbooks, training equipment, and lecture facilities of the program?

	← good				poor →	X
	5	4	3	2	1	
テキスト/ textbooks	8	6				1
研修機材/ training equipment	11	3				1
講義施設/ lecture facilities	11	3				1

回答が 1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

６．研修運営管理について

What is your evaluation of the general administration and management of the training program?

	← good				poor →	X
	5	4	3	2	1	
ＪＩＣＡ	15					
受入機関/ training institution	13	2				
ｺｰﾃﾞｨﾈｰﾀｰ/ coordinator	15					

７．期待充足度　Did the training meet your expectations?

← satisfied				unsatisfied →	X
5	4	3	2	1	
10	5				

回答が 1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

８．到達目標達成度　Evaluation of level of objective accomplishment

(1)　到達目標１　**Objective 1: To understand the background and outline of administrative system for flood management in Japan.**

MEWNR 職員と WRMA 職員が、日本における行政やコミュニティによる洪水管理に関する事例を学び、洪水管理に関する基礎的な能力向上を図る。

到達目標 1 の達成度　Did you achieve objective 1?

	← 十分達成できている fully achieved			達成していない → unachieved		X
	5	4	3	2	1	
研修実施前 before the training		4	5	3	3	
研修実施後 after the training	11	4				

回答が 3、4、5 の場合、今回の研修で得た情報・知識は、業務に活用可能か。

If your answer is 3,4,or, 5, do you find the information and knowledge obtained through the training program

useful to your job in your country?

← 十分活用出来る very useful				活用できない → not useful	X
5	4	3	2	1	
12	2				

回答が 4、5 の場合、業務おける具体的な活用内容及び方法

If your answer is 4 or 5, please describe how it applies to your job.

*Currently I am coordinating Floods Management in the Water Resources Management Authority (WRMA) (マタガロ)

*Will initiate proposals to develop policies to implement modern technologies and result oriented outputs. （ズーコ）

*In Kenya flood is managed under catchment areas. The case of Japan is different having country government in place in Kenya. Now it will be easier to compare.（エリザベス）

*Kenya use of catchments. Their catchment strategies are being reviewed. The knowledge gained here can be incorporated in them. I am involved in the review.（ジル）

*That rivers have to be managed efficiently by classifying the rivers according to their importance, some by the central government and others at the prefecture levels.（ローズ）

*As officer in charge of flood management, this will assist me administer a similar system in Kenya. （ガオ）

*There is need to restructure the administrative system in Kenya to achieve effective management of FM. Effective collaboration is lacking in Kenya and there is need to create collaboration mechanisms.（ムティエ）

*The training has added me a lot of knowledge on flood management and will apply the same in Kenya.（ボイート）

*The training has improved my understanding as a flood management officer as it relates to Water Resources Management Authority Mandate.（マイナ）

*Acquired knowledge and skills on flood management mitigation approaches while supporting communities participation on water resource management which I will do with others.（ギトンガ）

*The experience and knowledge of Japanese background and outline of administrative system is important in development of integrated flood management plan for Gucha-Migori basin. （ジ

ヒア）

*Institutional framework for flood management and structural and nonstructural measures implemented in Japan can be replicated in Kenya to reduce impacts of floods. Also, methods of data collection, monitoring and dissemination can be implemented in my country. （ナンシー）

*Classification of rivers and existence of river law, give clear outlines in river management system which can be applied in my country Kenya, this is helping me to develop appropriate laws and policies. （ジョシュア）

*Some solutions to the problems of the local people I work with can be achieved with what we have locally. （フレディ）

*it will enhance proper planning and action. （デビッド）

回答が 1、2 の場合、その理由　If your answer is 1 or 2, Please describe the reasons.

*I had no knowledge on the administrative system for flood management in Japan before. （デビッド）

(2)　到達目標２　**Objective 2: To understand the background and outline of community based flood management in Japan.**

コミュニティ防災活動を支援するための、WRMA 職員の能力向上を図る。

到達目標２の達成度　Did you achieve objective 2?

	← 十分達成できている fully achieved			達成していない → unachieved		X
	5	4	3	2	1	
研修実施前 before the training	1	3	6	3	2	
研修実施後 after the training	9	6				

回答が 3、4、5 の場合、今回の研修で得た情報・知識は、業務に活用可能か。

If your answer is 3,4,or, 5, do you find the information and knowledge obtained through the training program

useful to your job in your country?

← 十分活用出来る very useful				活用できない → not useful	X
5	4	3	2	1	
9	6				

回答が 4、5 の場合、業務おける具体的な活用内容及び方法

If your answer is 4 or 5, please describe how it applies to your job.

*The entry point for the management of floods in Kenya is through the community (WRUA), Integrated Flood Management is incorporated in the sub catchment management plan developed with WRUA.（マタガロ）

*The communities will be sensitized to own up and be part of the program/project implementations.（ズーコ）

*Being in charge of community activities in Kenya in WRMA I will be able to introduce disaster education using Kaeru caravan so train communities on developing community flood hazard map. （エリザベス）

*The use of locally available materials and resources for flood management i.e. production of equipment for EWS and using trainer of trainees TOT. A s a member of FMU, I can pass the same knowledge to the other staff members.（ジル）

*WRMA needs to develop a nationwide flood hazard map and develop flood sign that can be used in the country,（ローズ）

*To assist communities administer a similar flood management system in Kenya.（ガオ）

*It provides knowledge which can be used in Kenya to mobilize and organize community participation in FM and disaster management in general.（ムティエ）

*Community involvement in flood management is of paramount importance.（ボイート）

*Community involvement in flood management is very important. （マイナ）

*Information and knowledge I gained will be shared with community in the piloted area and other staff members. The project funded by JICA is ongoing. （ギトンガ）

*Involving communities in the flood area within the basin by training WRMA members.(ジヒア)

*In Japan, communities have been trained to prepare hazard maps and self-help/mutual in flood management and this is really applicable to communities living in flood prone areas in Kenya. （ナンシー）

*The application of traditional systems/technology by local resident in flood management, use community hazard map is applicable in Kenya. （ジョシュア）

*We should copy the Japanese on how they have dealt with the problem of floods since the 16th century where the current technology was not available. （フレディ）

*When the community are fully involved it eases the process and understand better. （デビッド）

回答が 1、2 の場合、その理由　If your answer is 1 or 2, Please describe the reasons.

*I didn't know how the community respond to the disaster. （デビッド）

(3)　到達目標 3　**Objective 3: To understand roles and efforts of governmental organizations/insstitutions to support communities for conducting community based flood management activities.**

WRUA のリーダーが、コミュニティ防災活動を実施する上で、有効な知識・ノウハウを身に付ける。

到達目標３の達成度　Did you achieve objective 3?

	← 十分達成できている fully achieved			達成していない → unachieved		X
	5	4	3	2	1	
研修実施前 before the training		5	5	3	1	1
研修実施後 after the training	11	3				1

回答が 3、4、5 の場合、今回の研修で得た情報・知識は、業務に活用可能か。

If your answer is 3,4,or, 5, do you find the information and knowledge obtained through the training program

useful to your job in your country?

← 十分活用出来る very useful				活用できない → not useful	X
5	4	3	2	1	
11	2				2

回答が 4、5 の場合、業務おける具体的な活用内容及び方法

If your answer is 4 or 5, please describe how it applies to your job.

*I will be able to broaden the list of governmental organizations/institutions to support communities for conducting community based flood management activities i.e. enhanced coordination.(マタガロ)

*The government should take the front role in formulating and initiating projects and guide the communities on the best practices.（ズーコ）

*I will be able to outline activities specific to WRMA's mandate in regards to floods and also now am able to outline roles of other organizations（エリザベス）

*I can prepare maps (appropriate) for the management of floods.（ジル）

*The government has to develop and enforce the regulations, by involving the community. Historical data is important to use during formulation of the new laws.（ローズ）

*To engage government organizations/institutions in supporting communities to conduct flood management activities.（ガオ）

*Knowledge can be used in assignment of roles and organize community support mechanisms. It can guide policy direction in designation of roles and position of community in Kenya. （ムティエ）

*National government through Water Resources Management Authority should invest more on FM. （ボイート）

*Involvement of government (Water Resources Management Authority) should be enhanced in flood management in collaboration with other government organizations.（マイナ）

*Developing awareness on flood disaster reduction through programs such as role plays modeled along IZA Kaeru Caravan. （ジヒア）

*The government of Kenya through review and improvement of water resources management plans will enable the government to strengthen its support to fund community flood fighting project. Also after this training I will be in a position to train communities from experienced

point of view on how should respond to floods adequately. （ナンシー）
*The role of municipality/prefecture government in river basin management, development of ICT, this will help me to advice the government and community on importance of collaborative response. （ジョシュア）
*The government here in Japan is leading from the front in flood management. I will encourage the same in my country. （フレディ）
*When all are inclusive in tackling flood as a calamity. People and property are saved. （デビッド）

回答が 1、2 の場合、その理由　If your answer is 1 or 2, Please describe the reasons.

*I had no idea on the roles and efforts applied by different entities, （デビッド）

(4) 到達目標４　**Objective 4: To develop reports to utilize knowledge and skills acquired through this training for the future of Republic of Kenya.**

日本で習得した知見やノウハウをケニア国内で活かすためのレポートが作成される。

到達目標４の達成度　Did you achieve objective 4?

	← 十分達成できている fully achieved			達成していない → unachieved		X
	5	4	3	2	1	
研修実施前 before the training		4	7	2	1	1
研修実施後 after the training	11	3				1

回答が 3、4、5 の場合、今回の研修で得た情報・知識は、業務に活用可能か。

If your answer is 3,4,or, 5, do you find the information and knowledge obtained through the training program

useful to your job in your country?

← 十分活用出来る very useful			活用できない → not useful		X
5	4	3	2	1	
6	5	2			2

回答が 4、5 の場合、業務おける具体的な活用内容及び方法

If your answer is 4 or 5, please describe how it applies to your job.

*I will be able to develop focused project/program proposals for integrated flood management in flood prone river basins in Kenya now and in the near future.(マタガロ)
*The skills and knowledge acquired should be properly documented and reported, and share it with other colleagues and relevant institutions. （ズーコ）
*From knowledge gained in Japan it will help me work in many innovative ways to deliver community based activities.（エリザベス）

*I will take part in the development of the Action Program Report and in training others.（ジル）
*Action plans that have been compiled will be addressed at 3 levels, short term will be in our members, medium and long term plans we will develop proposals and submit for funding. （ローズ）
*Knowledge and skills acquired will assist in implementing flood management activities in Kenya. （ガオ）
*It serves as a starting point for enhancing knowledge and technology transfer and learning of measures that can be customized for Kenya. （ムティエ）
*To apply the technology and management system used in Japan for flood management in Kenya. （ボイート）
*Information management system (Data gathering, analysis and use in flood management) will improve my involvement in flood activities. （マイナ）
*Preparation of reports on flood and drawing up historical flood maps. （ジヒア）
*The knowledge acquired from this training has expanded the scope of understanding in view of flood management and I can prepare reports in practical point view. （ナンシー）
*This will help me develop an action plan to be tabled to the government and community for implementation review. （ジョシュア）
*The issue of data collection should be made a priority for without good data nothing tangible can be achieved.（フレディ）
*Will be able to train others on the best way based on the training and when many have the idea we can achieve, （デビッド）

回答が 1、2 の場合、その理由　If your answer is 1 or 2, Please describe the reasons.

*I had no idea in the skills and the level of reports in place for the people of Japan. （デビッド）

Ⅱ.その他 Others

1．**JICA** のブリーフィングについて　What is your evaluation of JICA's briefing?

← good				poor →	X
5	4	3	2	1	
10	4				1

回答が 1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

2. 日本の印象　What kind of impression of Japan did you get through your stay here?

← favorable				unfavorable →	X
5	4	3	2	1	
11	3				1

（1）回答が 1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

（2）回答が 4、5 の場合、その理由　If your answer is 4 or 5, please describe the reasons.

* This country is developed. People are friendly, hospitable, kind, honest and very organized in the way they do things. Very clean country and environment conscious and every person active.（マタガロ）

*The people of Japan are very welcoming, charming and friendly. All other facilities such as transport are excellent and efficient.（ズーコ）

*The Japanese are very friendly and TIC is home away from home. The training very good and coordinator of great assistance.（エリザベス）

*All the places I visited the people were courteous. （ジル）

*The country is very safe even when it is dark. Conservation for environment is everyone's responsibility, separation of waste starts with everyone, Toilet facilities are located everywhere and open, Nature is conserved and museums for river and religion are kept for future developments and site seeing.（ローズ）

*Good coordination and organization. （ガオ）

*Environmental consciousness is high and degree of cleanliness. Extensive forest cover (up to 70%) and well-orderly living as well as good use of space.（ムティエ）

*Disciplined, respectful, hospitable and well organized people who respect the government. （ボイート）

*Welcoming, respectful, orderly and great lovers of nature (clean environment). （マイナ）

*Good reception and facilitations were conversant with the topics for they were all committed to ensure we were comfortable and objective for the training met.（ギトンガ）

*High commitment exhibited by lecturers in Japan. High level of organization in running systems. （ジヒア）

*Japan and its citizens are hospitable, humble, welcoming and even the Japanese foods were very excellent. I enjoy my stay in Japan. （ナンシー）

*The infrastructure development is realizing timely socio-economic needs of a society.（ジョシュア）

*The Japanese people are very hard working people and very civilized. （フレディ）

*Japan is a wonderful country with a lot of things to learn. People are friendly and in general a suitable place of gaining knowledge. （デビッド）

3. その他コメント　Any other comments

* Given another opportunity, I would wish to come back. You are welcome to Kenya.（マタガロ）

*Very glad to have been granted an opportunity to learn in Japan and share their way of life and operations. （ズーコ）

*The training has enhanced my skills on flood management, Though the weather was extremely cold for me. （エリザベス）

*The development is breathtaking but I am glad there were guides and helpers from JICA and Newjec to help us stay and learn. I also hope that we did not offend anybody. Thanks a lot for your patience for us.（ジル）

*The TIC facility is very good and comfortable for the participants. The facilitators are ready to listen and answer all questions that are asked. The coordinator was very good and helpful in all activities both at TIC and in the field visit. I thank you all and keep it up.（ローズ）

*The training was successful. （ガオ）

*The government of Japan, though faced by National calamities, is always resilient and ready to move on in life without wavering. （ボイート）

*Hard working people who face challenges of life positively. To me Japanese people are innovative and have prospered due to the same. （マイナ）

*We hope we get another chance for similar education tours and trainings to ensure the flood limit introduced into WRMA-Kenya kicks off successfully in collaboration with JICA.（ギトンガ）

*I am deeply humbled by the excellent dedication of the Japanese lecturers and our coordinator. Thank you very much. I wish come back again. （ジヒア）

*JICA is a nice institution and fit for capacity building program. （ナンシー）

*The local residents in Japan are more concerned with their environmental conservation reducing risk of water pollution in all river basins. Japan’s achievement in 16 century is what Kenya needs in 21 century, （ジョシュア）

*Japan is a very developed country but the Japanese people have not let that get into their heads. They are polite, friendly and the level of hospitality is very high. Congratulation and keep it up. （フレディ）

*The effects of the Japan government and its people to face and fight different disasters that affect them in are one way or the other makes me salute you all. Many disasters have been minimized and dealt with from the right information at the right time. （デビッド）

添付資料(d)　研修員による
アクションプラン・レポート

من الشعب الياباني
From the People of Japan

INTRODUCTION TO ACTION PLAN REPORT FOR FLOOD MANAGEMENT IN KENYA

Members:
Eng. Matagaro
Nancy
Rose

Presentation outline

- **Background**
- **History of floods in Kenya**
- **Institutional framework**
- **Future flood management in Kenya**
- **Future role of WRMA in flood management**

Background

3

- Kenya is situated in East Africa with an area of approximately 582, 000 km^2 and its current population density is about 69 persons/km^2
- The country is affected by floods following torrential rainfall. The bimodal rainfall occurs in months of March- June (long rains) and October - December (short rains) with mean annual of 600mm/a.
- The type of floods being experienced in the country are flash floods, fluvial floods, coastal floods as a result of storm surge and pluvial flooding.

History of floods in Kenya

4

- Kenya's record of flood disasters indicates the worst floods recorded in 1961-62 and 1997-98, the latter ones being the most intense, most widespread and the most severe.
- The affected areas then were mostly Nyando and Nzoia river basins (Nyanza and Western regions), Tana and Lumi river basins (see Table 1 and Figure 1)

Cont.

Table 1: Number of people affected by floods in Kenya

Year	Affected areas	People affected
2003	Nyanza, Western, Tana	170,000
2002	Nyanza, Western, Tana	150,000
1997/98	Widespread	1.5 million
1985	Nyanza, Western, Tana	10,000
1982	Nyanza	4,000

Cont.

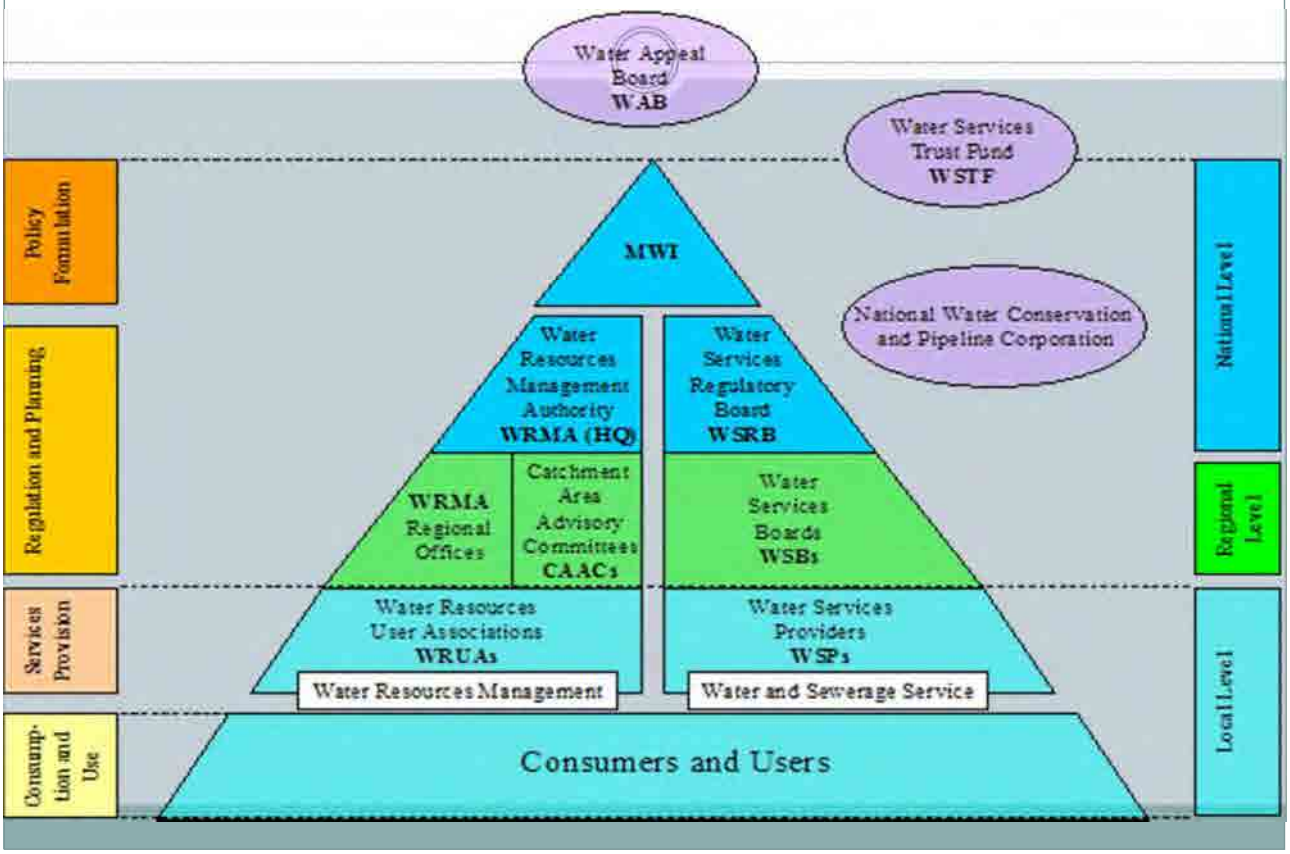
Flood management in Kenya was practiced since 1970s by the affected communities using traditional methods such as:

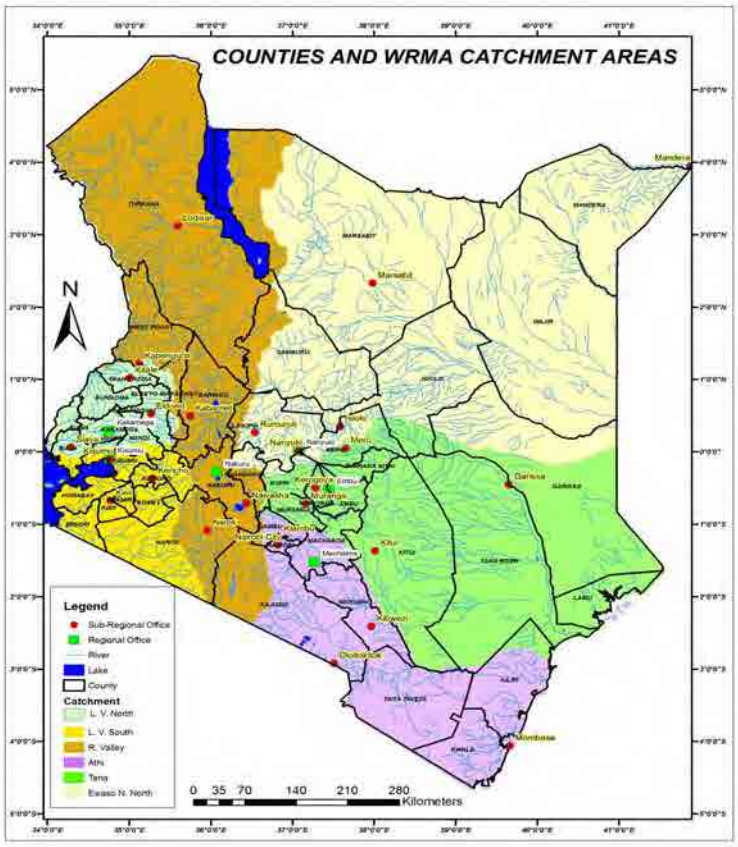
- Construction of flood drainage canals
- River bank protection using stones from river beds
- Construction of terraces to reduce run offs (soil and water conservation)
- Construction of wooden bridges
- Earth dams

Institutional Set up

- In 1992, The Government of Kenya with the assistance of the Government of Japan through JICA, developed the National Water Master Plan(NWMP).
- Arising from the recommendations of the NWMP, the National Water Policy of 1999 was developed
- Based on that policy, the Water Act 2002 was enacted.
- In the Water Act 2002, the Water Services and Water Resources Management , functions and responsibilities were separated.
- There was creation of the water institutions

Institutional Framework





The future of flood management in Kenya

- Develop flood policy and institutional framework for flood management
- The country cannot eradicate floods but the communities have to adopt climate change resilience.
- The country will continue to corporate with development partners in flood management.
- The flood and disaster management will be incorporate in educational curriculum to ensure continuous awareness.

Future role of WRMA in flood management

- Review the CMS to incorporate modern technology of monitoring networks and integrated flood management . This CMS will ensure development of SCMPs and IFMPs.
- Develop project proposals for flood prone areas
- Work with community organizations i.e. WRUAs in resource mobilization
- Coordinate flood management stakeholders forums
- Develop river basin management master plan for long-term.

ARIGATO GOZAIMASU

Asante

GROUP 2 NEW FINDINGS AND RELEVANCE

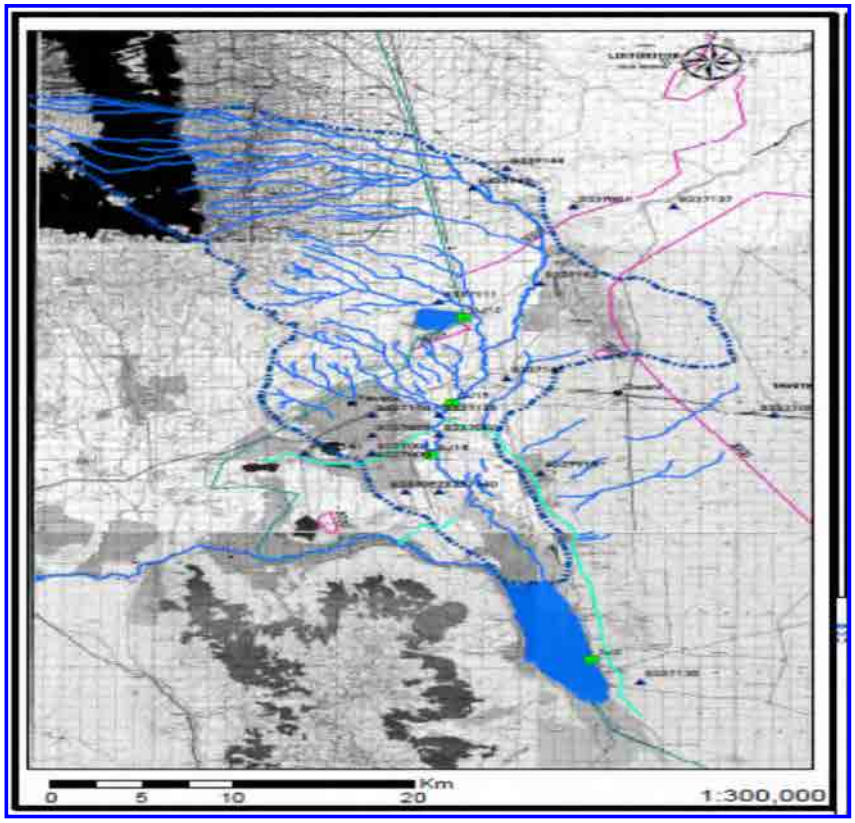
Members (representing Lumi basin);

ALEXANDER NZYUKO

STEPHEN NGAO

JOSEPH MAINA

FREDY REUNA



INTRODUCTION

- Lumi River Basin is within the border of Kenya and Tanzania in the southern part of the Republic of Kenya and it is located in the south-east part of Mt. Kilimanjaro.
- Catchment area of Lumi River is about 590km^2 (of which 75% of the area is in Kenya), and the total length of the river is approximately 71km flowing from north to south. The width of the river is about 20km (east to west) in the widest place.
- Lumi River originates from Mt. Kilimanjaro and it flows towards south direction via Taveta District in the easten part of Kenya. It then flows into Lake Jipe and again flows into Luvu River within the territory of Tanzania.
- There are 2 WRUAs, Upper and Lower4 Lumi for collaborative management of water resources in conjuction with Water Resources Management Authority(WRMA) and other stake holders
- An integrated flood management forum has been formed and with support of JICA through New Jec, a draft Integrated Flood Management Plan has been developed.
- The pilot project being undertaken an evacuation centre-Shelter, raised toilet and raised road. This project was selected by the IFM forum with the guidance of NewJec

NEW FINDINGS RELEVANT TO LUMI SUB- BASIN

	FINDING	RELEVANCE	PROBLEMS	MODIFICATION
1	Real time data collection and management system	Yes	No real time data capture equipment	Automate existing data collection equipment e.g Rainfall, Water level
2	Well conserved catchments and protected riparian areas	Yes	• Ignorance of riparian law requirement • Poor law enforcement • Conflicting legislation on land allocation and riparian land management • Catchment degradation	Harmonization of relevant legislation
3	Long history of flood management dating back to 16th century	No	Flood menace was not significant	Flood menace is now significant owing to climate change and increase in population and hence management is necessary.
4	River classification for better management	yes	Lack of policy	Develop policy
5	Drainage pumps in areas adjacent to the embankments	yes	• High cost of procuring the pumps • Skilled manpower	• Install in key selected areas • Train manpower

6	**River basin based museums**	yes	• **Insufficient historical data/ information**	• **Develop/initiate museum set up in WRMA regions with significant flood issues**
7	Man-made river diversions	yes	• High cost • Land availability	Rehabilitate dykes and flood drainage canals
8	Development and promotion of hazard maps for effective use using standardized symbols	yes	Inadequate qualified staff	• Train adequate W RMA and roll out the maps development in all affected areas in the country • Develop standardized flood map symbols for the country

9	Establishment of Evacuation centers	Applicable	High cost	• Use local technology and materials
10	Establishment of Evacuation centers and preparation of a list of targeted evacuees	yes	High cost of constructing evacuation centers	Use local technology and materials
11	Traditional dykes (e.g Tatami) and commemorativ e ceremonies for flood control works	Yes		• Use secured banana e.g stems and sand bags • Introduce ceremonies for flood control works

THANK YOU FOR YOUR PATIENCE

Group 3

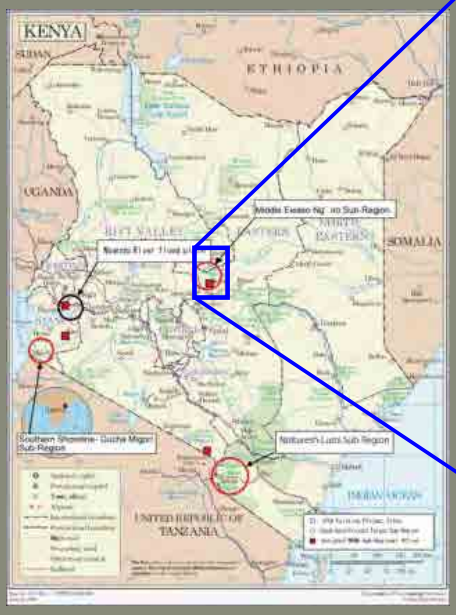
ACTION PROGRAM REPORT

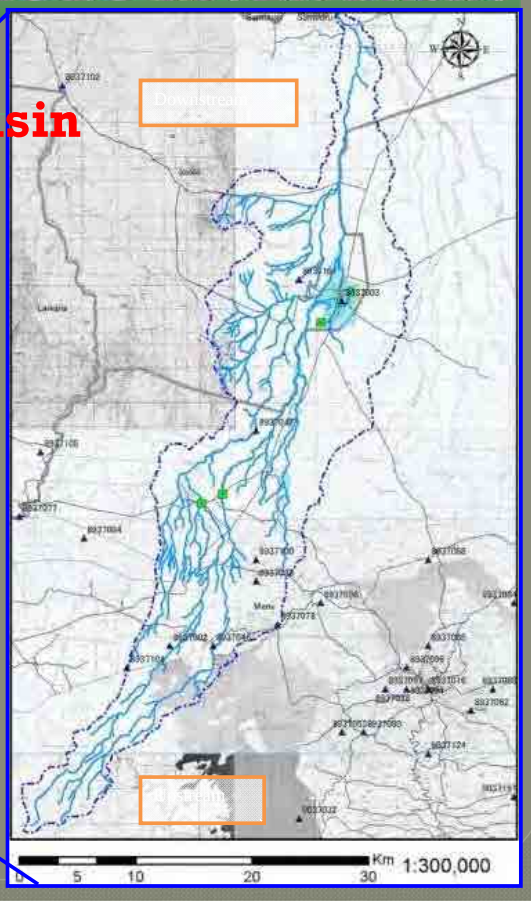
Group Members

1. T. Mutie
2. A. Gitonga
3. D. Mwiti
4. P. Njiru

BRIEF OUTLINE OF ISIOLO RIVER BASIN

Location of Isiolo River Basin





Presentation Outline

1.Brief of the Isiolo Basin

1.New Findings Relevant and Applicable to Isiolo

Natural Conditions

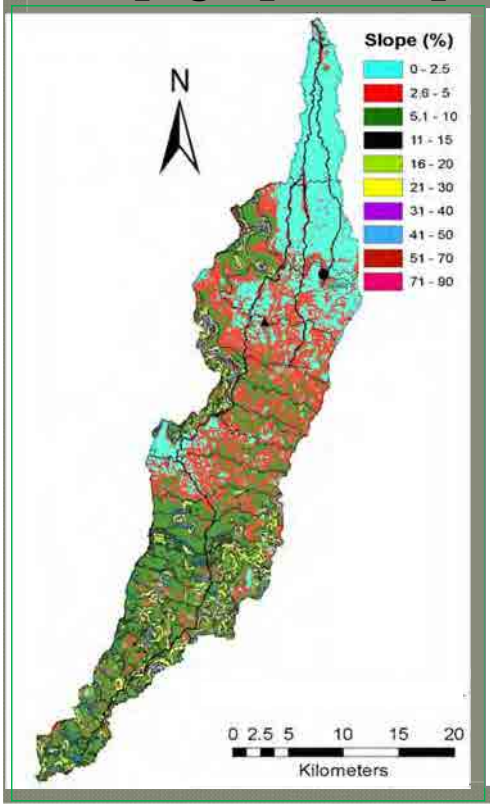
Topography

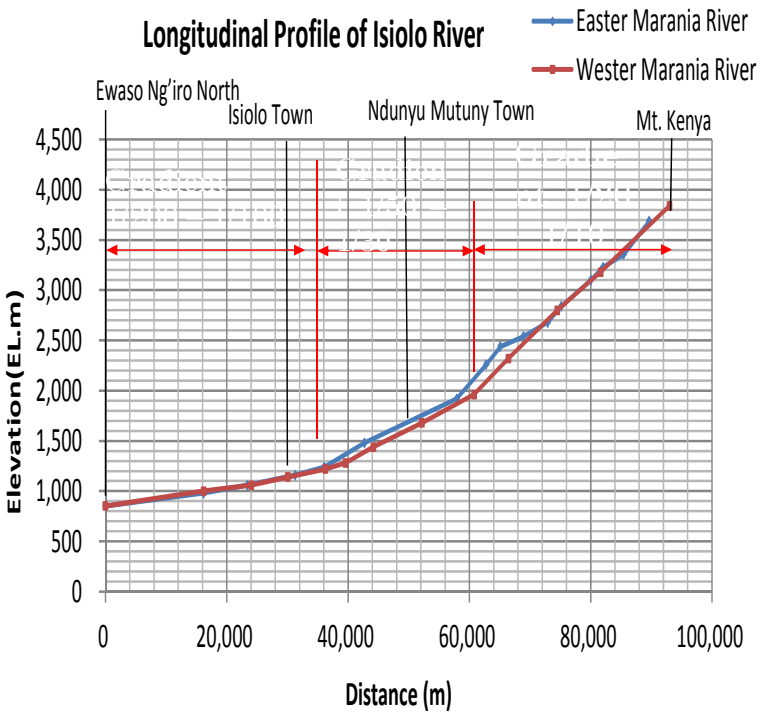
Feature of Isiolo River Basin

Area -683 km^2
Length -95 km
Width -15 km
Highest Altitude -EL3905 m
Lowest Altitude -EL872 m
Mean Altitude -EL1746 m

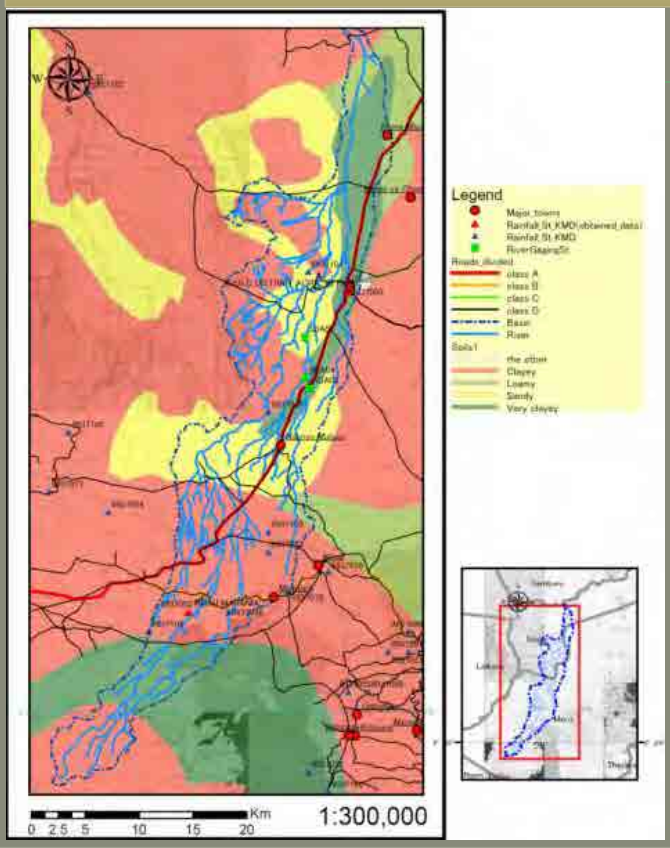
Natural Conditions (cont.)

Topographic Slope and Longitudinal Profile of the River





Natural Conditions (cont.)



Soils

Clayey soil s are found all over the river basin,

Sandy soil is distributed in patches and mostly found on the area to the left bank of the river, from the middle of the basin towards the downstream end.

High clayey content soil is found on the right bank side to the downstream

Loam layer composed of silt and clay in the proportion of 25% to 40% is distributed in patches.

Isiolo Town is located on the area with strong clayey soils

Flood Damage

Situation of inundation in the town center where businesses have been affected.

Situation of inundated building.

Small culvert along drainage channel

Drainage channel along road

Activities

1. Development of the Draft IFMP
2. Implementation of the river bank stabilisation on a tributary of Isiolo river
3. IFM Committee in place

3.1 Institutional arrangements of Flood Management in Kenya

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1.	Lack of IFM Framework in Kenya		Lack of Policy, Legal & Institutional framework	Develop policy and legislation to guide institutional framework and definition/ assignment of roles

3.2 River Law in Japan and Flood Management

S/No	NEW FINDINGS	APPLCABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	• River Classification and assignment of management roles	• Yes	• Legal Framework	This is in the act and will be done as per the resource quality objectives

3.3 Supporting for improving Self-help and Mutual Assistance Activities

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
2	Role of Research in Flood disaster management	Yes	Lack of Awareness	We will work with the universities-sign MOUs

3.4 Case Examples and Lessons of Community Based Activities

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Strengthening capacity on local government by training and drills	Yes	Lack of framework	Start at county level and proceed to the local institutions
2	Manufacture of early warning equipment using simple/local materials	Yes	Lack of capacity	We will start with the pilot areas now we have been trained
3	Involving community approach in floods disaster management	Yes	-	Adopt by involving the WRUAs
4	Using Local Resources for sustainability	Yes	Lack of capacity and awareness	Use Trainers of Trainees

3.5 Disaster Mitigation Education

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Use of Kaeru caravan as a means of creating awareness of disaster knowledge and skills using drills and games	Yes	Lack of awareness	Customise to local circumstances. involve local educational institutions

3.6 Experience of Disaster Mitigation Education

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Customisation of the Kaeru caravan to different cultures and circustances	Yes	Lack of awarenes s	Adopt and customize to local characters ’fish, lion, camel,tortoise , etc’

3.7 Practice of the Planning Disaster Mitigation Education

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Organization of an education Training program	Yes	Lack of capacity and awareness	Adopt and Customize to local situations. Creation of capacity

3.8 River Basin Management in Japan

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	There is a well administrative structure for river basin management and designated organizations for disaster mitigation	Yes	Lack of Policy direction	Develop the adequate policy for implementation on the ground
2	There are historical records of river basin management	Yes	Poor record management and awareness	Develop mechanisms for record keeping. Start collecting materials and information

3.9 Yodo River Basin Flood management and Typhoon No. 18-

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Long term water Resource Planning; • Water Master Plan- 100 to 200 yrs • River improvement Plans	Yes	Policy Direction	Use the National Water Masterplan 2050.
2	Water Quality Monitoring Robot on the river basins	Yes	Awareness	Use the in situ equipment and explore the automation
3	Flood control Dams	Yes	High cost, Politics and Environmental concerns	Two dams are planned. Resource mobilisation to be done

3.11 Yodo River Basin, 'Seta River'- Setagawa River Sub-merged Weir

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Advanced Approach on IWR on Flood management using multipurpose	Yes	• Cost • Environmental concerns	Implement the construction of planned dams

3.12 Ibo River -Community based activities; Tatami dyke, community based flood map

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Dyke Construction of portable Tatami using the local material	Yes	Awareness	R. Bank stabilisation using the local materials
2	Preparations and operations of community Hazard Maps and Evacuation centre and Routes in urban towns.	Yes	Awareness	Create awareness and routes for evacuation. Print large formats. Erect reflective FHM in the flood prone areas

3.13 Flood fighting activities and emergency response at the flooding 'role of each sector'

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Integrated Disaster information system management and Radar collection of rainfall real time	Yes	High cost	• Adopt a strategy of starting small and simple and progressively build up (Short-term, Medium term and Long term) • Explore use of public internet such as Safaricom • JICA already has proposal for some type of IMS • Longitudinal profile of the rivers for each pilot case to be re-done using satellite images (from USGS) and GIS technology. • Collection of information on past flood disasters to be commenced and capturing of future records to be organised and done systematically.

3.13 Flood fighting activities and emergency response at the flooding 'role of each sector' Cont.

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
3	• Flood-fighting teams are based on Law and there is clear Role of fire-fighting and flood fighting teams	Yes	Lack of awareness and necessary framework& Legislation	Adopt and make necessary framework & Law to guide flood fighting
4	Use of simple flood-fighting materials and techniques such as sand bags	Yes	Lack of awareness and necessary framework& Legislation	Adopt and make necessary framework & Law to guide flood fighting

3.14 Community based flood hazard map

S/No	NEW FINDINGS	APPLICABLE TO KENYA –YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Two levels of community flood hazard map - one made by the MLIT with standard symbology, and the local community hazard map with all the basic information.	Yes	Lack of awareness and Policy	Adoption and policy formulation

3.15 Yodo river basin 'Katsura river'

S/No	NEW FINDINGS	APPLICABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Slanting RGS with graduations increasing both upwards and downwards from zero	Yes	Awareness	Further enquiry on its use
2	Use of the river for recreational purposes	Yes	Lack of planning	Identify areas suitable for these purposes
3	River bank and bed stabilization	Yes	High costs	Adopt

3.16 Review of the pilot activities

S/No	NEW FINDINGS	APPLCABLE TO KENYA – YES/NO	PROBLEMS	NECESSARY MODIFICATIONS
1	Integrated Flood Mgt. Plan Structure Process	Yes	Lack of awareness	Adopt for all future cases.
2	Community contribution WDC		May not be applicable to Higher funding levels	Review of the WDC framework

THANKS FOR YOUR LISTENING

Presentations on Action Plan Report Lower Gucha Migori Group 4

Joshua Ojwang
Samuel Njihia
Joseph Boit
Elizabeth Diego

Outline

- Introduction
- Gucha Migori River Basin
- Achievements
- New findings and relevance to Lower Gucha Migori Sub Catchment

Introduction

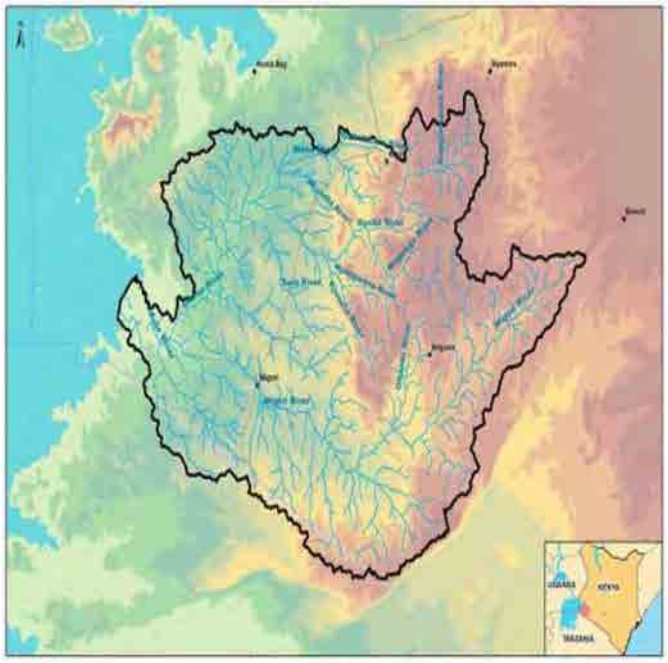
Gucha Migori River Basin is in Sothern Shoreline, Lake Victoria South Catchment Area in Kenya. It is a vast basin covering five counties with nine active WRUAs.

The basin is divided into three zones the upstream that consists of Nyamira, Kisii and Transmara East districts; midstream that covers Migori, Kuria and Uriri districts; downstream that consists mainly Nyatike district flood prone area.

The sources of the river are the steep hilly areas both in Nyamira and Kisii highlands as well as lolgorian and Kehancha.

The river profile is steep at the source but in the middle and lower ridges it is low

Gucha Migori river basin



Achievements

- Establishment of CFMO in LOGUMI under the LOGUMI WRUA
- Establishment of Early Warning System
- Developing 6No Flood hazard maps and hydrograph
- Developed community flood action plan that has been incorporated in the SCMP.
- Identification of IFMC members

New findings and relevance to Lower Gucha Migori Sub Catchment

- Use of skeleton triangle structures to control river bank erosion this is applicable and we shall use hyacinth reeds to make the structure. The hyacinth reeds are locally available in L. Victoria.
- Single river bank embankment can be applied at new deviation point of the river.
- Implementation of river management by case example of shingen rule can be applied by mobilizing communities to form WRUAs and creating CFMOs in the sub catchment to implement flood activities

Cont ‘

- Manmade Manriki forest to control floods is applicable and it takes a long time for the trees to grow; tree planting is the mandate of Kenya Forest Service and can be done in collaboration with KFS and through water catchment conservation in macalder, Got Kachola
- Mobilize WRUAs in the Kisii highlands to conserve the upper catchment
- Real time data relay and the investment on technology is applicable can be done through transmission by phone from the WRUA gauge readers.

Cont’

- There is an automatic gauging station at river Gucha Migori which can be upgraded to relay information hourly to WRMA office.
- Dedicated museums on river management : this can be adopted by having catchment area river museums. Thim Lich Oinga Museum (National Museum) in gogo falls can be improved with river and flood management history.

Cont'

- Classification of rivers and accurate length of river: the rivers in Southern Shoreline can be classified and their lengths measured and ascertained.
- Preservation of information/data on historical events is applicable though there is inadequate historical data in Kenya. In Lower Gucha Migori we shall gather flood history from the older generation and document.

Cont'

- Sabo dams for Sediment control applicable in upper catchments of LOGUMI to curb sediments emanating from the highlands.
- University research on disaster management : gather information on research results of floods in Kenya and implement relevant results/findings for the sub catchment and engage with universities to research on rivers in Southern Shoreline Gucha Migori river Basin

Cont'

- Dual purpose river maintenance-removal of sand and stones for construction hence widening the river applicable in a controlled manner while enforcing the laws especially on sand harvesting in LOGUMI
- Reclamation of encroached wetlands in upper catchment areas of Southern Shoreline Gucha Migori river system

Cont'

- Use of dam e.g Amagase to control massive destruction by typhoon No 13. in LOGUMI there can be water pans for storing flood water and construction of check dams
- Learning technology from external experts and modifying to suit local scenarios undertake the activities of flood hazard map and EWS to other WRUAs in Southern Shoreline Gucha Migori

Cont'

- Improve on the Sub Catchment Management Plan after developing Integrated Flood Management Plans
- Designated Evacuation centers in various flood prone areas that can be managed by the WRUAs for multipurpose and income generating activities; an evacuation centre to be constructed at Nyora, Kabuto and Nyakweri area

New Findings Cont'

- Reflective water marks on river embankment to indicate levels of water. In Southern Shoreline Gucha Migori, concrete column on river bank can be constructed and inscribed with reflective mark to indicate the level of water and put up reflective evacuation sign posts.
- Kaeru caravan for disaster education amongst children can be adopted and the characters modified to suit local scenarios with fish character in flood prone areas to be introduced among school going children.

Cont'

- Long term catchment management and conservation plan as evidenced by current forest cover initiated about 100 years ago in Japan. To be incorporated in the SCMPs of Southern Shoreline Gucha Migori

New Findings Cont'

- Flood run off analysis to be done by WRMA at the Kisii Sub Regional level

Photo Gallery

Skeleton works to be modified with hyacinth and replicated

Clean river – Katsura river

Kaeru Caravan to be implemented in Gucha Migori – Fish

Riverbank embankment

Forested area with a shrine

من الشعب الياباني
From the People of Japan

1

SUMMARY OF ACTION PLAN REPORT FOR FLOOD MANAGEMENT IN KENYA

Presented By
Eng. Wilfred Matagaro Ochenge
Date: 2013/11/26

Presentation Outline

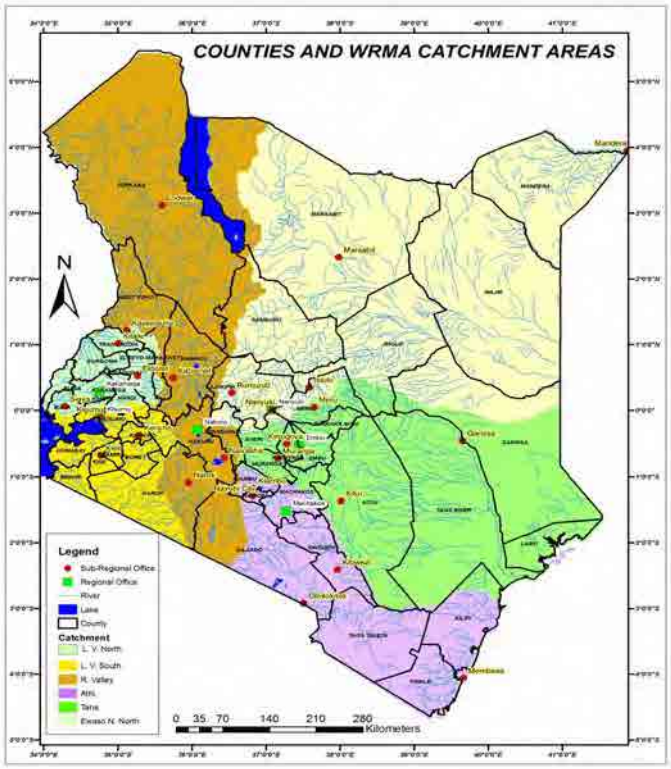
1. Introduction of APR
2. Objectives of training in Japan
3. Training report and New findings
4. Framework of draft WRMA action plan in flood management
5. Action items to be done by WRMA after the training
6. Concluding Remarks.

Introduction

- Due to climate change, Kenya is prone to seasonal floods and droughts.
- WRMA has been mandated as a lead agency in water resources management to manage floods, among other core functions, on behalf of the government.
- There was need for capacity building for WRMA to undertake integrated flood management and hence this training under the government of Japan and Kenya through JICA.
- Below is a map showing WRMA catchment area and counties

WRMA catchment areas and counties

Map



Objectives of training

- To understand the background and outline of administrative system for flood management in Japan.
- To understand the background and outline of community based flood management in Japan.
- To understand roles and efforts of governmental organization
- To develop reports to utilize knowledge and skills acquired through this training for the future of the republic of Kenya

New Findings

From the four presentations the following are the new findings that are relevant and applicable:

- Use of locally available material for flood management i.e use of bamboo and hyacinth to make the skeleton works in Lower Gucha Migori
- Integrated disaster information management system
- River museums
- River classification and assignment of management roles in Japan, involves the central government, the prefecture and the municipalities while in Kenya such framework does not exist. we may need to review.

New Findings Cont.

- Inculcation of disaster management awareness from early childhood age.
- Existence of river law with specific roles and responsibilities in integrated flood management in Japan while in Kenya the Water Act 2002, plays role in management of rivers. It does not fully address integrated flood management.
- The MLIT has initiated development of flood hazard maps with standardized symbols, the prefectures have customized the flood hazard maps. In Kenya the communities first develop the flood hazard maps.

Framework of draft WRMA Action Plan in Flood Management

Institutions	Roles before floods	Roles During floods	Roles After floods
Ministry of Environment Water and Natural Resources	Develop Flood policy	Inter-government/ ministerial Coordination	Review and update the policy
County Government	Domesticate the flood policy	Mobilise resources	Support Rebuilding

Framework cont'd

Institutions	Roles before floods	Roles During floods	Roles After floods
WRMA	• Flood Management Plans and budget • Early warning • Inter county and agencies coordination • Put in place structural and non-structural measures • Community mobilization	• High flow, rainfall and sediment monitoring • Information disseminati on	• Review the flood mgt plans • Update the flood hazard maps • Update the early warning systems • Mitigate on the flood structural and non-structural measures • Update the database

Framework cont'd

Institutions	Roles before floods	Roles During floods	Roles After floods
Kenya Meteorological Department	• Early warning	• Rainfall monitoring • Information dissemination	•Update weather database. •Disseminate information.
Regional Development Authority	Identify and share information on flood prone areas	Implement Integrated Flood management plans	Support Rebuilding
Kenya Red Cross Society	• Stock Resources for Flood disaster • Perform evacuation drills	• Evacuation of the vulnerable • Removal victims • Distribution of relief items • Disseminate information	Update the database

Framework Cont'

- Establishment of the Flood management department in WRMA
- It is involved in formation of Flood management committees
- It develops Integrated Flood Management Plans
- It is involved in the implementation WRUA development Cycle and the Integrated Flood Management Module.
- Training of trainers on Integrated Flood management

Framework Cont'

- In the future the lessons learnt will be replicated in the development of IFMP in the identified flood prone river basins

Action items by WRMA after training

- Train WRMA staff on flood management in the 2nd stage training in December 2013
- WRUAs to be trained by the trained staff 2014
- Initiate the development of integrated flood management policy
- Mapping of flood prone areas in the country
- Assess flood monitoring network for collecting and disseminating of information
- Development of integrated flood management plans for other sub catchments.

Actions Cont.

15

- Review of Catchment Management Strategies to incorporate IFM
- Review the annual budget for flood management
- Develop project proposals for flood management in flood prone areas
- Dissemination of flood information to public

Actions Cont'

16

- Finalize the draft IFMPs for the pilot projects
- Train community to develop 'my disaster prevention and hazard maps'.
- Develop TOR for code of practice to support self help/mutual projects
- Development framework for river classification
- Coordinate flood management stakeholders forums

Concluding Remarks

- The training was a good opportunity and an eye opener for WRMA/WRUA in flood management activities in Japan.
- It is our hope that this technical cooperation will continue and be strengthened from time to time.

ARIGATO GOZAIMASU

Asante

添付資料(e)　荒川下流河川事務所 HP

における研修視察受入の紹介

事務所について

- 事務所基礎データ
- 事務所の取り組み
- 荒川に関する連絡会・会議
- あらかわ告知板
  - 2013年
  - 2012年
  - 2011年
  - 2010年
  - 2009年
  - 2008年
  - 2007年
- 記者発表

あらかわ告知板 2013年

ケニア共和国の政府等公的機関の方々が荒川下流河川事務所を見学されました。

2013年11月15日
国土交通省 関東地方整備局 荒川下流河川事務所

１１月１１日（月）、国際協力機構（JICA）の「洪水管理のための能力開発プロジェクト」研修で来日されているケニア共和国の政府等公的機関の１５名の方々が、自国の洪水管理の参考とすることを目的に荒川下流河川事務所を来訪されました。
荒川の概要・防災情報システム・水門施設・あらかわ号（災害対策支援船）・堤防強化対策等について現地説明をしました。


【 荒川の概要説明 】


【 防災情報システム・水門施設説明 】


【 災害対策支援船の乗船 】

資料一覧

2013年一覧に戻る

荒川下流河川事務所ホームページトップに戻る ページの先頭に戻る

サイトの使い方 | サイトご利用条件 | プライバシーポリシー | 関連リンク | お問い合わせ

国土交通省 関東地方整備局 荒川下流河川事務所 〒115-0042 東京都北区志茂5-41-1 TEL： 03-3902-2311 （代）

付属資料 3-1

コミュニティベース洪水ハザードマップ作成活動報告書

Developing Community Based Flood Map

for

Geographical Data for Flood Management Plan

in

Effective Flood Management in the Pilot Project Area

GUCHA-MIGORI: Site visit Report

NOVEMBER 2012

GEOGRAPHICAL DATA: MAPPING OF FLOOD PRONE AREAS

1. Objective

- To meet the Regional Office and Sub-regional office WRMA, and request them to assign a staff during the visit to Lower Gucha Migori. This aims at capacity building of WRMA staff to be able to collect geographical data especially on mapping of the area that experience flooding;
- To meet the LOGUMI WRUA members and enhance their capacity further on developing Community Flood Hazard Map and also transferring these features on community hazard map to the topographical map; and
- To record the coordinates of various landmarks, flood prone areas including the depth and inundation period, evacuation centre, identify evacuation routes, health facilities and raised areas that normally are not affected by floods.

2. Overall Itinerary

a) 13 November 2012 (Tuesday)

08:00: Arrival of JICA Expert and Project Supervisor for Isiolo
09:00: Meeting with Regional Office, WRMA-LVSC
11:00: Leave Kisumu for Kisii to meet WRMA-LVSC Southern Shoreline, Kisii
12:30: Meeting with WRMA-LVSC Southern Shoreline, Kisii Sub-regional Manager
13:30: Meeting with WRMA-LVSC Southern Shoreline, staff
14:00: Leave Kisii for Homa Bay to observe the WRMA's automated rainfall station
15:00: Observation of rainfall station and hold meeting with District Water Officer
17:00: Return to Kisii Town

b) 14 November 2012 (Wednesday)

08:30: Meet at Sub-regional Office and leave for Lower Gucha Migori SC
11:00: Meeting with three LOGUMI WRUA members to accompany the team for site visit
11:30: Recording of GPS coordinates and take pictures in Kabuto, Nyora and Luanda
17:00: Return to Kisii Town

c) 15 November 2012 (Thursday)

08:30: Meet at Sub-regional Office and leave for Lower Gucha Migori SC
11:00: Meeting with LOGUMI WRUA members to accompany the team for site visit
11:30: Recording of GPS coordinates, take pictures in Tulu, Ayeko, Aeko and Ratienyi
17:30: Return to Kisii Town

d) 16 November 2012 (Friday)

09:30: Meet at Sub-regional Office and leave for Lower Gucha Migori SC
12:00: Meeting with LOGUMI WRUA members to draw the SC flood hazard map
14:30: Recording of GPS coordinates, take pictures in Tito and Muhuru Bay
17:30: Return to Kisii Town

3. Site/Organization/Person Visited

i. WRMA-LVSC Regional Office, Kisum
ii. WRMA-LVSC Sub-regional Office Southern Shoreline, Kisii
iii. District Water Office, Homa Bay
iv. LOGUMI WRUA

4. Counterpart Personnel Accompanied

i. Mr. Kibati, WRMA-LVSC Sub-regional Office Southern Shoreline, Kisii

5. Accompanied Personnel (Japanese side)

i. Mr. Naonori OKAWA

6. Major Findings

i. WRMA-LVSC Regional office does not have a GIS expert, but they have staff who can competently use the GIS software.
ii. WRMA-LVSC Regional office staff who can use the GIS software was away on official assignment for two weeks, therefore he could not accompany the Project Team to Lower Gucha Migori SC.
iii. WRMA-LVSC Sub-regional office do not have the GIS software neither do the office have an officer who can operate the GIS software.
iv. WRMA-LVSC Sub-regional office has an officer who can help community develop community flood hazard map. But he is currently preparing for transfer to another station and was also engaged in an official assignment in Oyugis.
v. Data collection and storage challenge; WRMA came to existence in 2005. Before 2005 data collection and storage was the responsibility of the Ministry of Water and Irrigation (MWI), and some of the data is still with MWI and is yet to be shared with or transferred to WRMA;
vi. The old men and women have information that is engraved in their hearts that is profitable if it can be collected, recorded and stored as data. For example one old man was able to describe the history of heavy flood other than the annual regular in Lower Gucha Migori as follows: 1947, 1957, 1961, 1963, 1985, 1997-1998, 2006, and 2011;
vii. LOGUMI WRUA are able to develop a community flood hazard map and they had developed a community flood hazard for the most affected area of Kabuto-Nyora area;
viii. LOGUMI SC experiences flash floods that are as a result of heavy rainfall in the hilly areas. The flash flood is experienced mainly in Luanda, Misiwi, Tito and Ratienyi areas. The SC also experiences the riverine floods as a result of river bursting its banks and the main area affected are Kabuto, Nyora, Aeko and Kimai. There is also backflow

water from the lake that causes floods in Aneko and Aeko areas; and

ix. LOGUMI WRUA area of jurisdiction is vast, and therefore effort to come up with one flood hazard map for the Sub-catchment by the community is not easy and therefore need for three separate community flood hazard map. One map for Kimai, Kabuto, Nyora, Tulu, Aneko and Aeko; another map for Luanda Misiwi area and last but not least map consisting of Ratienyi, Tito and Muhuru Bay.

7. Meetings

7.1 Meeting with WRMA-LVSC Regional Office

The meeting took place on 13th November 2012 at WRMA-LVSC Regional Office in Kisumu. The following persons were in attendance:

1) Mr. Willis MEMO who represented the Regional Manager;
2) Mr. Naonori OKAWA the JICA Expert;
3) Mr. Jared OTIENO Flood Management Activities Supervisor for Isiolo;
4) Mr. Clement NGIDA Flood Management Activities Supervisor for Gucha Migori.

Meeting with WRMA-LVSC Regional Office

The following salient issues were discussed:

- ✓ GIS: There are officers in the regional office who have basic knowledge on GIS software operations while there is a staff who is not a GIS expert but can competently use the software;
- ✓ GIS software is installed in some of the computers at the Regional Office;
- ✓ Matter arising: The Regional Office wanted information if the staff at the Regional Office can be trained on how to transfer the community flood hazard map to the topographical map using GIS software.

7.2 Meeting with Sub-regional Manager WRMA Kisii

The meeting took place on 13th November 2012 at Nyabenda Hotel in Oyugis Town. The following persons were in attendance:

1) Mr. Bilancio MATURWE, the Sub-regional Manager;
2) Mr. Joseph Boit, the CMO and WRMA counterpart staff to the Project;
3) Mr. Naonori OKAWA the JICA Expert;
4) Mr. Jared OTIENO Flood Management Activities

Meeting with WRMA Kisii Sub-regional Office

Supervisor for Isiolo;

5) Mr. Clement NGIDA Flood Management Activities Supervisor for Gucha Migori.

The following salient issues were discussed:

- ✓ Community Flood Hazard Map: The Sub-regional manager pointed out that the only one staff who had the capacity in developing community flood hazard map received transfer letter to another station, and the staff had not yet transferred the technique to other staff;
- ✓ Capacity development: The SRO does not have personnel who can use the GIS software (which is not installed in any of the computers at the SRO). Sub-regional manager requested that the capacity of the SRO should be built in the GIS software operation;
- ✓ Challenges at the SRO: The Sub-regional manager revealed that there was a challenge with data management at the SRO. He clarified that the SRO does not have staff that can download data from the automated station, and therefore they had to rely on Kisumu leading to gaps in data collection. He explained to the team that currently the SRO has five RGS automated stations under their care though only one is located on Gucha Migori system. He further stated that there are two automated rainfall stations under the care of SRO. 1KB05 Wath Onger station was installed in 1998 and rehabilitated in 2010. Another challenge that the SRO faces is rampant vandalism of the hydro-met stations. Another challenge that the SRO faces is the limited number of computers at the SRO with three computers serving fourteen staff.
- ✓ GPS Gadgets: WRMA-LVSC Southern Shoreline, Kisii has two GPS gadget that they use for data collection. The Sub-regional manager also requested that the staff at the SRO be capacity built in the use of GPS gadget not only in recording data but downloading the data to the computer and where necessary analysis the data.
- ✓ Meeting with WRMA at the SRO: The meeting at the SRO was a courtesy call because at the meeting with Sub-regional manager, he assigned the staff Mr. NJIHIA to accompany the Project Team to the Lower Gucha Migori.

7.3 Meeting with District Water Officer

The meeting took place on 13th November 2012 at District Water Office in Homabay Town. The following persons were in attendance:

1) Mr. Samuel NJIHIA, CMO WRMA Kisii;
2) Mr. ATHERO, the Water Rights Officer;
3) Mr. Naonori OKAWA the JICA Expert;
4)Mr. Jared OTIENO Flood Management

Meeting with DWO Sub-regional Office

Activities Supervisor for Isiolo;

5) Mr. Clement NGIDA Flood Management Activities Supervisor for Gucha Migori.

The automated rainfall station is located at the District Water Office (DWO).

- ✓ Data Management: The district water officer stated that initially the storage of data was with the DWO and as a result of transition triggered by Water Act of 2002 that made many DWOs think that they were going to be redundant, and therefore these DWOs were not keen on taking care of the data and therefore misplacement of these data.
- ✓ Geographical data: There are no maps indicating the areas of supply only one map that is a photocopy of the plan for the supply.
- ✓

7.4 Meeting with Community Members

During the excursion field trip the Project Team interacted with the community members at various site locations and discussed the flood issues in their respective areas. The following salient issues emerged during the discussions:

- ✓ Kimai area: Community members informed the Project Team that there is a natural depression that acts as a water pan and is able to collect flood water with depth of between 1M to 1.5M over the inundation period of six months though the water level reduces overtime;

Natural depression area location being showed by Community members

- ✓ Kabuto area: Head teacher explained that the school was constructed by the community with assistance from world vision which constructed one class. He further pointed out that the water tanks and hand washing points were provided by Afya Plus which is an organization under USAID. He also clarified that during flood disaster community members evacuate to school and the school administration gives the affected families two classes that they use as a place of refuge;

Water tank at Kabuto School, the school is an evacuation place

- ✓ Nyora area: Community members explained that the former Kabuto School had a borehole that community members use as a water point due to the clean water that they draw from the borehole. The borehole is currently damaged and

Water point at former Kabuto School, the borehole is currently damaged

community members are unable to use it. Head teacher at Nyora explained that the school is used by community members as an evacuation place when their homes are affected. He clarified that only when the floods are heavy that is when the school is also affected leading to evacuation of the evacuees to Nyakweri Primary School. He further stated that the last time such heavy floods was in 2006;

- ✓ Luanda area: Community members pointed out that the area is affected by flash floods. The major impact of the flash floods is destruction of the farmlands and caving in of toilets leading to sanitation problems. The flash floods are caused by the heavy rains in the nearby hills. The health personnel at the nearby health facility explained that the floods affect the health facility with the flood depth of 30CM. The health personnel further explained that a wing for in-patient admission is under construction;

Community member points at the source of flash floods

- ✓ Nyakweri area: The teachers at school explained that the school is at a raised location and is never affected by floods. The clarified that during floods community members evacuate to the school whereby they settle at the school play ground and KRCS provide tents and other relief services to the evacuees;

- ✓ Ogongo area in Tulu: Community members explained that during flood the water overflows into the old river channel that over flows their farms. The old man in the area explain the flood history in the area as follows:1947, 1957, 1961, 1963, 1985, 1997-1998, 2006, and 2011;

- ✓ Aneko area: Community members explained that the R. Gucha-Migori changed its course at the entry point to the Lake Victoria four points including the current entry point at Kabuto-Nyora area. The old man explained to the Project Team that the pressure of the back flow from the Lake Victoria was heavier than the pressure of the river flow especially when flooding leading to the back flow of the water back to the river channel leading the river to change its course in the process;

The third location point where R. Gucha-Migori changed course on the old channel

- ✓ Aeko area: Community members explained that the floods mainly affected the farmlands. They

Community members explain the effects of floods in Aeko area

further explained that the homesteads are affected by floods as a result of back flow from the Lake Victoria. The flood depth in the area is 50CM with a duration of three to four weeks; and

- ✓ Ratienyi area: Community members explained that there is R. Ratienyi that has its source in the neighbouring hills that leads to floods during heavy rains. The flood affects mainly the farmlands and livestock and in case of heavy floods the nearby homesteads are affected. The flood depth in the area is 50CM to 1M with inundation duration of three to four weeks.

8. Site Visits for recording of GPS Coordinates

Day 1

Target for Day 1: Collection of GPS coordinates of various landmarks, evacuation centres, health facilities, schools, water points, dangerous spots, evacuation routes and affected homes and farmlands in Kabuto-Nyora area and Luanda. Discuss with community members on flood issues to get more flood information from community members.

Conditions: The LOGUMI WRUA were participating in a WSTF training in Homa Bay and therefore they assigned three members to accompany the Project Team during the process of recording GPS coordinates and taking pictures.

Note: It is important to note that the LOGUMI WRUA members' capacity on developing community flood hazard map had been realized in June 2012 wherein the Kabuto-Nyora area Flood Hazard Map was developed.

Observations:

1) It was observed that in Kimai area there is a natural depression that acts as a water pan that collects water during flooding with a depth of over one meter during the onsets of floods and reduces both in the area coverage and depth overtime of six months. The community pointed out that in case it rains in the area while the water in the depression is plenty it leads to flooding of the nearby homes leading to evacuation. Two danger points along the evacuation route were also noted;
2) It was observed that in Kabuto area that during floods community members evacuate to Kabuto primary school. The school has part of the classes having mud-walled classes which are eroded. The head teacher explained that during floods when evacuees move to school, the school management gives evacuees two classes to use as rescue places. Kabuto Dispensary the only health facility in the area is marooned with flood water leading to difficulty in accessing the facility. The floods in Kabuto are as a result of R. Gucha Migori bursting its banks. There is heavy erosion of the riverbanks on the right side of the river where Kabuto is located but the water seems to overflow the Nyora side more than Kabuto side. Though community people pointed out that there are streams that also overflow into Kabuto

after excessive water of R. Gucha Migori flowing into these streams. There are danger spots that were noted that gives some evacuees difficulties to access the evacuation centre and even the health facilities. Community members also pointed out that using boats to cross the river during floods was dangerous.

3) It was observed in Nyora area that it is the most affected and the former Kabuto school that was located in Nyora area was relocated to its current location due to floods in the area, the former school is currently used as a water point due to the borehole that has fresh clean water having been drilled there. During floods in Nyora most areas accessibility is by boats. The farmlands in the area are affected. The community members move to Nyora primary that acts as an evacuation place for evacuees. The evacuees use the field and the church that is located in school for rescue with KRCS providing tents that evacuees use. During heavy floods Nyora primary school also gets affected that leads the evacuees to move to Nyakweri Primary School that is at a raised place and evacuees use the school playing ground as a rescue place with KRCS providing tents to the evacuees. There are danger spots that were noted in Nyora with one place that has a seasonal stream having a flood depth of 1.2M during heavy floods.
4) It was observed in Luanda area that the area is affected by the heavy rains in the nearby hills that lead to flash floods as the water move downstream to the lake at high velocity. The major damages include collapsing of toilets, washing away of crops in the farms and destroying homes that are located on the path of the flash floods.
5) It was observed that Nyakweri Primary School and the area is located in the raised places and is never directly affected by floods. Nyakweri school acts as an evacuation places for most evacuees during flooding. It was also noted that during heavy floods three schools moved to Nyakweri primary school to continue with their education programmes at Nyakweri Primary School. The school has toilets but they are not enough when evacuees move to the school leading to overstretching of resources at Nyakweri school.

Conclusion: The target for day one activities was realized. It is important to note that culverts were proposed by community members as an intervention measures for the danger spots. It was also proposed by community that an evacuation centre be constructed that can carter for affected families in Kabuto and Nyora areas and the community members capacity on proper evacuation procedures and management of evacuation centre be developed.

Place : District Water Office compound Homabay
Description : Observation of the automated rainfall station

Place : LOGUMI WRUA Office
Description : Project Team and the LOGUMI WRUA discuss on ways of transferring of the flood hazard map to topographical map

Place : R. Gucha Migori at Wath Onger
Description : Observation of the automated river-gauge station

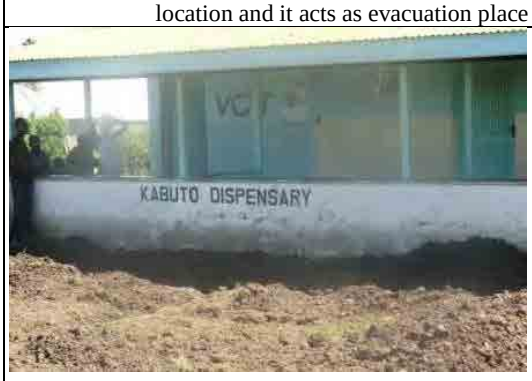
Place : Kimai village
Description :Natural depression that acts as water pan with a diameter of about 100M

Place : R. Gucha-Migori
Description : Eroded river banks wherein the water overflows and floods Kabuto

Place : Kimai-Kabuto boundary
Description : danger spot during flooding that makes accessibility difficult community have proposed culvert as intervention measure

Place : Kabuto Primary school
Description : Kabuto primary school at the new location and it acts as evacuation place

Place : Kabuto village
Description : Danger spot during flooding that makes accessing Kabuto school difficult



Place : Kabuto Village
Description :Kabuto dispensary a health facility in the area that gets marooned during flood

Place : Former Kabuto Primary school
Description :Water point in the area but the borehole got damaged recently

Place : Nyora Primary School
Description : An evacuation place that also during heavy floods get inundated

Place : Luanda area
Description : Health Facility in the area that has a dispensary

Place : WRMA-LVSC Regional Office
Description : JICA expert explains to WRMA-LVSC

Place : LOGUMI WRUA Office
Description : JICA Expert meet with WRUA Executive

Day 2

Target for Day 2: Collection of GPS coordinates of various landmarks, evacuation centres, health facilities, schools, water points, dangerous spots, evacuation routes and affected homes and farmlands in Tulu, Ayeko, Aeko and Ratienyi. Discuss with community members on flood issues to get more flood information from community members.

Conditions: The LOGUMI WRUA members availed themselves for the activity and the manual for community hazard map development was distributed to them. Two members were assigned to accompany the Project Team during the process of recording GPS coordinates and taking pictures and interview with community members.

Note: The initial plan was to have the LOGUMI WRUA members' transfer the Flood Hazard Map to the topographical map. But due to the concluded WSTF training leading to fatigue to the members and quorum could not be mobilized and it was agreed that site visits to be carried out instead.

Observations:

1) It was observed that in Tulu area there is a stream that taps from the overflow of the flooding water from R. Gucha Migori leading to floods in the area with flood depth of over 50CM (fifty centimeters). The fields that are used as grazing lands get flooded leading to loss of livestock.
2) At Ogengo area the community members were able to describe the flood in the area during the flood as a result of the overflow from the old channel.
3) It was observed that in Ayeko area where the old R. Gucha Migori channels passes through gets affected by the backflow of water from the Lake Victoria leading to floods that wash away the crops in the farmlands. The old channel is dry but during floods the excessive water from the new channel flow through the old channel. The community members pointed out that the place where the old channel flows into the Lake Victoria as a danger point with deaths recorded during floods. The community members also pointed out that hippopotamus infestation of the area makes the place even more dangerous.
4) It was observed in Aeko area that it is mostly affected by the excessive flood water from R. Gucha Migori that strays to the area as it flows downstream to L. Victoria and thereby affecting the farmlands. The community members also pointed out that the backflow from the L. Victoria affects their homes leading to damages of houses with flood depth of 1M (one metre) noted.
5) It was observed in Ratienyi area that the area is affected by the heavy rains in the nearby hills that lead to flash floods which also leads to the seasonal streams in the area to overflow leading to the destruction of the farmlands and heavy losses of the livestock.

Conclusion: The target for day two activities was realized.

Place : Agenga Chief's camp
Description : Vandalized KMD rainfall station

Place : Tulu area
Description : Gullies along the road

Place : Tulu Area
Description :Grazing land that gets inundated 50cm depth

Place : Ayeko old channel entry point to lake
Description : Danger spot that deaths have been recorded

Place : Aeko village
Description : The area where farmlands have been abandoned due to floods

Place : Aeko Village
Description : Community member points the depth of floods that affects Aeko

Place : Aeko village
Description : The area where the backflow from adjacent lake floods the area

Place : Nyangenda Primary School
Description : Raised place near Aeko that is not affected by floods

Note for Day 2 activities: It is was proposed that Tulu, Ayeko and Aeko be incorporated in Kabuto-Nyora Community Flood Hazard Map while Ratienyi area be part of the Tito, Muhuru Bay community flood hazard map that will be developed by WRUA.

Day 3

Target for Day 3: LOGUMI WRUA members to draw the community flood hazard map of their geographical jurisdiction indicating the salient flood features. Project Team to collect GPS coordinates of affected area in Tito area and visit the automated rainfall station at Muhuru Bay. Transferring of the features on community flood hazard map and observed features to the topographical map. Discuss with community members on flood issues to get more flood information from community members.

Conditions: The LOGUMI WRUA members attended the meeting and stated that they were able to draw the map by themselves. Two members were assigned to accompany the Project Team during the process of recording GPS coordinates and taking pictures.

Note: The LOGUMI WRUA jurisdiction is vast and some areas are affected by flash floods from heavy rains while other areas are as a result of the river bursting its banks or backflow from the lake affecting some of these areas.

Observations:

1) It was observed that in Tito area there is a stream that has its source in the hills and during the heavy rains the area is flooded by the stream water as it flows to the Lake Victoria at Muhuru Bay.
2) It was difficult for LOGUMI WRUA to draw the community flood hazard map of Lower Gucha Migori Sub-catchment on A2 paper. The map was drawn but capturing the flood features including the names of the village proved difficult for LOGUMI WRUA members.

Conclusion: The target for day three activities was not effectively realized. The Project Team was able to collect GPS coordinates of affected area in Tito area and visit the automated rainfall station at Muhuru Bay. The LOGUMI WRUA were able to draw the sub-catchment map and were able to add the flood features, but the map by itself was difficult to understand by community members. It was unanimously agreed therefore that WRUA develops three maps as follows: 1) Kabuto, Nyora. Ayeko and Aeko map, Luanda-Misiwi map and Ratienyi, Tito, Muhuru Bay map.

Lesson learnt:

1) That during the development Community Flood Hazard Map all gender must be represented including the aged.
2) One person should be appointed by community to lead in the drawing of the map.
3) In case there are many people in attendance the participants should be divided into groups and after drawing each group make a presentation thereafter the participants agree on various points of dispute and one map is drawn.

Place : LOGUMI WRUA Office
Description : LOGUMI WRUA members draw flood hazard map for Lower Gucha Migori SC

Place : LOGUMI WRUA Office
Description : JICA Expert explains to the WRMA SRO staff on the process of transferring the community hazard map to topographical map

Place : Tito area
Description :WRUA member points flood direction

Place : Tito area
Description :Blocked stream channel that floods Tito area

Place : Muhuru Bay
Description : Honorium WRMA gauge reader shows how he reads the manually

Place : Muhuru Bay
Description : Honorium WRMA gauge reader hands the records of the last four months to WRMA staff

Place : Muhuru Bay
Description : Vandalized automated rainfall station

Place : LOGUMI WRUA Office
Description : Topographical map with hand-marked flood features

Definitions of terminologies

Vulnerability: the degree of fragility of a (natural or socio-economic) community or a (natural socioeconomic) system towards natural hazards. It is a set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of the impact and the consequences of natural hazards.

Vulnerability is determined by the potential of a natural hazard, the resulting risk and the potential to react to and/or to withstand it, i.e. its adaptability, adaptive capacity and/or coping capacity.

Hazard: A potential event that could cause loss of life or damage to property or environment

Risks: The scientific approach defines the risk as the probability and extent of damage due to a particular flood. Conventionally the risk is expressed by the notation ***Risk = Flooding x Vulnerability*** .

Flood related risk refers to the probability of harmful consequences, or expected losses resulting from interactions between natural hazards and vulnerable conditions.

Disaster: The serious disruption of the functioning of society causing widespread human, material or environmental losses which exceed the ability of the affected communities to cope using their resources. Disasters occur when negative effects of the hazards are not well managed.

Flood: a temporary covering by water of land normally not covered by water. This shall include floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas, and may exclude floods from sewerage systems.

Flood risk: the combination of the probability of a flood event and of the potential adverse consequences to human health, the environment and economic activity associated with a flood event.

Flood plain maps indicate the geographical areas, which could be covered by a flood according to one or several probabilities: floods with a very low probability or extreme events scenarios; floods with a medium probability floods with a high probability.

Flood hazard maps are detailed flood plain maps complemented with: type of flood, the flood extent; water depths or water level, flow velocity or the relevant water flow direction. In the community flood hazard mapping process, the community members along with the executing agencies and the concerned governmental officials, demarcate flood hazardous areas, evacuation centres and evacuation routes.

Objective s of flood hazard maps:

i) Understand the characteristics of flood in the community;
ii) Understand the weaknesses to floods in the community;
iii) Increase awareness of personal flood mitigation measures; and
iv) Assist the establishment and strengthening of community organisations for flood disaster mitigation.

N/B: It is desirable that community flood hazard maps should be shown on the community board for dissemination of proper evacuation routes and places dangerous to the community.

Flood risk map: indicate potential adverse consequences associated with floods under several probabilities, expressed in terms of: the indicative number of inhabitants potentially affected; type of economic activity of the area potentially affected; installation which might cause accidental pollution in case of flooding.

Damage: the amount of destruction or damage, either in health, financial, environmental functional and/or other terms as a consequence of an occurred hazard.

Developing Community Flood Hazard Map

Preparatory Work

1. Arrangement of Place
2. Arrangement of Map and Stationary
3. Formulation of Program

Implementation

1. Introduction
2. Explanation of the Steps in drawing Hazard Map;
3. Identification of the person who will lead in drawing the community flood hazard map;
4. Implementation of Step 1: Analysis of the current condition
   (a) Draw the boundary of the area;
   (b) Identification of the major link roads within the area;
   (c) Drawing of current natural conditions in the communities (residential area, agricultural land, grass land, forest, river, hilly area etc.);
   (d) Drawing of community transport and communication infrastructure (road and culverts , footpaths, drainage, bridges, dykes, fields etc,); and
   (e) Drawing of other community infrastructures (office, school, hospital, church, evacuation facility, kiosk, storage etc.)
5. Implementation of Step 2: Analysis of community vulnerability
   (a) Drawing source and direction of the flooding water into the affected area;
   (b) Drawing past flooded areas and duration of inundation;
   (c) Indicating on the map the places of past serious accident and damages during flood period
   (d) Indicating on the map evacuation route, evacuation place, resource activity, communication etc
6. Formulation of countermeasures

Discussion on community based necessary actions such as resource, evacuation route, evacuation center management, communication etc.

Table: Graphic images for the steps involved in drawing community flood hazard map

 Arrangement of material	 Explanation of the steps in drawing hazard map	 Identifying a person to lead in drawing the map
 Drawing the boundaries of the area	 Drawing the link roads, culverts, rivers, streams, bridges etc	 example of community drawn flood hazard map

REPORT ON VISIT TO LUMI RIVER BASIN PROJECT AREA ON 6TH -9TH NOVEMBER 2012.

Objectives of the Visit:

1. To Introduce new JICA Expert on Mapping to Regional Office and Sub-regional Office
2. To meet Lower Lumi WRUA Members and Conduct a training on Flood Hazard Mapping
3. Site Visits to the hot spots and marking using GPS of the Project Sites.

Day one – 6th November 2012 – Meeting at WRMA Regional Office in Machakos

Present

Naori OKAWA	JICA Expert- Mapping
Clement NGIDA	NEWJEC – Kisii Supervisor
Robert OWAGA	NEWJEC – Loitokitok Supervisor
John NGILU	Surface Water Officer Athi River Catchment

The meeting began with the introduction of the participants. The present officer available at the Machakos Regional Office was the Surface water Officer, Mr. Ngilu. He apologized on behalf of the Regional Manager who was away on official business. Mr. Okawa the mapping expert explained the mission for his visit and at the office and subsequently to the sub regional office and the Lower Lumi River basin. His main assignment was for the preparation of the flood hazard map for the Lumi River Basin. He also inquired whether there was any staffs in the region or sub region that were proficient in using GIS. Mr. Ngilu said there were no particular staff assigned for the GIS although there three members who had undergone some training including himself. Mr. Ngilu also inquired whether it was possible to train the regional office on the preparation of the flood hazard maps. We passed on the information from the headquarters during the last project meeting that it would be useful if a staff member from the regional office accompanied us for the exercise. After consultations with his Regional Manger it was agreed that Mr. Ngilu would accompany us for the exercise in Taveta.

Day two – 7th November 2012 – Meeting at WRMA Sub- Regional Office in Loitokitok

Present

Naori OKAWA	JICA Expert- Mapping
Clement NGIDA	NEWJEC – Kisii Supervisor
Robert OWAGA	NEWJEC – Loitokitok Supervisor
John NGILU	Surface Water Officer- Athi Catchment Area
Joseph MAINA	Catchment Management Officer-Nolturesh-Lumi Sub Region

The meeting commenced with the introduction of Mr. Okawa to Mr. Maina the Catchment Management Officer for Nolturesh Lumi SRO. Mr. Okawa then explained his assignment in Lower Lumi to Mr. Maina. This involved conducting training to the Lower Lumi WRUA members to prepare

flood hazard maps, the preparation of the maps and finally a field survey on the flooding hotspot s within the basin. Finally the identified flooding hot spots and important landmarks in the basin such as the main water sources, the schools, churches, evacuation centres and evacuation routes together with their data i.e. latitudes longitudes and elevations would be incorporated into the flood hazard map. All the above accurate data would them be incorporated into the area topographic maps that had already been prepared. Mr. Maina was also incorporated into the team that was to visit Lower Lumi for the exercise in drawing the flood hazard map.

Conducting Training on Development of Flood Hazard Maps with Lower Lumi WRUA

The training on the development of the flood hazard maps involved:

i) Definition of terminologies

This involved teaching the community on the various terminologies involved in flood management activities such as vulnerability, disaster, flooding, risk, damage, flood hazard maps and flood risk maps.

ii) Step by step explanation of the process for developing the community flood hazard maps

Preparatory Work

1. Arrangement of Place
2. Arrangement of Map and Stationary
3. Formulation of Program

Implementation

1. Introduction
2. Explanation of the Steps in drawing Hazard Map;
3. Identification of the person who will lead in drawing the community flood hazard map;
4. Implementation of Step 1: Analysis of the current condition Draw the boundary of the area;
   (a) Identification of the major link roads within the area;
   (b) Drawing of current natural conditions in the communities (residential area, agricultural land, grass land, forest, river, hilly area etc.);
   (c) Drawing of community transport and communication infrastructure (road and culverts , footpaths, drainage, bridges, dykes, fields etc,); and
   (d) Drawing of other community infrastructures (office, school, hospital, church, evacuation facility, kiosk, storage etc.)
5. Implementation of Step 2: Analysis of community vulnerability
   (a) Drawing source and direction of the flooding water into the affected area;
   (b) Drawing past flooded areas and duration of inundation;
   (c) Indicating on the map the places of past serious accident and damages during flood period
   (d) Indicating on the map evacuation route, evacuation place, resource activity, communication etc
6. Formulation of countermeasures

Discussion on community based necessary actions such as resource, evacuation route, evacuation center management, communication etc.

iii) The practical part of the exercise where the WRUA members first drew the map of the area on the ground using the readily available materials like twigs flowers stones and fruits.

iv) Transferring the map drawn on the ground to paper (Rough draft)

v) Transferring the draft to a final copy with all the necessary corrections from the WRUA members themselves.

vi) Incorporating the flood hazard map to the topographic map using the accurate data from the field visits which included the GPS position from the landmarks visited.

DAY Three – 8th November 2012 – Preparation of Final Copy of Map and Field Visits

The WRUA Members were divided into two groups, one group was to accompany the project team to the various flooding hotspots in the area and the rest of the group would continue with the work of finalizing and refining the maps they had begun drawing the previous day. The field survey would include the following

i) Identification of place (School, Evacuation Centre/place, Hospital etc)
ii) Depth of flooding (< 0.5m,>0.5 m)
iii) Duration of flooding(in weeks or months)
iv) Type of flooding(Flash floods/Riverine/Gulleys)
v) Direction of the flood flows.
vi) Longitude, latitude and altitude.

The areas visited on this day included Lake Jipe and Jipe Vilage, Rekeke, Kimala Mata and Kimorigo. The main gulleys causing flooding in Lower Lumi from the Tsavo West National Park were also marked and their details taken.

Day Four-9th November 2012 Transfer of Flood Hazard Map to Topographic map and Field Visits

The project team and the WRUA members used the data that had been collected the previous day to incorporate the flood hazard map that had been prepared into the topographic map for the Lower Lumi flood plain.

Therafter the project team and selected WRUA members embarked on the second field survey. The areas visited on the second day included Abori School Kimorigo Dispesary, Abori church, Njoro Kubwa Canal and Kitobo Springs while collecting all the required data. The previous day in the evening there had been heavy rains in the area. As a result some of the photos shown can be used in distinguishing the area before a heavy storm and after a heavy storm. The photos are included below for comparison.

		
Date : 7th November 2012 Description : Mr. Okawa JICA Expert explains a point at Nolturesh Lumi SRO Location : Nolturesh –Lumi SRO		Date : 21st September 2012 Description : Mr. Okawa JICA Expert explains a point at Nolturesh Lumi SRO Location : Nolturesh –Lumi SRO
		
Date : 8th November 2012 Description : Counterpart Staff introduces days agenda Location : Danida Hall, Taveta		Date : 8th November 2012 Description :Kisii Supervisors explains the process of preparation of Flood Hazard Map Location : Danida Hall, Taveta
		
Date : 8th November 2012 Description : WRUA members participate in drawing map on the ground Location : Danida Hall, Taveta		Date : 8th November 2012 Description : Transferring the map from the ground to paper Location : Danida Hall, Taveta

		
Date : 8th November 2012 Description : Preparing the final copy of the Flood hazard map from the rough draft Location : Danida Hall		Date : 8th November 2012 Description : Lake Jipe Gauging Station (Landmark) Location : Lake Jipe
		
Date : 8th November 2012 Description : Gulleys channeling flood waters to Lower Lumi (Masaini) Location : Rekeke		Date : 8th November 2012 Description : Final Draft of Flood Hazard Map Location : Danida Hall, Taveta
		
Date : 8th November 2012 Description : Mafete gulley in dry condition Location : Taveta Town		Date : 9th November 2012 Description : Mafete gulley after a storm Location : Taveta Town

		
Date : 8th November 2012 Description : Route to Abori School before storm Location : Road to Abori School		Date : : 9th November 2012 Description : Route to Abori School after storm Location : Road to Abori School
		
Date : 8th November 2012 Description : House in village before storm Location :Kimorigo		Date : 9th November 2012 Description : House in village after storm Location :Kimorigo
		
Date : 8th November 2012 Description : Evacuation place located in Eldoro village Location : Eldoro Village		Date : : 9th November 2012 Description : Abori School with flood marks Location : Kimorigo

MINUTES OF MEETING BETWEEN JICA EXPERT AND WRMA NANYUKI RO, ISIOLO SRO AND WRUA MEMBERS

1. Objective

- To make community Flood Hazard map at middle zone of Isiolo river
- To assess the existing flood problems and various intervention that are put in place
- To explain to WRMA RO and SRO on the importance of keeping flood data.

2. Discussions

1) Day 1, meeting at Nanyuki RO

Attendance

WRMA

- Mr. S.W. Wan'gombe – DTCM (Regional Manager ENNCA)

JICA PROJECT TEAM

- Mr. Naonori OKAWA JICA Expert (GIS)
- Mr. Clement NGIDA Project supervisor – Kisii
- Mr. Jared OTIENO Project supervisor - Isiolo

The meeting took place at Regional Manager Office on November 19, 2012 at 5.50 p.m. Mr. Okawa explained the purpose of the meeting and the activity for the week in Isiolo sub – region area. During the discussion, Regional Manager (RM) informed the meeting of the capacity of RO, and SRO staff on GIS user and knowledge. In the RO, there are 2no. WRMA staff who can use GIS and in Isiolo SRO, only 1no. staff who is the SRM who can use GIS. RO has one PC which is installed GIS software. There are a number of GPS gadgets in the RO and 3no. in SRO in Isiolo. Mostly the GPS gadgets are mainly used in boreholes, water pans, dams and intake works data, no much effort has been put to use GPS in flood related data.

The RO has only one report on the past floods of 8th September 2010, which affected Kiandongoro area in Rumuruti Sub-regional office.

The biggest challenge that was pointed by RM was the lack of flow of information from WRMA HQ to RO and SRO. This made it impossible to facilitate RO staff to join the Project team in community hazard map development. However, the GIS experts at RO were on a short course training outside the country.

Meeting at WRMA ENNCA Regional Office at Nanyuki explaining the purpose of the visit

2) Day 2, meeting at WRMA SRO at Isiolo

Attendance

WRMA

- Mr. George Karichu – Accountant/Administrator
- Mr. Gideon Gituma – SWO
- Mr. Collins Odhiambo - WCO

JICA PROJECT TEAM

- Mr. Naonori OKAWA JICA Expert (GIS)
- Mr. Clement NGIDA Project supervisor – Kisii
- Mr. Jared OTIENO Project supervisor - Isiolo

The meeting took place at WRMA SRO in Isiolo on November 20, 2012 at 9.30 a.m. Mr. Okawa explained the purpose of the visit. He explained the importance of collecting flood data in terms of water depth, water volume and rainfall data for proper flood damage analysis. In drawing community hazard map, there is need to include the young, old, middle age and women, this will enhance analysis of flood map and flood danger points.

Mr. Clement explained the need for WRMA SRO staff to attend the activities in community hazard map development. This will enhance the capacity of WRMA staff to expand to other flood prone areas within the sub-region since the concentration was on the middle part of Isiolo sub catchment. The issue of flow of information arose; the SRO either did not receive any communication either from WRMA HQ or RO.

Meeting at WRMA SRO at Isiolo explaining the purpose of the visit and steps in developing community hazard map

Workshop on development of community Hazard map

The workshop took place at Isiolo WRUA office at Maili Saba on November 20, 2012. Mr. Clement led the community in explaining the importance of Flood map and why it must be drawn by the community both across the ages and gender. The chairman of the Isiolo WRUA explained the various challenges facing the community and why the attendance was not very well as expected. The various challenges identified by the chairman were as follows:

- Community calendar is busy since this is the long rainy season in the area, many members were busy attending to their farm lands.

- The community believes in hand outs, if there is no such provision for the opportunity cost of attending the meeting, not many will attend.
- Many development partners in the area are also adapting from giving out incentives to the community whenever they attend meeting, this has led to low esteem for the community to attend such meetings. However, there is element of change of attitude in some members of the community and they are encouraging each other to attend such important meeting since the benefit is for the community and generations to come.

The chairman explained to the meeting various instances that the community has succumb to losses as a result of floods. He urged members to be positive as the exercise will increase our survival tactics during the floods and minimize loss to properties.

The community having understood the necessity of the flood hazard map, choose one member to draw under the guidance of the rest of the community members. The project team also helped to guide the community on hazard map development and the exercise went on smoothly. On the map, the community identified flood danger points, affected areas and priority of danger points based on the collateral damage the community has experienced.

1. Isiolo WRUA Office at Maili Saba (Chairman welcoming, WRMA SRO staff and JICA Expert)
2. Mr. Clement explaining the need and steps in developing community hazard map.
3. Isiolo WRUA chairman start to sketch flood hazard map by drawing main road
4. WRUA member corrects mistake in first draft flood hazard map.

The community after drawing the first sketch of the flood map, they pointed out the mistakes and drew the second draft that was acceptable by all members. The hazard map mainly covered the middle zone of the Isiolo sub catchment. The upper and lower region hazard maps were to be developed by the community/WRUA and WRMA officials in the next step of the activities.

Drawing and finalizing the second draft of the community Flood hazard map

付属資料 3-2

Isiolo 川流域洪水管理計画案

ケニア共和国
洪水に脆弱な地域における効果的な
洪水管理のための能力開発プロジェクト

Isiolo 川流域
洪水管理計画（案）

2013 年 7 月

株式会社ニュージェック

ケニア共和国
洪水に脆弱な地域における効果的な洪水管理のための能力開発プロジェクト

Isiolo 川流域洪水管理計画（案）

目　次

1. 河川流域洪水管理計画の方針（案）

1.1 当該河川流域における洪水管理の方針（案）

Isiolo 川流域はケニア山麓に位置しているため全般的に地形勾配が急であり、降雨から洪水が流出するまでの時間が短く、洪水ピーク流量も大きいという特徴がある。Isiolo 市街地は、地域の社会経済活動の中心であり、ナイロビからケニア北部への唯一の幹線国道が通っているため、今後、交通の要衝や観光拠点としての開発が計画されている重要な地方都市である。また、洪水管理を含む水資源管理全般について、WRMA Middle Ewaso Ng’iro Sub Regional Office (SRO)の所管区域に含まれており、Isiolo 川流域内には Isiolo WRUA が設立されており、WRMA と共同して草の根レベルの水資源管理を行っている。

主な洪水被害は、Isiolo 市街地での外水・内水氾濫による社会経済活動の停滞や人的被害、及び、流域全体各所における局所的な河川氾濫と河岸浸食による土地・農地の流失や土砂災害、道路・橋梁の損害である。したがって、当該河川流域における洪水管理の方針は、Isiolo 市街地の浸水被害を軽減すること、及び、地域経済活動において重要な箇所における局所的な河川氾濫と河岸浸食被害の軽減に重点を置く。

洪水管理計画の策定に当たっては、構造物・非構造物対策の適切な組み合わせや、自助・共助・公助といった視点を考慮するとともに、WRUA をはじめとする利害関係者やコミュニティの参加を通して合意形成を図る。さらに、計画段階から WRUA やコミュニティが協働することにより、WRUA・コミュニティのオーナーシップの醸成を図り、構造物対策の当該流域内での普及・展開と維持・管理や非構造物対策において、WRUA・コミュニティが主体となって実施していく。

なお、本計画の対象期間は 2013～2018 年の 5 年間とし、必要に応じて適宜見直していくものとする。

1.2 WRMA の役割と責任

本計画の作成主体は WRMA である。WRMA は、WRUA が主体となって実施可能な事業を Sub-Catchment Management Plan (SCMP)に組み込めるよう WRUA の支援を行い、さらに、洪水対策事業の実施に当たって技術的支援を行う。WRUA が主体とならない事業については、WRMA が関係ステークホルダーと調整を図りながら、事業の実施を促進する。

1.3 河川流域委員会

洪水管理は河川流域内の多様なステークホルダーが協力しなければ達成できないものである。また、一つの河川流域が上流・下流・左右岸などによって複数のサブ流域に分けられている場合もある。

以上を踏まえ、WRMA は、河川流域内のステークホルダーを一同に集め、河川流域単位で洪水管理に関する情報共有・調整を行うことを目的として、統合洪水管理河川流域委員会(Integrated Flood Management River Basin Committee)を設立する。

同委員会に参画を求める河川流域内のステークホルダーを以下に挙げる。

表 1.3.1 Isiolo 川流域のステークホルダー

No	Organization	Remarks
1	Isiolo River WRUA	One representative from each of the six Zones
2	Provincial Administration	County Commissioner
3	Ministry of State for Special Programmes	Active in providing humanitarian assistance to disaster victims in Isiolo area
4	Kenya National Highways Authority/Kenya Rural Roads Authority – Representative	One representative each from KenHA and KeRRA
5	Ministry of Water and Irrigation	Irrigation Department representative
6	Ministry of Lands	District Physical planner
7	Ministry of Agriculture	District Agricultural Officer
8	Ministry of Livestock	District Livestock Officer
9	Ministry Of Education	District Education Officer
10	Ministry of Development of Northern Kenya and Other Arid Lands	Active in providing humanitarian assistance to disaster victims in Isiolo area
11	Kenya Meteorological Department	Contact Person at National Level
12	Ewaso Ng'iro North Development Authority (ENNDA)	Representative from Regional Office
13	National Environmental Management Authority	District Officer
14	County Council of Isiolo	One representative
15	County Council of Meru	One representative
16	Red Cross	Representative from Regional Office
17	World Vision	Representative from Regional Office
18	Food for Hungry (fhi)	Representative from Regional Office
19	Lewa Conservancy	CAAC member
20	Pastoralists	One representative
21	Farmers	One representative
22	CAAC	Chairman
23	Environment/Natural Resources Management CBOs	Environment representative
20	Kenya Wildlife Service	One representative from Isiolo area
21	Religious Group	One each from Christian and Muslim
22	Northern Water Service Board (NWSB)	One representative
24	Kenya Forest Service	CAAC member
26	Department of Social Services	Registers WRUAs and other social welfare groups
29	Kenya National Chamber of Commerce and Industry	Isiolo chapter
30	Catholic Diocese of Isiolo	One representative
31	WRMA	HQ, RO, SRO

同委員会では、関係ステークホルダー間の意見交換、洪水管理計画の承認、コンセンサス構築、役割分担の議論、活動評価等を行う。委員会は、当面は数か月に 1 回程度の開催頻度で、次のような内容について討議する。

表 1.3.2 統合洪水管理委員会開催スケジュール（案）

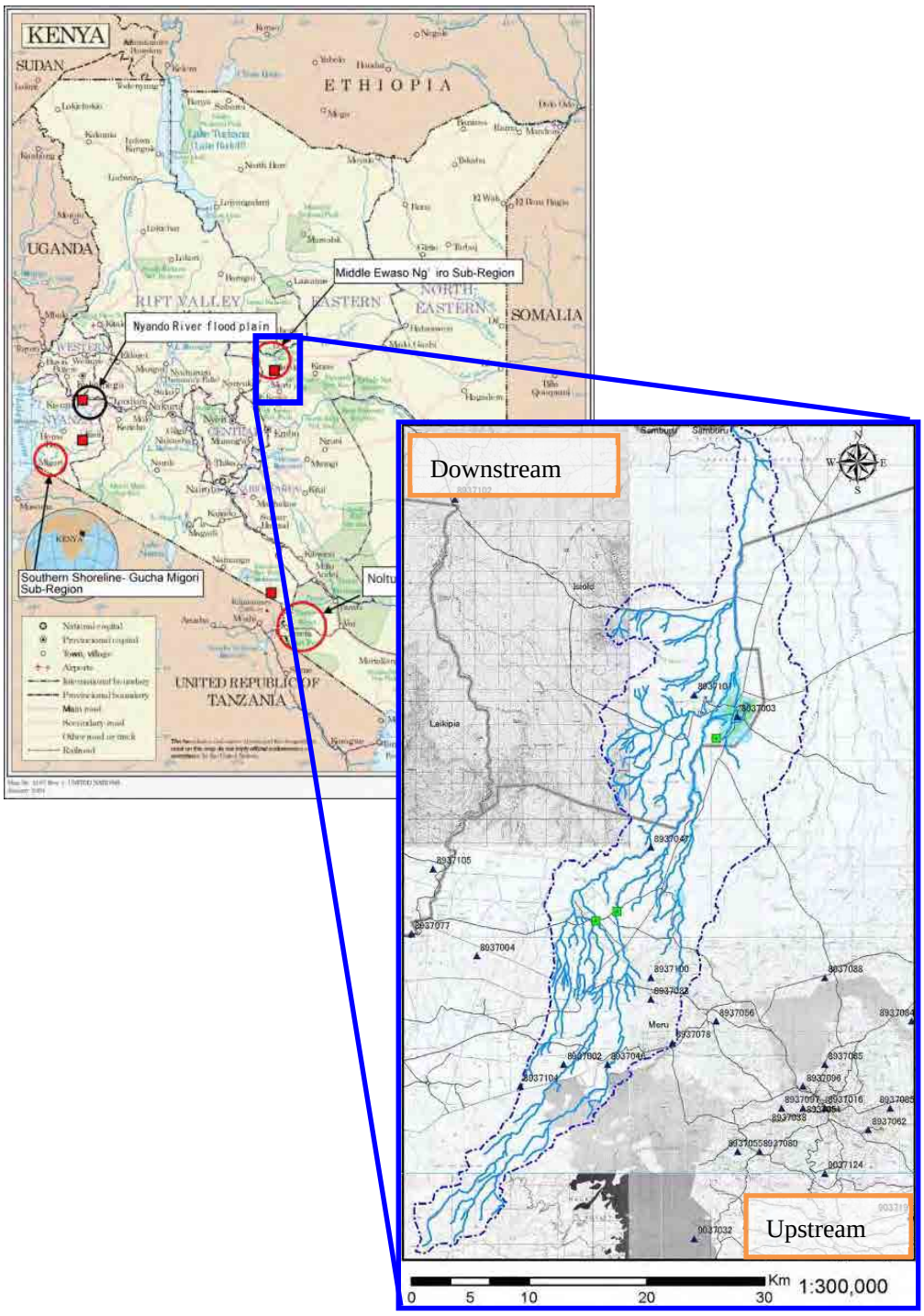
回	討議内容	備考
第 1 回	・ 洪水の現状・問題点についての共有 ・ 考えられる洪水対策についての議論	2013 年 1 月 23 日に実施
第 2 回	・ 洪水管理計画（案）の提示 ・ 洪水管理計画（案）の議論 ・ パイロット事業の合意形成（本プロジェクトのみ）	
第 3 回	・ 洪水管理計画（案）の議論 ・ パイロット事業の進捗報告（本プロジェクトのみ）	
第 4 回	・ パイロット事業の評価（本プロジェクトのみ）	

1.4 環境社会配慮

洪水対策事業を計画するに当たっては、ケニア国 Environmental Management and Coordination Act (EMCA) 1999 に基づき、適切な環境社会配慮を行う。

2. ISIOLO 川流域の概要

Isiolo 川流域は、アフリカ東部のケニア共和国の中央部、ケニア山麓の北部に位置している。



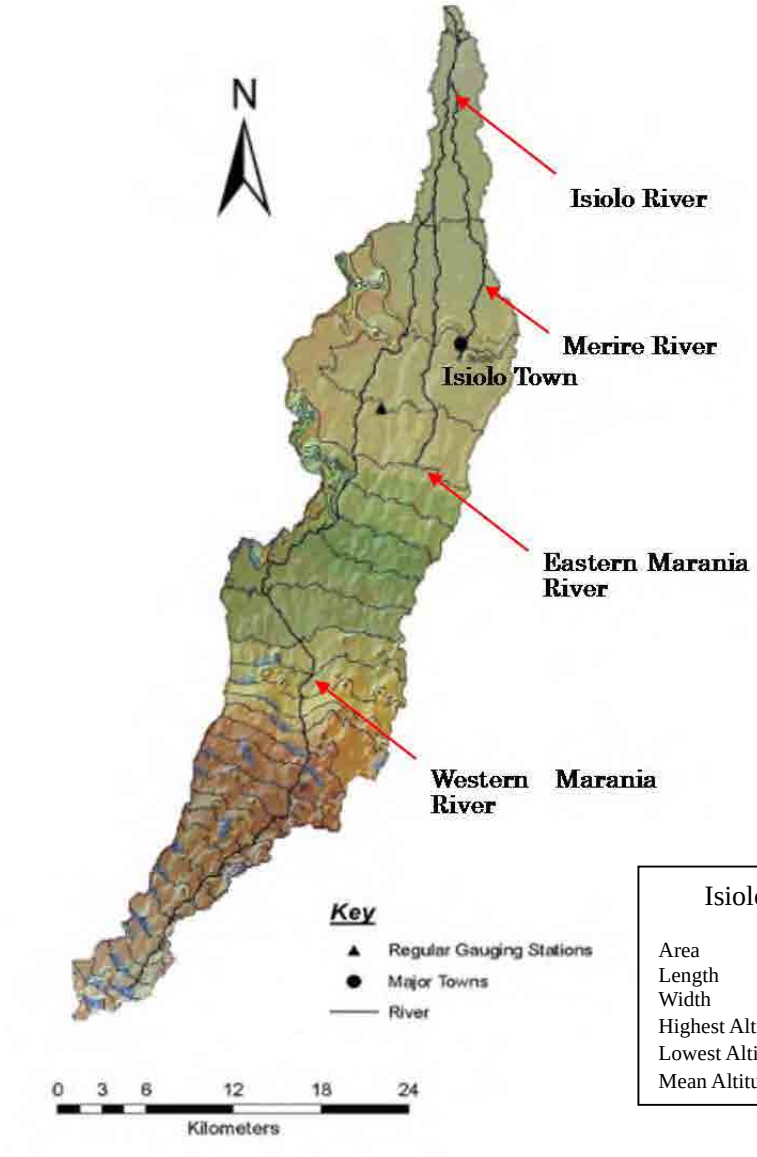
Isiolo 川流域の位置

2.1 自然条件

2.1.1 地形・土壌

(1) 地　　形

Isiolo 川流域の面積は約 683 km^2 で、全長は南北におよそ 95km、東西の幅は最も広いところで 15km となっている。Isiolo 川はケニア山を源流とし、Meru Central, Imenti North, Isiolo District の 3 つの District を経て流下し、Archer's Post 付近で Ewaso Ng'iro North 川と合流している。上流には数多くの支川があり、Isiolo Town の下流で Isiolo 川に合流している。主な支流に Western Marania 川、Eastern Marania 川、Merire 川がある。



Isiolo 川流域諸元

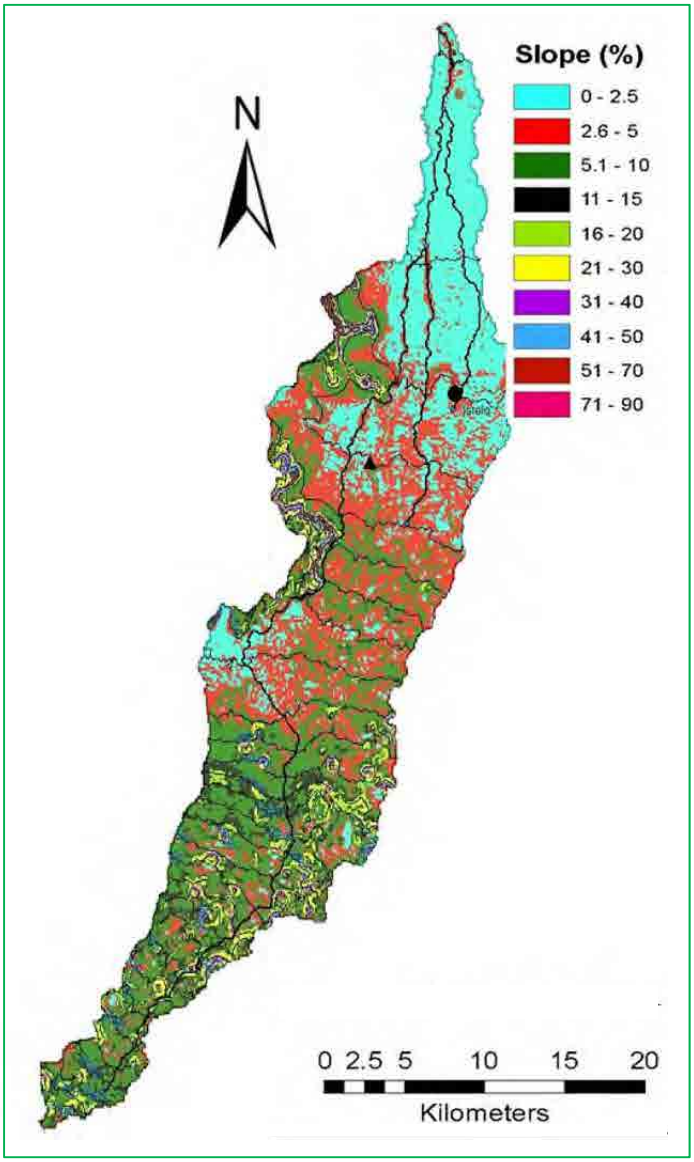
Area	-683 km^2
Length	-95 km
Width	-15 km
Highest Altitude	-海抜 3905 m
Lowest Altitude	-海抜 872 m
Mean Altitude	-海抜 1746 m

出典：WRMA 資料に JICA Project Team が加筆

図 2.1.1　Isiolo 川流域図と標高分布

流域における地形勾配を以下に示す。流域において、上流のケニア山周辺から中流域にかけては急峻であり、10～70%くらいの勾配の極めて急な箇所が点在している。中流域では、概ね 5～2.6%までと緩和され、下流域では 2.5%までの緩勾配の地形となっている。

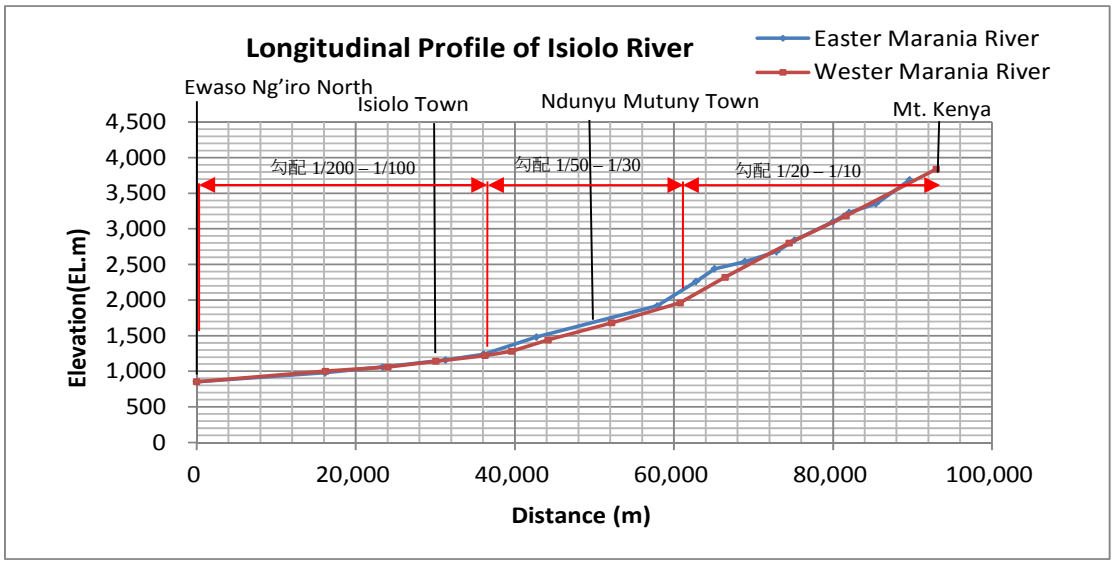
Isiolo 川流域では Isiolo Town を中心とした地形勾配が急勾配な区間から緩い区間へ移行する地域に居住区が集中している。その理由の一つにこの付近では泉が湧き出ることや地形勾配の変化点であるため、地下水位が高いことが考えられる。勾配が急な山岳地形の地点では、局地的な激しい雨が発生する事が多い。



出典：WRMA 資料に JICA Project Team が加筆

図 2.1.2 Isiolo 川流域の地形勾配分布

Isiolo 川の縦断勾配を次図に示す。

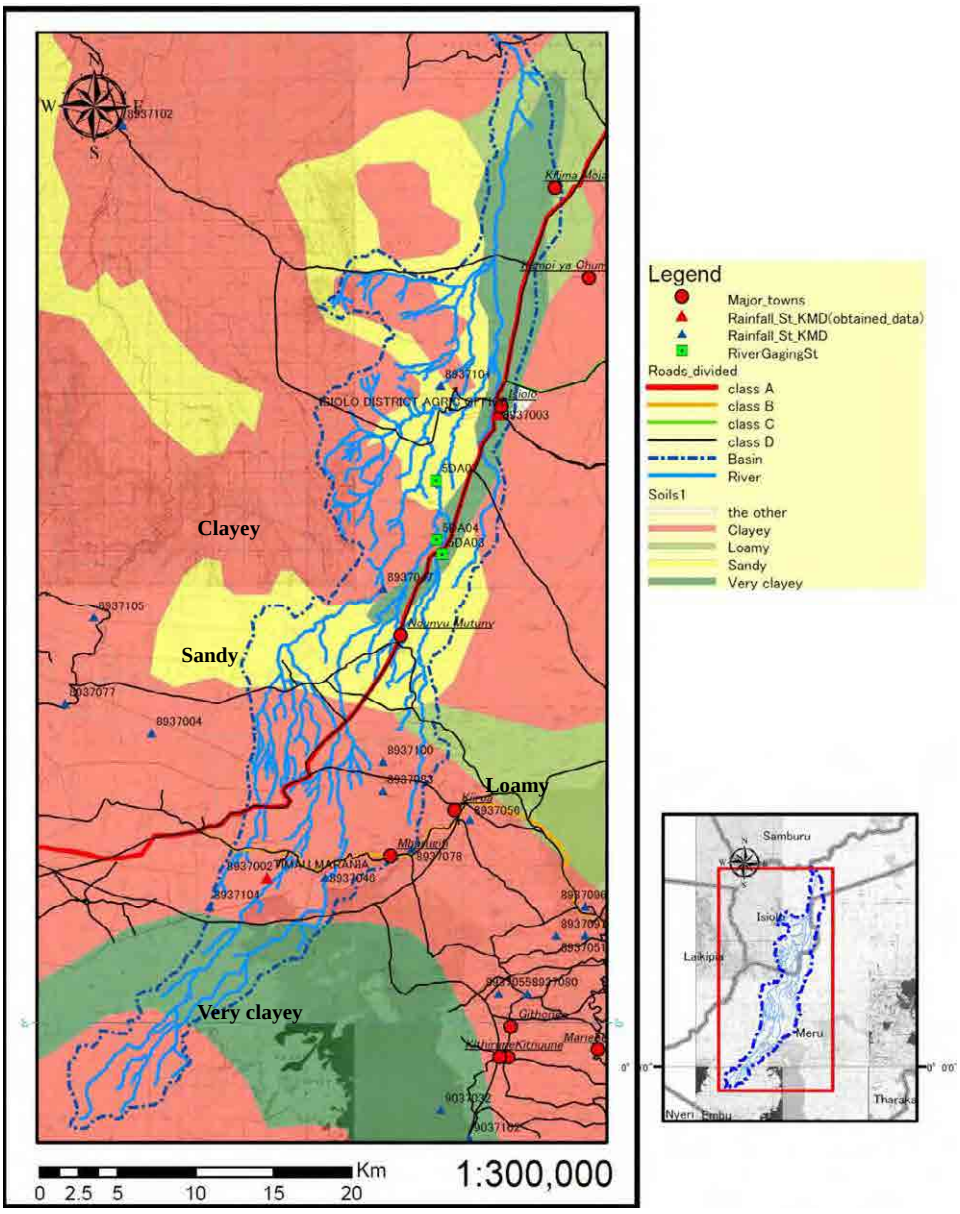


出典：1/50,000 地形図をもとに JICA Project Team が作成

図 2.1.3 河川流路縦断図

(2) 土　　壌

Isiolo 川流域における土壌分布図を以下に示す。流域全般に粘土質の土壌が覆っており、中流域の一部と中流から下流にかけての本川左岸側に砂質の土壌が分布している。下流域の本川右岸側は粘性質の高い土壌であり、シルトおよび粘土の含有割合が 25～40%程度で構成されるローム層が分布している。Isiolo Town は強い粘土質の土壌上に立地している。



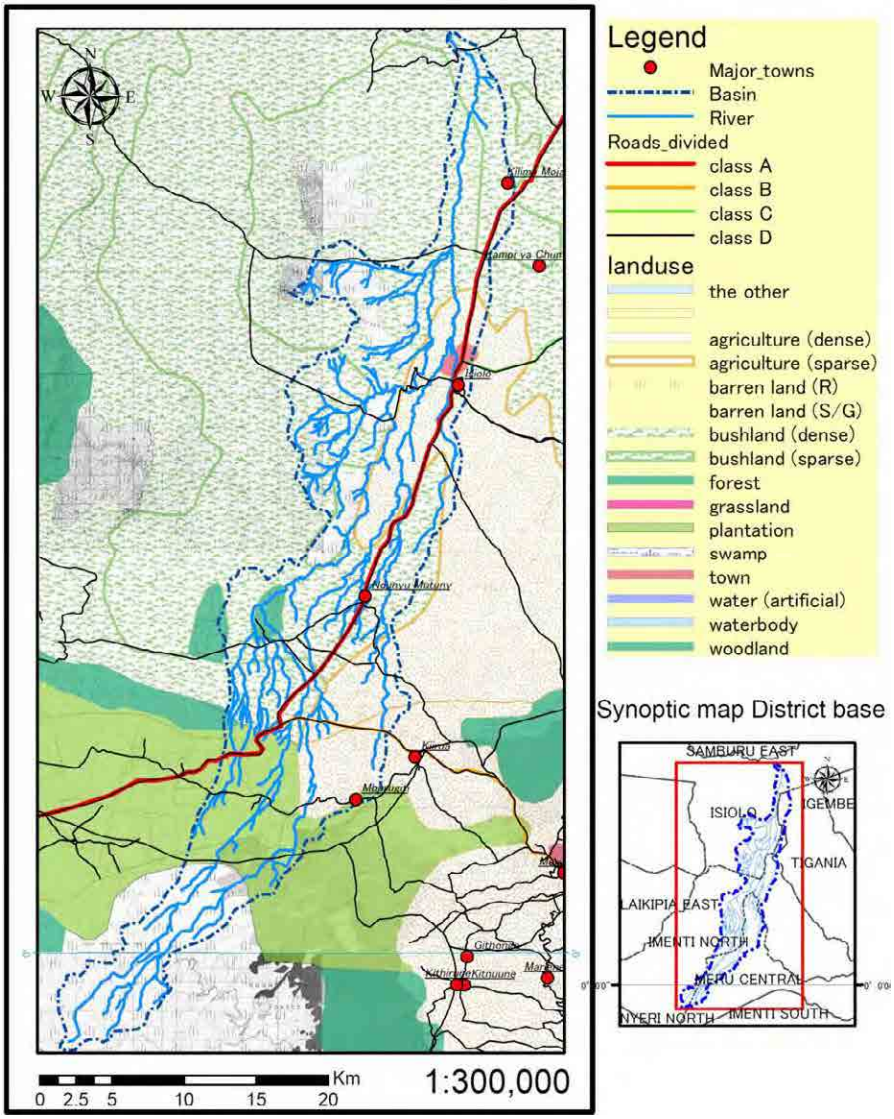
出典: Kenya soil survey (KSS) in 1982 and revised in 1997.をもとに JICA Project Team が作成

図 2.1.4 土壌分布図（Soil texture）

2.1.2 植生・土地利用

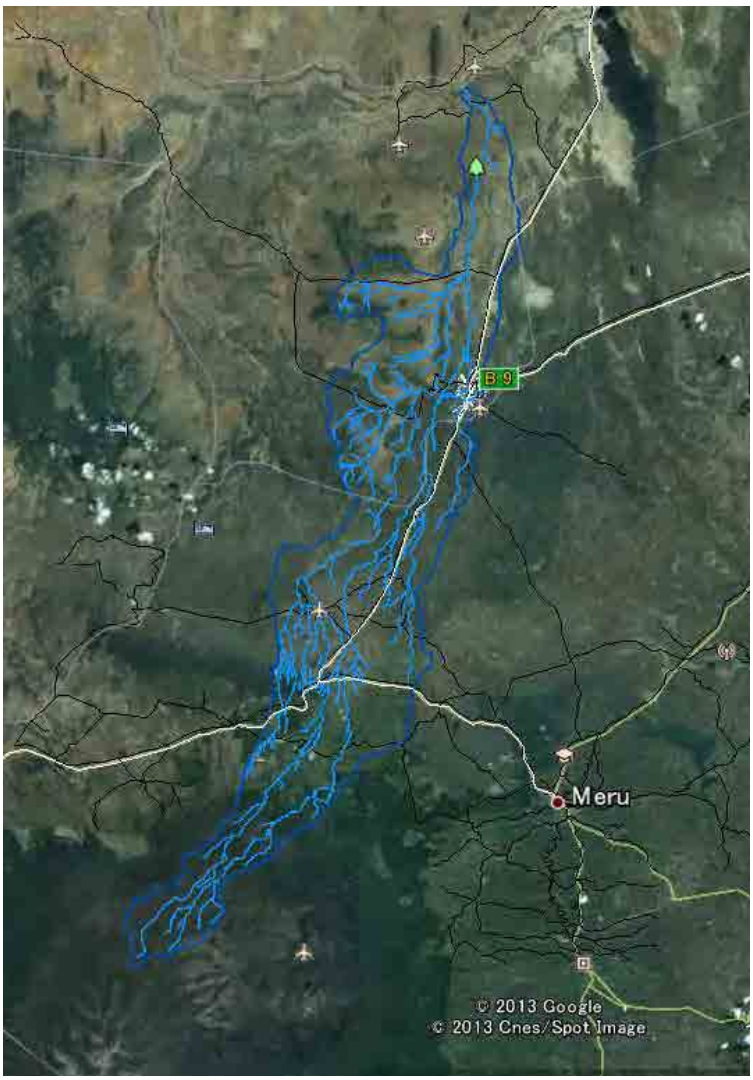
(1) 土地利用

Isiolo 川流域における土地利用特性及び衛星写真を以下に示す。上流域の山間部は土地利用図から読み取れるように不毛地となっており、山肌が露出している。中上流域においてはプランテーションが行われている。中流域から下流域にかけて低木林地が広がり、中流域の Western Marania 川及び Eastern Marania 川の沿川と Isiolo Town の市街地近郊に農地が存在している。なお、本流域は乾燥地帯に属しており、乾燥に強い植生に限られているため、森林占有面積は極めて少ない。



出典: JICA, National Water Master Plan のデータをもとに JICA Project team が作成

図 2.1.5 Isiolo 川流域における土地利用



出典：Google Earth 画像データ（2012 年 12 月 10 日）に JICA Project Team が加筆

図 2.1.6　Isiolo 川流域の衛星写真

NRM3 と CETRAD の調査によると、Isiolo 流域の 1995 年時点で 29.1km^2 であった森林面積が 2002 年時点は 14.1km^2 になっており、1995 年から 2002 年の間に 15km^2 の森林が損失したとされている。これは、年間で平均 2.1km^2 の森林損失が起こっていることになり、この年間森林損失率が続けば、2018 年には流域内のすべての森林が消滅してしまうことになる。

2.1.3 気象・水文

(1) 雨量及び水位観測の状況

(a) 観測地点

KMD 所管の雨量観測所及び水位観測所の位置図を以下に示す。雨量観測所を三角形、水位観測所を四角形で示しており、そのうち、本プロジェクトにおいて日雨量データを入手した雨量観測所を赤で着色している。地図に示されている番号は観測所番号を表す。

雨量観測所番号 8937002 の Timau Marania 地点は上流域の山地部、観測所番号 8937003 の Isiolo District Agric Office (以降 Isiolo DAO と表記)は Isiolo 市街地近郊に位置している。

水位観測所番号 5DA03 の Kithima 地点は中流域、観測所番号 5DA07 の Isiolo 地点は Isiolo 市街地近郊に位置している。

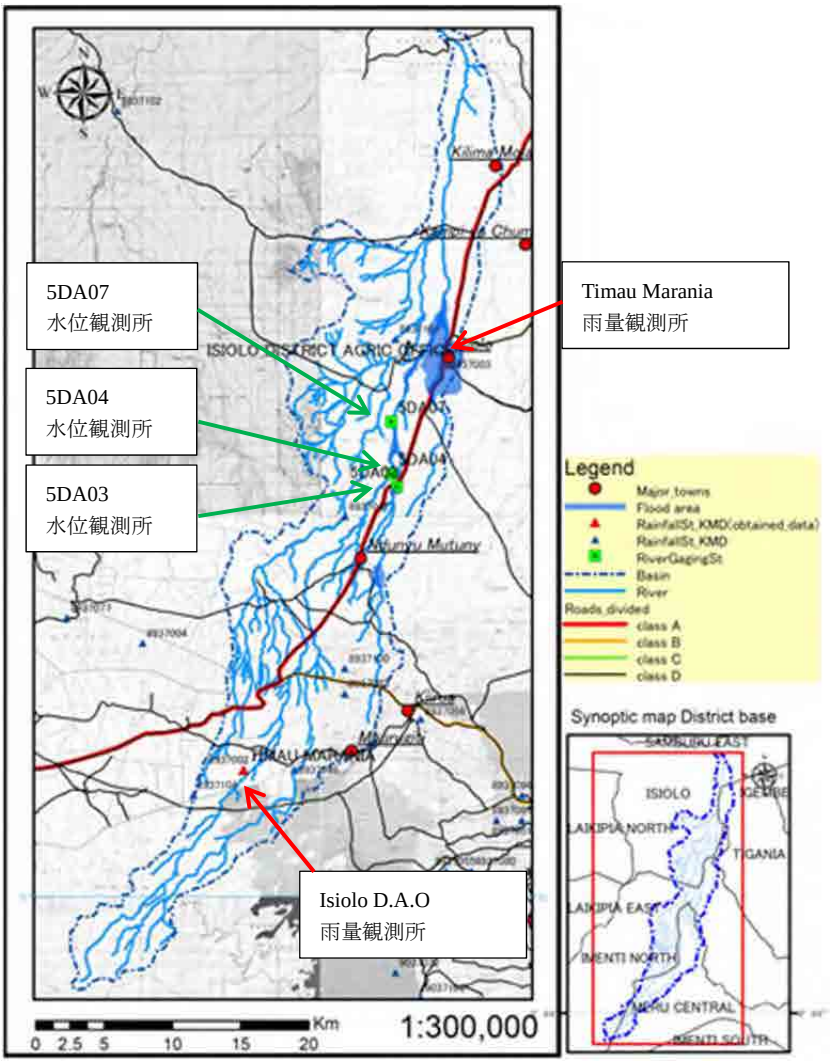


図 2.1.7 雨量観測所及び水位観測所の位置図

水位観測所番号：5DA07
観測河川：Eastern Marania River

同　　左

水位観測所番号：5DA04
観測河川：Eastern Marania River
特記：水位計が折れており、破損している。

水位観測所番号：5DA03
観測河川：Eastern Marania River

(b) 雨量観測データ

Isiolo 川流域内及び近傍の KMD 所管する雨量観測所の一覧を以下に示す。

Timau Marania, Isiolo DAO、Muchene Forest の 3 ヶ所に関しては、WRMA が 1989 年から 2003 年ごろまで雨量観測を行っていた。表 2.1.1 のうち、WRMA 地域事務所から Timau Marania, Isiolo DAO の 2 地点についての日雨量データを入手出来ている。入手できた観測期間は、Timau Marania は 1930～2011 年、Isiolo DAO は 1957 年～1989 年（欠測期間を含む）である。一方、Muchene Forest のデータは、観測データが存在するはずであるが、WRMA 地域事務所には保管されておらず、入手することが出来なかった。

なお、2003 年以降の雨量観測は KMD（ケニア気象庁）に移管され、WRMA との間でデータ共有される方向で調整が進んでいるが、現在までのところ実現できていない。

表 2.1.1 Isiolo 川流域内及び近傍の KMD 所管雨量観測所の一覧

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

出典：KMD

(c) 水位・流量観測データ

Isiolo 川流域の水位観測所の一覧を以下に示す。下記の表のうち、観測データを入手できた地点は着色した観測所番号 5DA07 のみである。自動観測はなされておらず、目視による水位観測はなされているが、朝と夕方の 1 日 2 回の観測であり、洪水時の流量を捉えているとはいえない。

表 2.1.2 Isiolo 川流域の水位観測所一覧

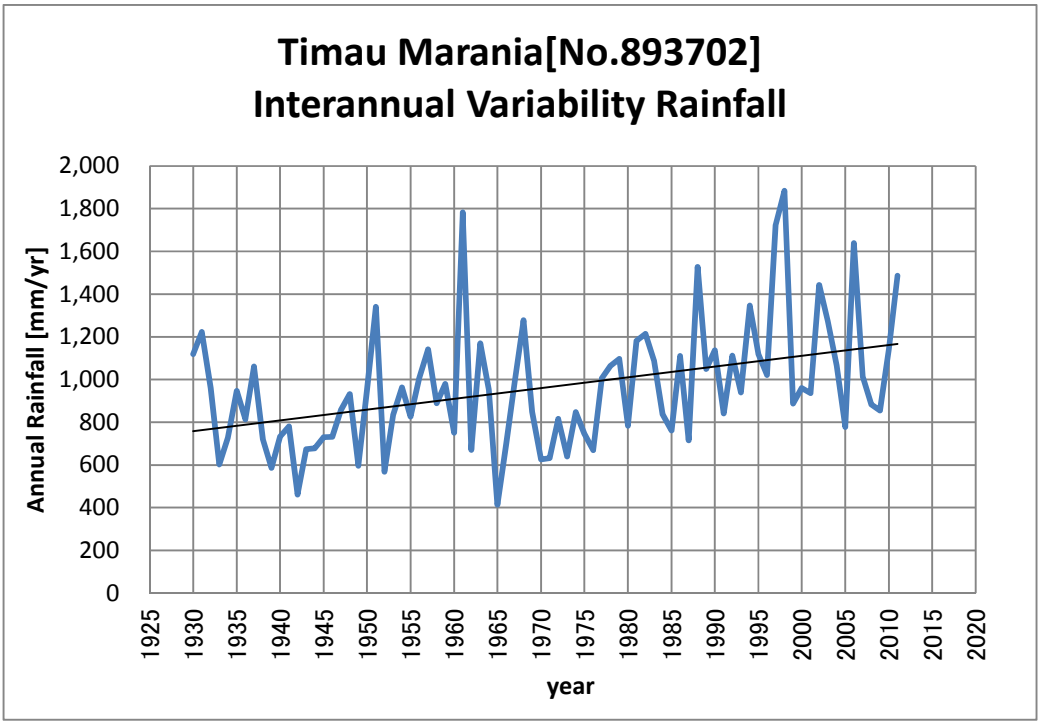
No.	ID	Name	River Name	Manual/ Auto/ Both	National/ MU/IMU/ Special	Daily/ Hourly/ Both	Operational	Start Year	End Year	SRO in charge
1	5DA07	Isiolo	Isiolo	Manual	MU	Daily	Yes	1976/1/1	N/A	MEN
2	5DA03	Kithima	Kithima	Manual	Intra-MU	Daily	Yes	2010/9/1	N/A	MEN
3	5DA04	Rugusu	Rugusu	Manual	Intra-MU	Daily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

出典：WRMA

(2) 降水量の特性

(a) 年降水量の長期的な推移

Timau Marania 地点における 1930 年～2011 年の観測期間の年降水量の推移を以下の図に示す。1930 年～2011 年間における観測記録のうち、年降水量の最高値を示したのは 1998 年の 1883mm/yr であり、同観測期間の年降水量の平均は 959mm/yr である。年降水量の平均値は上昇傾向にある。



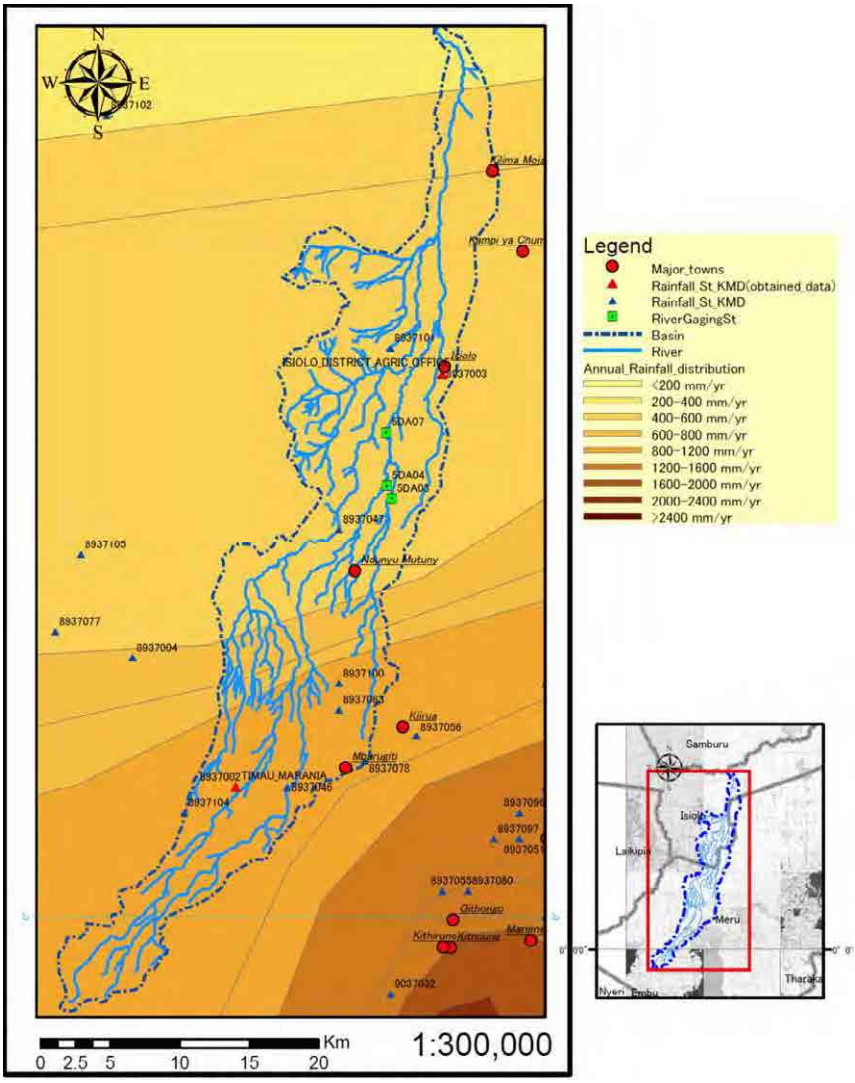
出典: 1930～2011 年の年降水量データをもとに、JICA Project Team が作成

図 2.1.8 Timau Marania 地点における年降水量の推移

(b) 年降水量分布

月平均気温は高地の 7.6°C から低平地の 32°C の間で分布しており、低平地は半乾燥地帯に属している[1]。水源であるケニア山周辺の年間降水量は 1,200 mm/yr を超えており、流域最大の都市である Isiolo 市街地では年間降水量が平均 600 mm/yr 程度である。Isiolo 川流域における年間降水量の分布状況を以下に示す。この分布図から、上流域と中下流域において降雨分布が異なることを読み取ることができる。標高 2,500 m から 3,900 m の上流域は年間降水量が 800 - 1,200 mm/yr に分布しており、流域面積の約 6 割を占めている中流域から下流域にかけては 400 - 600 mm/yr に分布している。

[1] Isiolo WRUA and WRMA, SCMP (March 2009)



出典: JICA, National Water Master Plan のデータをもとに JICA Project Team が作成

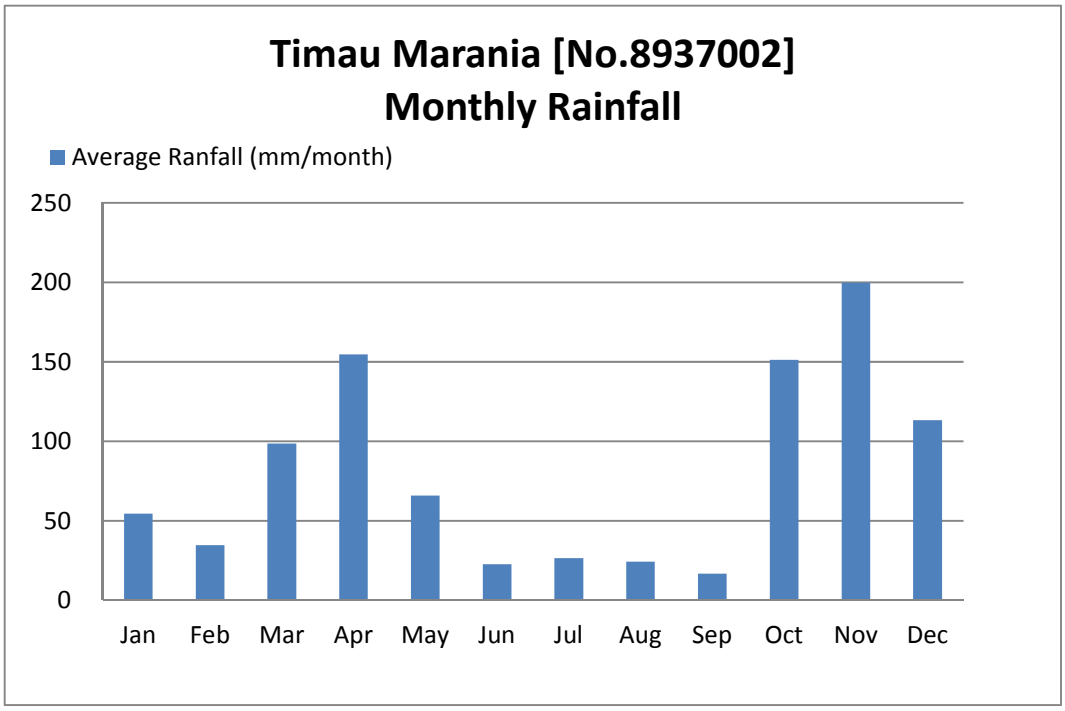
図 2.1.9 Isiolo 川流域の年間降雨量分布図

(c) 月降水量

Isiolo 川流域では年間に 2 度の雨季があり、3 月から 5 月と 10 月から 12 月の雨期において降水量が多くなっている。Isiolo 川上流域に設置された Timau Marania 雨量観測地点における月別降水量を以下に示す。下記の図に示すとおり、4 月と 11 月の降雨量が年間を通じて最も多くなっていることがわかる。なお、最も降水量が大きい 11 月の月別降水量は 200 mm/month となっている。

また、近年は、短時間に激しい降雨となる傾向にある。その一方で、乾期の 2 月、8 月、9 月には下流域において河川水が枯渇している[2]。

2 Isiolo SCMP



出典：降水量データ（:1930 年～2011 年の）をもとに、JICA Project Team が作成

図 2.1.10　Timau Marania 地点月別降水量

(d) 日降水量

Timau Marania 地点

Timau Marania 地点における 1957 年～1988 年の日降水量データから、各年の年最大日雨量と年間降水量、欠測日数、欠測期間を以下の表に示す。表中の赤字で示された数値は欠測期間のあった年の年間総雨量であり、欠測期間中に雨が降っていれば年間雨量として不足している可能性があることを示している。

1957 年～1988 年の観測期間における既往最大日雨量は 1983 年 12 月 28 日に観測した 127.7mm/day である。年降水量の既往最大は 1961 年の 1737mm/yr である。（データセットが異なり、前出した年降水量データから示された既往最大年雨量の発生年、雨量とは異なっている。）

表 2.1.3 Timau Marania 地点の観測記録概要

Year	Date	MaximumDailyRainfall [mm/day]	AnnualRainfall [mm/yr]	Number of missing data	Period of missing data
1957	1957/10/29	85.6	872	32	1/1-2/1
1958	1958/4/26	67.1	667	0	
1959	1959/12/11	114.3	823	90	1/2-4/1
1960	1960/10/25	51.8	751	0	
1961	1961/12/14	104.6	1,737	28	2/2-3/1
1962	1962/10/12	33.8	645	0	
1963	1963/5/29	63.0	1,161	0	
1964	1964/4/18	64.0	975	0	
1965	1965/3/25	26.4	414	0	
1966	1966/3/29	43.2	703	0	
1967	1967/11/26	52.1	985	0	
1968	1968/4/3	94.0	1,278	0	
1969	1969/5/2	84.3	865	0	
1970	1970/10/15	51.1	625	0	
1971	1971/4/27	61.7	631	0	
1972	1972/6/22	54.1	815	0	
1973	1973/4/15	32.9	640	0	
1974	1974/11/7	52.8	849	0	
1975	1975/11/17	42.6	740	0	
1976	1976/12/14	42.3	634	30	9/2-10/1
1977	1977/11/7	68.8	1,008	0	
1978	1978/11/26	49.4	1,052	0	
1979	1979/2/1	75.8	1,097	0	
1980	1980/10/19	62.5	775	30	9/2-10/1
1981	1981/11/7	65.3	1,173	0	
1982	1982/10/29	73.2	1,214	0	
1983	1983/12/28	127.7	1,093	0	
1984	1984/11/15	75.6	837	0	
1985	1985/11/12	65.1	775	0	
1986	1986/10/26	63.4	1,119	0	
1987	1987/6/4	64.7	723	0	
1988	1988/12/21	67.8	1,537	0	

出典：WRMA が保有する Timau Marania 地点日降水量データ（1957 年～1989 年）から JICA Project Team が作成

ケニア全国的にみると小雨期が 11～12 月と、大雨期が 3～5 月とされている。欠測の無い年（27 ヵ年）で年最大値を記録している時期を見ると、小雨期で 10 回、大雨期で 9 回であり、小雨期・大雨期を除いた時期としては、10 月に 5 回、2 月に 1 回、6 月に 2 回となっている。

1957 年の欠測期間は 1 月 1 日から 2 月 1 日で小雨期、大雨期に該当しない期間であることから、年最大値が発生する確率はほとんどない。

1959 年は 1 月 1 日から 4 月 1 日であり大雨期が入っているが、小雨期である 12 月 11 日に 114.3mm と大きな雨量記録しており、これを上回る雨が降る確率はほとんどないと考えられる。

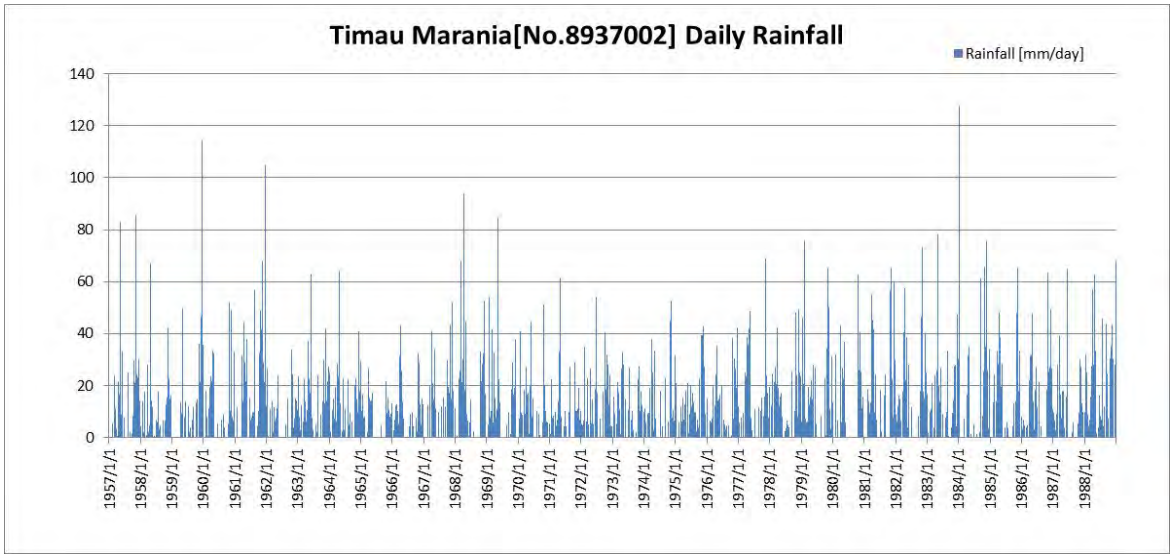
1961 年は欠測期間が 2 月 2 日から 3 月 1 日と小雨期、大雨期からほとんど外れており、12 月 14 日に 104.6mm と大きな値を記録しているため、これを超える値が発生する可能性は、ほとんどないと判断できる。

1976 年は欠測期間が 9 月 2 日から 10 月 1 日であり、小雨期、大雨期に該当しない期間であり、この期間中に年最大値が発生する可能性は低いと判断できる。

1980 年の欠測期間も同じく、9 月 2 日から 10 月 1 日であり、1976 年と同様、この期間中に、年最大値の降雨が発生する可能性は低い。

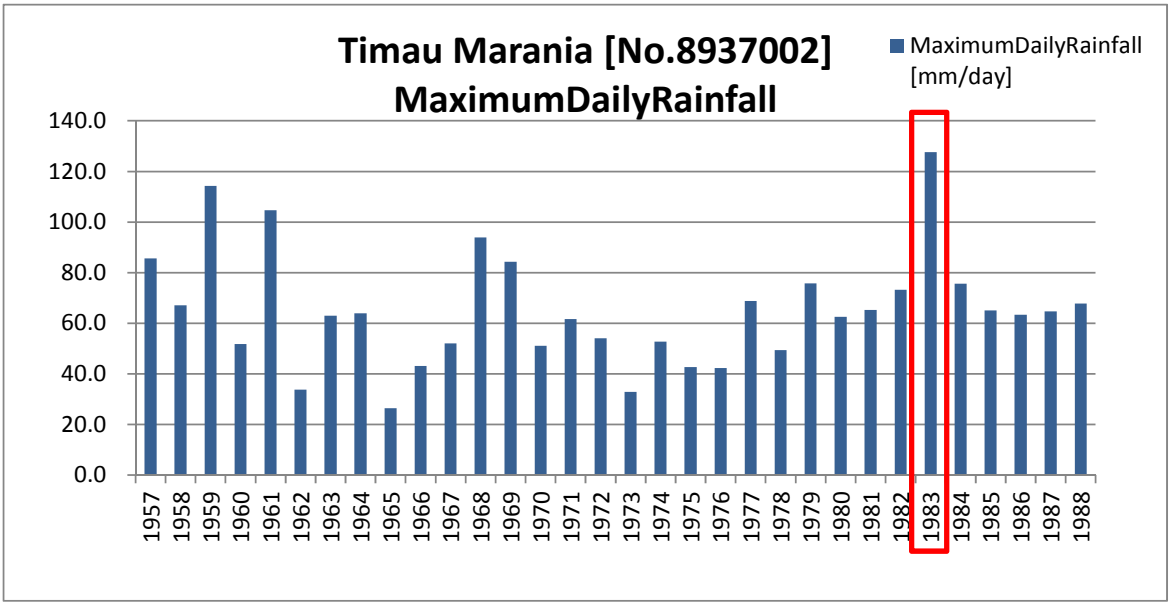
以上のことから、それぞれの欠測期間について、年最大の雨量が発生している可能性は低いと判断できるため、これらの値を解析に用いることとした。

Timau Marania 地点における 1957 年～1989 年の観測期間の日雨量の推移、及び年最大日雨量を以下の図に示す。



出典：WRMA が保有する Timau Marania 地点日降水量データ（1957 年～1989 年）から JICA Project Team が作成

図 2.1.11 Timau Marania 地点の日雨量の推移



出典：WRMA が保有する Timau Marania 地点日降水量データ（1957 年～1989 年）から JICA Project Team が作成

図 2.1.12 Timau Marania 地点の年最大日雨量

流域内の雨量観測所 Timau Marania 地点の 30 年間の観測期間（欠測期間あり）における年最大日雨量をもとに各確率規模別（1/50、1/30、1/20、1/10、1/5）の確率統計解析を行った。採用確率分布モデルの選定には国土開発技術研究センター「高水計画検討の手引き」の確率水文量設定の考え方に基づき Gumbel 分布を採用した。

水文統計解析の計算結果及びその端数を処理した計画日雨量を以下に示す。

表 2.1.4 Timau Marania 地点の確率規模別雨量計算結果

確率年	Jack Knife 推定値 日雨量(mm/day)	計画日雨量 (mm/day)
1/5	81.6	82
1/10	95.1	96
1/20	108	108
1/30	115.4	116
1/50	124.7	125

雨量観測地点名：Timau Marania

観測期間：1957 年～1988 年

採用確率分布モデル：Gumbel 分布

Isiolo DAO 地点

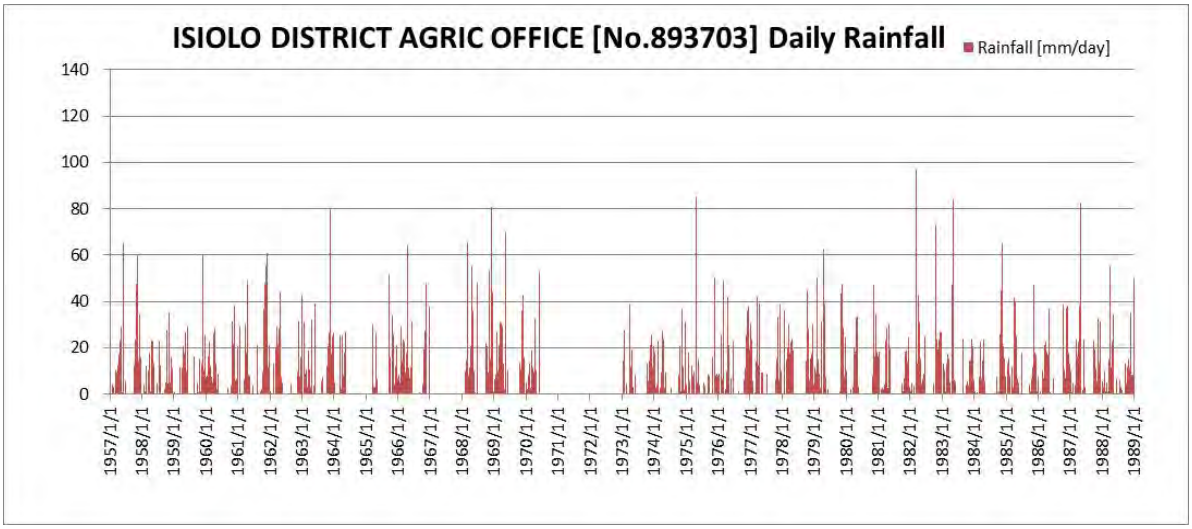
1957 年～1988 年の観測期間における各年の年最大日雨量と年間降水量、欠測日数、欠測期間を以下の表に示す。観測期間における既往最大日雨量は 1982 年 3 月 10 日に観測した 97 mm/day であり、年降水量の最大値は 1961 年の 1,261 mm/year である。

表 2.1.5 Isiolo DAO 地点の観測記録概要

Year	Date	MaximumDailyRainfall [mm/day]	AnnualRainfall [mm/yr]	Number of missing data	Period of missing data
1957	1957/05/28	65.3	737	0	
1958	1958/11/06	35.6	455	0	
1959	1959/11/24	60.5	550	59	1/2-3/2
1960	1960/11/17	38.4	593	0	
1961	1961/11/25	61.0	1261	28	2/2-3/1
1962	1962/04/22	43.7	689	62	1/2-2/1, 10/2-11/1
1963	1963/11/15	79.7	859	0	
1964	1964/05/02	27.0	209	243	1/2-3/1, 6/2-9/1, 10/2-12/31
1965	1965/09/21	52.0	309	94	1/1-2/1, 5/2-6/1, 7/2-8/1
1966	1966/04/13	64.1	682	30	9/2-10/1
1967	-	0.0	0.0	183	3/2-6/1, 10/2-12/31
1968	1968/11/27	80.8	1243	1	1/1
1969	1969/05/03	70.0	906	0	
1970	1970/05/28	53.1	296	213	6/2-12/31
1971	-	0.0	-	-	No data
1972	-	0.0	-	-	No data
1973	1973/03/28	38.6	475	1	1/1
1974	1974/11/08	36.7	498	0	
1975	1975/04/18	85.2	475	0	
1976	1976/02/26	49.2	624	0	
1977	1977/03/23	42.1	646	0	
1978	1978/10/13	44.8	807	30	6/2-7/1
1979	1979/04/10	62.3	726	0	
1980	1980/11/10	47.7	528	0	
1981	1981/05/03	30.3	467	0	
1982	1982/03/10	97.0	763	0	
1983	1983/04/27	84.1	555	0	
1984	1984/11/08	65.4	535	0	
1985	1985/11/05	48.0	581	0	
1986	1986/10/10	38.8	694	0	
1987	1987/04/23	82.9	638	0	
1988	1988/03/25	55.2	717	0	

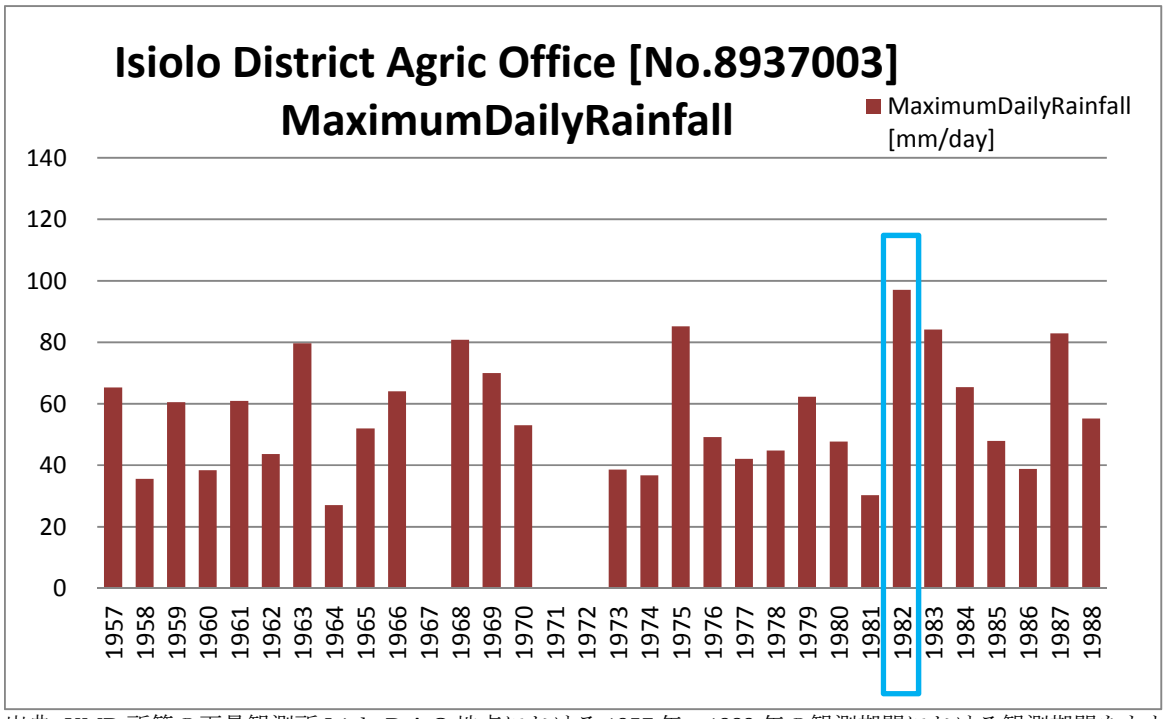
出典：WRMA が保有する Isiolo D.A.O 地点日降水量データ（1957 年～1989 年）から JICA Project Team が作成

Isiolo DAO 地点における 1957 年～1988 年の観測期間の日雨量の推移、及び年最大日雨量を以下の図に示す。



出典：WRMA が保有する Isiolo D.A.O 地点日降水量データ（1957 年～1989 年）から JICA Project Team が作成

図 2.1.13 Isiolo DAO 地点の日雨量の推移



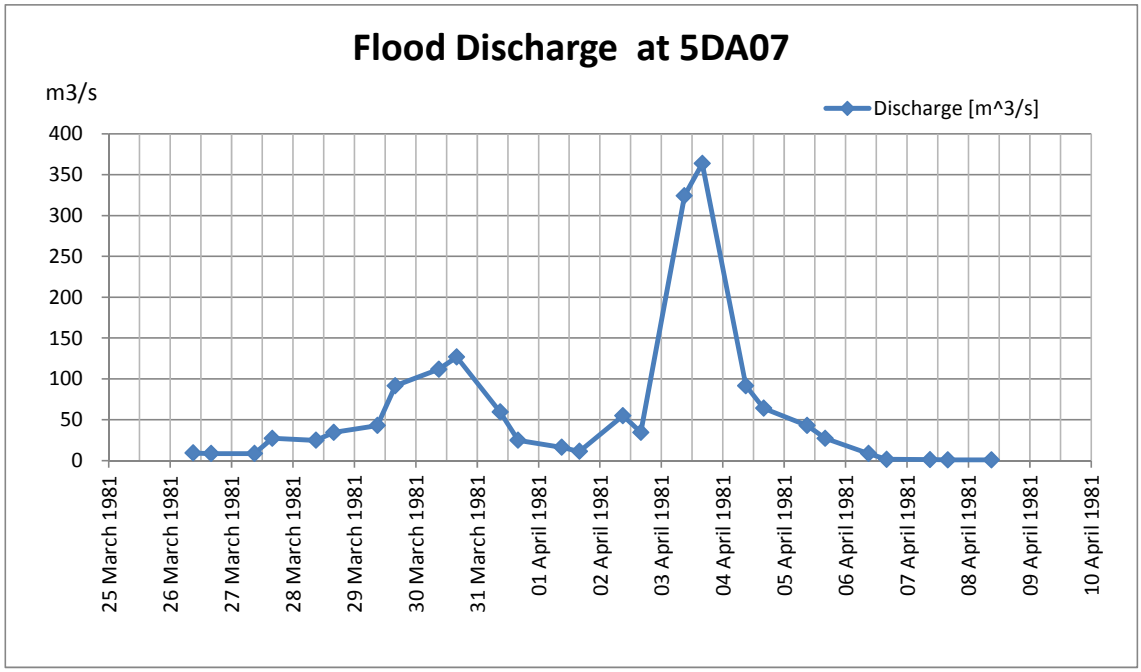
出典：KMD 所管の雨量観測所 Isiolo D.A.O 地点における 1957 年～1989 年の観測期間における観測期間をもとに JICA Project Team が作成

図 2.1.14 Isiolo DAO 地点の年最大日雨量

(3) 洪水ピーク流量

Isiolo town の直上流に位置する水位・流量観測所 5DA07 地点の 1971 年～2011 年の観測（日 2 回観測、ただし 12 年以上の未観測期間あり）における既往最大流量は 1981 年 4 月 3 日の 16 時に観測された 364 m^3/s である。同観測値を含む約 2 週間の期間の流量の変化を次図に示す。

ただし、9 時と 16 時の 1 日 2 回の観測体制となっているため、洪水ピーク流量を適切に捉えていない可能性がある。なお、これらのデータは、WRMA が水位から流量に換算したデータを提供されたものであり、水位データそのものは提供されていない。



出典：WRMA 所有のデータから JICA プロジェクトチームが図化

図 2.1.15 水位･流量観測所 5DA07 地点の既往最大流量

水文、水理学的見地から、洪水現象を把握するための検討を行った。具体的には、確率統計手法を用いて確率規模別の日雨量を算出し、さらに、日雨量から短時間降雨強度を推定し、合理式を用いて Isiolo 川流域内の主要な支川合流点および Isiolo 市街地直上流地点の確率規模別の洪水ピーク流量を算定した。通常合理式が適用される流域面積は 100km^2 程度以下があることが多く、本流域面積であれば適用しない範囲である。しかし、洪水時に水位・流量観測を実施しているわけではなく、過去の洪水流量記録がないため、洪水ピーク流量の推算には合理式を用いざるを得ないことからこの方法での検討を行った。流域分割図を以下の図に示す。

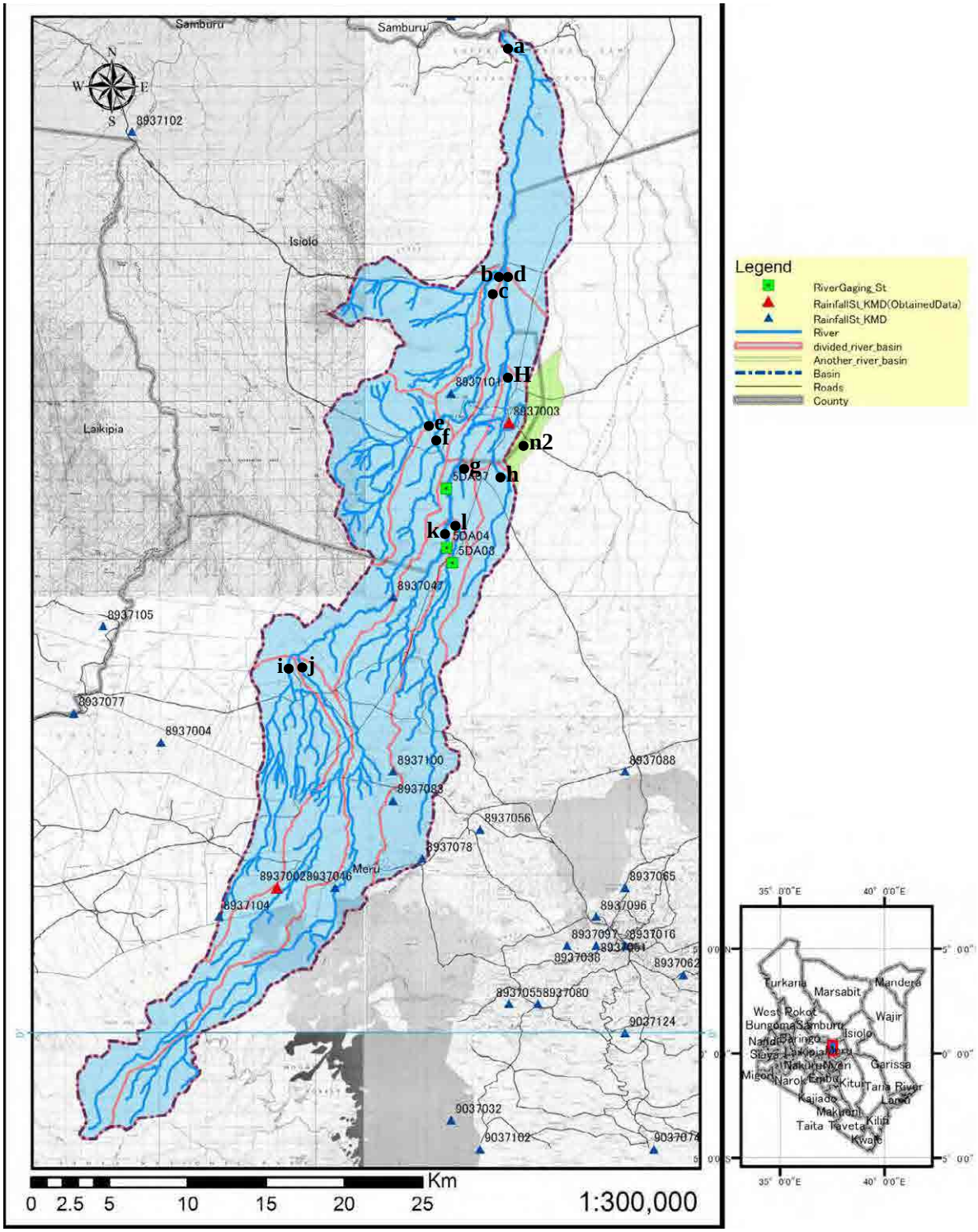


図 2.1.16　Isiolo 川流域分割図（流出計算地点表示版）

合理式

合理式及び設定計算条件を以下に示す。

$$Q = 1/3.6 * f * r * A$$ ----------合理式

Q ： 流量 (m^3/s)
f ： 流出係数
r ： 洪水到達時間内平均雨量強度 (mm/h)
A ： 流域面積 (km^2)

※ 合理式とは流域の最遠点から計算地点まで雨水が流下集中した時の洪水のピーク流量を簡易に求める計算式であり、地表面の被覆状態により流出係数を考慮して、降雨強度と流域面積の関数として流出量を算定する。

【合理式による洪水ピーク流量算出に用いた計算条件】

- 洪水到達時間算出式 tc：Kraven-Rziha
- 確率規模別計画日雨：1/50 r24 =125 mm/d、1/30 r24 =116 mm/d、1/20 r24 =108 mm/d、1/10 r24 =96 mm/d、1/5 r24 =82 mm/d
- 洪水到達時間内平均降雨強度式 r：物部式
- 流出係数 f = 0.6（ただし、n2 地点は f=0.45 を採用）
- 流域面積：総流域面積 $474km^2$

以下に合理式による洪水ピーク流量計算結果を示す。Ewaso Ng'iro North river に合流する Isiolo 川流域の最下流地点のピーク流量は確率規模 10 年で約 $650m^3/s$ である。同じく確率規模 10 年の Eastern Marania 川及び Merire 川の Isiolo town の直上流の g 及び h 地点のピーク流量はそれぞれ約 280 m^3/s、85 m^3/s となっている。

表 2.1.6 合理式による洪水ピーク流量算出結果
（左から順に確率規模 1/50、1/30、1/20、1/10、1/5）

Point	Arrival time of flood t_c (min)	Riverbasin area A(km^2)	1/50 : r24 = 125mm/day Peak discharge Qp(m^3/s)	1/30 : r24 = 116mm/day Peak discharge Qp(m^3/s)	1/20 : r24 = 108mm/day Peak discharge Qp(m^3/s)	1/10 : r24 = 96mm/day Peak discharge Qp(m^3/s)	1/5 : r24 = 82mm/day Peak discharge Qp(m^3/s)	River	Name of the Point
i	96	45.0	238	221	206	183	156	-	
j	218	64.1	196	182	169	151	129	Western.M.R	
k	275	90.1	236	219	204	181	155	Eastern.M.R	
l	131	46.3	199	184	172	153	130	-	
e	71	40.4	260	242	225	200	171	-	
f	333	150.6	347	322	300	267	228	Western.M.R	
g	297	145.6	362	336	313	278	237	Eastern.M.R	Isiolo townの直上流地点
h	76	17.6	109	101	94	83	71	Merire.R	Isiolo townの直上流地点
b	76	11.4	70	65	61	54	46	-	
c	400	229.6	468	435	405	360	307	Western.M.R	
d	368	184.3	397	369	343	305	260	Eastern.M.R	Western.M.Rとの合流地点
H	104	27.1	136	126	117	104	89	Merire.R	Eastern.M.Rとの合流地点
a	489	473.6	844	783	729	648	554	Isiolo.R	Ewaso Ng'iro North river合流点
n2	31	2.4	21	19	18	16	13	-	隣接流域からの流路変更地点

この検討過程において算出された洪水到達時間は、洪水予警報のリードタイムを検討するにあたり活用可能である。

2.2 社会経済条件

2.2.1 行　　政

(1) 地方行政

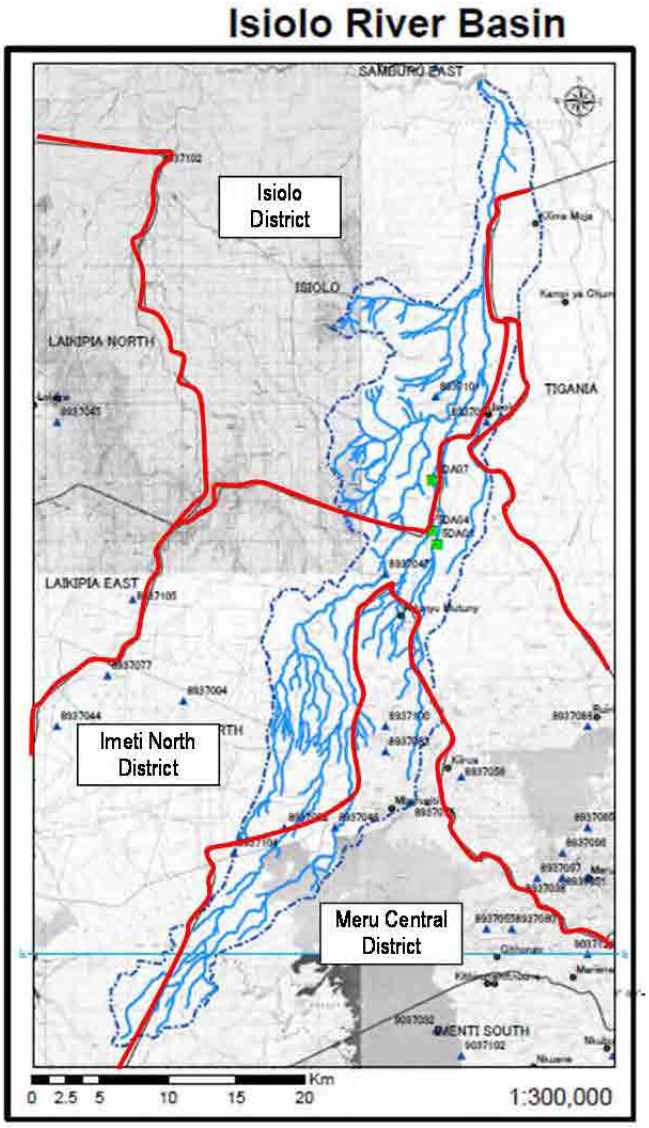
2013 年 3 月の時点におけるケニア共和国の行政区分を以下に示す。

表 2.2.1 ケニア国における行政区分

Administration Unit	Ruler
Province	Province commissioner
District	District commissioner
Division	Chief
Location	Chief
Sub location	Assistant Chief
Community Unit	Leader
Village	Elder

ケニア共和国における行政システムは、大統領府の下に地方政府（Province – District – Division – Location – Sub-location）が位置づけられ組織構成されている。最も小さな行政単位は「Sub- location」となっている。また、行政機関ではないが、地域のコミュニティ区分として Village がある。各々の組織において首長は、Province は Province commissioner、District は District commissioner、Division 及び Location は Chief、Sub Location は Assistant Chief、 Village は Elder となっている。

Isiolo 川流域は、主に 3 つの District（Meru Central, Imenti North, Isiolo）に含まれている。Isiolo川流域とDistrictの位置関係及びIsiolo川流域に含まれる行政組織を以下に示す。



出典: International Livestock Research Institute GIS unit
1998 年時点における District の分類データをもとに JICA Project Team が作成

図 2.2.1 Isiolo 川流域と District の位置関係

3 つの District 内の Division、Location、Sublocation のうち Isiolo 流域に含まれるものを以下の表に整理した。

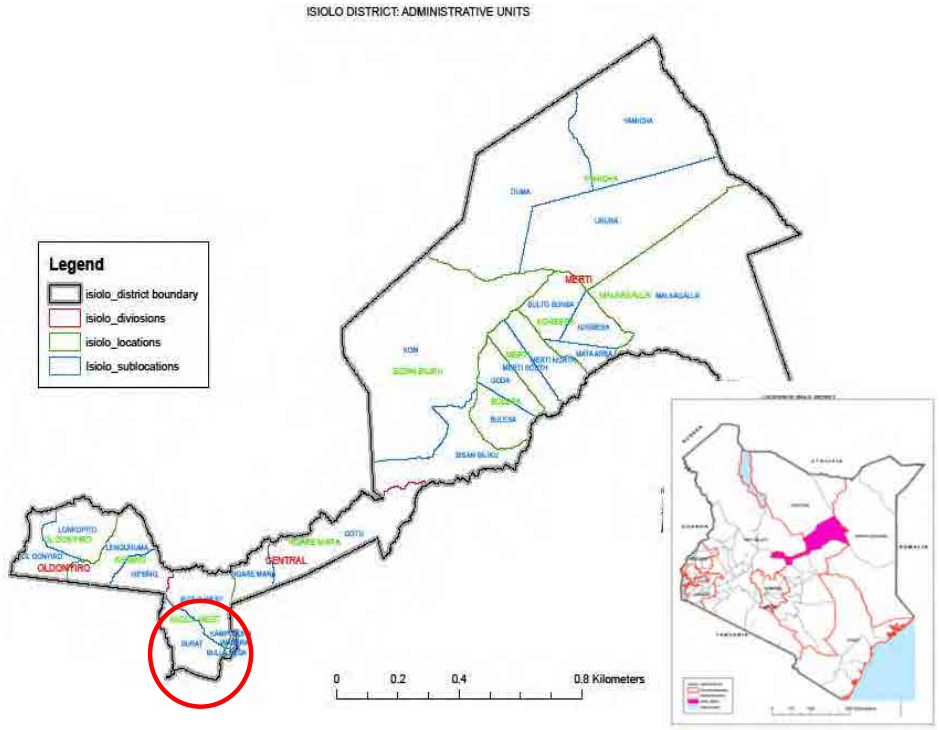
表 2.2.2 Isiolo 川流域に含まれる行政区分（2004 年 7 月時点）

Districts	Divisions	Locations	Sublocations
Isiolo	Central	Central	Bulla Pesa
			Kampi Odha
		Isiolo East	Kiwanjani
			Wabera
		Isiolo West	Burat

			Isiolo West
		Ngare Mara	Ngare Mara
Meru Central	Abothuguchi West	Kiamiogo	Kiamiogo
		Kibirichia	Kimbo
		Ntugi	Mboroga
		Ntumburi	Kamarete
			Thiira
	Buuri	Kiirua	Kithima
			Nkando
		Kisima	Ntirimiti
		Rwarera	Kirwiro
			Mugae
	Timau	Kisima	Buuri
			Mutonyi
		Ngusishi	Mutarakwa
	Mt Kenya Forest	Mt Kenya Forest	Mt Kenya Forest
	National Park	National Park	National park
Meru North	Akithi	Akithi	Thinyaine
	Tigania North	Buuri	Nturingwi
	Tigania West	Mituntu	Mumui

出典：Center for Training and Integrated Research in ASAL Development February 2005 , Upper Ewaso Ngiro River Basin Sub Catchments Directory

Isiolo District とその中に含まれる Division、Location、Sub location の境界を以下に示す。図中の赤い円は Isiolo 川流域の位置を示している。



出典：Isiolo District Development Plan (2008 - 2012)

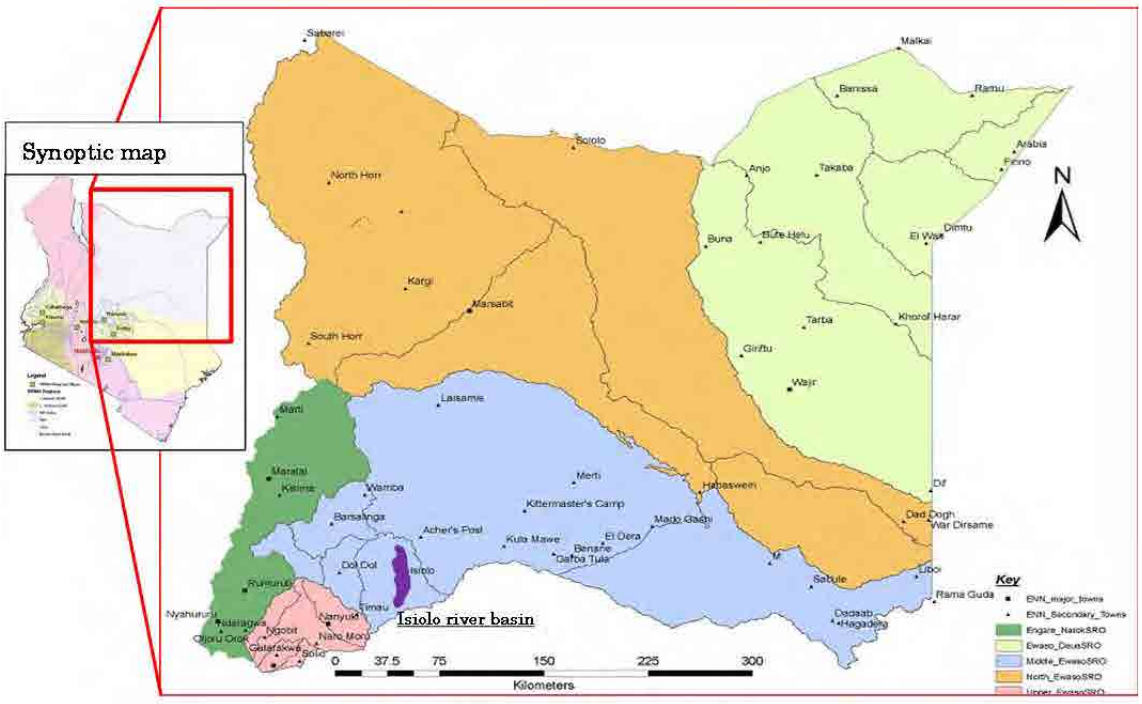
図 2.2.2 Isiolo District の位置

(2) WRMA の管轄地域

水資源に関連する行政を担う WRMA（Water Resource Management Authority）による管理区域と Isiolo 川流域の関係を以下に示す。

WRMA では行政管理上、全国を 6 つの Catchment に分割しており、Isiolo 川流域が含まれるのは「Ewaso Ng'iro North Catchment Area（ENNCA）」と呼ばれる Catchment である。

Ewaso Ng'iro North Catchment Area（ENNCA）には、ENNCA 全体を管轄する Nanyuki Regional Office がある。また、Catchment を Upper Ewaso Ng'iro, Middle Ewaso Ng'iro, Engare- Narok Melphis, North Ewaso Laggas , Ewaso- Daua の 5 つに分け、それぞれの地域に Sub-Regional Office を設けている。Isiolo 川流域は図中のブルーのエリアである Middle Ewaso Ng'iro にあたり、Middle Ewaso Ng'iro Sub-Regional Office の管内に属している。



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

図 2.2.3 ENNCA Catchment 内の地域分けと Isiolo 川流域の位置

写真 2.2.1　WRMA Middle Ewaso Ng'iro（Isiolo）Sub-Regional Office

表 2.2.3 Isiolo 川流域管轄

	Regional Office Level	Sub regional Office Level	Sub Catchment Level
Area	Ewaso Ng’iro North Catchment Area(ENNCA)	Middle Ewaso Ng'iro Sub-Region	Isiolo Sub Catchment
WRMA / WRUA	WRMA ENNCA	WRMA Middle Ewaso Ng'iro (Isiolo) Sub-Regional Office	Isiolo WRUA

2.2.2　人　　口

Isiolo 川流域が含まれる Isiolo District における 2009 年時点の人口統計データを以下に示す。これによると、人口が集中しているのは Isiolo Town の含まれる Central Division で、4 万人を数え、District 全域の 4 割を占めている。家屋数においても、このエリアに集中しており、全域の 45%を占めている。

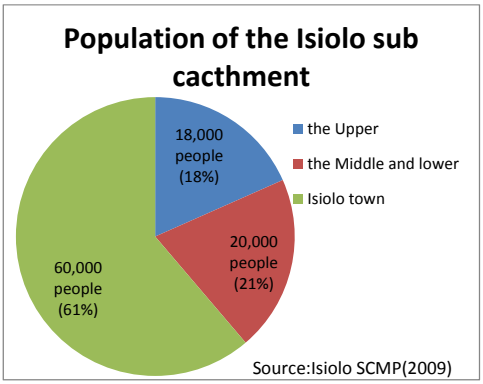
この Central District 内で、特に BULLA PESA と ODHA の Sub location では人口密度においても高い値を示し、それぞれ約 3,000 人／km^2、約 1,000 人／km^2 となっている。

表 2.2.4 Isiolo District における人口データ（2009 年時点）

District	Division	Location	Sublocation	Male	Female	Total	Households	Area in Sq. Km.	Population Density
ISIOLO	CENTRAL	CENTRAL	BULLA PESA	11,148	11,574	22,722	6,190	7.66	2,965.93
			ODHA	2,860	3,062	5,922	1,236	5.67	1,044.57
		WEST	BURAT	4,580	4,010	8,590	1,640	345.51	24.86
			ISIOLO WEST	2,162	2,100	4,262	1,004	396.86	10.74
	CHERAB	KORBESA	BULTO BONSA	351	402	753	173	299.13	2.52
			KORBESA	871	939	1,810	361	247.40	7.32
			MATA ARBA	237	266	503	108	121.97	4.12
		MALKAGALLA	MALKAGALLA	1,105	1,071	2,176	443	2,812.81	0.77
		YAMICHA	DUMA	236	121	357	80	1,652.59	0.22
			URURA	587	470	1,057	243	1,621.58	0.65
			YAMICHA	807	764	1,571	307	1,552.10	1.01
	EAST	EAST	KIWANJANI	1,459	1,537	2,996	651	4.41	680.03
			WABERA	7,305	7,130	14,435	3,045	8.57	1,683.76
		NGARE MARA	GOTU	1,040	887	1,927	491	778.93	2.47
			NGARE MARA	2,071	1,522	3,593	759	184.96	19.43
	MERTI	BISAN BILIQU	BISAN BILIQU	663	686	1,349	285	636.46	2.12
			KOM	276	252	528	127	2,567.21	0.21
		BULESA	BULESA	851	888	1,739	384	316.65	5.49
			GODA	628	537	1,165	233	240.92	4.84
		MERTI	MERTI NORTH	2,375	2,448	4,823	998	312.92	15.41
			MERTI SOUTH	1,221	1,289	2,510	552	241.66	10.39
	OLDONYIRO	KIPSING	KIPSING	1,666	1,741	3,407	745	204.62	16.65
			LENGURUMA	1,031	1,122	2,153	473	335.74	6.41
		OLDONYIRO	LONKOPITO	1,406	1,450	2,856	587	365.81	7.81
			OLDONYIRO	3,444	3,528	6,972	1,348	255.06	27.34
Total				50,380	49,796	100,176	22,463	–	–

出典: Kenya National Bureau of Statistic, Census 2009

このうち、Isiolo 川流域における人口については、Isiolo Sub Catchment Management Plan によると約 98,000 人である。その流域内での位置による内訳は、下記の図に示すとおり、上流に約 18,000 人、Isiolo 市街地を除く中・下流域に約 20,000 人、そして Isiolo 市街地に 60,000 人となっている。これは他の地域と比べて水資源が豊富な中流域に人々が集まる傾向を示すとともに、流域最大の都市である Isiolo town が経済の中心であることを示している。



出典：Isiolo SCMP の人口データをもとに JICA Project Team が作成

図 2.2.4 Isiolo 川流域の人口

2.2.3 産　　業

Isiolo 川流域で最も盛んな産業は農業となっている。養蜂、苗木の生産も行われている。食用牛や毛皮用の牧畜が上流域で行われている。このほか、炭の生産、ホテル業が行われている。最も多い生産物は、玉ねぎ、ジャガイモ、キャベツ、豆等の農作物である。中流には泉があり、農業の灌漑用水として使用されている。

2.3 開発計画

2.3.1 VISION 2030

Isiolo 市街地は現在、ケニアの北部開発の拠点として大きな経済成長をとげている。ケニア政府が掲げる 2008 年から 2030 年の開発計画である「Vision2030」によると、主な開発計画は以下のとおりである。

(1) 物流回廊の整備

ケニア国では、Isiolo を経由して、南スーダンやエチオピアとの間を結ぶ新しい物流回廊の開発が計画されている。このプロジェクトでは、Lamu 港から Garissa、Isiolo、Maralal、Lodwar、Lokichoggio を経由してエチオピアと南スーダンへ至るルートを取り、Isiolo は交通の要衝として整備される予定である。この回廊は、新しい道路ネットワーク、鉄道ネットワーク、石油パイプライン、Lamu 空港、Lamu にある港湾で構成される予定であり、沿岸部と Isiolo に開発予定のリゾート都市も結ぶことになっている。Vision 2030 では具体的なルートは明示していないが、計画の中で名前が挙がっている都市を以下の地図の黄色のピンマークで示す。

図 2.3.1 物流回廊整備計画の主要地点

(2) リゾート都市の開発

ケニア山や Meru 国立公園を観光資源とし、その拠点となるリゾート都市として Isiolo

の開発が計画されている。さらに、Isiolo は国の北部での経済活動の足がかりとなることが期待されている。

(3) National water supply and sanitation

現在の沿岸部の都市や Isiolo 等のリゾート開発予定地の水需要をまかなうことを狙い、Mzima パイプラインの拡張が計画されている。

2.3.2 ISIOLO DISTRICT DEVELOPMENT PLAN (2008-2012)

Isiolo District の開発計画である「Isiolo District Development Plan」によると、以下のような計画がある。

(1) Water Harvesting

コミュニティの水へのアクセスを改善するプロジェクトである。コミュニティは開発したいサイトを示し、審査を経てファンドを得ることによって貯水池を自らの手によって掘ることになっている。

(2) Opening of Northern Tourlist Circuit

Kuramawe 地区の道路を整備して Garbatua Road に結び、Isiolo までのアクセスを強化することになっている。

2.3.3 IMENTI NORTH DISTRICT DEVELOPMENT PLAN (2008-2012)

Isiolo 川流域の中流・上流にあたる Imenti North District 及び Meru Central District の開発計画を網羅する「Imenti North District Development Plan」によると、以下のような計画がある。

(1) Mt. Kenya east pilot project

主に河川沿いの植生を回復することを狙い、苗木の植林事業が計画されている。毎年雨季に 100,000 本の苗木を植林することになっている。

(2) Sirmon water project

2000 世帯にクリーンな水を供給するため、7km の水路管を整備する計画がある。

2.3.4 EWASO NGI'RO NORTH CATCHMENT AREA CATCHMENT MANAGEMENT STRATEGY (JUNE 2009)

Ewaso Ngi'ro North Catchment において WRMA が掲げる管理計画である「Ewaso Ngi'ro

North Catchment Area Catchment Management Strategy」によると、「Water storage options in ENNCA」の章に以下のように、表流水貯留と地下貯留の構想が示されている。

表 2.3.1 Water storage options in ENNCA

Scale	Surface Storage Options	Ground Storage Options
Household and on-Farm	Roof catchment tanks, (< 50 m^3) Farm pond (< 500 m^3)	RWH Underground tanks (<500 m^3)
Farm/Community/WRUA	Runoff harvesting to pan or dam (< 50,000 m^3), typically offline (out-stream)	Sand dams or sub-surface dams
Sub-catchment	Small – medium sized dam (< 500,000 m^3), on-course or off-course	Artificial groundwater recharge
Catchment (State Schemes)	Large multi-purpose dam, (>500,000 m^3) typically in- stream	

3. ISIOLO 川流域の洪水特性分析と洪水対策の検討

3.1 洪水被害実績

3.1.1 ISIOLO 川流域における洪水被害実績

Isiolo 川流域においては、下表に示すとおり、近年、ほぼ毎年のように洪水が発生している。主な洪水被害としては、農作物の損害や家畜の死亡、家屋の損壊などの生計上の損失、道路や電線などのインフラの損壊、肥沃な表土の浸食や土砂堆積による農地の被害、水源の汚染や水因性疾患などの健康上の問題、水源を巡る紛争の増加、備蓄食料が損害を受けることによる食糧不足から生じる栄養上不足問題などが挙げられる。

表 3.1.1 近年の洪水実績

年　月	場　所	洪水被害の概要	洪水分類
2012 年 9 月 25 日	Isiolo 市街地、Kiwanjani Sublocatioarn	強風を伴った 20 分程度の豪雨が原因。Isiolo 市街地では膝下程度の水深のフラッシュ洪水が発生し、交通や経済活動に支障が生じた。ただし、その時間は 1 時間程度であった。Kiwanjani Sublocation は空港周辺の居住区で市街地よりも標高が高いところに位置しており、主な被害は強風による家屋の倒壊であった。	市街地での浸水
2011 年	Isiolo 市街地付近	農地破壊、カルバートの閉塞、Isiolo 水供給公社（IWACO）の取水施設が破壊、家屋流失	河川溢水による浸水
2006 年 10 月	Kulamawe, Bullapesa, Bulla Arera, Juakali, Kambiodha, Kambibulle, Kampigabra and kabiwacho villages	Isiolo 川が氾濫し、人的被害は被災者数約 5000 人、死者 8 人。被災者は Isiolo・カソリック教会に避難してテント生活を余儀なくされた。	河川溢水による浸水
2005 年		死者 10 人	—

出典：WRMA や Isiolo WRUA からの聞き取りにより JICA Project Team が作成

3.1.2 コミュニティから聴取した洪水の状況

Isiolo 川流域において、洪水被害が発生している主なコミュニティの状況について、聞き取り調査を行った。その結果を以下に示す。

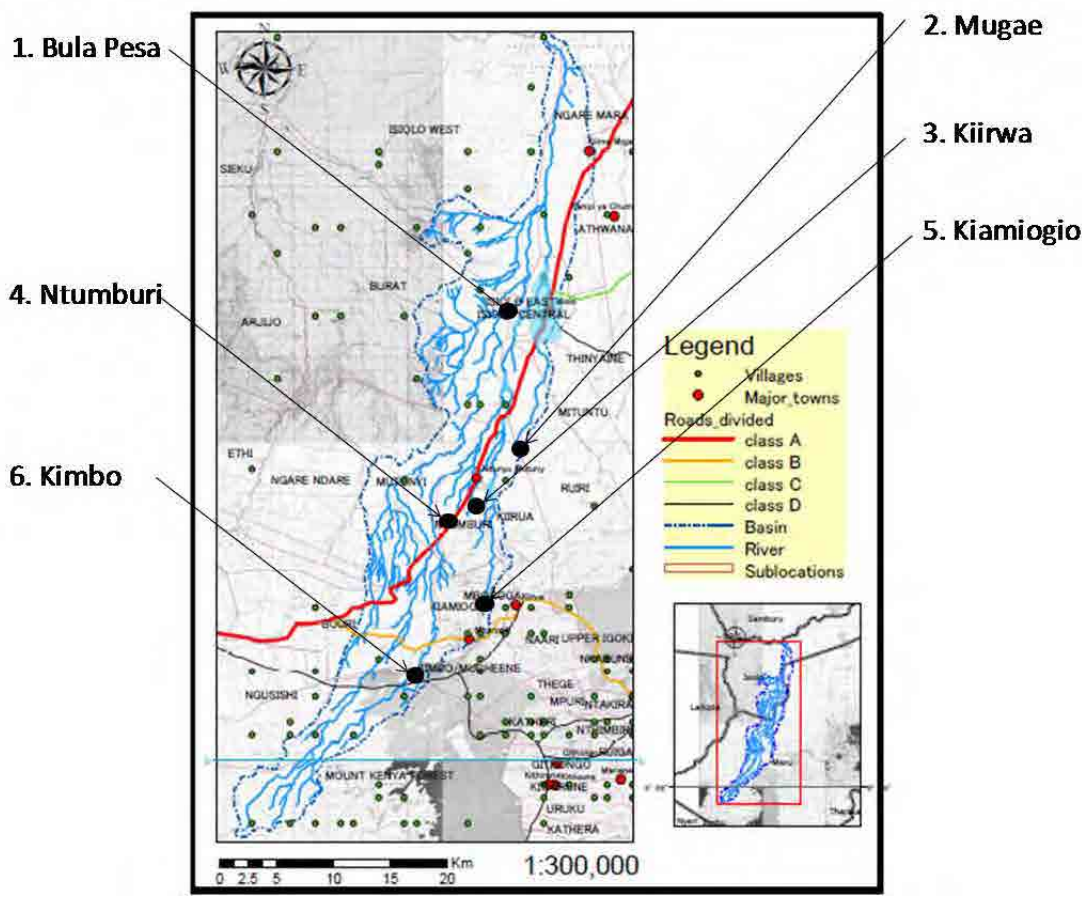


図 3.1.1　Isiolo 川流域図とコミュニティの位置図

表 3.1.2　Isiolo 川流域のコミュニティの洪水状況調査結果

No	コミュニティ	人口（人）	浸水深	浸水時間	浸水頻度	洪水分類
1	Bula Pesa	22, 722	Between 50 cm to 1.5 m	2-3 Hours	Erratic, but mostly expected between Oct.- Dec. every year	市街地浸水 河川溢水
2	Mugae	1,217	Approximately 50 cm	2-3 Hours	Erratic	土石流 河岸浸食
3	Kiirwa	4,196	Between 50 cm to 1.5 m	2-3 Hours	Erratic	土石流 河岸浸食
4	Ntumburi	2,847	Between 50 cm to 1.5 m	2-3 Hours	Erratic	河岸浸食 河川溢水
5	Kiamiogio	3,181	Approximately 50 cm	2-3 Hours	Erratic	土石流 河川溢水
6	Kimbo	4,149	Approximately 50 cm	2-3 Hours	Erratic	河岸浸食 土石流

以下にプロジェクトチームの聞き取り調査によって得た各コミュニティの主な被害状況とその洪水タイプを示す。

1. Bula Pesa
   - Merire 川が溢水し、居住地が浸水する.....市街地浸水
   - 流れてくる水や土砂を含んだ水の勢いで家屋が破損する.....河川溢水
   - 道路が浸水することにより、学校や道路へのアクセスが途絶える.....市街地浸水
   - 稀ではあるが Merire 川による洪水のために人が亡くなる.....市街地浸水
2. Mugae
   - 土石流が取水施設や橋など河川周辺の施設に被害を与える.....土石流
   - 浸食が進み耕土が削られることで農地がやせ、農作物の生産量が減少する.....土砂流出
3. Kiirwa
   - 土砂が混じった雨水が農地に流入し、農作物が埋もれる.....土石流
   - 日常的に使用されている道路が浸食され、農作物の市場への輸送が困難になる.....河岸浸食
4. Ntumburi
   - 河岸浸食が農地を削り、農作物の生産量が減少する.....河岸浸食
   - 氾濫水が作物を押し流す.....河川溢水
   - 簡易的な橋が浸水して破損し、学校や病院などの公共施設へのアクセスが困難になる.....河川溢水
5. Kiamiogio
   - 土砂が農地に貯まり、作物を沈める.....土石流
   - 簡易的な橋が浸水して破損し作物を市場に届けることができない.....河川溢水
6. Kimbo
   - 農地での浸食が耕土を流出させ、農地がやせる.....土砂流出
   - 土石流が道路をふさぎ、農作物を市場に運ぶのを阻害する.....土石流

3.2 洪水特性分類と洪水被害メカニズム

3.2.1 洪水特性分類と洪水被害発生メカニズムの概念

Isiolo 川流域の洪水をその特性から分類すると、以下の 4 つに分けることができる。

タイプ	洪水特性	主な発生場所
A	市街地での浸水	Isiolo Town
B	河川溢水による浸水	中流域及び支川
C	土石流被害	上流域及び支川上流
D	河岸浸食/土壌浸食	全域

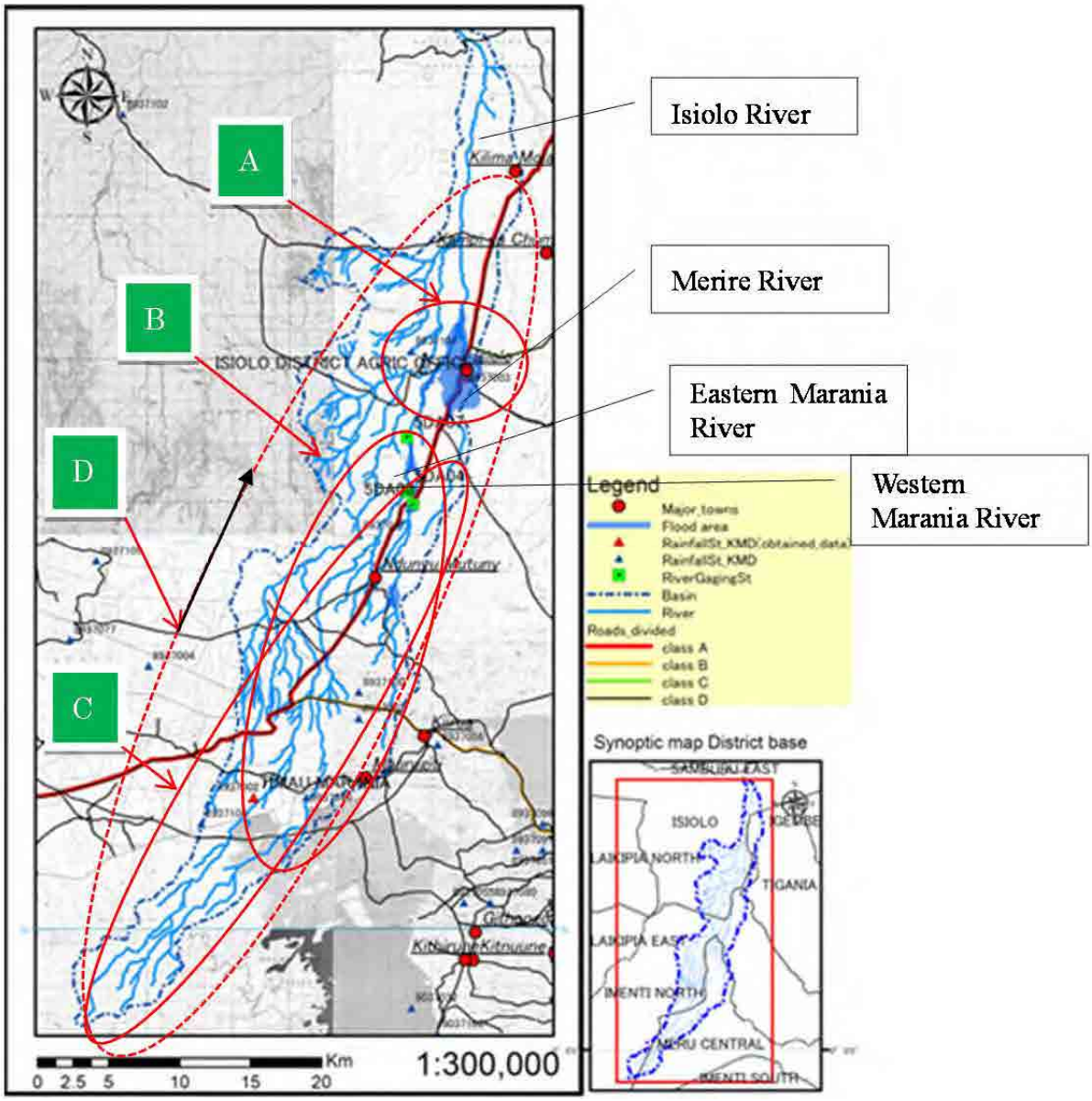
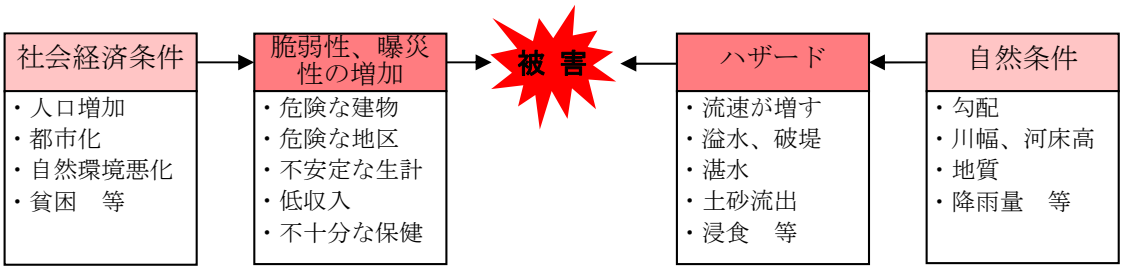


図 3.2.1 Isiolo 川流域における洪水タイプとその大まかな発生エリアのイメージ図

洪水被害は、以下に示すように、当該地域における自然条件、社会経済条件と密接な関係を持っており、自然条件によりハザードの増加、社会経済条件により脆弱性と曝災性（Exposure）の増加が規定され、洪水被害につながる。

前述した A～D の分類において、第 2 章で整理した各々の自然条件および社会経済条件をもとに洪水特性について分析する。



出典：石渡幹夫「コミュニティと防災援助(1997)」の資料を元に JICA Project Team が加筆

図 3.2.2 洪水被害の発生条件

3.2.2 ISIOLO 市街地での浸水（タイプ A）

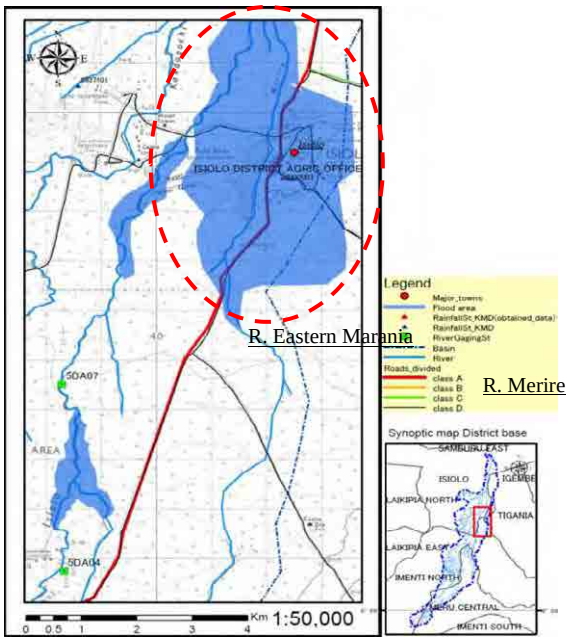
洪水タイプ A は、Isiolo 市街地での浸水であり、その洪水特性を自然条件と社会条件から分析した結果を次に示す。

(1) 自然条件からの洪水特性

第 1 章で整理した Isiolo 川流域の自然条件とそれに伴う当該地域におけるハザードを以下に示す。

表 3.2.1 Isiolo 市街地の自然条件とハザード

自然条件	ハザード
地形勾配は約 1/50、河川勾配は約 1/100	表面流や洪水氾濫水の流速が速い
粘土質の土壌	土中に浸透せず、表面流になる。



・ 市街地内を Merire 川が流れ、市街地西側を Eastern Marania 川と Western Marania 川が流れている。なお、市街地西側を流れる二つの川は、Isiolo Town の洪水とは直接的

な関係はない。

・ 地形勾配としては約 1/50 で河川勾配も約 1/100 とやや急であるため、降雨の流出が早く、表面流や洪水氾濫水の流速が速い。


Isiolo 市街地の浸水の様子

・ 表土は粘土質であるため降雨が地下に浸透しにくい特性がある。

・ 市街地及びその周辺は、半乾燥地帯に位置しているため植生は灌木であり、植生による降雨遮断効果や保水機能が小さいため、流出率も高いと推察される。


Isiolo 市街地の浸水の様子

・ 降雨量のデータとしては日雨量しか存在しないが、Isiolo 市街地の観測点 Isiolo DAO の日最大降雨量は 97 mm/day である。この地域の降雨特性として、数時間といった短時間で集中的に降ることを考慮すると、数時間のうちに 90 mm 以上が降るような降雨現象であると推察される。合理式での洪水到達時間内降雨強度の計算でも、年再起確率 1/10 で Isiolo 市街地直上流の h 地点で 28.5 mm/h と計算されており大きな不整合はない。

・ Merire 川の確率洪水流量は、1/10 で 85 m^3/s、1/5 でも 75 m^3/s と計算されており、現状の河道の大きさからは安全に流下させることは出来ないため数年に一度は Merire 川が溢れることが当然と言える。

(2) 社会条件からの洪水被害特性

自然条件と同様に、社会経済条件とそれに伴う当該地域における災害への脆弱性と曝災性を以下に示す。これに伴い、以下のような洪水特性が確認されている。

表 3.2.2 Isiolo 市街地の社会経済条件と脆弱性等

社会経済条件	脆弱性・曝災性
居住区が集中している（流域人口の 6 割。人口密度高い 3000 人／km^2）	被災人口が多い
流域内家屋数の 4.5 割を占める	被災家屋が多い
商業の中心	浸水に伴う活動停止が発生する
交通の要衝	浸水に伴う物流の停止、停滞
リゾート都市としての整備	浸水に伴うサービス提供の停止
空港の整備	洪水への悪影響等

・ Isiolo 市街地の人口は、約 60,000 人とされており、市街地が短時間であっても洪水による被害を受けることによる影響は、地域の社会・経済上、極めて大きなインパクトがある。

・ 上位計画に従って空港拡張や道路新設などのインフラ開発が進められ、さらに、それに伴って住宅開発も進められているが、それらの開発計画による洪水や都市排水への影響が十分に考慮されていない。

(3) 市街地での浸水被害のメカニズム

市街地の浸水に関して、さらに詳細に分析すると以下の 3 つの要因が考えられる。

1) Merire 川の流下能力不足による溢水洪水（外水）

市街地を縦断する Merire 川の流下能力不足が Isiolo 市街地の浸水の要因の一つとなっている。これには自然条件的な問題及びそれを増大させる社会経済的問題が存在している。


Isiolo 市街地を流れる Merire 川

自然条件的な問題としては、Merire 川の川幅が狭く、河道断面積が少ないことである。Merire 川の現況の流下能力は、概略の断面形状では概ね川幅約 5m、高さ約 0.5m である（写真参照）。短形断面を仮定し、河床勾配を 1/100 とすると、流下能力は 4m^3/s 程度とみなされる。

先に述べた合理式による計算では、Isiolo Town の直上流地点における 5 年確率洪水流量は約 75m^3/s、10 年確率洪水は約 85m^3/s となっている。上流での溢水のためこのすべてが市街地に流入するわけではないが、流下能力は明らかに不足していることがわかる。


Isiolo 市街地の Merire 川沿いに設置されているカルバート

一方、Merire 川の河床材料は砂が主成分であり、河道の高さは 0.5～1m 程度と小さい。カルバートの上流側に土砂が堆積し、ゴミとともにカルバートの閉塞の原因となっている。

社会経済的問題として挙げられるのは、主に下流の Merire 川周辺で家屋を不法に川岸の水際に建設する住民がいることである。それにより、川幅を拡幅することが難しくなっていおり、対応策が必要とされている。

Merire 川に近接して建てられた家屋
（上流を望む）家屋の塀が河川に近接している

Merire 川の市街地最下流部（上流を望む）
左岸側の小屋は違法居住者の家屋

また、上流からの土砂の堆積の他に、不法投棄によるゴミの堆積及びゴミによるカルバートの閉塞も流下能力を著しく低下させている原因の一つとなっている。市街地最下流部にあるボックスカルバートが閉塞することにより、その上流側が堰上げされ、一時的に水位が上昇し、浸水深が 2～3m を超えるような現象が生じている。2005 年に死者 10 名、2006 年に死者 8 名が発生しているが、洪水による死者は堰上げされて上昇した水位によって溺死したり、流されたりしたものと言われている。

Merire 川の Isiolo 市街地最下流部にかかる
ボックスカルバート構造の橋（下流を望む）

2) 市街地全体の雨水排水システムの未整備（内水）

Isiolo 市街地では、排水路やカルバート、道路側溝等の排水設備が面的なネットワークとして機能するよう整備されていない。このため、市内の排水能力が低く、市街地に強い雨が降ると、雨水が排水されずに地表に滞留することで内水洪水が生ずる。水深は最大 50 ㎝と大人の膝下程度であるが、地形的には最大勾配 2.5%（1/40）程度ある箇所もあるため、市街地の狭い路地などでは流速も速く、子供や女性、老人といった災害弱者に対しては危険であり、転んで怪我をしたといった報告もある。また、2～3 時間と短時間ではあるが、洪水発生の時間帯によっては市街地中心の商業地区が浸水することによってすべての経済活動が停止することから、この地域の経済への影響が極めて大きいと言える。

商店が立ち並ぶ中心部での浸水の様子

家屋の浸水の様子

以上をとりまとめると、Isiolo 市街地での洪水は内水被害、外水被害の両方が存在していることがわかる。同様な地方都市の排水不良を伴う内水洪水はケニア国においてよく聞かれることであり、MWI や WRMA との議論の中でも、その対応の必要性は認識されていることがわかっている。

3) 市街地東側空港付近からの流入

近年、Isiolo 市街地の山側に空港と道路が建設されている。従来は、市街地の南側から流下してきた雨水は市街地へ向かわず、市街地の東側の斜面を北へ流下していたが、施設の建設後は、南側からの雨水が空港と道路の盛土に遮られ、市街地へと誘導されている。空港完成後に洪水が頻発するようになったとの住民の意見があり、2012 年 9 月の洪水をはじめ、近年の市街地の洪水の一要因であることが指摘されている。

施設建設の前後での変化を以下の図に示す。

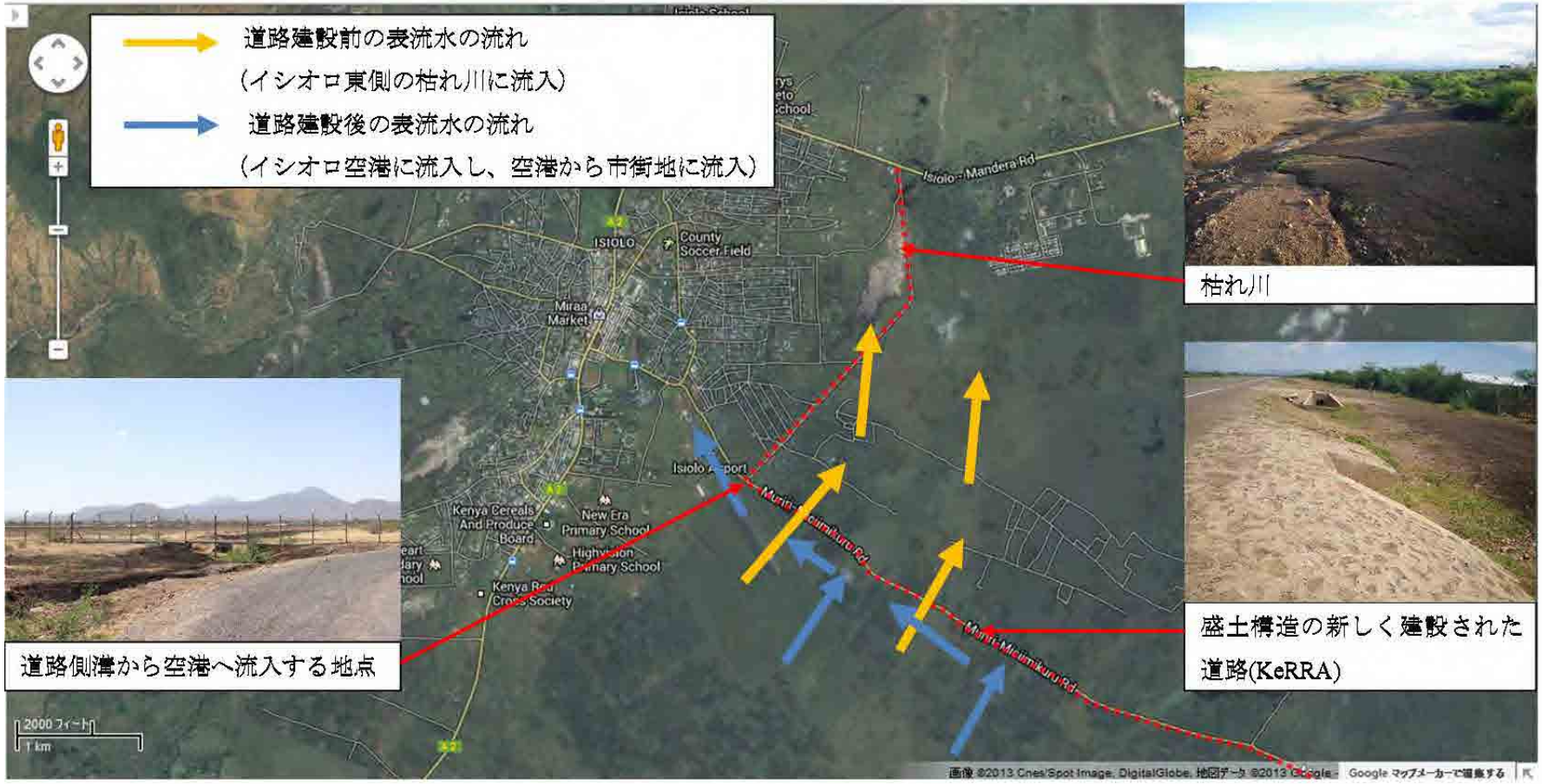
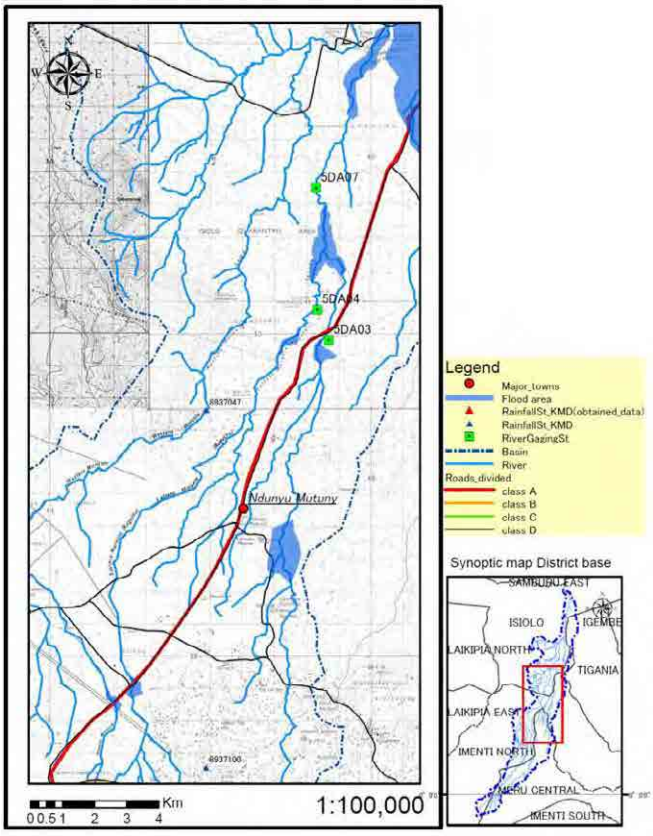


図 3.2.3 道路建設前と建設後の表流水の流下方向

3.2.3 中流域での河川からの溢水による浸水（タイプ B）

洪水タイプ B の中流域での河川からの溢水による浸水について、その洪水特性を自然条件と社会条件から分析した結果を次に示す。



(1) 自然条件からの洪水特性

第 1 章で整理した Isiolo 川流域の自然条件とそれに伴う当該地域におけるハザードを次表に整理した。

表 3.2.3 Isiolo 川中流域の自然条件とハザード

自然条件	ハザード
地形勾配 1/20 河川勾配 1/50~1/30	流速が大きい。
勾配の変化、扇状地と同程度の地形勾配	流路が不安定

- 主要河川流路としては Eastern Marania 川と Western Marania 川があるが、その他に小支川が多く流れており、それらは普段は水がない枯れ川である。
- 地形勾配は約 1/20、河川勾配は 1/50～1/30 程度と急であるため、洪水時の河川流の流速が大きい。また、扇状地の地形勾配と同等であるため、流路が不安定であることが推察される。
- 上流域の降雨が流出してくる地域であるため、ケニア山麓の集中豪雨が流出してくる。上流域の表土は粘土質であるため、地下浸透しにくく、洪水時の流出率も大きいことが推察される。

(2) 社会条件からの洪水被害特性

自然条件と同様に、社会経済条件とそれに伴う当該地域における災害への脆弱性と曝災性を以下に示す。これに伴い、以下のような洪水特性が確認されている。

表 3.2.4 Isiolo 川中流域の社会経済条件と脆弱性等

社会経済条件	脆弱性・曝災性
枯れ川の付近に家屋が点在している	枯れ川からの出水による被害が発生。人口、家屋数は多くはなく、影響はあるが小さい。
プランテーション、農地、低木林が分布	農業被害が発生する。生計への影響があるが従業員中心で農業への影響は中程度とみられる。
幹線道路が通っている	河岸浸食に伴う物流の停止、停滞があり、広範囲に見た場合、交通への影響は大きい。
観光資源の開発	浸水に伴う開発の遅延、サービス提供の停止が想定されるが、重点開発地域から少しはずれるためリゾートへの影響は小さい。

・ 植生・土地利用的には農地や灌木林であり、農地への洪水被害が大きい。

・ Isiolo 市街地に近い場所では市街地の拡大に伴って、枯れ川の流路や近傍に家屋が建てられ、そうした家屋が洪水流の直撃によって破壊されるような被害も生じている。

洪水により破壊された家屋

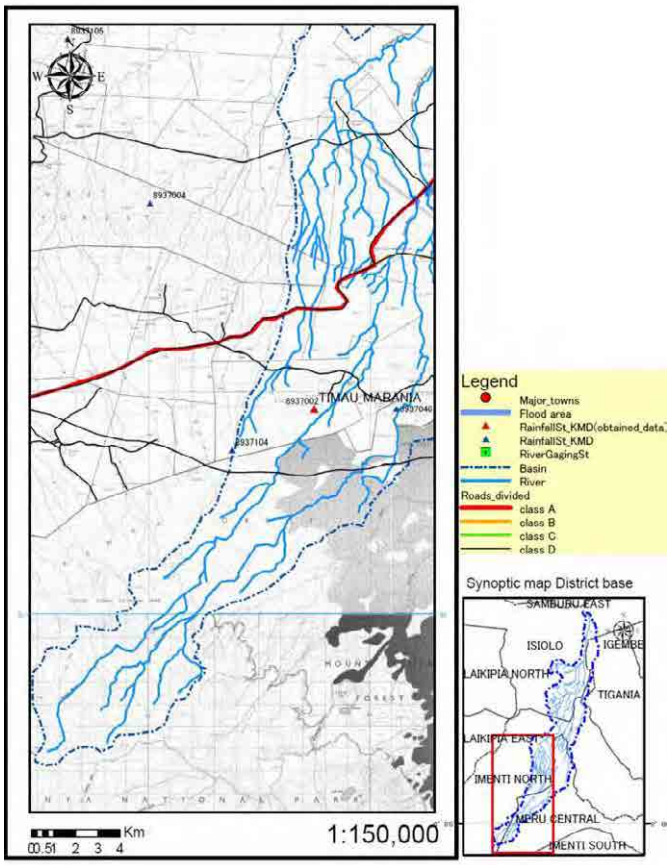
洪水により破壊された家屋

(3) 中流域での河川からの溢水による洪水被害のメカニズム

Isiolo 川中流部に流れ込む小支川の多くは枯れ川で普段の流量が少ないため、河道が明瞭ではない。地形勾配としては 5%（1/20）、河川勾配でも 1/50～1/30 と急勾配であるため、洪水時の流速が大きく、流路が不安定である。一方、Isiolo 市街地の拡大に伴って、本来、河道が明瞭ではないことから、枯れ川である場所やその近傍に家屋が建てられている。その結果、洪水時に洪水流が河道から溢れたり、あるいは、流路が変わったりして、新たに建てられた家屋を直撃するような被害が発生している。

3.2.4 上流域での土石流被害（タイプ C）

洪水タイプ C の上流域での土石流被害について、その洪水特性を自然条件と社会条件から分析した結果を次に示す。



(1) 自然条件からの洪水特性

第 1 章で整理した Isiolo 川流域の自然条件とそれに伴う当該地域におけるハザードを以下に示す。これに伴い、以下のような洪水特性が確認されている。

表 3.2.5 Isiolo 川上流域の自然条件とハザード

自然条件	ハザード
地形は急峻	洪水流の流速が速い
表土は粘土質だが、火山堆積物が存在	地質が脆い

- 主要河川流路としては Eastern Marania 川と Western Marania 川である。
- 河床勾配が 1/10 程度と極めて急であり、洪水流の流速は極めて大きいことが推察される。
- 表土は粘土質とされているが、火山堆積物が存在するため、地質的に脆い可能性がある。

(2) 社会条件からの洪水被害特性

自然条件と同様に、社会経済条件とそれに伴う当該地域における災害への脆弱性と曝災性を以下に示す。これに伴い、以下のような洪水特性が確認されている。

表 3.2.6 Isiolo 川上流域の社会経済条件と脆弱性等

社会経済条件	脆弱性・曝災性
居住区は散在している（人口、家屋数とも少数）	被災人口、家屋数ともに少なく、影響は小さい
中核行政組織が複数にまたがる	調整が困難である
土地利用が農地に限定されている	土石流等による農地被害が発生するが、規模は大きくないため影響は中程度とみられる。
一部プランテーション実施	プランテーションでの被害が発生する。生計への影響が発生するが、規模は大きくなく影響は中程度とみられる。
観光資源の開発	浸水に伴う開発の遅延、サービス提供の停止が想定されるが、重点開発地域から少しはずれるためリゾートへの影響は小さい。

・ 植生・土地利用上は、裸地、プランテーション、農地であり、土石流発生による被害としては農地への被害が多い。

・ 人口密度が低いため、土石流被害はあるものの、被災する人口や家屋は多くない。

写真 3.2.1 土石流による河道の被害

上流域では、洪水と同時に河岸浸食・土壌浸食の被害が顕著である。農地が浸食されることによって、農作物の収穫量が減少するほか、河岸が浸食され、下流への土砂流出も問題となっている。

(3) 上流域での土石流被害のメカニズム

上流域は河床勾配が 1/10 程度と極めて急であるため、洪水時の流速も極めて大きい。火山性堆積物が存在するので、地質的には脆いと言え、洪水時に土砂が混じることが多く、土石流が頻発している。主な洪水被害は、流出土砂が農地を覆ってしまうことによる農業被害が多いと考えられる。しかし、人口密度が低いため、土石流被害の実態は詳細には把握されていない。

3.2.5 全域での河岸浸食/土壌浸食（タイプ D）

洪水タイプ D の全域での河岸浸食/土壌浸食について、その洪水特性を自然条件と社会条件から分析した結果を次に示す。

(1) 自然条件からの洪水特性

第 1 章で整理した Isiolo 川流域の自然条件とそれに伴う当該地域におけるハザードを以下に示す。これに伴い、以下のような洪水特性が確認されている。

表 3.2.7 Isiolo 川全流域の自然条件とハザード

自然条件	ハザード
概ね乾燥地帯で流量が少ないが、局地的な激しい降雨がある	土砂の流下による河床上昇、川幅が狭小
森林の減少	土壌浸食、土砂流出

・ 全域において河川流路は急勾配であり、湾曲部において浸食されている河岸が多い。

(2) 社会条件からの洪水被害特性

自然条件と同様に、社会経済条件とそれに伴う当該地域における災害への脆弱性と曝災性を以下に示す。これに伴い、以下のような洪水特性が確認されている。

表 3.2.8 Isiolo 川全流域の社会経済条件と脆弱性等

社会経済条件	脆弱性・曝災性
一部を除き河川沿いの居住区は少ない（人口、家屋数とも少数）	河岸浸食由来の被災人口、家屋数ともに少なく、影響は小さい
農業がさかん	農業被害が発生する。生計への影響が発生するが、1 カ所毎の規模は小さいが、該当カ所は無数にあり、影響は大きいとみられる。
幹線道路が整備されている	河岸浸食に伴う物流の停止、停滞があり、広範囲に見た場合、交通への影響は大きい。
観光資源の開発	浸水に伴う開発の遅延、サービス提供の停止が想定され、一部重点開発地域を含みリゾートへの影響は中程度とみられる。

・ 中上流域では、河岸浸食はあるものの、人口密度が低く、人家が密集している地域はない。そのため、河岸浸食による被害としては、農地の浸食や、道路や橋梁などの交通インフラへの被害が主である。

・ 下流域の特に Isiolo 市街地付近では、河岸浸食による住宅地への影響も見受けられるが、河川沿いの土地所有自体に問題があることも地域関係者からは指摘されている。

市街地内の河岸浸食

Eastern Marania 川河岸浸食地点

(3) 全域での河岸浸食被害のメカニズム

Isiolo 川は河川流路が急勾配であり、河道湾曲部では岩が露頭していない限り、河岸が浸食されやすい傾向にある。一方、国道 A2 は Isiolo 周辺の社会・経済活動に重要な幹線道路であるばかりでなく、ケニア北部への最も重要な幹線道路である。そのため、A2 国道が河川を渡る箇所で、橋梁が洪水時に損壊して不通になることによる経済的影響は極めて大きいと推察される。

3.3 洪水被害分析及び対策の検討

3.3.1 ISIOLO 市街地の洪水被害及び対策の検討

(1) 被害とその原因

これまでの現地調査をもとに、Isiolo 市街地での洪水被害に関してロジックツリーによる分析を行った

図 3.3.1 に示すように左から順に被害の種類、具体的な被害、被害の状況、その原因というように、右に行くほど被害の具体的な原因を示すように整理している。

Isiolo 市街地では、市街地全体の短期的な浸水による被害が発生している。具体的には、防災に関する意識・知識・情報の不足から来る人的被害、浸水によって移動が困難になるために起こる物流・人流への被害、また土砂の流入や氾濫水の流下による家屋や土地の損失である。

この大規模浸水は防災に関する意識・知識・情報の不足以外に、物理的な要因として、市街地を横切る Merire 川の流下能力不足、市街地の東側に近年新しく建設された空港及び道路の新設によって雨水の流路が変化し、市街地に直撃するようになったこと、また Isiolo 市街地自体の排水システムの整備が進んでいないために起こる排水不良の 3 つの要因が考えられる。

洪水によって浸水した Isiolo 市街地の道路

洪水の後、ぬかるんだ道路の様子

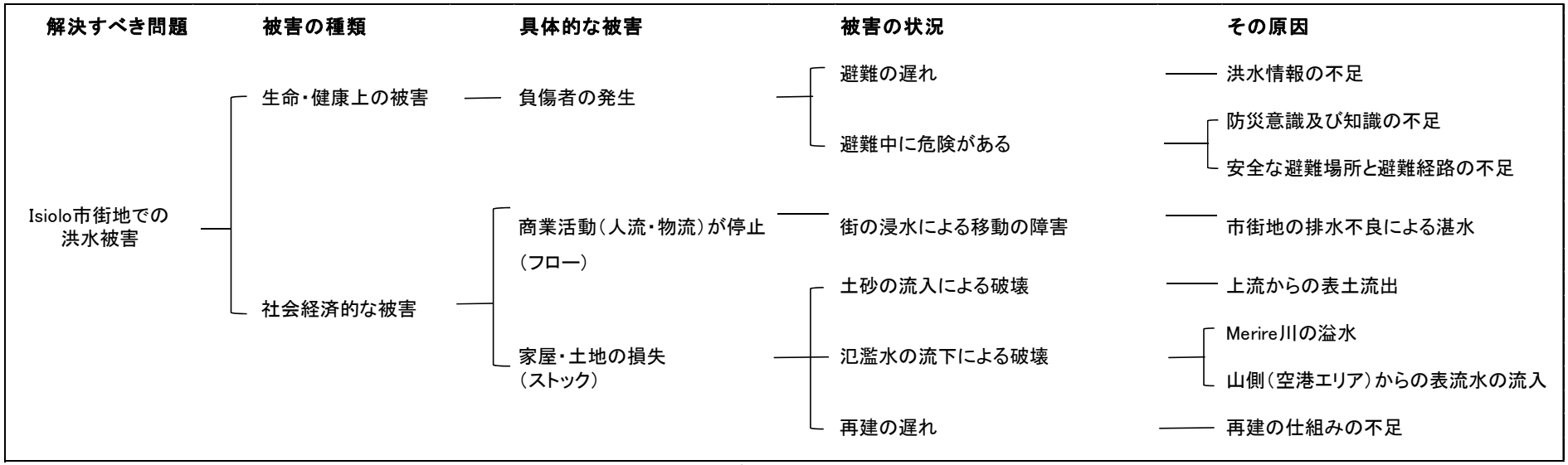


図 3.3.1 プロブレム・ツリー分析

(2) 対策案

これらの解決策を導き出すため、オブジェクティブ・ツリー分析を行った。結果を下記の図に示す。なお、左に解決すべき問題を置き、そこから対処方法を具体化している。

Isiolo 川流域においては、ケニア山の影響により上流で激しく雨が降っていても、中流域、下流域では雨が降っていないということがある。このような場合、予め上流の雨量や水位の情報を掴んでいることによって避難や水防活動などの有効な対策をとることができる。これには、洪水早期警戒システムの構築という対策方法がある。コミュニティでも簡単に使用できる簡易雨量計で上流の雨量を計測し、その情報を下流へ伝達するといったことが考えられる。


簡易雨量計

防災意識が低いことにより、洪水時に水が流れている道路を無理に通ろうとして怪我をしたり、水没している橋を渡ろうとして流されたりするなど危険な事態が発生している。これを避けるには、洪水がどれだけ危険であるかを住民に意識させるための防災教育の実施が有効であると考えられる。


排水不良により洪水になる市街地

市街地の排水不良も被害を拡大する原因の一つとなっている。排水に関わるインフラが機能しない、または整備されていないことから少量の雨で市街地の湛水が発生し、道路の寸断等で移動障害となったり、商店に水が浸入したりして商業活動が停止する。これには、市街地の排水ネットワークの整備や道路側溝を整備するという対策方法と、土嚢を積むことで商店への浸水を防ぐことなどが考えられる。


既に土嚢対策を行っている商店

また、Merire 川からの溢水により、家屋や建物の損壊や資産の損失が起こる。これには、Merire 川の流下能力を高めて溢水を防ぐため、Merire 川の掘削、拡幅という対策方法がある。また、河岸に近い位置での居住を制限する土地利用規制、流下の妨げとなるゴミを取り除くゴミ拾いキャンペーンという対策方法がある。


ゴミの不法投棄が多い Merire 川

さらに、市街地東側斜面における道路の新設や空港拡張の影響により、洪水の流出経路が変更させられていることに伴い、市街地の浸水状況がよりひどくなっている。これには、排水路やカルバートの整備によって洪水流出の経路を元に戻す対策や洪水調整池による流出抑制という対策方法がある。

場所:Isiolo Town

市街地に設置されている数少ない排水路
場所: Isiolo Town

空港近くに設置されているカルバート
場所: Isiolo Town

以上の結果を受けて、考えられる対策方法を以下に整理する。

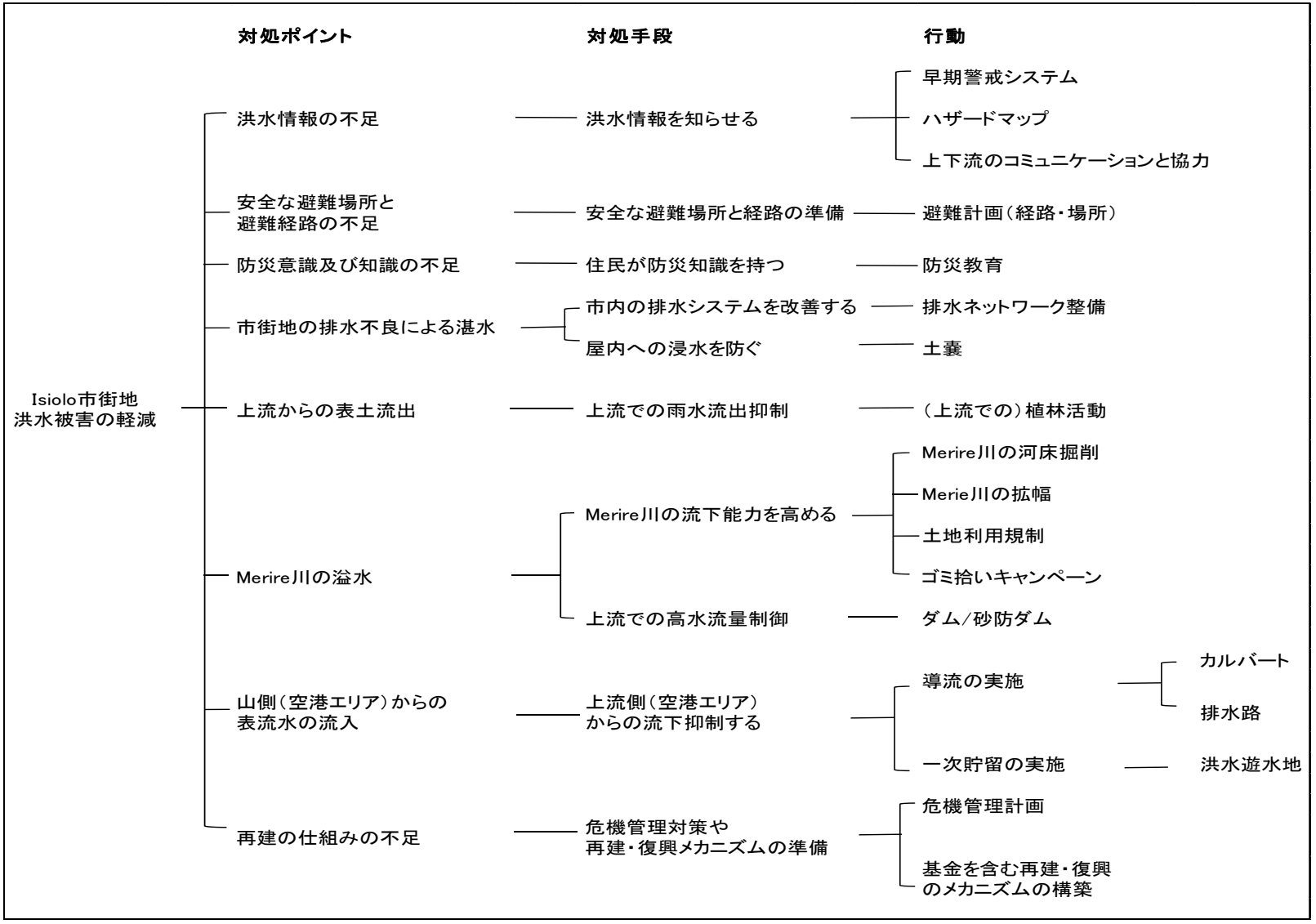


図 3.3.2 オブジェクティブ・ツリー分析

前述のツリー分析の結果を考慮し、考えられる対策案を下表に示す。

表 3.3.1 Isiolo 市街地での対策候補

考えられる対策方法	対策の内容	対象地域
早期警戒システム	Isiolo 川流域で、上流で雨量・水位など洪水に関する情報を収集・分析し、それを Isiolo 市街地へ伝達する。	Isiolo 市街地
ハザードマップ	コミュニティ内での洪水のインパクトを共有するためのツール	Isiolo 市街地
上下流のコミュニケーションと協力	上流域・下流域のコミュニティメンバーによる雨量・水位の情報共有は被害軽減や避難、災害対応、被害者救出等にも役立つ。	Isiolo 市街地
避難計画	避難計画は避難計画た安全な避難所及び避難計画、避難訓練も含む。	Isiolo 市街地
防災教育	住民に対し、現状の洪水被害を自ら軽減する方法を教育する。	Isiolo 市街地
排水ネットワーク整備	Isiolo 市街地全体での整備	Isiolo 市街地
土嚢	土嚢作成指導、材料提供	Isiolo 市街地
植林活動	樹木またそれを推進する活動	Isiolo 市街地
Merire 川の河床掘削	堆積土砂の掘削	Isiolo 市街地
Merire 川の拡幅	拡幅	Isiolo 市街地
土地利用規制	土地利用規制に関する法整備	Isiolo 市街地
ゴミ拾いキャンペーン	Merire 川周辺でのゴミ拾いキャンペーンを実施	Isiolo 市街地
ダム / 砂防ダム	上流でのダム又は砂防ダムの建設	Isiolo 市街地
排水路	空港エリアでの道路の排水路整備	Isiolo 市街地
カルバート	空港エリアでのカルバート整備	Isiolo 市街地
洪水調整池	空港エリアでの洪水調整池整備	Isiolo 市街地
危機管理計画	組織が緊急時に対応できるように準備し、人々の災害に対する対応力のポテンシャルの向上を目指す	Isiolo 市街地
基金を含む再建・復興のメカニズムの構築	長期的な再建と経済復興のプロセスは震災後に避難場所から戻ってくる人々や新たな場所への移住が発生する際に必要となる	Isiolo 市街地

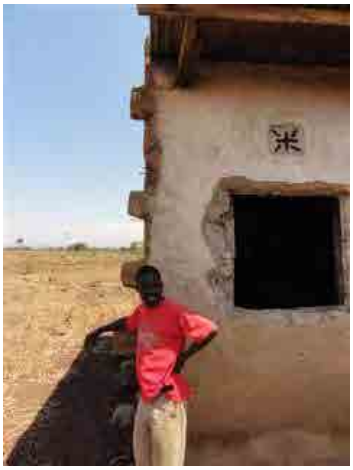
3.3.2 市街地以外の郊外（主に ISIOLO 市街地より上流）の洪水被害及び対策の検討

(1) 被害とその原因

これまでの現地調査をもとに、Isiolo 市街地の場合と同様に、市街地以外の郊外、主に Isiolo 市街地より上流での被害に関してロジックツリーによる分析を行った。

市街地以外の郊外は前章で前述のとおり、中流域の河道の移動、上流域の土石流の発生、河岸浸食及び土壌浸食による被害が主である。Isiolo 市街地以外の郊外では農地が多く、農業に関する被害が顕著であり、土石流による農地の破壊や河岸浸食による土地の流出が起こっている。

また、浸水によって家屋や橋などのインフラに被害がもたらされており、住民の生活に大きな影響を及ぼしている。



男性のひじのあたりまで浸水する
場所: Isiolo 川中流

河岸浸食が進んだ Eastern Marania 川
場所: Isiolo 川上流

Isiolo 郊外の橋

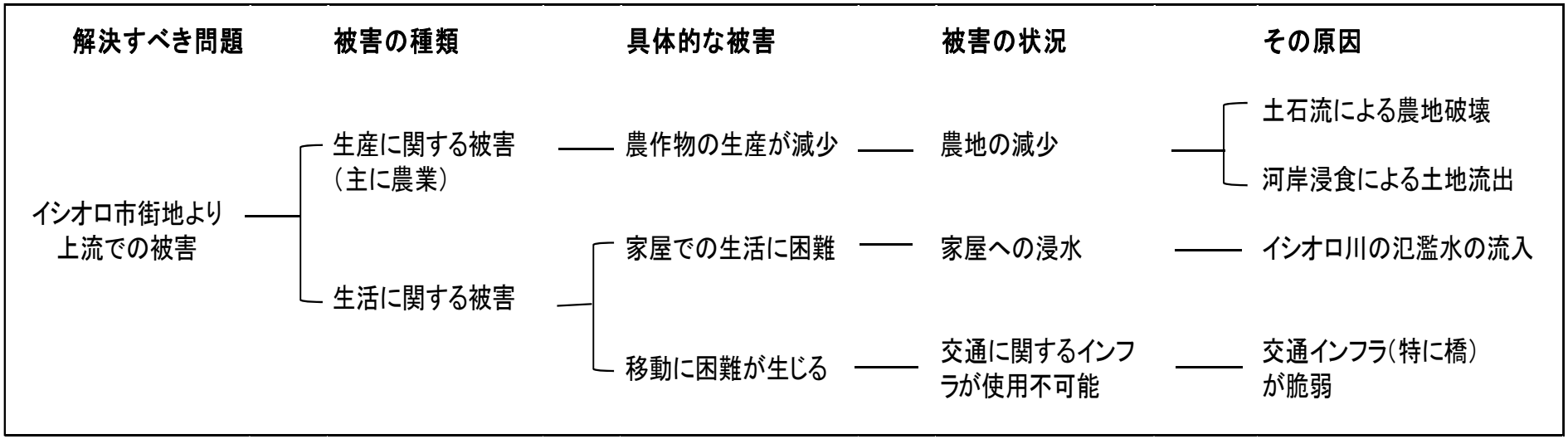


図 3.3.3 プロブレム・ツリー分析

(2) 対策案

この地域では土石流による農地の破壊によって農作物の生産に悪影響を与えているが、これは土石流の流出には砂防ダムの設置が有効であると考えられる。また、河岸浸食に対する対策としては、護岸が考えられる。

洪水によって家屋やインフラが損壊し生活への支障が発生する被害に関しては、河道改修を行い、Isiolo 川の溢水を抑制するという対策方法がある。また、橋そのものを改修するという考え方もある。

砂防ダム（Nzoia 川の例）

護岸 （Nzoia 川の例）

これらの解決策を導き出すため、オブジェクティブ・ツリー分析を行った。結果を次の図に示す。なお、左に解決すべき問題を置き、そこから対処方法を具体化している。考えられる対策方法を以下に整理する。

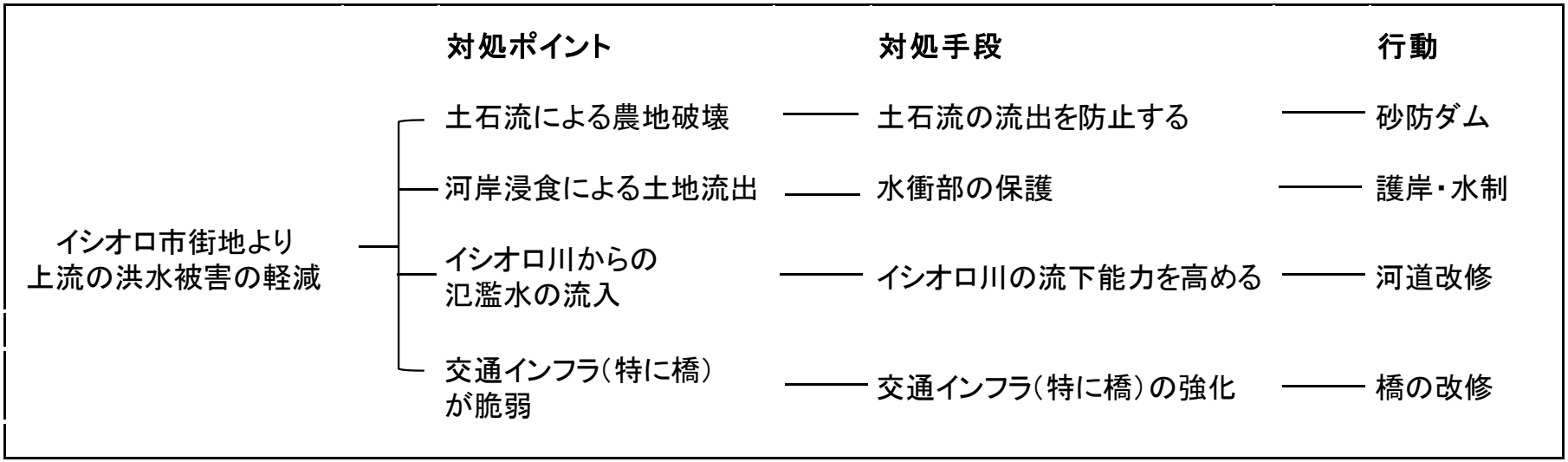


図 3.3.4 オブジェクティブ・ツリー分析

表 3.3.2 市街地以外の郊外（主に Isiolo 市街地より上流）における対策候補

考えられる対策方法	対策の内容	対象地域
砂防ダム	Isiolo 川での砂防ダム設置	上流
護岸	Isiolo 川での設置	流域全体
河道改修	Isiolo 川の河道改修	中流域及び支川
橋の改修	Isiolo 川での橋の改修	中流域及び支川

3.3.3 洪水対策の候補（ロングリスト）

Isiolo 川流域における洪水対策候補（ロングリスト）を下に示す。

表 3.3.3 Isiolo 川流域における対策候補全体の一覧（ロングリスト）

No.	考えられる対策方法	対策の内容	対象地域
1	早期警戒システム	Isiolo 川流域で、上流で雨量・水位など洪水に関する情報を収集・分析し、それを Isiolo 市街地へ伝達する。	Isiolo 市街地
2	ハザードマップ	コミュニティ内での洪水のインパクトを共有するためのツール	Isiolo 市街地
3	上下流のコミュニケーションと協力	上流域・下流域のコミュニティメンバーによる雨量・水位の情報共有は被害軽減や避難、災害対応、被害者救出等にも役立つ。	Isiolo 市街地
4	避難計画	避難計画は避難計画た安全な避難所及び避難計画、避難訓練も含む。	Isiolo 市街地
5	防災教育	住民に対し、現状の洪水被害を自ら軽減する方法を教育する。	Isiolo 市街地
6	排水ネットワーク整備	Isiolo 市街地全体での整備	Isiolo 市街地
7	土嚢	土嚢作成指導、材料提供	Isiolo 市街地
8	植林活動	樹木またそれを推進する活動	Isiolo 市街地
9	Merire 川の河床掘削	堆積土砂の掘削	Isiolo 市街地
10	Merire 川の拡幅	拡幅	Isiolo 市街地
11	土地利用規制	土地利用規制に関する法整備	Isiolo 市街地
12	ゴミ拾いキャンペーン	Merire 川周辺でのゴミ拾いキャンペーンを実施	Isiolo 市街地
13	ダム / 砂防ダム	上流でのダム又は砂防ダムの建設	Isiolo 市街地
14	排水路	空港エリアでの道路の排水路整備	Isiolo 市街地
15	カルバート	空港エリアでのカルバート整備	Isiolo 市街地
16	洪水調整池	空港エリアでの洪水調整池整備	Isiolo 市街地
17	危機管理計画	組織が緊急時に対応できるように準備し、人々の災害に対する対応力のポテンシャルの向上を目指す	Isiolo 市街地
18	基金を含む再建・復興のメカニズムの構築	長期的な再建と経済復興のプロセスは震災後に避難場所から戻ってくる人々や新たな場所への移住が発生する際に必要となる	Isiolo 市街地
19	護岸	Isiolo 川での設置	流域全体
20	砂防ダム	Isiolo 川での砂防ダム設置	上流
21	河道改修	Isiolo 川の河道改修	中流域及び支川
22	橋の改修	Isiolo 川での橋の改修	中流域及び支川

3.4 優先的に対処すべき洪水被害の選定

3.4.1 コミュニティによる洪水被害分析ワークショップの結果

Isiolo 川流域においては、2012 年 11 月 7 日に Isiolo サブ流域の問題分析を行うために WRUA メンバー、WRMA-SRO 職員及び JICA プロジェクトチームメンバーによってワークショップを開催した。

その結果、洪水の原因としては次のとおりの分析がなされた。

表 3.4.1 WRUA メンバーからの聞取りによる洪水の原因分析

テーマ	原因	洪水による主な影響
洪水	ケニア山腹の降雨	枯れ川の急増水によるフラッシュフラッド
	上流の土砂流出	
	排水路の容量不足	市街地の排水不良による氾濫
	空港の調節地未整備	

また、被害については、次のとおりの分析がなされ、WRUA メンバーによる優先順位の意見も示された。

表 3.4.2 WRUA メンバーによる被害分析と優先順位

WRUA メンバーによる優先順位づけ	大項目	一時的被害	二次的被害
①	土壌浸食	・農地の表土流出 ・農作物被害 ・土砂流出	・農地不足 ・収穫不足 ・土地不足 ・カルバートの詰り
②	インフラ被害	・電線 ・道 ・橋 ・取水施設 ・カルバート	・停電 ・マーケットに商品が届かない ・病院、学校に行けない ・水不足、水争い、干ばつ ・水のあふれ
③	水質汚染	・病気発生 ・衛生状態悪化	・コレラ、赤痢、腸チフス発生
④	生活・生計被害	・投棄ゴミ散乱 ・トイレが溢れる ・家屋損壊	・カルバートの詰り、水溢れ ・衛生状態 ・転居を余儀なくされる
⑤	生命	・流されて人が死亡 ・家畜が溺死	

3.4.2 優先すべき洪水被害の選定

前章で述べたとおり、Isiolo 川流域の洪水被害は、A) Isiolo 市街地での浸水被害、B) 中流域での河川からの溢水による浸水、C) 上流域での土石流被害、D) 全域での河岸・土壌浸食と大きく 4 つに分類される。前節のコミュニティによる洪水被害の評価を踏まえ、それぞれの洪水被害の影響度を社会的影響（被災者数、被災家屋数）と経済的影響（商業、農業、交通、観光への影響）に分けて評価すると、下表のとおりとなった。

表 3.4.3 優先すべき洪水被害の選定

洪水のタイプ	社会的影響		経済的影響				優先度
	被災者数	被災家屋数	商業活動への影響	農業への影響	交通への影響	観光への影響	
A. 市街地での浸水被害	**大**	**大**	**大**	小	**大**	中	極めて高い
B. 中流域での河川からの溢水による浸水	小	小	小	中	小	小	やや低い
C. 上流域での土石流被害	小	小	小	中	小	中	やや低い
D. 全域での河岸・土壌浸食	小	小	小	中	**大**	中	交通への影響のある箇所では高い

4 つの洪水被害のタイプのうち、Isiolo 市街地での浸水被害が、最も社会・経済的に与える影響が大きいことが分かる。次いで、河岸浸食のうち、特に、交通への影響の恐れのある箇所の被害の影響度が大きいとの結果となった。

これらのことから、Isiolo 川流域において最も優先的に取り組むべき洪水被害として、市街地の洪水被害を選定する。その次に、交通への影響の高い箇所における河岸浸食についても優先的に対応をするものとする。以下に優先すべき対策案を示す。

表 3.4.4 優先すべき洪水対策の選定

No.	考えられる対策方法	対策の内容	対象
1	早期警戒システム	Isiolo 川流域で、上流で雨量・水位など洪水に関する情報を収集・分析し、それを Isiolo 市街地へ伝達する。	Isiolo 市街地
2	ハザードマップ	コミュニティ内での洪水のインパクトを共有するためのツール	Isiolo 市街地
3	上下流のコミュニケーションと協力	上流域・下流域のコミュニティメンバーによる雨量・水位の情報共有は被害軽減や避難、災害対応、被害者救出等にも役立つ。	Isiolo 市街地
4	避難計画	避難プログラムは避難計画た安全な避難所及び避難計画、避難訓練も含む。	Isiolo 市街地
5	防災教育	住民に対し、現状の洪水被害を自ら軽減する方法を教育する。	Isiolo 市街地
6	排水ネットワーク整備	Isiolo 市街地全体での整備	Isiolo 市街地
7	土嚢	土嚢作成指導、材料提供	Isiolo 市街地
8	植林活動	樹木またそれを推進する活動	Isiolo 市街地
9	Merire 川の河床掘削	堆積土砂の掘削	Isiolo 市街地
10	Merire 川の拡幅	拡幅	Isiolo 市街地
11	土地利用規制	土地利用規制に関する法整備	Isiolo 市街地
12	ゴミ拾いキャンペーン	Merire 川周辺でのゴミ拾いキャンペーンを実施	Isiolo 市街地
13	ダム / 砂防ダム	上流でのダム又は砂防ダムの建設	Isiolo 市街地
14	排水路	空港エリアでの道路の排水路整備	Isiolo 市街地
15	カルバート	空港エリアでのカルバート整備	Isiolo 市街地
16	洪水調整池	空港エリアでの洪水調整池整備	Isiolo 市街地
17	危機管理計画	組織が緊急時に対応できるように準備し、人々の災害に対する対応力のポテンシャルの向上を目指す	Isiolo 市街地
18	基金を含む再建・復興のメカニズムの構築	震災後に避難場所から戻ってくる人々や新たな場所への移住が発生する際に必要となる、長期的な再建と経済復興のプロセスでの支援及び基金の設立	Isiolo 市街地
19	護岸	Isiolo 川での護岸設置	全域

4. 洪水管理事業の評価

4.1 評価の視点

前章で候補となった対策案について、より詳細な検討を加える。その検討結果を踏まえ、それぞれの対策案を多角的な視点から評価すべく、妥当性・有効性・効率性・インパクト・持続性の五項目を使用することとした。なお、五項目は今回の選定にあたって定義づけを行い、次表に示す 5 つの評価軸において A、B、C の 3 段階で評価を行った。

表 4.1.1 対策案評価軸５項目の定義

1	妥当性 (Relevance)	ステークホルダーの要望、対象地域のニーズと合致しているか 経済的被害・人的被害が大きいかどうか
2	有効性 (Effectiveness)	被害軽減の度合い （受益者数、軽減する冠水期間・面積・被害者数）
3	効率性 (Efficiency)	費用対効果 （想定される事業費の定性的大きさと上記の被害軽減度合いから判断）
4	インパクト (Impact)	同流域内または他地域の波及効果（他地域での普及） 二次的効果
5	持続性 (Sustainability)	維持管理及び事業の効果継続性 （パイロット事業が設計通り完成、または導入された場合を想定）

＊DAC 評価五項目を参考に、今回の検討に合うように定義付けした。

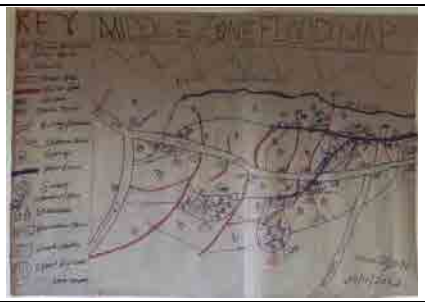
4.2 各対策案の評価

表 4.2.1 Isiolo 市街地での浸水被害対策事業の評価検討(1)

No.		1		
対象地区と原因		Isiolo 市街地（Merire 川の溢水）		
対策		早期警戒システム		
概要		上流での降雨量や水位をもとに下流へ警戒情報を伝達するシステム。警報を基に、身の安全を確保し、土嚢準備などの水防活動を行う。		
イメージ				
評価項目				
五項目評価	妥当性	早期警戒システムはケニアではまだ一般的ではないが、防災情報の不足を訴える声はある。流速が速く、洪水時の移動や家屋への打撃が大きいため、住民が少しでも早く情報を知り、対策をするのは有意義である。	B	2
	有効性	警戒情報は広範囲に伝達することが可能である。警報があっても洪水対策を知らなければ被害軽減度合いは高くないが、防災教育と同時に実施することで、その効果は高まる。	B	2
	効率性	比較的安価な予算で広範囲に効果を与えられる。	A	3
	インパクト	比較的容易に他地域でも導入でき、上・下流のｺﾐｭﾆﾃｨのｺﾐｭﾆｹｰｼｮﾝが活発になる、双方の防災意識が高まる、等の付加的効果もある。	A	3
	持続性	簡易的で安価な計測器・伝達システムであれば、維持管理が容易である。	A	3
合計			13	
メリット		コミュニティベースの早期警報システムは低コストで実施可能である		
デメリット		簡易計測器であれば正確性に欠ける可能性がある 上下流のコミュニティの協力が不可欠であり、交渉・準備に時間がかかる カウンティとの協働に手間・時間がかかる		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		上流・下流の住民の協働が必要		
事業実施者（メインアクター）		WRUA/County/District		
事業関係機関		<支援行政機関> KMD/スペシャルプログラム省 <技術支援>MWI, WRMA <他の支援機関>KRCS		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		共助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.2 Isiolo 市街地での浸水被害対策事業の評価検討(2)

No.		2		
対象地区と原因		Isiolo 市街地(全般)		
対策		ハザードマップ		
概要		洪水ハザードマップは一般的に洪水時の危険（強度、危険な範囲、浸水の深さ、浸水時間、頻度など）や避難情報（避難所の位置、避難ルート、危険個所）に関する情報を提示・普及するものである。		
イメージ				
評価項目				
五項目評価	妥当性	住民からの要望が高い。経済的・人的被害も多く、対象地域での必要性も非常に高い。	A	3
	有効性	受益者数は、イシオロ市街地に住んでいる全住民であり、多い。	A	3
	効率性	ハザードマップ作製は低コストで可能である。（パンフレット印刷や看板設置には別途予算が必要）費用は低く抑えることができ、高い効果が見込めるため効率性は高いと言える。	A	3
	インパクト	他地域への普及は比較的容易である。	A	3
	持続性	防災教育とともにハザードマップを普及することで持続性は高くなる。	A	3
合計			15	
メリット		簡単な地図であり、理解するのに難しい知識は必要としない。		
デメリット		実施のためには一部のコミュニティメンバーがハザードマップ作成方法を学ぶ必要がある。		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		マップ作成のプロセスへの参加		
事業実施者（メインアクター）		WRUA		
事業関係機関		<支援行政機関> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		共助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.3 Isiolo 市街地での浸水被害対策事業の評価検討(3)

No.		3		
対象地区と原因		Isiolo 市街地 （全般）		
対策		上下流のコミュニケーションと協力		
概要		上流域・下流域のコミュニティメンバーによる雨量・水位の情報共有。被害軽減や避難、災害対応、被害者救出に役立てる。		
イメージ				
評価項目				
五項目評価	妥当性	上流・下流双方のコミュニティでの必要性が高い。	A	3
	有効性	受益者数は多い。イシオロ市の住民全てが受益者となり、有効性は高いと言える。	A	3
	効率性	コミュニケーションツールと双方で協力することに関しての費用は低く、ある程度の効果も見込めるため効率性は高いと言える。	A	3
	インパクト	他地域への普及は難しくはない。二次的効果は高い。	A	3
	持続性	上流・下流の双方にメリットがあれば、協力関係は持続すると考えられる。	B	2
合計			14	
メリット		上下流でのコミュニケーション・協力関係が良い状態であれば、流域全体で良い効果が得られる。		
デメリット		一般的に、下流の住民のみが受益者になる場合が多い。		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		コミュニケーションと協働への参加		
事業実施者（メインアクター）		WRUA		
事業関係機関		<技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		共助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.4 Isiolo 市街地での浸水被害対策事業の評価検討(4)

No.		4		
対象地区と原因		Isiolo 市街地 （全般）		
対策		避難計画		
概要		避難訓練と避難所管理の準備及び実施		
イメージ				
評価項目				
五項目評価	妥当性	住民、特に子供たちの必要性が高く、通学路での被害も多発している。また、女性や老人の被害も多い。	A	3
	有効性	受益者数は多い。イシオロ市の住民全てが受益者となり、有効性は高いと言える。	A	3
	効率性	避難計画策定に関してのコストは低く、効果も見込めるため効率性は高い。	A	3
	インパクト	他地域への普及は難しくはない。二次的効果は高い。	A	3
	持続性	防災教育とともに避難プログラムを行うことで持続性は高くなる。	B	2
合計			14	
メリット		構造物対策ですべての洪水被害を完全に軽減できるわけではないため、避難計画の様な非構造物対策が重要となる 避難は洪水被害による、貧困や人命の喪失を改善するために重要な対策である		
デメリット		避難訓練は繰り返し行う必要がある		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		避難訓練への参加		
事業実施者（メインアクター）		WRUA		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		共助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.5 Isiolo 市街地での浸水被害対策事業の評価検討(5)

No.		5		
対象地区と原因		Isiolo 市街地（全般）		
対策		防災教育		
概要		防災に関する知識や情報を普及し、防災意識を高め、被害を軽減する術を身につけるための教育活動。必要に応じてｶﾘｷｭﾗﾑ化を図る。		
イメージ				
評価項目				
五項目評価	妥当性	WRMA からコミュニティ強化の観点から要望が高い。洪水時の外出で負傷する、土嚢等の対策をせず水が家屋に流入する、避難経路が分からず動けない等、知識があれば避けられる被害もあるため、必要性は高いものと考えられる。	A	3
	有効性	防災教育を受けた人数に対して一定の効果が出る。学んだ知識や情報を活かして洪水対策を行う際、場所が限定されず、教育を受けた人がそれぞれ必要な場所で対策を実施することができ、効果も拡散する。	B	2
	効率性	一度に大人数に知識を与えることができ、予算も少なくてすむ上、定着すれば効果は大きい。	A	3
	インパクト	受益者が家族に教える、友達に教える、など与えられた知識の広がる可能性が高い。	A	3
	持続性	学校の先生、コミュニティリーダー等その土地の人が講師になれば活動は持続していく。また、カリキュラム化を図ることで定着性も増す。	A	3
合計			14	
メリット		費用が小さい 子供のころに学んだ知識は大人になって身についている 子供が学校で学んだ知識は親や親せきなどに伝達される		
デメリット		教育関係者との協力・協働が必要となり、時間を要する まず教員への教育が必要となり、それに関する時間・費用が必要である		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		教員へのサポート		
事業実施者（メインアクター）		学校、WRUA		
事業関係機関		<許認可> 教育省、County/District <技術支援>MWI, WRMA <他の支援者>KRCS、PTA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.6 Isiolo 市街地での浸水被害対策事業の評価検討(6)

No.		6		
対象地区と原因		Isiolo 市街地（内水）		
対策		市街地全域の排水ネットワークの整備		
概要		市街地全体排水設備を整える		
イメージ				
評価項目				
五項目評価	妥当性	市街地には商業地区が集中しており経済的な損失が大きく対策を求める声は多い。水質汚染にも関係し、WRUA の要望がある。加えて近年集中豪雨が増えているといわれており、更に被害が増大しているため排水設備の整備は急務である。	A	3
	有効性	市街地全体で整備が進めば効果が高い。	A	3
	効率性	費用が莫大だが、効果もそれ以上にあり、市街地の浸水の根本的な対策となる。	A	3
	インパクト	他地域への波及効果は少ない。（それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。）	C	1
	持続性	事業後の継続的な維持管理が不可欠となる。	C	1
合計			11	
メリット		排水ネットワークの不備は衛生状態の悪化にも関連しており、整備されれば、衛生被害も減少すると考えられる。		
デメリット		ステークホルダーとの交渉、測量、計画、設計等の実施前の検討に長い時間を要する。		
環境への負の影響		汚水処理設備が整備されていない場合、雨水が汚水と混ざって川に流れ、環境に影響を及ぼす場合がある。		
EIA の必要性		有り		
住民負担の有無		なし		
事業実施者（メインアクター）		County/District		
事業関係機関		<許認可> 計画省 <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.7 Isiolo 市街地での浸水被害対策事業の評価検討(7)

No.		7		
対象地区と原因		Isiolo 市街地（全般）		
対策		土嚢		
概要		砂を詰めた袋を縛り積み上げることで、水や土砂の移動を妨げる		
イメージ				
評価項目				
五項目評価	妥当性	住民はその効果と必要性を認識しており、一部の商店・民家では自主的に実施されている。市街地浸水の要因の一つであるインフラ整備不足を補う最も簡易的な方法である。	A	3
	有効性	大きな効果を得るには、多数の土嚢が必要である。	B	2
	効率性	費用は少なく、効果も限定的である。	B	2
	インパクト	比較的簡易的な対策であるため、他地域でも応用可能である。	A	3
	持続性	一度その方法を学べば活動は持続でき、維持管理も容易である。	A	3
合計			13	
メリット		準備期間が短い 低コストで実施可能		
デメリット		一時的な対策に過ぎない 土嚢で水の流入の全てが防げるわけではない		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		個人負担		
事業実施者（メインアクター）		WRUA、個人		
事業関係機関		<支援行政機関> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		自助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.8 Isiolo 市街地での浸水被害対策事業の評価検討(8)

No.		8		
対象地区と原因		Isiolo 川上流		
対策		植林活動		
概要		上流の山の植林によって植生の保護・回復を図ることにより、雨水（洪水）に対する貯留効果を高める。		
イメージ				
評価項目				
五項目評価	妥当性	土砂流入被害を受けている農民も必要性を認識している。WRUA の要望も高い。また、“Imenti North District Development Plan”の中でも植林事業が計画されており、上位計画とも一致する。	A	3
	有効性	適切な規模で実施されれば、一定の効果が期待される。	B	2
	効率性	大きな効果を得るには大規模な植林が必要であり、費用もかさむ。	B	2
	インパクト	比較的導入が容易であり、他地域で活動が広まる可能性はある。また、環境保全にも貢献する。	B	2
	持続性	事業者の意識に根付けば活動自体の継続性も高が、苗が成長するまでの維持管理が必要である。	B	2
合計			11	
メリット		準備期間が短い 低コストで実施可能 環境に良い影響を与える 地球温暖化防止にも貢献する		
デメリット		目に見える効果が表れるまでには時間がかかる イシオロの気候は樹種に制約がある		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		WDC マニュアルによると、地元住民は Alarm Status のサブ流域では 15%、Alert または Concern Status のサブ流域では 25%の負担をしなければいけないと定められている。それは、現金、労働、物品のいずれでも構わない。		
事業実施者（メインアクター）		WRUA		
事業関係機関		<許認可> Kenya Forest Service <技術支援>MWI, WRMA <他の支援者>KRCS		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		共助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.9 Isiolo 市街地での浸水被害対策事業の評価検討(9)

No.		9		
対象地区と原因		Isiolo 市街地（Merire 川の溢水）		
対策		Merire 川の浚渫		
概要		河床を浚渫し、流下能力を向上させる対策		
イメージ				
評価項目				
五項目評価	妥当性	Merire 川からの浸水被害は多数報告されてあり、住民や WRMA からの要望は高い。河道断面積が少ないことによる流下能力不足が原因であることから、必要性は高い。	A	3
	有効性	Merire 川溢水が大幅に減少すると予想され、被害軽減が期待できる。	A	3
	効率性	費用が莫大だが、効果も大きい。	B	2
	インパクト	他地域への波及効果は少ない。（それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。）	C	1
	持続性	掘削後も河床に土砂が堆積する可能性があり、河道維持のための浚渫費用が発生する恐れがある。	C	1
合計			10	
メリット		メリレ川の流下能力が高まり、湛水軽減効果が見込める		
デメリット		ステークホルダーとの交渉、測量、計画、設計等の実施前の検討に長い時間を要する 土砂流入の状況によっては、浚渫は継続して行わなければならない。		
環境への負の影響		現在のメリレ川は汚水が既に流れているものの、それ以上の負の影響はないものと考えられる 住民移転が発生する可能性がある		
EIA の必要性		有り		
住民負担の有無		なし		
事業実施者（メインアクター）		NWCPC		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.10　Isiolo 市街地での浸水被害対策事業の評価検討(10)

No.		10		
対象地区と原因		Isiolo 市街地（Merire 川の溢水）		
対策		Merire 川の拡幅		
概要		川の川幅を広げて、河川の流下断面積を大きくする対策		
イメージ				
評価項目				
五項目評価	妥当性	住民や WRMA からの要望はある。河道断面積不足による流下能力不足が溢水の原因であることから、必要性もあるが、家屋を河岸の水際に建設している箇所もあり、実際には住民からの反対も予想される。	B	2
	有効性	Merire 川溢水が大幅に減少すると予想され、被害軽減が期待できる。	A	3
	効率性	費用が莫大だが、効果も大きい。	B	2
	インパクト	他地域への波及効果は少ない。（それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。）	C	1
	持続性	河床掘削よりは維持費は少なくて済む可能性はあるが、事業後の継続的な維持管理は必要である。	C	1
合計			9	
メリット		メリレ川の流下能力が高まり、湛水軽減効果が見込める		
デメリット		ステークホルダーとの交渉、測量、計画、設計等の実施前の検討に長い時間を要する 河岸近くに家が建っており、住民移転が発生する可能性がある。ステークホルダーとの交渉に困難を要するものと考えられる。		
環境への負の影響		現在のメリレ川は汚水が既に流れているものの、それ以上の負の影響はないものと考えられる 住民移転が発生する可能性がある		
EIA の必要性		有り		
住民負担の有無		なし		
事業実施者（メインアクター）		NWCPC		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.11 Isiolo 市街地での浸水被害対策事業の評価検討(11)

No.		11		
対象地区と原因		全国展開(Merire 川の溢水)		
対策		土地利用に関する法整備		
概要		川の近くでの建物を建設禁止及び土地の不法占拠禁止の法律・条例を制定		
イメージ		-		
評価項目				
五項目評価	妥当性	河岸近くに建設された家は不法であることが多く、そのために川の拡幅対策ができない等の問題がある。規制により、河川沿いの不法住居がなくなれば、洪水被害のリスク軽減の効果が高い	B	2
	有効性	施行までに長期間要する	B	2
	効率性	費用はほとんど発生しないが、直接的な減災効果は限定的である。	B	2
	インパクト	地域の広がりはあるが、波及効果はない	B	2
	持続性	規制制定後も継続的な取り締まり、監視が必要	B	2
合計			10	
メリット		不法占拠・占有等の規制取り締まりにより、被害リスクを軽減		
デメリット		住民移転が発生する可能性がある 規制と教育活動は同時に行う必要がある 政府レベルの対策であり、法律の制定までには時間がかかる		
環境への負の影響		なし		
EIA の必要性		不要		
住民負担の有無		なし		
事業実施者(メインアクター)		Ministry of Lands/WRMA		
事業関係機関		<技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.12　Isiolo 市街地での浸水被害対策事業の評価検討(12)

No.		12		
対象地区と原因		Merire 川周辺（Merire 川の溢水）		
対策		ゴミ拾いキャンペーン		
概要		河川・雨水の流下を妨げる廃棄物を除去する活動		
イメージ		 (Source: City of Kurume)		
評価項目				
五項目評価	妥当性	住民からゴミの不法投棄問題に関しては多数不満の声が上がっており、要望が高い。Merire 川の少ない河道断面積がゴミによってさらに小さくなり、溢水しやすくなっている。また、カルバートの閉塞の要因にもなっており、ニーズが高い。	A	3
	有効性	川床のゴミの除去で川からの溢水の減少、またカルバートのごみの詰まり解消によって、その機能を取り戻す。	B	2
	効率性	費用は少なく、一定の効果が見込める。	A	3
	インパクト	導入が容易であるため、活動が他の地域でも広まる可能性がある。また、環境美化や衛生面の改善にも貢献する。	A	3
	持続性	事業自体の効果を認識すれば、防災意識が高まり、継続性も高い。	A	3
合計			14	
メリット		メリレ川からの溢水が減少する 低コストで実施可能 コミュニティ活動である。 簡単に実施できる 準備期間が短い		
デメリット		拾ったゴミの処理方法を考慮する必要がある		
環境への負の影響		不要		
EIA の必要性		なし		
住民負担の有無		ゴミ拾い活動への参加		
事業実施者（メインアクター）		WRUA		
事業関係機関		<支援行政機関> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		共助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.13 Isiolo 市街地での浸水被害対策事業の評価検討(13)

No.		13		
対象地区と原因		Isiolo 市街地 (全般)		
対策		ダム/砂防ダム		
概要		砂防ダムは低地や河道に建設する比較的小規模な構造物である		
イメージ		 (Source: WRMA, NALEPO Project in Athi CA)		
評価項目				
五項目評価	妥当性	上流と下流の双方共に土砂堆積被害はある。上流の地質はもろく、土砂流出が起こりやすい。必要性はかなり高い。しかしながら、小規模な砂防ダム一基による劇的な被害の軽減は期待できない。大きな被害軽減のためには大規模なダムを設置するか小規模ダムを多数設置するかのいずれかの方法が必要である。	B	2
	有効性	砂防ダムが設置された場所周辺での土砂被害は食い止めることができるが、砂防ダム一基の効果は限定される。	B	2
	効率性	費用・効果共に中規模である	B	2
	インパクト	それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。	C	1
	持続性	継続的な維持管理は不可欠である。WRUA が WSTF 基金を利用してダムを設置した場合、維持管理費用は別途必要となる。	C	1
合計			8	
メリット		土砂をせき止め、土砂流出を防ぐことができる		
デメリット		ステークホルダーとの交渉、測量、計画、設計等の実施前の検討に長い時間を要する		
環境への負の影響		下流への影響や、水の流れをせき止めたことによる生物への影響が懸念される		
EIA の必要性		規模が大きい場合は必要と考えられる		
住民負担の有無		WDC マニュアルによると、地元住民は Alarm Status のサブ流域では 15%、Alert または Concern Status のサブ流域では 25%の負担をしなければいけないと定められている。それは、現金、労働、物品のいずれでも構わない。		
事業実施者（メインアクター）		WRUA/NWCPC		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助・共助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.14　Isiolo 市街地での浸水被害対策事業の評価検討(14)

No.		14		
対象地区と原因		山側・空港エリア（内水）		
対策		排水路		
概要		雨水を一つに集め、適切で安全な方向に流す		
イメージ				
評価項目				
五項目評価	妥当性	市街地の浸水被害は甚大で Isiolo Town からも要望が強い。山側から市街地への雨水の流路を元に戻す対策であり、ニーズが高い。	A	3
	有効性	空港付近の雨水対策をすれば市街地の浸水も軽減される。	A	3
	効率性	費用は中程度であるが、かなりの効果が見込める。	A	3
	インパクト	他地域への波及効果は少ない。（それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。）	C	1
	持続性	事業後も継続的な維持管理は必要であるが、維持管理費はそれほど高額でないと考えられる。実施体制を確立する必要がある。	B	2
合計			12	
メリット		ステークホルダーとの交渉、測量、計画、設計等の実施前の検討に長い時間を要する		
デメリット		コストが高い 計画・設計・工事に長い時間を必要とする		
環境への負の影響		土地の掘削が必要となる 重機を使用する必要がる		
EIA の必要性		必要		
住民負担の有無		WDC マニュアルによると、地元住民は Alarm Status のサブ流域では 15%、Alert または Concern Status のサブ流域では 25%の負担をしなければいけないと定められている。それは、現金、労働、物品のいずれでも構わない。		
事業実施者（メインアクター）		County/District/WRUA		
事業関係機関		<許認可> KeRRA <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助・共助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.15　Isiolo 市街地での浸水被害対策事業の評価検討(15)

No.		15		
対象地区と原因		山側・空港エリア（内水）		
対策		道路下のカルバート増設		
概要		雨水を安全に流下させる		
イメージ				
評価項目				
五項目評価	妥当性	市街地の浸水被害は甚大で Isiolo Town からも要望が強い。山側からの雨水の流路を変更させる対策であり、ニーズは高い。	A	3
	有効性	空港付近の雨水対策をすれば市街地の浸水も軽減される。	A	3
	効率性	費用・効果共に中規模。	B	2
	インパクト	他地域への波及効果は少ない。(それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。)	C	1
	持続性	事業後も継続的な維持管理は必要であるが、維持管理費はそれほど高額でないと考えられる。実施体制を確立する必要がある。	B	2
合計			11	
メリット		空港エリアからの雨水の流入は減少する		
デメリット		計画・設計・工事に長い時間を必要とする 最適な設置場所が Isiolo Town と MeruTown の境界にあり、双方との調整に時間がかかる		
環境への負の影響		土地の掘削が必要となる 重機を使用する必要がる		
EIA の必要性		必要		
住民負担の有無		WDC マニュアルによると、地元住民は Alarm Status のサブ流域では 15%、Alert または Concern Status のサブ流域では 25%の負担をしなければいけないと定められている。それは、現金、労働、物品のいずれでも構わない。		
事業実施者(メインアクター)		KeRRA		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助・共助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.16　Isiolo 市街地での浸水被害対策事業の評価検討(16)

No.		16		
対象地区と原因		山側・空港エリア（内水）		
対策		洪水調整池		
概要		雨水を一時的に貯留し、洪水のピーク流量を減少させる		
イメージ		 (Source: Mie Prefecture)		
評価項目				
五項目評価	妥当性	市街地の浸水被害は甚大で Isiolo Town からも要望が強い。空港周辺の雨水の流出抑制対策であり、必要性は高い。	A	3
	有効性	空港付近の雨水対策をすれば市街地の浸水も軽減される。	A	3
	効率性	費用は大きいが、それだけの効果が見込まれる。	B	2
	インパクト	他地域への波及効果は少ない。（それぞれの地域の洪水特性や地形、気候等、に応じ、個別の設計・計画が必要である。）	C	1
	持続性	事業後も継続的な維持管理は必要であるが、維持管理費はそれほど高額でないと考えられる。実施体制を確立する必要がある。	B	2
合計			11	
メリット		空港エリアからの雨水の流入は大幅に減少する		
デメリット		空港当局との調整が長期にわたる可能性がある 莫大な費用が必要である 計画・設計・工事に長い時間を必要とする 大規模用地が必要である（空港内の土地が最適）		
環境への負の影響		掘削が必要である		
EIA の必要性		必要		
住民負担の有無		なし		
事業実施者（メインアクター）		空港庁		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.17 Isiolo 市街地での浸水被害対策事業の評価検討(17)

No.		17		
対象地区と原因		Isiolo 市街地 (全般)		
対策		危機管理計画		
概要		組織が緊急時に対応できるように準備し、人々の災害に対する対応力のポテンシャルの向上を目指す。危機管理計画を策定するためには、人的資源及び資金の管理、関係者間の連絡調整、技術的援助、物質的援助の枠組みも含む (出典: Contingency Planning Guide 2012, International Federation of Red Cross and Red Crescent Societies, 2012)		
イメージ		—		
評価項目				
五項目評価	妥当性	現在、洪水被害軽減に対する備えは十分ではない。よって危機管理計画を含めた発災後の対応はカウンティ及び住民から必要とされている。	A	3
	有効性	有効な危機管理計画は災害救援の迅速性かつ有効性を高める。よって、被害の緩和に大きく貢献する。	A	3
	効率性	危機管理計画策定に大きな予算は必要ない。大きな効果も見込めるため、効率性も高い。	A	3
	インパクト	他地域への普及は有益であると考えられる。	A	3
	持続性	危機管理計画の策定はカウンティの職務であり、責任を持って継続されるべきである。カウンティが職務として行えば、持続性は高くなると考えられる。	A	3
合計			15	
メリット		危機管理計画は全てのセクターが含まれ、災害時の迅速かつ効率的な支援に貢献する。		
デメリット		危機管理計画の策定及び実施にはある程度の時間が必要である。		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		カウンティへの情報提供		
事業実施者（メインアクター）		County/District		
事業関係機関		<許認可> スペシャルプログラム省 <技術支援>MWI, WRMA <他の支援者>KRCS、World Vision		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.18　Isiolo 市街地での浸水被害対策事業の評価検討(18)

No.		18		
対象地区と原因		Isiolo 市街地 (全般)		
対策		基金を含む再建・復興のメカニズムの構築		
概要		震災後に避難場所から戻ってくる人々や新たな場所への移住が発生する際に必要となる、長期的な再建と経済復興のプロセスでの支援及び基金の設立		
イメージ		—		
評価項目				
五項目評価	妥当性	被災者は再建・復興プロセスでの援助が必要である。	A	3
	有効性	受益者は援助の予算によって決まる	B	2
	効率性	援助額が大きければ、コストは高くなる。効果は中規模である。	B	2
	インパクト	基金や援助を他地域に普及するには地元政府や国の予算によるため、他地域への普及度合いは中程度。	B	2
	持続性	持続性は地元政府や国の予算が継続するかによる。	B	2
合計				11
メリット		洪水被害からの再建・復興は地域にとって重要であり、地域活性化にも寄与する		
デメリット		地元政府や国の予算を必要とする		
環境への負の影響		なし		
EIA の必要性		なし		
住民負担の有無		なし		
事業実施者（メインアクター）		County/District		
事業関係機関		<許認可> County/District <技術支援>MWI, WRMA <他の支援者>KRCS		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

表 4.2.19　全域の河岸浸食対策に関する評価検討

No.		19		
対象地区と原因		Isiolo 川上流		
対策		護岸		
概要		河岸を保護する対策工。河岸の浸食を防ぐ		
イメージ				
評価項目				
五項目評価	妥当性	河岸人口、家屋数は少ないが、河岸浸食によって農耕地等の土地が減少しているため、WRUA からの要望が高い。また、主要幹線道路との交差部ではインフラ被害につながり、必要性は高い。	A	3
	有効性	河岸浸食対策としては効果が限定的であるが、幹線道路の保護となり、物流・人流への被害軽減にも貢献する。	B	2
	効率性	費用・効果共に中規模	B	2
	インパクト	比較的簡易的な護岸であれば、他地域での応用も可能である。加えて、コンクリートに比べて透水性が高く、環境への影響は少ない。	B	2
	持続性	事業後も継続的な維持管理が必要である。しかし、簡易的なものであれば、維持管理も難しくはない。	B	2
合計			11	
メリット		護岸設置場所周辺の河岸浸食を防ぐ		
デメリット		上下流への影響や対岸への影響を考慮する必要がある		
環境への負の影響		護岸の設置には重機が必要であり、環境への影響は起こりうる。		
EIA の必要性		大規模な護岸であれば EIA が必要だが、小規模な護岸であれば必要ない		
住民負担の有無		WDC マニュアルによると、地元住民は Alarm Status のサブ流域では 15%、Alert または Concern Status のサブ流域では 25%の負担をしなければいけないと定められている。それは、現金、労働、物品のいずれでも構わない。		
事業実施者（メインアクター）		WRUA		
事業関係機関		<許認可>WRMA/ County/ District、道路省/ KeNHA <技術支援>MWI, WRMA		
公助（行政レベル） 共助（コミュニティレベル） 自助（個人レベル）		公助・共助		

A (3 point) :　Excellent / B (2 point) : Good / C (1 point) : Poor

4.2.1 五項目評価における評価

評価表での評価対象となった全ての対策の 5 項目評価の総合得点を下記の表で示す。これらの事業については、点数の高いものから実施していくことが望ましいが、事業実施にあたっては種々の先行業務があるため、そのことを考慮し、次章の事業実施計画を検討した。

表 4.2.20 五項目評価･評価点

構造物・非構造物	No.	対策案	備考	点数
構造物	14	空港エリア排水路	事前調査･計画･調整が必要	12
	6	排水ネットワーク整備	事前調査･計画･調整が必要	11
	15	空港エリアカルバート	事前調査･計画･調整が必要	11
	16	空港エリア洪水調整池	事前調査･計画･調整が必要	11
	19	護岸		11
	9	Merire 川の河床掘削	事前調査･計画･調整が必要	10
	10	Merire 川の拡幅	事前調査･計画･調整が必要	9
	13	ダム/砂防ダム	事前調査･計画･調整が必要	8
非構造物	2	ハザードマップ		15
	17	危機管理計画		15
	3	上下流のコミュニケーションと協力		14
	4	避難計画		14
	5	防災教育		14
	12	ゴミ拾いキャンペーン		14
	1	早期警戒システム		13
	7	土嚢		13
	18	基金を含む再建・復興のメカニズムの構築		11
	8	植林活動		11
	11	土地利用規制		10

5. 洪水対策の事業実施計画

5.1 本洪水管理計画で実施する洪水対策

洪水管理計画では、市街地の洪水被害を軽減すること、次に、交通への影響の高い箇所の河岸浸食対策を優先的に実施していく。

これらの対策のうち、WRUA で実施すべき事業については、SCMP を更新する際に組み込むよう WRUA の支援を行う。

(1) 構造物対策

構造物対策については、優先度の順に次の順番で実施する。

- 市街地の排水ネットワーク整備の調査
- 空港付近からの流入対策（排水路、道路下カルバート、調整池）の調査・協議
- 交通に影響する河岸浸食部の護岸
- Merire 川の改修（河床掘削、拡幅）の調査・協議
- Merire 川上流でのダム/砂防ダムの調査・協議

(2) 非構造物対策

非構造物対策については、優先度の順に次の順番で実施する。

- ハザードマップ
- 上下流のコミュニケーションと協力
- 避難訓練
- 防災教育
- ゴミ拾いキャンペーン
- 洪水早期警戒システム
- 土嚢積み
- 植林活動
- 土地利用規制

5.2 洪水対策の実施スケジュール（案）

洪水対策の実施スケジュール（案）を次頁のとおり提案する。
ここで、
メインアクター： 実際に事業を実施する主体。規模によって複数の選択肢があり得る。
支援アクター
NGO： 事業実施を支援する NGO
行政官庁： 事業実施を支援あるいは、許可権限を有する官庁
技術官庁： 事業実施に当たって技術的支援を行う官庁

表 5.2.1 イシオロ川流域洪水対策の実施スケジュール(案)

	対策/活動内容	対策実施に必要な準備等	メインアクター（実施者）	支援アクター			WRMAの役割	WRUAの役割	1年次	2年次	3年次	4年次	5年次	6年次以降
				NGO	行政官庁	技術官庁								
構造物	空港周辺での排水路設置	調査・測量・協議	County/District/WRUA		KeRRA	MWI, WRMA	関連省庁との連携	計画、建設、維持管理	調査・協議					
	市街地全体の排水ネットワーク整備	調査・測量・協議	County/District		計画省	MWI, WRMA	関連省庁との連携	維持管理				調査・協議		
	空港周辺での道路下カルバート設置	調査・測量・協議	KeRRA		County/District	MWI, WRMA	関連省庁との連携	維持管理	調査・協議					
	空港周辺での洪水調整池設置	調査・測量・協議	空港庁		County/District	MWI, WRMA	関連省庁との連携		調査・協議					
	護岸（交通に影響のある箇所、農地被害）		WRUA		WRMA/County/District、道路省/ KeNHA	MWI, WRMA	技術アドバイス	計画、建設、維持管理						
	Merire川の改修（拡幅等）	調査・測量・協議	NWCPC		County/District	MWI, WRMA	関連省庁との連携	維持管理			調査・協議			
	Merire川上流でのダム/砂防ダムの設置	調査・測量・協議	WRUA/NWCPC		County/District	MWI, WRMA	関連省庁との連携	計画、建設、維持管理			調査・協議			
非構造物	洪水ハザードマップ		WRUA		County/District	MWI, WRMA	関連省庁との連携、技術アドバイス	連携・参画・住民啓発						
	災害対応計画	検討・協議	County/District	KRCS/World Vision	スペシャルプログラム省	MWI, WRMA	関連省庁との連携、技術アドバイス	連携・参画・住民啓発	検討・協議					
	上下流のコミュニケーションと協力	委員会で実施中	WRUA		MWI, WRMA	MWI, WRMA	関連省庁との連携、技術アドバイス	連携・参画・住民啓発						
	避難計画	検討・協議	WRUA		County/District	MWI, WRMA	関連省庁との連携、技術アドバイス	連携・参画・住民啓発	検討・協議					
	防災教育		学校, WRUA	KRCS/ PTA	教育省/County/District	MWI, WRMA	関連省庁との連携、技術アドバイス	連携・参画・住民啓発						
	ゴミ拾いキャンペーン		WRUA		County/District	MWI, WRMA	関連省庁との連携	連携・参画・住民啓発						
	洪水早期警報システム	調査・協議	WRUA/County/District	KRCS	KMD/スペシャルプログラム省	MWI, WRMA	技術アドバイス	計画・構築・運営管理への参画	調査・協議					
	土嚢積み		WRUA		County/District	MWI, WRMA	関連省庁との連携	連携・参画・住民啓発						
	復興・復旧（基金含む）		County/District	KRCS	スペシャルプログラム省	MWI, WRMA	関連省庁との連携	連携・参画・住民啓発						
	植林活動		WRUA	KRCS	Kenya Forest Service	MWI, WRMA	関連省庁との連携	連携・参画・住民啓発						
	土地利用規制		WRMA MOL		土地省	MWI, WRMA	関連省庁との連携	連携・参画・住民啓発						

6. 提言事項

・ 具体的な構造物の設計にあたり、雨量、河川流量の観測結果が不足している。WRMA は雨量、水位観測を着実に実施し、その精度を上げて、必要なデータの蓄積を進めるべきである。

・ 長期的には、市街地全体の雨水排水不良（内水）対策や Merire 川からの溢水洪水（外水）対策を検討すべきである。

As of 3 August 2013

REPUBLIC OF KENYA
PROJECT ON CAPACITY DEVELOPMENT
FOR
EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREA

ISIOLO RIVER BASIN
INTEGRATED FLOOD MANAGEMENT PLAN
- DRAFT -

August 2013

NEWJEC

Republic of Kenya
Project on Capacity Development for Effective Flood Management in Flood Prone Area

Isiolo River Basin Integrated Flood Management Plan
- Final Draft -

Table of Contents

1. POLICY OF RIVER BASIN FLOOD MANAGEMENT PLAN (DRAFT)

1.1 POLICY OF FLOOD MANAGEMENT IN THE RELEVANT RIVER BASIN (DRAFT)

The Isiolo river basin is located on the foot of Mt. Kenya and then the topographic slope is steep generally. Therefore reading time of flooding from rainfall starting is short and it has the feature that flooding peak discharge is high.

The Isiolo city area is a centre of socio economic activity in the region and is an important rural city. It has development plans as a strategic important place of transportation or a centre of sightseeing base, since the national highway is running from Nairobi to northern Kenya through Isiolo.

The Isiolo river basin is belongings to the jurisdiction of WRMA Middle Ewaso Ng'iro Sub Regional Office (SRO) concerning the general water resource management flood management inclusive flood management. Then, Isiolo WRUA is established in the Isiolo river basin, and implements grass-roots water management in collarroboration with WRMA.

The principal flood damages are, socio economic stagnation and human damage by both inundations inside and outside the levee in Isiolo city area, lost of farmlands and sediment related disasters by local inundation or bank erosion in various points of river basin and destruction of roads or bridges.

Therefore the important point of the flood management policy in relevant river basin shall be mitigation of damage in Isiolo city area and mitigation of local inundation or river bank erosion damage in socio economically important points.

In the course of drawing up the flood management plan, the appropriate combination of structural and non-structural measures or the view point of "Self-help", "Mutual support" and "Public assistance" should be considered. And also consensus building among the stakeholders through the participation of WRUA or communities should be implemented

WRUA and communities implement the distribution, evolution, maintenance of structural measures and non-structural measures with initiative.

WRUA and communities shall work together from the period of project planning so that incubate their ownership

The scoping period of this plan is 5 years from 2013 to 2018, the contents of plan will be revised properly in necessity.

1.2 THE ROLE AND RESPONSIBILITY OF WRMA

Main constituent of this plan is WRMA. WRMA should assist WRUA to make it possible for it to build realizable tasks in to the Sub-Catchment Management Plan (SCMP) by itself. In addition, WRMA provide the technical assistance to implement the countermeasures against

flooding matters.

Concerning the tasks that WRUA has no initiative, WRMA shall precede the implementation of tasks while coordinating it with relevant stakeholders.

1.3 RIVER BASIN COMMITTEE

Flood management cannot achieve the objectives without the cooperation of various stakeholders in the river basin.

Some river basins are divided by plural sub catchment such as upper stream, lower stream, left bank and right bank.

According to this condition, WRMA shall establish "Integrated Flood Management River Basin Committee" in order to share the information concerning flood management and coordinate in river basin unit.

The stakeholders in the relevant river basin preferable to participate in the committee are listed below.

Table 1.3.1 The Stakeholders in Isiolo River Basin

No	Institution/Organization	Remarks
1	Isiolo WRUA	One representative from each of the six Zones
2	Provincial Administration	County Commissioner
3	Ministry of State for Special Programmes	Active in providing humanitarian assistance to disaster victims in Isiolo area
4	Kenya National Highways Authority/Kenya Rural Roads Authority - Representative	One representative each from KenHA and KeRRA
5	Ministry of Water and Irrigation	Irrigation Department representative
6	Ministry of Lands	District Physical planner
7	Ministry of Agriculture	District Agricultural Officer
8	Ministry of Livestock	District Livestock Officer
9	Ministry Of Education	District Education Officer
10	Ministry of Development of Northern Kenya and Other Arid Lands	Active in providing humanitarian assistance to disaster victims in Isiolo area
11	Kenya Meteorological Department	Contact Person at National Level
12	Ewaso Ng'iro North Development Authority (ENNDA)	Representative from Regional Office
13	National Environmental Management Authority	District Officer
14	County Government of Isiolo	One representative
15	County Government of Meru	One representative
16	Kenya Red Cross Society	Representative from Regional Office
17	World Vision	Representative from Regional Office
18	Food for Hungry (fhi)	Representative from Regional Office
19	Lewa Conservancy	CAAC member
20	Pastoralists	One representative
21	Farmers	One representative
22	CAAC	Chairman
23	Environment/Natural Resources Management CBOs	Environment representative
20	Kenya Wildlife Service	One representative from Isiolo area
21	Religious Group	One each from Christian and Muslim
22	Northern Water Service Board (NWSB)	One representative
24	Kenya Forest Service	CAAC member
26	Department of Social Services	Registers WRUAs and other social welfare groups
29	Kenya National Chamber of Commerce and Industry	Isiolo chapter
30	Catholic Diocese of Isiolo	One representative
31	Kenya Airpot Authority	
32	WRMA	HQ, RO, SRO

In the committee, exchanging of opinions between the relevant stakeholders, approval of flood management plan, consensus building, discussion of role sharing and activity evaluation etc. shall be done

Committee members shall be discussing about the following themes once in every some months for the time being.

Tabel 1.3.2 The Schedule of Integrated Flood Management Committee Meeting(Draft)

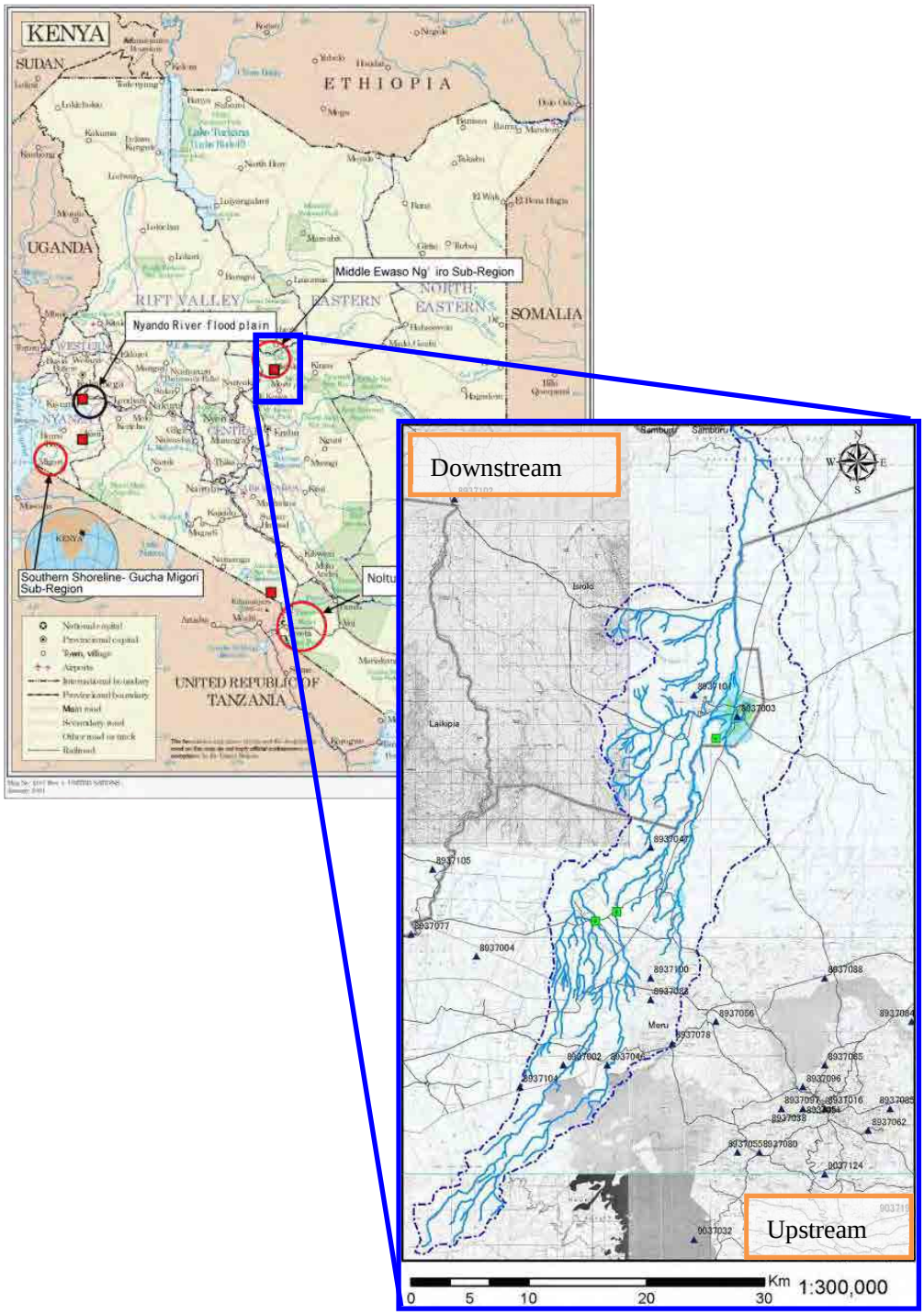
	Discussion Themes	Remarks
1st Meeting	・Information sharing on current situation and problems in flooding ・Discussion on conceivable flood measures	Already done in Jan. 23rd , 2013
2nd Meeting	・Suggestion of flood management plan(draft) ・Discussion on flood management plan(draft) ・Consensus building on pilot project(This project only)	
3rd Meeting	・Discussion on flood management plan(draft) ・Progress reporting of pilot project(This project only)	
4th Meeting	・Evaluation of pilot project(This project only)	

1.4 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

On planning the flood measures project, the appropriate environmental and social consideration shall be done based on Kenyan regal code “Environmental Management and Coordination Act (EMCA) 1999”.

2. OUTLINE OF ISIOLO RIVER BASIN

Isiolo River Basin is located at the northern part of the piedmont of Mt. Kenya in the central part of the Republic of Kenya.



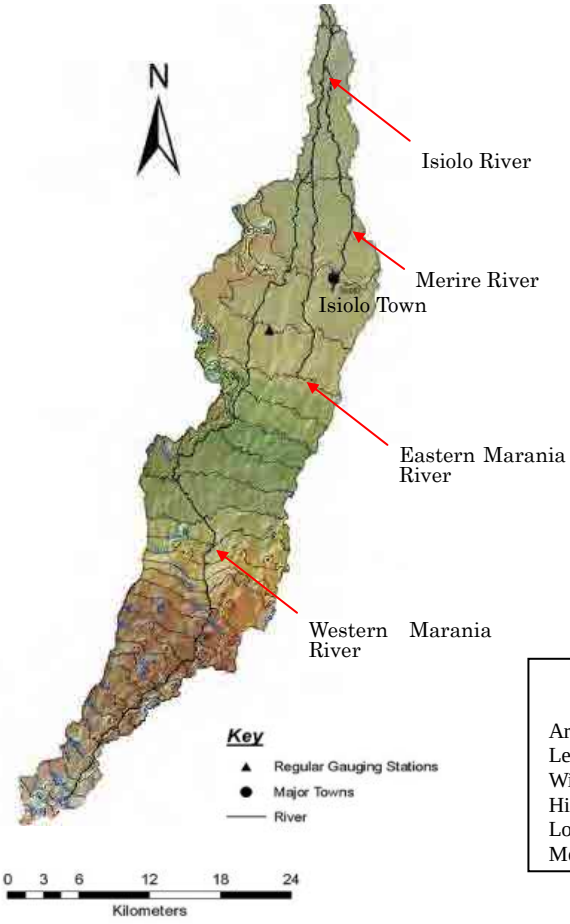
Location of Isiolo River Basin

2.1 NATURAL CONDITIONS

2.1.1 Topography and Soil

(1) Topography

Catchment area of Isiolo River is about 683km^2 and the total length of the river is approximately 95km flowing from south to north. The river width reaches about 15km (east to west) in the widest part. Isiolo River originates from Mr. Kenya and it flows towards the north via three districts of Meru Central, Imenti North and Isiolo. The river flows together with Ewaso Ng'iro North in the vicinity of Archer's Post. There are many tributaries in the upstream and these tributaries are confluent with Isiolo River at the downstream of the Isiolo Town. Major tributaries are Western Marania River, Eastern Marania River and Marire River.



Feature of Isiolo River Basin

Area	-683 km^2
Length	-95 km
Width	-15 km
Highest Altitude	-EL3905 m
Lowest Altitude	-EL872 m
Mean Altitude	-EL1746 m

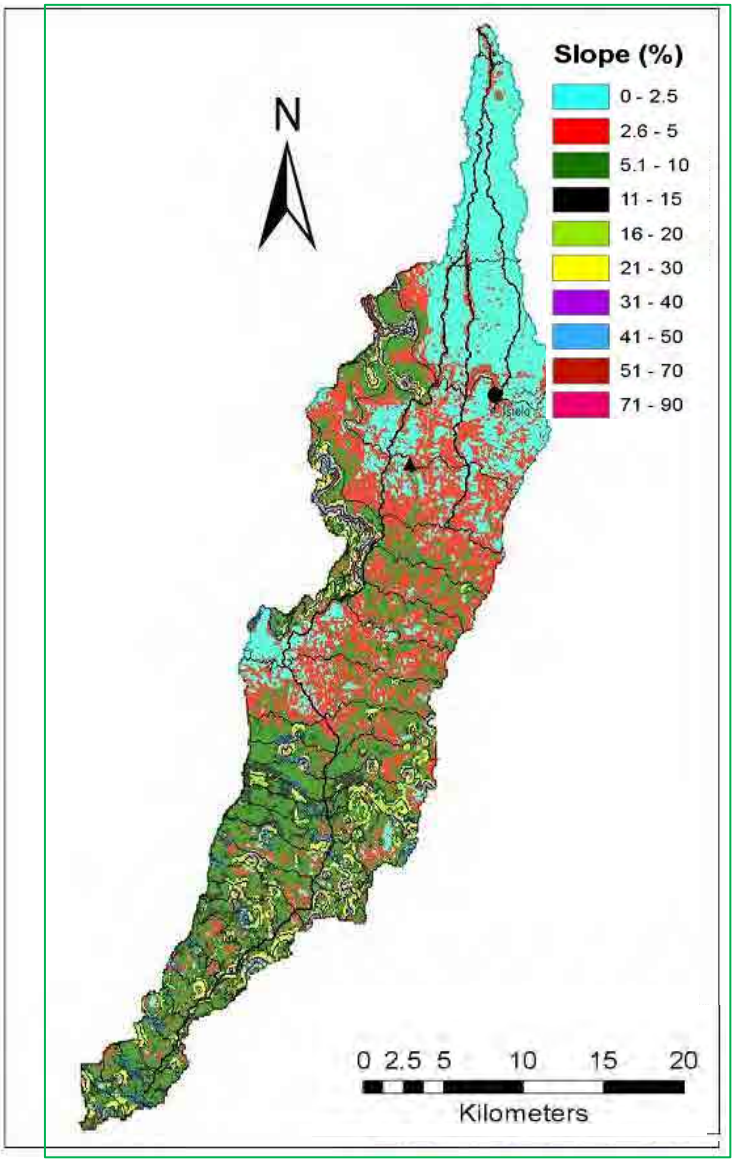
Source: Prepared by JICA Project Team based on WRMA's data

Figure 2.1.1 Map of Isiolo River Basin and Elevation Distribution

Topographic slope in the river basin is shown in Figure 1.1.2. There are some steep slopes of the river course varying from 10 to 70% in the vicinity of Mt. Kenya in the upstream to the

middle stream. In the middle stream, the river course is rapid with the slope of approximately 5 to 2.6%. On the other hand, in the downstream, the river course shows the characteristic of rather flat with the maximum slope of 2.5%.

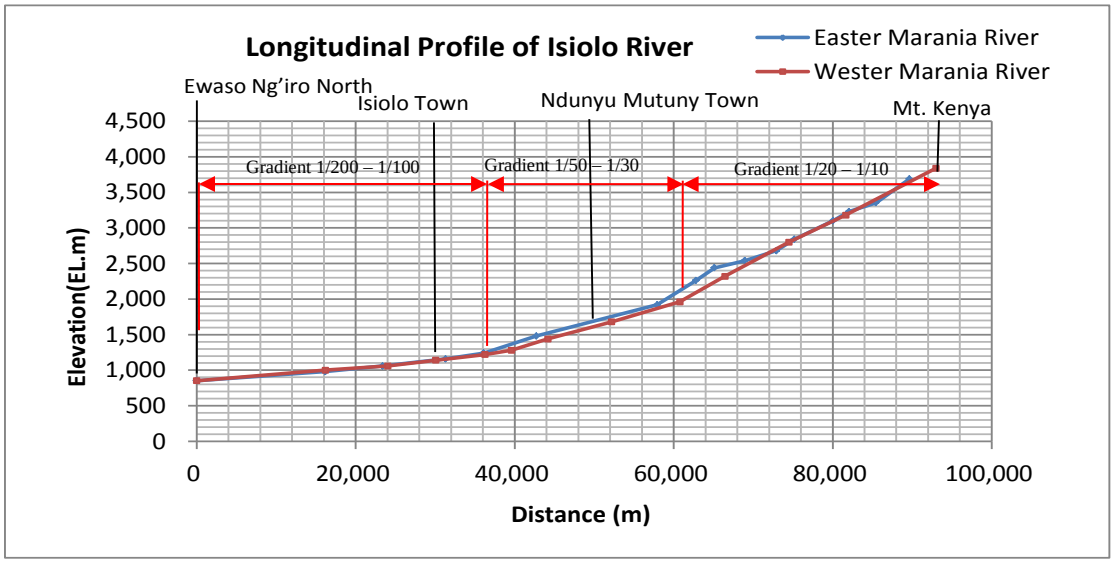
In Isiolo River Basin, the residential area is dominated on the transition area of the river course near Isiolo Town where the topographic slope of the river is turned from steep to flat. One of the reasons is that there is a spring in this vicinity and the groundwater level is shallow as this area is the transition point of topographic slope of the river. In the mountainous area where the river slope is steep, it tends to have regional heavy rain.



Source : Prepared by JICA Project Team based on WRMA's data

Figure 2.1.2 Distribution Map of Topographic Slope of Isiolo River Basin

Figure 2.1.3 shows longitudinal gradient of Isiolo River.

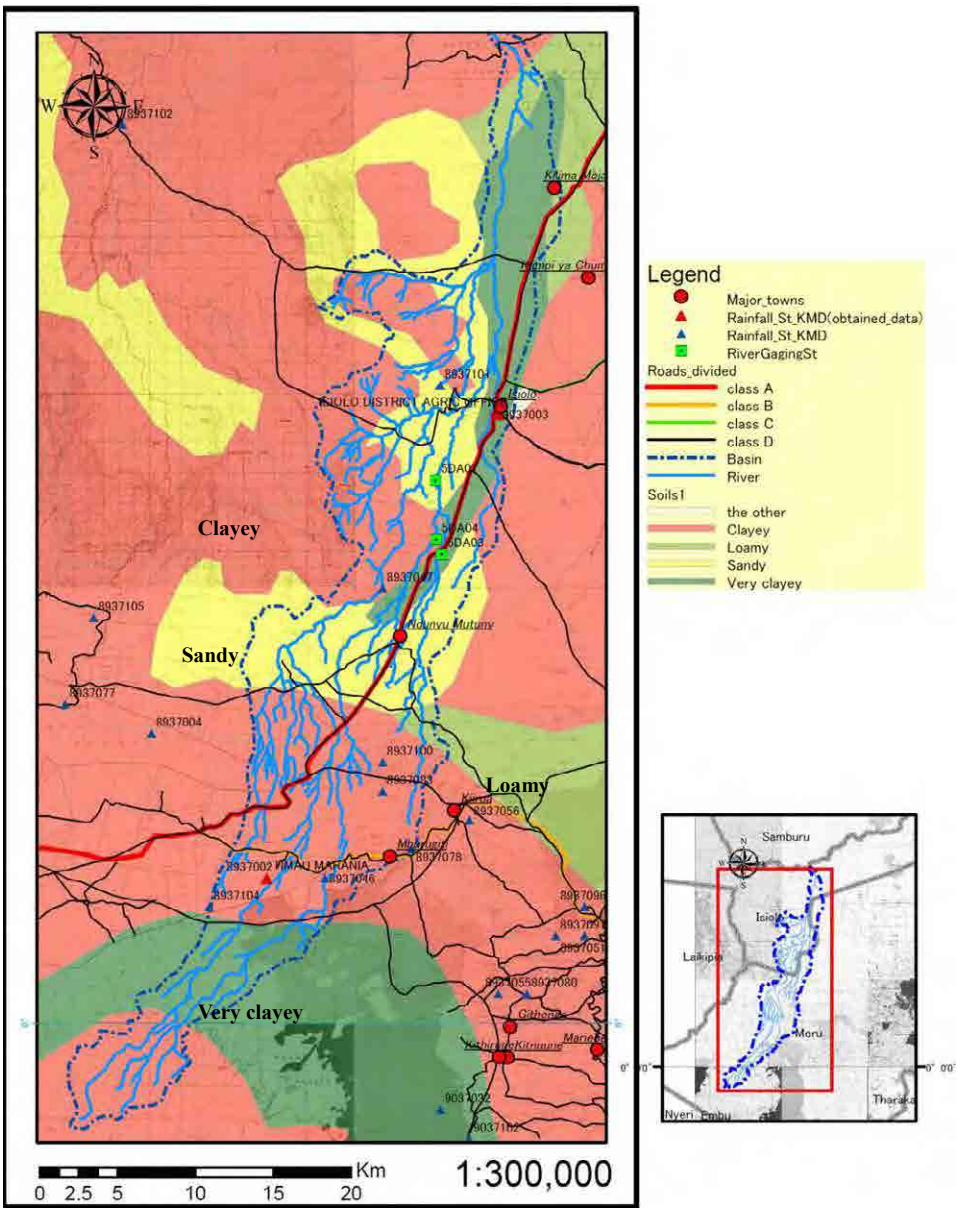


Source : Prepared by JICA Project Team based on 1/50,000Topo Map

Figure 2.1.3 Longitudinal Profile of Isiolo River

(2) Soil

Soil Distribution Map of Isiolo River Basin is as per Figure 1.1.4. Clayey soil covers all through the river basin, and sandy soil is distributed at the left bank of the river, from a part of the middle river basin and the middle stream to the downstream. High clayey content soil is deposited in the right bank of the downstream and the loam layer composed of silt and clay with the proportion of 25 to 40% is distributed. Isiolo Town is located on the strong clayey soil land.



Source: Prepared by JICA Project Team based on Kenya Soil Survey (KSS) in 1982 and revised in 1997.

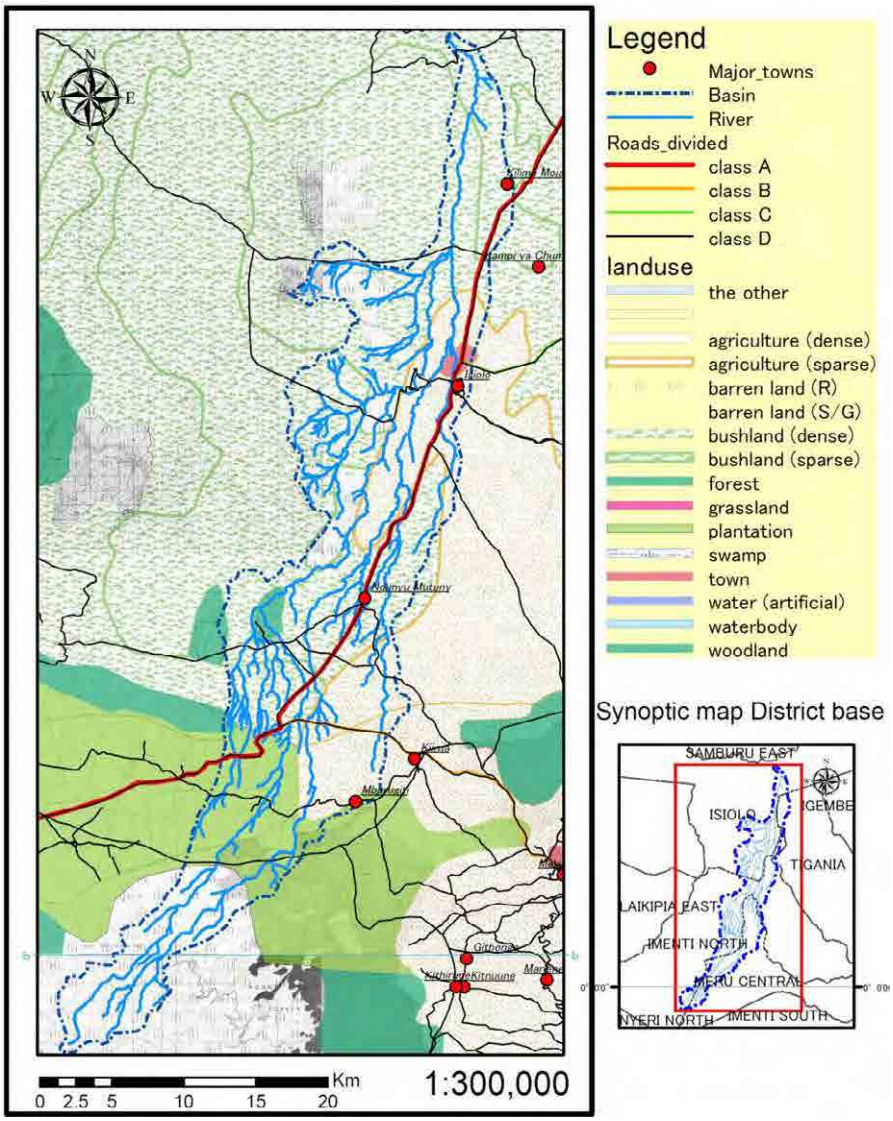
Figure 2.1.4 Soil Distribution Map (Soil texture)

2.1.2 Vegetation and Land Use

(1) Land Use

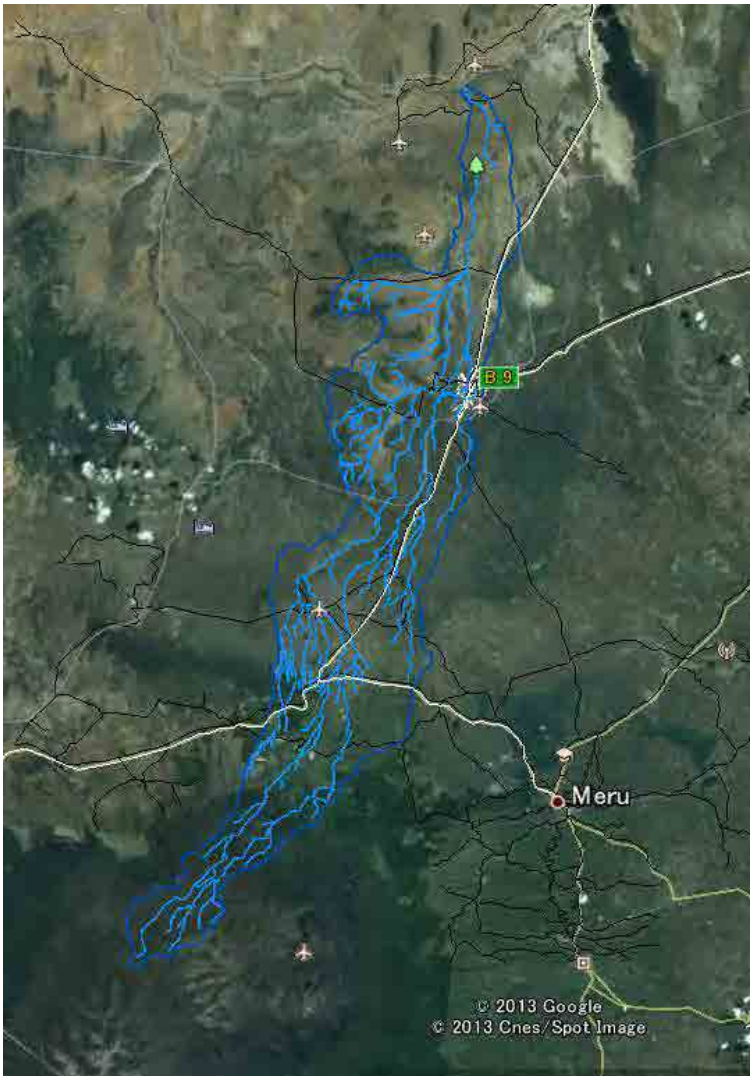
Land use characteristics of Isiolo River Basin are shown on Figure 2.1.5 and Figure 2.1.6. As seen in land use map, the mountainous area in the upstream river basin is a barren land, and from Google Earth Image Data it is known that the mountain is bare. In the middle river basin the plantation is extended. From the middle to downstream river basin the scrubland is extended, and there exists agricultural lands along the Western Marania River and Eastern Marania River of the middle river basin and in the suburb of downtown of Isiolo Town. In addition, as this river basin belongs to dry region and the xerophile vegetation is limited, forest

area is extremely few.



Source: Prepared by JICA Project Team based on the data of National Water Master Plan, JICA

Figure 2.1.5 Land Use in Isiolo River Basin



Source : Prepared by JICA Project Team based on Satellite Image of December 10, 2012

Figure 2.1.6 Satellite Image of Isiolo River Basin

According to the survey of NRM3 and CETRAD, 29.1km^2 of forest area in 1995 in Isiolo River Basin is decreased to 14.1km^2 in 2002. It is reported that 15km^2 of forest has been lost between 1995 to 2002. 2.1km^2 of forest loss has occurred in average every year. If the forest loss is continued at this rate, the forest in the river basin will totally be disappeared by 2018.

2.1.3 Hydrology and Meteorology

(1) Feature of Rainfall and Water Level Gauging Station

(a) Gauging Stations

Figure 2.1.7 shows locations of KMD rainfall and water level gauging stations. Rainfall gauging stations are indicated in triangle shape (▲), while the water level gauging stations are shown in box-shape (■). Rainfall gauging stations where the daily rainfall data have already been obtained by JICA project team are colored in red. The numbers given in the map mean the gauging station number.

Timau Marania Rainfall Gauging Station (No. 8937002) is located in the mountainous area of the upstream river basin, while Isiolo District Agric Office (hereinafter referred to DAO) is located in the suburb of downtown of Isiolo.

Kithima Water Level Gauging Station (No.5DA03) is located in the middle river basin, while Isiolo Gauging Station (No.5DA07) is located in the suburb of downtown of Isiolo.

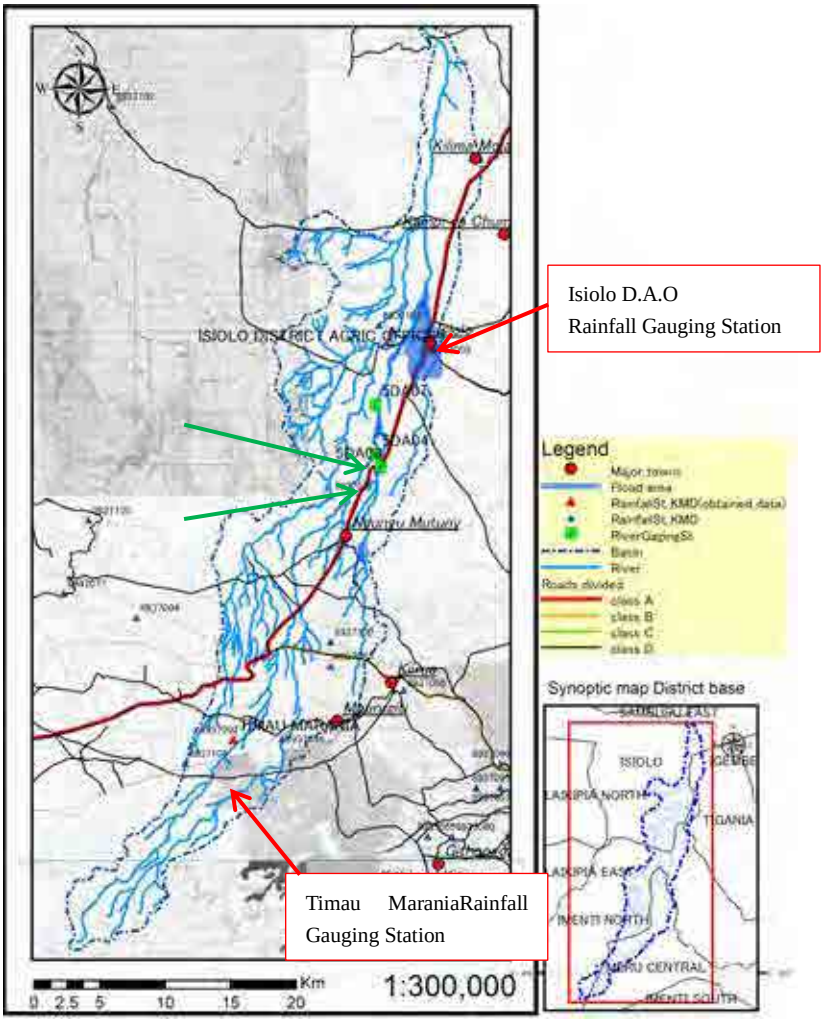


Figure 2.1.7 Location Map of Rainfall and Water Level Gauging Stations

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

Same as left.

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

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

(b) Rainfall Observation Data

Table 2.1.1 shows a list of KMD Rainfall Gauging Station within Isiolo River Basin and its vicinity. Of the stations listed below, those stations obtained daily rainfall data are Gauging Station of Timau Marania and Isiolo DAO indicated by color. Observation periods of the daily rainfall obtained are 32 years from 1957 to 1989 (including missing period).

For Timau Marania Gauging Station No.8937002, the monthly rainfall data is obtained for 82 years from 1930 to 2011.

Table 2.1.1 List of KMD Rainfall Gauging Station within Isiolo River Basin and its Vicinity

STATION_NUMBER	stationname	Y	X	Year_Opened	Year_Closed	Obtain	ar_Closed	Obtain
8937002	TIMAU_MARANIA	0.083	37.450	1925	_	obtain	_	obtain
8937003	ISIOLO_DISTRICT_AGRIC_OFFICE	0.350	37.583	1930	_	obtain	_	obtain
8937004	NGARE_UNGA_FARM	0.167	37.383	0.167	1937	37.383	1941	1930	1941	
8937046	MARANIA_FOREST_NANYUKI	0.083	37.483	0.083	1951	37.483	1953	1951	1953	
8937047	BIRDS_HILL_RANCH_ISIOLO	0.250	37.517	0.250	1951	37.517	1963	1951	1963	
8937078	MUCHENE_FOREST_STATION	0.100	37.533	0.100	1973	37.533	_	1973	_	
8937083	NTUMBURI_PRIMARY_SCHOOL	0.133	37.517	0.133	1974	37.517	_	1974	_	
8937100	MARURU_PRIMARY_SCHOOL	0.150	37.517	0.150	1979	37.517	_	1979	_	
8937101	ISIOLO_LANDS_HEADQUARTERS	0.367	37.550	0.367	1980	37.550	_	1980	_	
9037155	SIRIMON_GATE_MT_KENYA_PARK	-0.033	37.283	-0.033	1970	37.283	_	1970	_	

Source :KMD

(c) Water Level and River Discharge Observation Data

List of water gauging stations in Isiolo River Basin is shown on Table 2.1.2 of the stations listed below, those stations obtained water level observation data is only Gauging Station Nos. 5DA07 indicated by color. Automatic measurement is not done at each water level gauging stations, but the visual observation is carried out two times in a day, i.e. in the morning and in the evening. Therefore, the river discharge at the time of flood is said to be inaccurate.

Table 2.1.2 List of Water Level Gauging Station in Isiolo River Basin

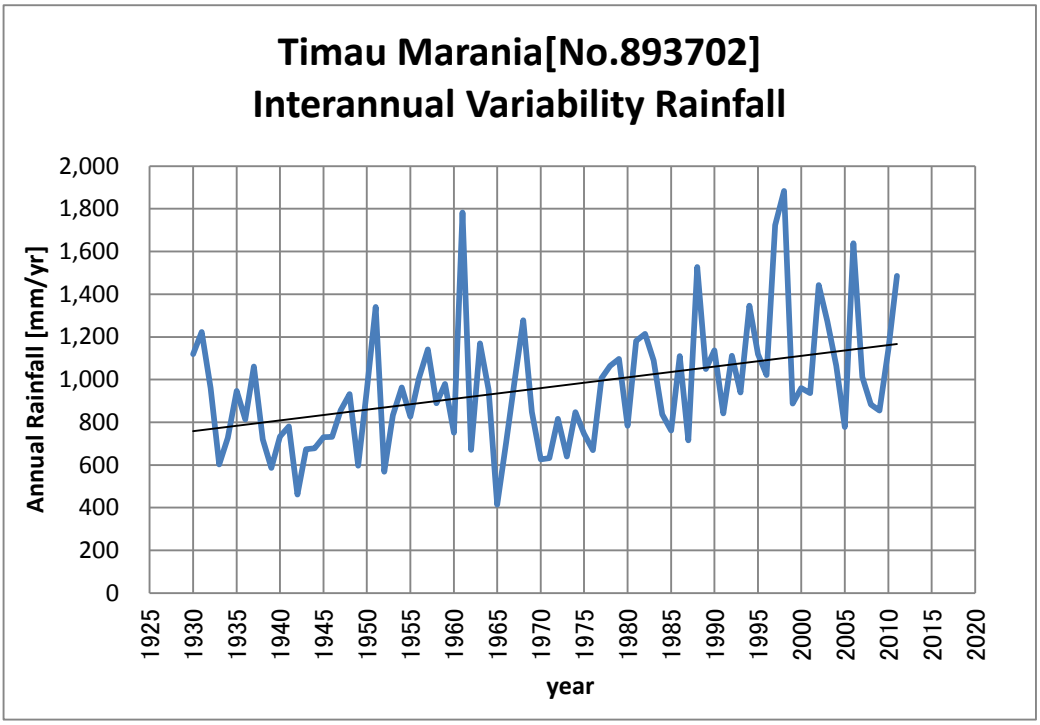
No.	ID	Name	River Name	Manual/ Auto/ Both	National/ MU/IMU/ Special	Daily/ Hourly/ Both	Operational	Start Year	End Year	SRO in charge
1	5DA07	Isiolo	Isiolo	Manual	MU	Daily	Yes	1976/1/1	N/A	MEN
2	5DA03	Kithima	Kithima	Manual	Intra-MU	Daily	Yes	2010/9/1	N/A	MEN
3	5DA04	Rugusu	Rugusu	Manual	Intra-MU	Daily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

Source : WRMA

(2) Feature of Annual Rainfall

(a) Long-Term Variability of Annual Rainfall

Figure 2.1.8 shows the variability of annual rainfall at Timau Marania Station in a period of 1930 to 2011. Out of the observation record from 1930 to 2011, the maximum annual rainfall, 1,883mm/year was recorded in 1998. The average annual rainfall during the same observation period is 959mm/year. The average annual rainfall tends to be increasing.



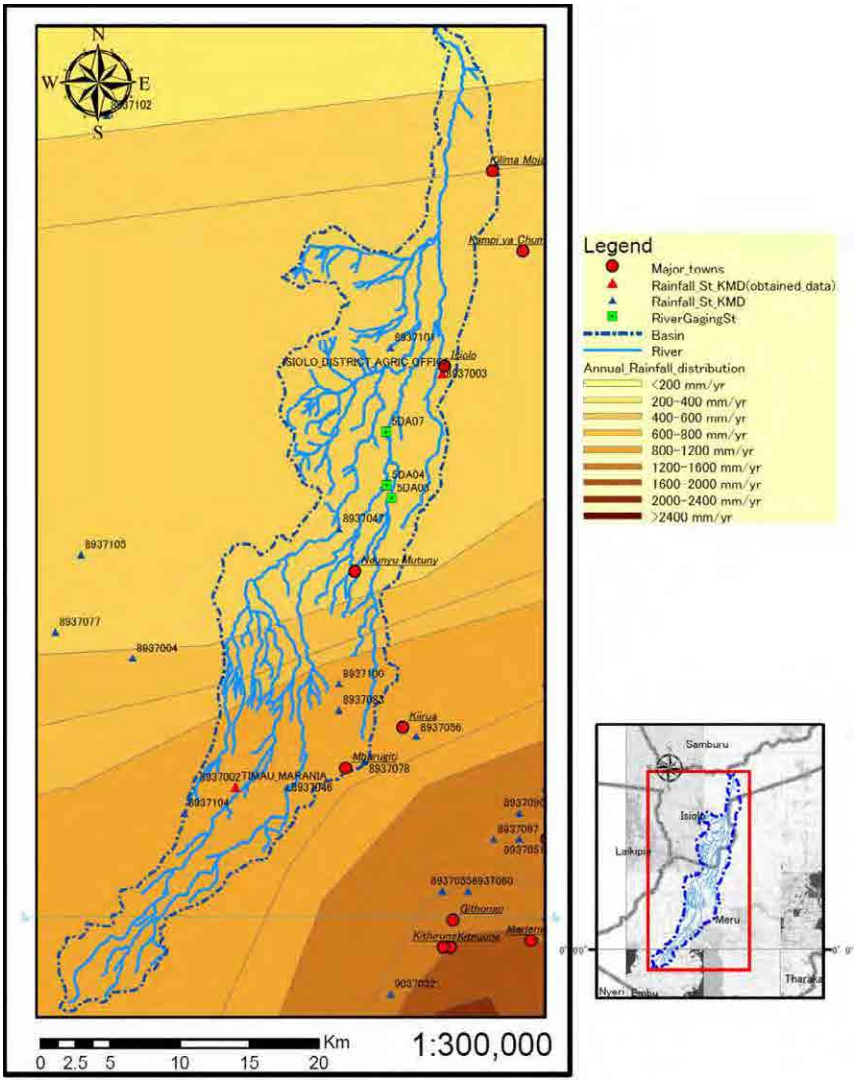
Source: Prepared by JICA Project Team based on WRMA's rainfall data of KMD gauging stations in the period between 1930 and 2011

Figure 2.1.8 Variability of Annual Rainfall at Timau Marania Station

(b) Distribution of Annual Rainfall

Monthly average temperatures vary from 7.6°C in highland to 32°C in low-lying area, and the low-lying area belongs to pindan.[1] Annual rainfall in the vicinity of Mt. Kenya, the headwaters of the river, goes beyond 1,200mm/year, and the average annual rainfall in the downtown of Isiolo which is the largest city in Isiolo River Basin, is approximately 600mm/year. Distribution of annual rainfall in Isiolo River Basin is shown below. From this distribution map, it is known that rainfall distribution is different between upstream and middle/downstream river basins. The annual rainfall in the upstream of EL.2,500m to EL.3,900m varies from 800 to 1,200mm/year, while those in the middle to downstream which occupies approximately 60% of the catchment area varies from 400 to 600mm/year.

[1] Isiolo WRUA and WRMA, SCMP (March 2009)



Source: Prepared by JICA Project Team based on National Water Master Plan, JICA

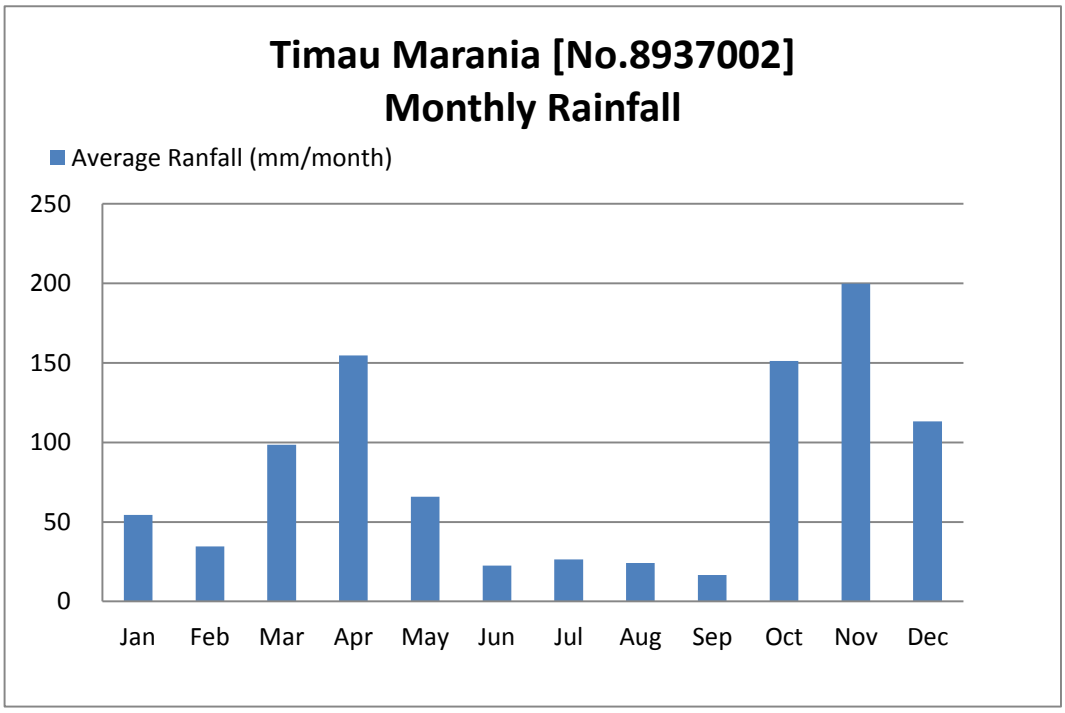
Figure 2.1.9 Distribution Map of Annual Rainfall of Isiolo River Basin

(c) Monthly Rainfall

There are two times of rainy seasons in Isiolo River Basin, i.e. March to May and October to December. Much rainfall is recorded during such a rainy season. Monthly rainfall at Timau Marania Rainfall Gauging Station in the upstream of Isiolo River Basin is shown on Figure 2.1.7. As shown in the following figure, it is understood that the maximum rainfall through the year can be observed in April and November. The heaviest monthly rainfall recorded in November is 200mm/month.

Besides, in recent years, it tends to have heavy rain in a short time. On the other hand, river flow is dried up during dry season of February, March, August and September.[2]

2 Isiolo SCMP



Source: Prepared by JICA Project Team based on WRMA's rainfall data of KMD gauging stations in the period between 1930 and 2011

Figure 2.1.10 Monthly Rainfall at Timau Marania Station

(d) Daily Rainfall

Timau Marania Station

Table 2.1.3 shows maximum daily rainfall, annual rainfall, number of missing data and period of missing data by the respective years from 1957 to 1989 at Timau Marania Station. Red numerical value indicates that there are missing data in the same year. And it means annual rain fall data of the year can be incorrect. The maximum daily rainfall recorded in the same period is 127.7mm/day observed in December 28, 1983. Those of the maximum annual rainfall are 1,737mm/year recorded in 1961. (Data set is different from data described above.)

Table 2.1.3 Observation Record at Timau Marania Station

Year	Date	Maximum Daily Rainfall [mm/day]	Annual Rainfall [mm/yr]	Number of missing data	Period of missing data
1957	1957/10/29	85.6	872	32	1/1-2/1
1958	1958/04/26	67.1	667	0	
1959	1959/12/11	114.3	823	90	1/2-4/1
1960	1960/10/25	51.8	751	0	
1961	1961/12/14	104.6	1,737	28	2/2-3/1
1962	1962/10/12	33.8	645	0	
1963	1963/05/29	63.0	1,161	0	
1964	1964/04/18	64.0	975	0	
1965	1965/03/25	26.4	414	0	
1966	1966/03/29	43.2	703	0	
1967	1967/11/26	52.1	985	0	
1968	1968/04/03	94.0	1,278	0	
1969	1969/05/02	84.3	865	0	
1970	1970/10/15	51.1	625	0	
1971	1971/04/27	61.7	631	0	
1972	1972/06/22	54.1	815	0	
1973	1973/04/15	32.9	640	0	
1974	1974/11/07	52.8	849	0	
1975	1975/11/17	42.6	740	0	
1976	1976/12/14	42.3	634	30	9/2-10/1
1977	1977/11/07	68.8	1,008	0	
1978	1978/11/26	49.4	1,052	0	
1979	1979/02/01	75.8	1,097	0	
1980	1980/10/19	62.5	775	30	9/2-10/1
1981	1981/11/07	65.3	1,173	0	
1982	1982/10/29	73.2	1,214	0	
1983	1983/12/28	127.7	1,093	0	
1984	1984/11/15	75.6	837	0	
1985	1985/11/12	65.1	775	0	
1986	1986/10/26	63.4	1,119	0	
1987	1987/06/04	64.7	723	0	
1988	1988/12/21	67.8	1,537	0	

Source : Prepared by JICA Project Team based on the observation data of the period of 1957 to 1989 at KMD owned Timau Marania Rainfall Gauging Station.

From October to December is short rainy season and from March to May is long rainy season in Kenya.

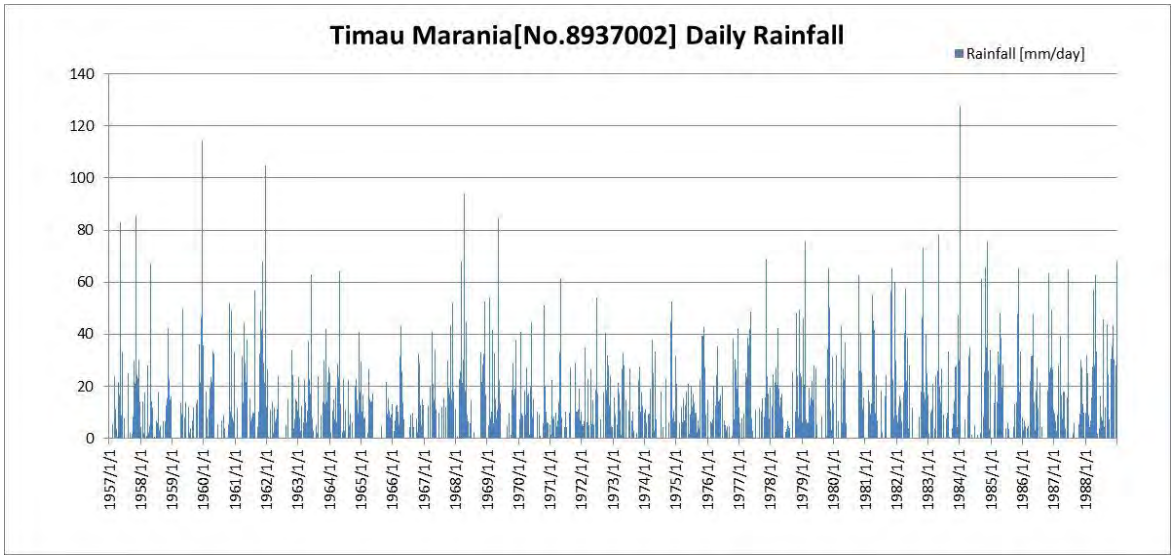
Concerning missing data (1957, 1959, 1961, 1976 and 1980), maximum daily rainfall of other 27 years is recorded 10 times in short rainy season, 9 times in long rainy season, 5 times in October, once in February and twice in June.

Missing period of 1957 is from 1/1 to 1/2. Frequency to occur maximum daily rainfall in this season is not high. Missing period of 1959 is from 1/1 to 1/4. The period includes long rainy season. However, maximum daily rainfall data recorded as 114.3mm in 11/12. This rainfall data is one of the highest records of the list and probability to exceed this rainfall is relatively low. Missing period of 1961 is from 2/2 to 1/3 that means just before

long rainy season. From same reason, the data 104.6mm of 14/12 is concluded as maximum rainfall of the year. Missing period of 1976 is from 2/9 to 1/10. There is no maximum daily rainfall recorded on the same season of other years. Possibility to record maximum rainfall is low. And also, missing period of 1980 is from 2/9 to 1/10. From same reason, the data is concluded as correct.

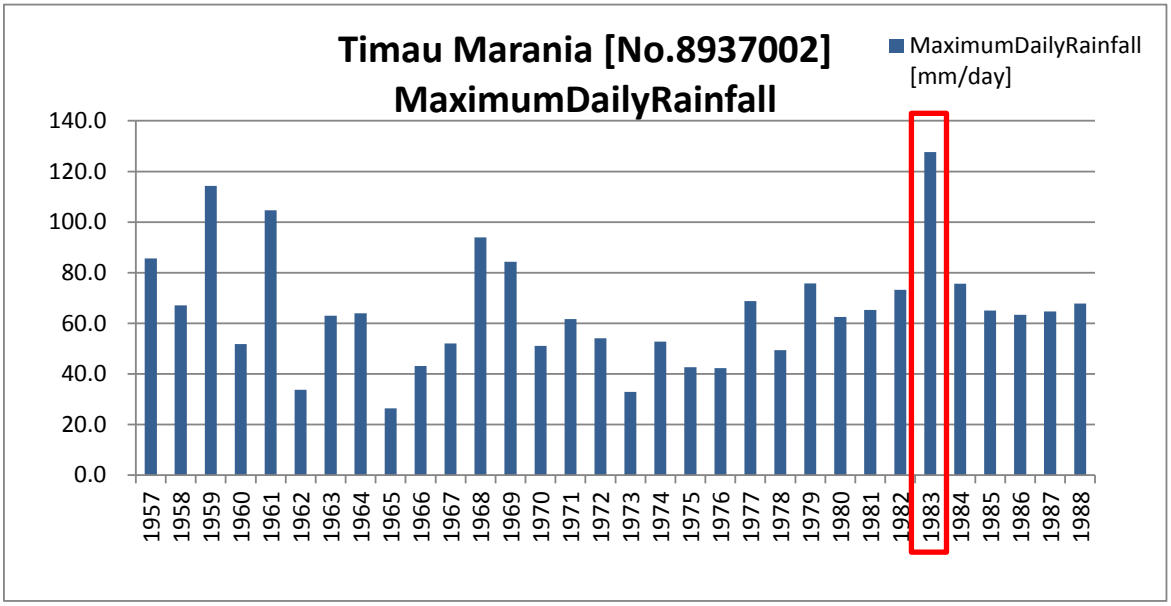
Therefore, probability to record maximum daily rainfall data in missing period is relatively low. JICA project team applies the data to analysis.

Variability of daily rainfall and maximum daily rainfall per year during the observation period of 1957 to 1989 at Timau Marania Station is shown on Figure 2.1.11



Source : Prepared by JICA Project Team based on the observation period of 1957 to 1989 at the KMD Timau Marania Rainfall Gauging Station that is offered by WRMA

Figure 2.1.11 Transition of Daily Rainfall at Timau Marania Station



Source : Prepared by JICA Project Team based on the observation data of the period of 1957 to 1989 at the KMD Timau Marania Rainfall Gauging Station that is offered by WRMA.

Figure 2.1.12 Maximum Daily Rainfall in a Year at Timau Marania Station

Probability statistics analysis by each probable years (1/50, 1/30, 1/20, 1/10 and 1/5) was carried out based on the maximum daily rainfall in a year during the observation period for 30 years (There are some missing periods.) at Timau Marania Rainfall Gauging Station within the river basin.

Table 2.1.4 shows the result of hydrological statistics calculation and the planned daily rainfall.

Applied Provability Distribution Model "Gumbel distribution" is selected based on "guideline of high water planning" by Japan Institute of Country-ology and Engineering.

Table 2.1.4 Result of Rainfall Calculation by Provable Years at Timau Marania Station

Name of Rainfall Gauging Station : Timau Marania
Observation Period : 1957 to 1989
Applied Provability Distribution Model : Gumbel distribution

Provable year	Jack Knife Estimate Daily Rainfall (mm/day)	Planned Daily Rainfall (mm/day)
1/5	81.6	82
1/10	95.1	96
1/20	108	108
1/30	115.4	116
1/50	124.7	125

Isiolo DAO Station

Maximum daily rainfall and annual rainfall, number of missing data and period of missing data by each year in the observation period of 1957 to 1989 are shown on

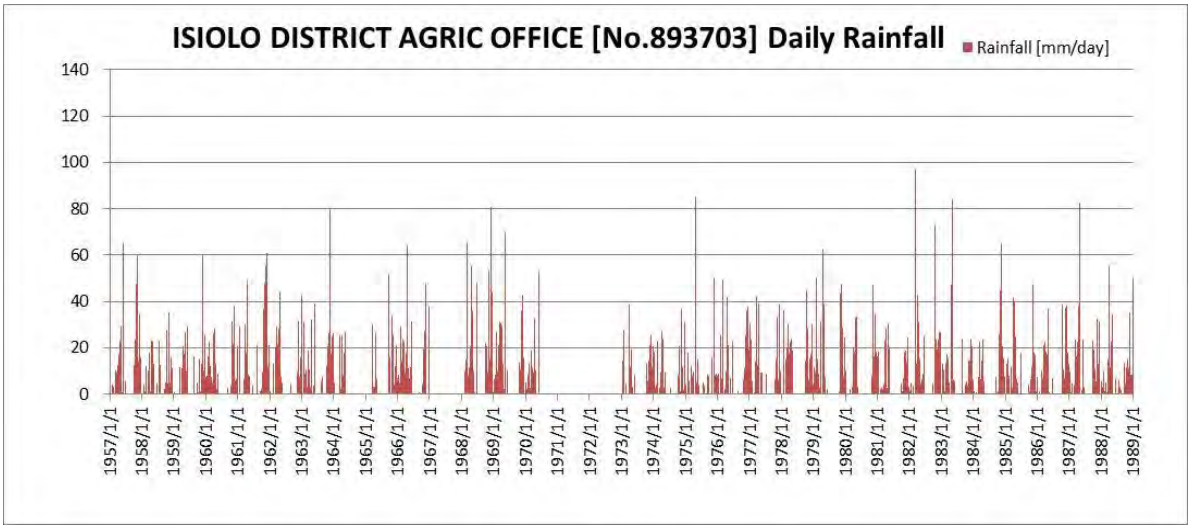
Table 2.1.5 below. The maximum daily rainfall in the observation period is 97mm/day recorded on March 10, 1982, and the maximum annual rainfall is 1,261mm/year recorded in 1961.

Table 2.1.5 Observation Record of Rainfall at Isiolo DAO Station

Year	Date	MaximumDailyRainfall [mm/day]	AnnualRainfall [mm/yr]	Number of missing data	Period of missing data
1957	1957/05/28	65.3	737	0	
1958	1958/11/06	35.6	455	0	
1959	1959/11/24	60.5	550	59	1/2-3/2
1960	1960/11/17	38.4	593	0	
1961	1961/11/25	61.0	1261	28	2/2-3/1
1962	1962/04/22	43.7	689	62	1/2-2/1, 10/2-11/1
1963	1963/11/15	79.7	859	0	
1964	1964/05/02	27.0	209	243	1/2-3/1, 6/2-9/1, 10/2-12/31
1965	1965/09/21	52.0	309	94	1/1-2/1, 5/2-6/1, 7/2-8/1
1966	1966/04/13	64.1	682	30	9/2-10/1
1967	-	0.0	0.0	183	3/2-6/1, 10/2-12/31
1968	1968/11/27	80.8	1243	1	1/1
1969	1969/05/03	70.0	906	0	
1970	1970/05/28	53.1	296	213	6/2-12/31
1971	-	0.0	-	-	No data
1972	-	0.0	-	-	No data
1973	1973/03/28	38.6	475	1	1/1
1974	1974/11/08	36.7	498	0	
1975	1975/04/18	85.2	475	0	
1976	1976/02/26	49.2	624	0	
1977	1977/03/23	42.1	646	0	
1978	1978/10/13	44.8	807	30	6/2-7/1
1979	1979/04/10	62.3	726	0	
1980	1980/11/10	47.7	528	0	
1981	1981/05/03	30.3	467	0	
1982	1982/03/10	97.0	763	0	
1983	1983/04/27	84.1	555	0	
1984	1984/11/08	65.4	535	0	
1985	1985/11/05	48.0	581	0	
1986	1986/10/10	38.8	694	0	
1987	1987/04/23	82.9	638	0	
1988	1988/03/25	55.2	717	0	

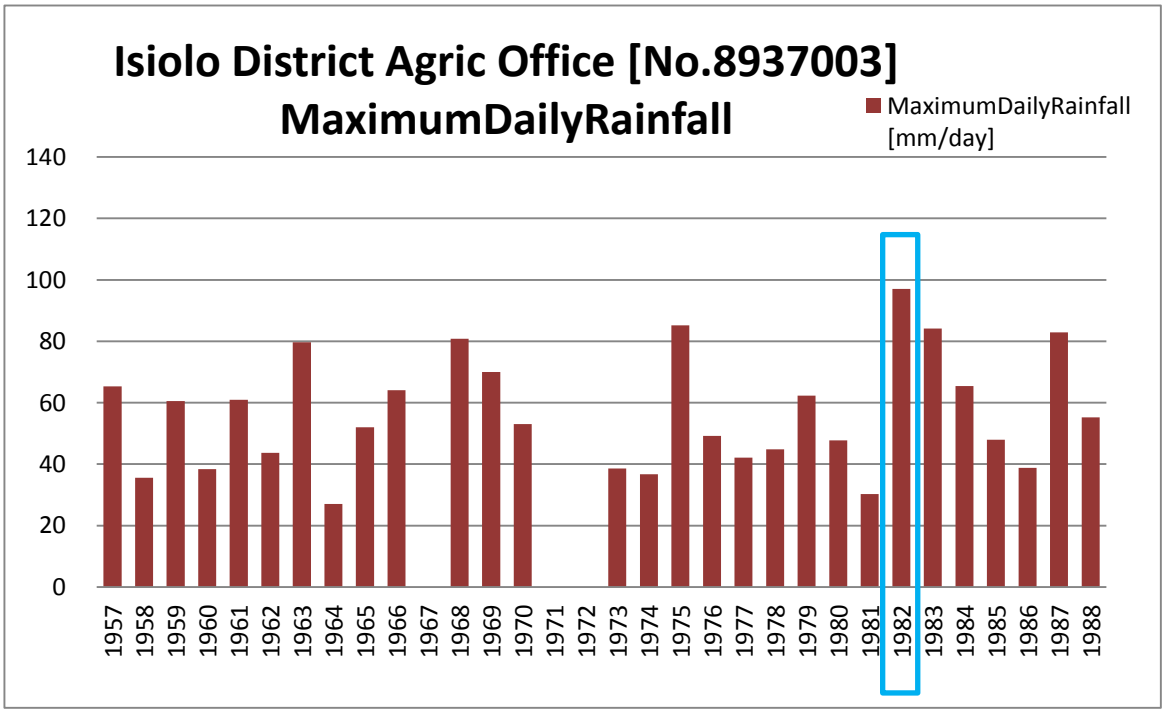
Source : Prepared by JICA Project Team based on the observation data for the period of 1957 to 1989 at KMD owned Isiolo DAO Rainfall Gauging Station

Variability of daily rainfall and maximum daily rainfall per year during the observation period of 1957 to 1989 at Isiolo DAO Station is shown on Figure 2.1.13



Source : Prepared by JICA Project Team based on the observation data for the period of 1957 to 1989 at KMD owned Isiolo DAO Rainfall Gauging Station

Figure 2.1.13 Transition of Daily Rainfall at Isiolo DAO Station



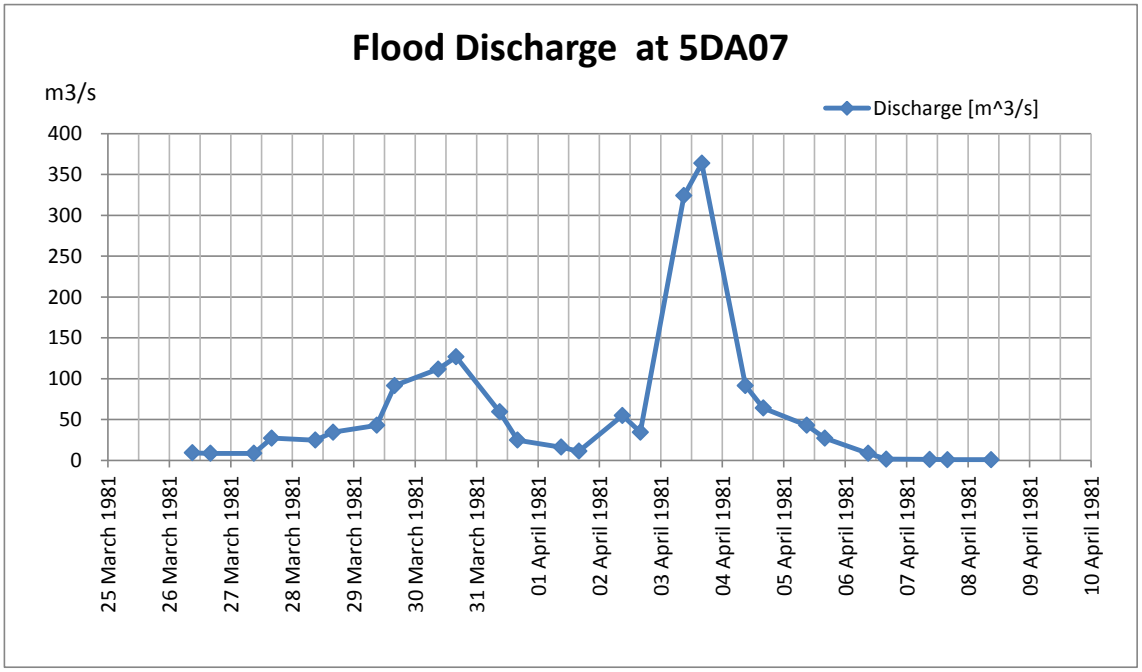
Source : Prepared by JICA Project Team based on the observation data for the period of 1957 to 1988 at KMD owned Isiolo DAO Rainfall Gauging Station

Figure 2.1.14 Maximum Daily Rainfall through the Year at Isiolo DAO Station

(3) Flood Peak Runoff Discharge

Peak flow on observation from 1971 to 2011 (There are missing data more than 12 years) at 5DA07 station that is located at upstream of Isiolo Town is 364 m^3/s on 16:00, 3/4/1981.

However, observation system works twice a day, 9:00 and 16:00. There is a possibility not to record correct flood peak runoff data. This data is offered by WRMA as converted data. Water level data is not offered.



Source : WRMA

Figure 2.1.15 Peak Flow of 5DA07station

Analysis from the view point of hydrology and hydraulics is studied. Specifically, daily rainfall data of each scale is calculated by stochastic method. In addition, rainfall intensity is estimated from the daily rainfall data. Flood peak runoff of each stochastic scale at main tributary stream and upstream of Isiolo Town is computed by rational formula. Generally, rational formula applies to basin area that is less than 100km2. However, rainfall and discharge measurement is not observed in this area and past flood flow data does not exist. There is no other choice. Dividing map of Isiolo River Basin is below.

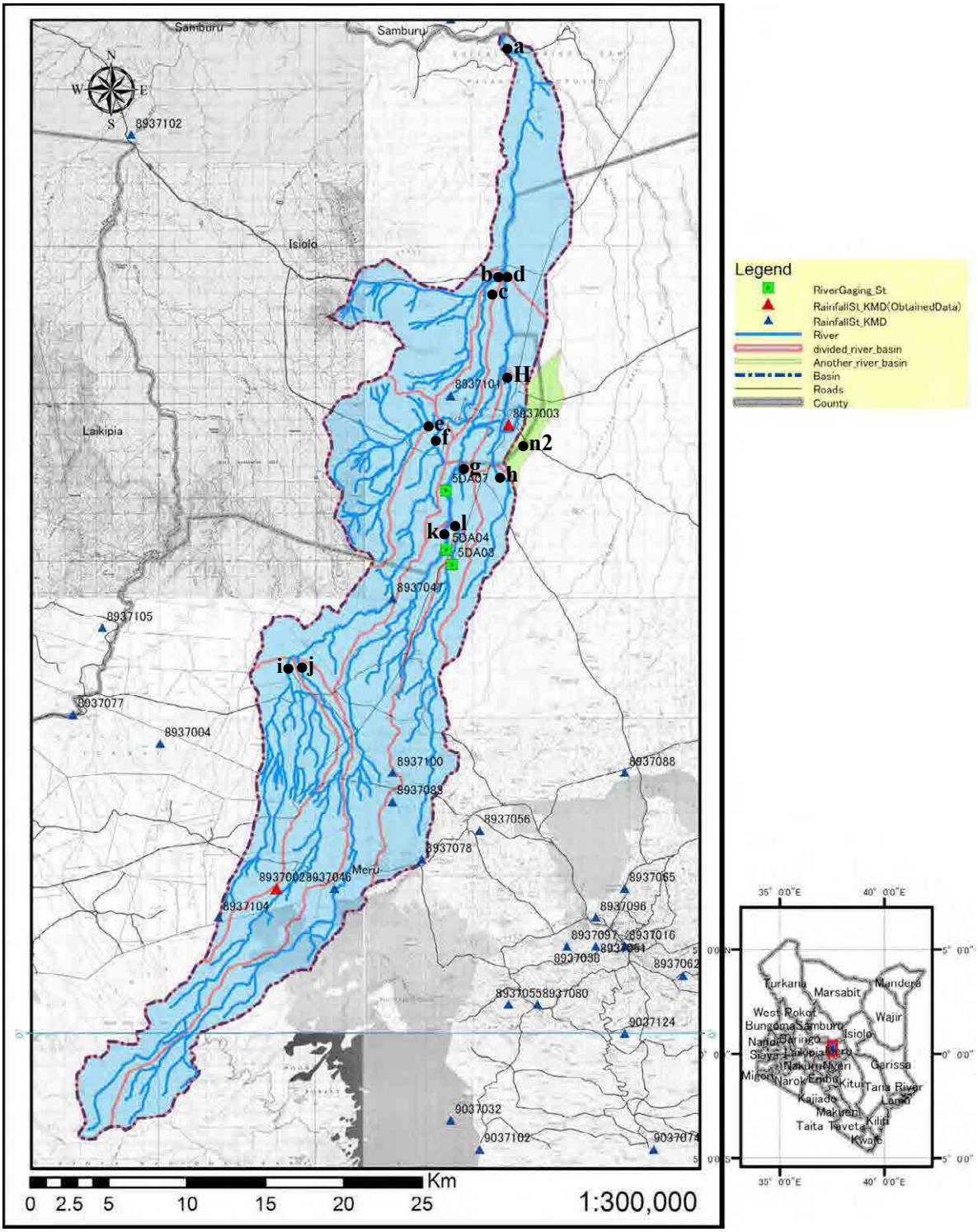


Figure 2.1.16 Dividing map of Isiolo River Basin (Sample spots are marked)

Rational formula

Rational formula and setting condition are below.

$$Q = 1/3.6 * f * r * A$$ ----------Rational formula

Q : flow discharge (m^3/s)

f : coefficient of discharge

r : average of rainfall intensity within arrival time of flood (mm/h)

A : dimension of river basin (km^2)

* Rational formula is a calculating formula to estimate flood peak runoff when rain water flows intensively from the most distant spots to sample spots. Considering canning condition of the surface, amount of flow is calculated by function as rainfall intensity and dimension of river basin.

[Condition of flood peak runoff calculation by rational formula]

- Calculating formula of arrival time of flood tc：Kraven-Rziha
- Planning daily rainfall of each scale：1/50 r24 =125 mm/d、1/30 r24 =116 mm/d、1/20 r24 =108 mm/d、1/10 r24 =96 mm/d、1/5 r24 =82 mm/d
- Formula of average rainfall intensity within arrival time of flood r：Monobe formula
- Coefficient of dischargef = 0.6（only n2 spot is applied f=0.45）
- Dimension of river basin：total dimension of river basin 474km^2

Table 2.1.6 shows the result of calculation of flood peak runoff by rational formula. The most inferior point of Isiolo River Basin to join in Ewaso Ng'iro North River is approximately 650m^3/s on 1/10. G and h spots of upstream of Isiolo Town (upstream of Eastern Marania River and Merire River) is 280 m^3/s、85 m^3/s on 1/10.

Table 2.1.6 Result of Calculation of Flood Peak Runoff by Rational Formula (Left to right : 1/50, 1/30, 1/20, 1/10, 1/5）

Point	Arrival time of flood t_c (min)	Riverbasin area A(km^2)	1/50 : r24 = 125mm/day Peak discharge Qp(m^3/s)	1/30 : r24 = 116mm/day Peak discharge Qp(m^3/s)	1/20 : r24 = 108mm/day Peak discharge Qp(m^3/s)	1/10 : r24 = 96mm/day Peak discharge Qp(m^3/s)	1/5 : r24 = 82mm/day Peak discharge Qp(m^3/s)	River	Name of the Point
i	96	45.0	238	221	206	183	156	-	
j	218	64.1	196	182	169	151	129	Western.M.R	
k	275	90.1	236	219	204	181	155	Eastern.M.R	
l	131	46.3	199	184	172	153	130	-	
e	71	40.4	260	242	225	200	171	-	
f	333	150.6	347	322	300	267	228	Western.M.R	
g	297	145.6	362	336	313	278	237	Eastern.M.R	Isiolo townの直上流地点
h	76	17.6	109	101	94	83	71	Merire.R	Isiolo townの直上流地点
b	76	11.4	70	65	61	54	46	-	
c	400	229.6	468	435	405	360	307	Western.M.R	
d	368	184.3	397	369	343	305	260	Eastern.M.R	Western.M.Rとの合流地点
H	104	27.1	136	126	117	104	89	Merire.R	Eastern.M.Rとの合流地点
a	489	473.6	844	783	729	648	554	Isiolo.R	Ewaso Ng'iro North river合流点
n2	31	2.4	21	19	18	16	13	-	隣接流域からの流路変更地点

Estimate arrival time can be utilized as lead time of early warning system.

2.2 SOCIO ECONOMIC CONDITIONS

2.2.1 Administration

(1) Local Administration

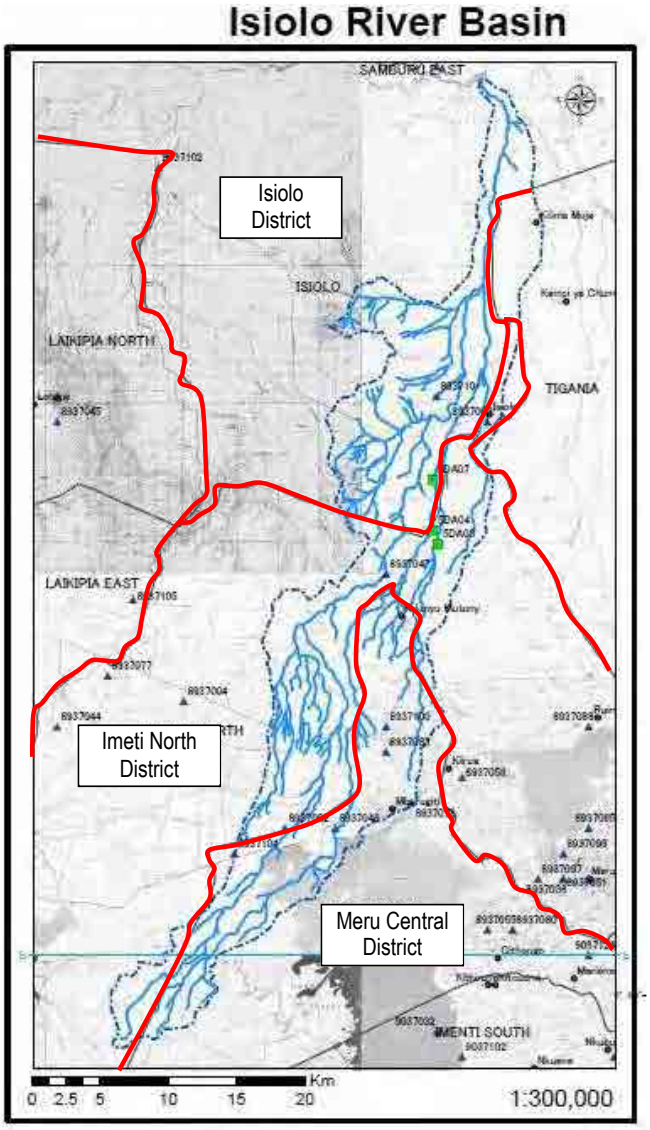
Administration division of the Republic of Kenya as of March 2013 is shown below.

Table 2.2.1 Administration Division in Republic of Kenya

Administration Unit	Ruler
Province	Province commissioner
District	District commissioner
Division	Chief
Location	Chief
Sub location	Assistant Chief
Community Unit	Leader
Village	Elder

In the administration system in Kenya, local governments (Province – District – Division – Location – Sub-location) are organized under President's office. The smallest administrative unit is Sub-location. Besides, although it is not an administrative organization, there is a village as a unit of rural community. Chieftains of the respective organizations are called "Province Commissioner" for Province, "District Commissioner" for District, "Chief" for Division and Location, "Assistant Chief" for Sub Location and "Elder" for Village.

Isiolo River Basin is mainly included in the three major districts of Meru Central, Imenti North and Isiolo. Locations of Isiolo River Basin and District and the administrative organizations included in Isiolo River Basin are shown in the following figure.



Source: International Livestock Research Institute GIS unit
Prepared by JICA Project Team based on the classified data in 1998

Figure 2.2.1 Locations of Isiolo River Basin and District

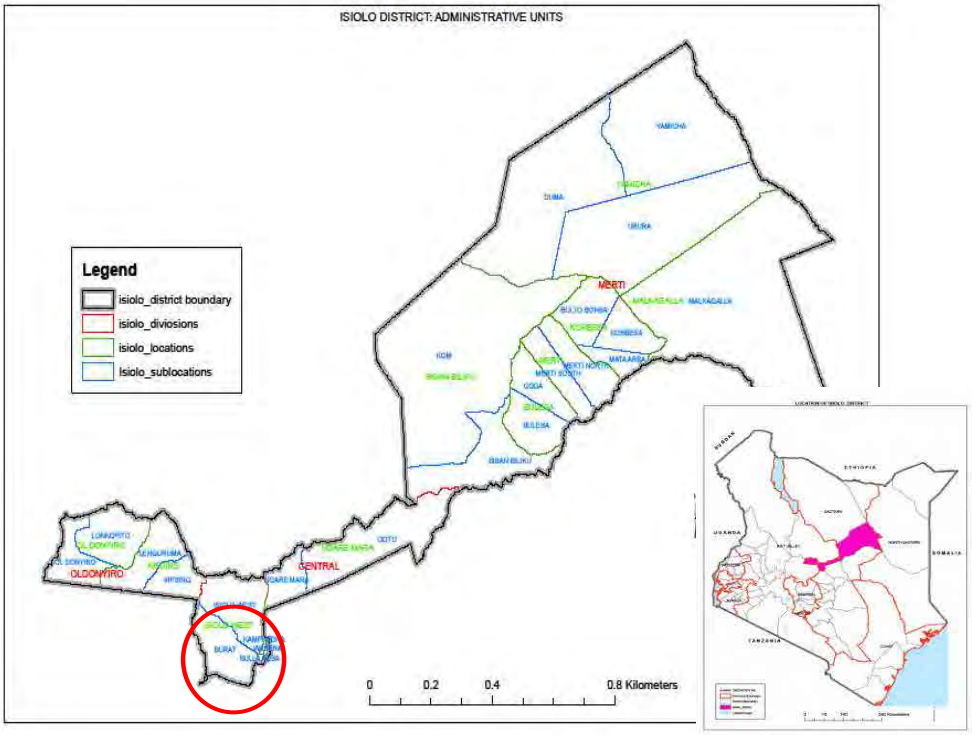
The detail of division of Division、Location, Sublocation in Isiolo River Basin is shown as below.

Table 2.2.2 Administrative division at Isiolo River Basin (June, 2004)

Districts	Divisions	Locations	Sublocations
Isiolo	Central	Central	Bulla Pesa
			Kampi Odha
		Isiolo East	Kiwanjani
			Wabera
		Isiolo West	Burat
			Isiolo West
		Ngare Mara	Ngare Mara
Meru Central	Abothuguchi West	Kiamiogo	Kiamiogo
		Kibirichia	Kimbo
		Ntugi	Mboroga
		Ntumburi	Kamarete
			Thiira
	Buuri	Kiirua	Kithima
			Nkando
		Kisima	Ntirimiti
		Rwarera	Kirwiro
			Mugae
	Timau	Kisima	Buuri
			Mutonyi
		Ngusishi	Mutarakwa
	Mt Kenya Forest	Mt Kenya Forest	Mt Kenya Forest
	National Park	National Park	National park
Meru North	Akithi	Akithi	Thinyaine
	Tigania North	Buuri	Nturingwi
	Tigania West	Mituntu	Mumui

Source : Center for Training and Integrated Research in ASAL Development February 2005 , Upper Ewaso Ngiro River Basin Sub Catchments Directory

Boundary of Isiolo District and Division、Location and Sub location in the district is shown as below. Red circle is the location of Isiolo River Basin.



Soruce : Isiolo District Development Plan (2008 - 2012)

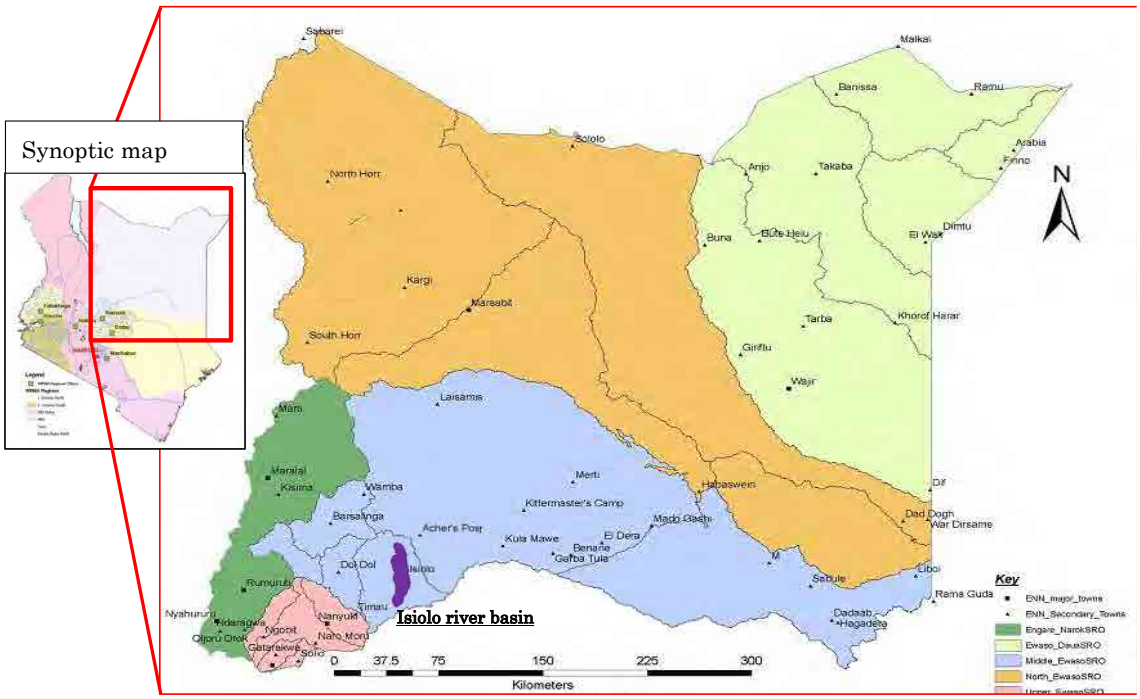
Figure 2.2.2 Location of Isiolo District

(2) Jurisdictional area of WRMA

Relation between the controlled area of WRMA (Water Resource Management Authority) responsible for the administration relating to the water resource and Isiolo River Basin is explained below.

WRMA divides the country in 6 catchment areas and Isiolo River Basin is included in the catchment called “Ewaso Ng’iro North Catchment Area (ENNCA)”.

Nanyuk Region Office in ENNCA have jurisdiction over the whole ENNCA. Besides, the catchment is divided into 5, i.e. Upper Ewaso Ng’iro, Middle Ewaso Ng’iro, Middle Ewaso Ng’iro, Engare-Narok Melphis, Morth Ewaso Laggas and Ewaso-Daua. There are Sub-Regional Offices in the respective regions. Isiolo River Basin is in Middle Ewaso Ng’iro indicated in blue color and belongs to Middle Ewaso Ng’iro Sub-Regional Office.



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

Figure 2.2.3 Regional Division within the ENNCA Catchment and Location of Isiolo River Basin

Photo 2.2.1 WRMA Middle Ewaso Ng'iro (Isiolo) Sub-Regional Office

Table 2.2.3 Demarcation of Isiolo River Basin

	Regional Office Level	Sub regional Office Level	Sub Catchment Level
Area	Ewaso Ng'iro North Catchment Area(ENNCA)	Middle Ewaso Ng'iro Sub-Region	Isiolo Sub Catchment
WRMA / WRUA	WRMA ENNCA	WRMA Middle Ewaso Ng'iro (Isiolo) Sub-Regional Office	Isiolo WRUA

2.2.2 Population

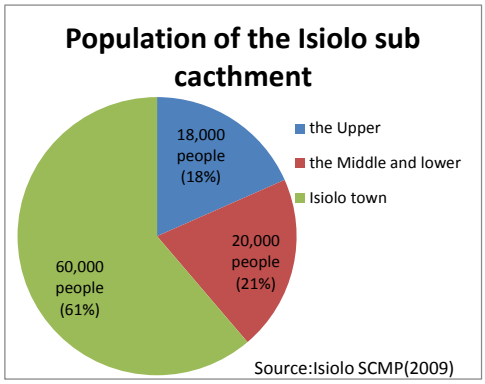
Population census data of 2009 in Isiolo District which includes Isiolo River Basin is presented in Table 2.2.4. The Central Division area including Isiolo Town is densely populated and the population reaches 40,000 persons occupying 40% of the total population of the whole district. No. of households is also concentrated in this area and occupies 45% of the whole district. Especially in Bulla Pesa and Odha of Central area, the population density is high, i.e. about 3,000 persons/km2 and about 1,000 persons/km^2, respectively.

Table 2.2.4 Population Census Data in Isiolo District (2009)

District	Division	Location	Sublocation	Male	Female	Total	Households	Area in Sq. Km.	Population Density
ISIOLO	CENTRAL	CENTRAL	BULLA PESA	11,148	11,574	22,722	6,190	7.66	2,965.93
			ODHA	2,860	3,062	5,922	1,236	5.67	1,044.57
		WEST	BURAT	4,580	4,010	8,590	1,640	345.51	24.86
			ISIOLO WEST	2,162	2,100	4,262	1,004	396.86	10.74
	CHERAB	KORBESA	BULTO BONSA	351	402	753	173	299.13	2.52
			KORBESA	871	939	1,810	361	247.40	7.32
			MATA ARBA	237	266	503	108	121.97	4.12
		MALKAGALLA	MALKAGALLA	1,105	1,071	2,176	443	2,812.81	0.77
		YAMICHA	DUMA	236	121	357	80	1,652.59	0.22
			URURA	587	470	1,057	243	1,621.58	0.65
			YAMICHA	807	764	1,571	307	1,552.10	1.01
	EAST	EAST	KIWANJANI	1,459	1,537	2,996	651	4.41	680.03
			WABERA	7,305	7,130	14,435	3,045	8.57	1,683.76
		NGARE MARA	GOTU	1,040	887	1,927	491	778.93	2.47
			NGARE MARA	2,071	1,522	3,593	759	184.96	19.43
	MERTI	BISAN BILIQU	BISAN BILIQU	663	686	1,349	285	636.46	2.12
			KOM	276	252	528	127	2,567.21	0.21
		BULESA	BULESA	851	888	1,739	384	316.65	5.49
			GODA	628	537	1,165	233	240.92	4.84
		MERTI	MERTI NORTH	2,375	2,448	4,823	998	312.92	15.41
			MERTI SOUTH	1,221	1,289	2,510	552	241.66	10.39
	OLDONYIRO	KIPSING	KIPSING	1,666	1,741	3,407	745	204.62	16.65
			LENGURUMA	1,031	1,122	2,153	473	335.74	6.41
		OLDONYIRO	LONKOPITO	1,406	1,450	2,856	587	365.81	7.81
			OLDONYIRO	3,444	3,528	6,972	1,348	255.06	27.34
Total				50,380	49,796	100,176	22,463	–	–

Source : Kenya National Bureau of Statistic, Census 2009

According to Isiolo Sub Catchment Management Plan, the population in Isiolo River Basin is approximately 98,000 persons. The breakdown by locations within the river basin is as per Figure 2.2.4, and the population by sub-catchment is about 18,000 persons in upstream, about 20,000 persons in middle/downstream and 60,000 persons in the downtown of Isiolo Town. This shows a trend of people to gather in the middle river basin where the water resource is abundant, and it also shows Isiolo, the largest town in the river basin is



Source : Prepared by JICA Project Team based on the population data of Isiolo SCMP

Figure 2.2.4 Population of Isiolo River Basin

the center of economy.

2.2.3 Industry

Agriculture is the most active industry in Isiolo River Basin. Production of honey and nursery tree is also done. Livestock farming for beef cattle and fur is carried out in the upstream basin. In addition, production of charcoal and running of hotel business are also done. The most popular agricultural crops are onion, potato, cabbage, banana, etc. Spring in the middle stream is utilized as irrigation water for agriculture.

2.3 DEVELOPMENT PLAN

2.3.1 Vision 2030

Downtown of isiolo is at present developed economically as the center of development in the northern part of Kenya. According to "Vision 2030" which is the development program of Kenyan government for 22 years from 2008 to 2030, major development programs are as follows.

(1) Development of Logistics Corridor

In Kenya, logistics corridor is planned to be developed connecting with South Sudan and Ethiopia via Isiolo. This project is passing through Garissa, Isiolo, Maralal, Lodwar and Lokichoggio from Lamu Port, and reaching to Ethiopia and South Sudan. Isiolo is scheduled to be developed as a strategic stop of transportation. This corridor will be composed of new road network, railway network, oil pipeline, Lamu Airport, port and harbor at Lamu, and it will connect the coastal area with the resort town to be developed in Isiolo.

Figure 2.3.1 Main Spot of Development Plan of Logistics Corridor

(2) Development of Resort Town

Isiolo is planned to be developed as resort town for a tourists to Mt. Kenya and Meru National Park. Further, Isiolo is expected to be a foothold of economical activitiesy in the northern part of the country.

(3) National water supply and sanitation

Mzima pipeline is planned to be expanded for the purpose of meeting to supply water demand in the proposed development sites of resort in the coastal town, Isiolo, etc.

2.3.2 Isiolo District Development Plan (2008-2012)

According to "Isiolo District Development Plan" which is the development plan of Isiolo District, there are the following programs.

(1) Water Harvesting

The project is to improve an access to the water for community. Community will present the site to be developed, and the community itself will construct the reservoir using the fund raised after appraisal.

(2) Opening of Northern Tourlist Circuit

Garbatua Road will be connected with Kuramawe district through development of the road, and the access to Iisiolo will be strengthened.

2.3.3 Imenti North District Development Plan (2008-2012)

According to "Imenti North District Development Plan" covering in detail the development plan of Imenti North District and Meru Central District in the upstream/middle stream of the Isiolo River Basin, there are the following programs.

(1) Mt. Kenya east pilot project

To improve mainly vegetation along the river, forestation project of nursery tree is planned. 100,000 pieces of nursery tree are planted in rainy season every year.

(2) Sirmon water project

7km of waterway pipe is planned to be constructed for supply of clean water to 2,000 households.

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

According to "Ewaso Ngi'ro North Catchment Area Catchment Management Strategy" which is the management plan of WRMA in Ewaso Ngi'ro North Catchment, the concept on storage of surface water and underground storage is presented in the Chapter of Water Storage Options in ENNCA as follows.

Table 2.3.1 Water Storage Options in ENNCA

Scale	Surface Storage Options	Ground Storage Options
Household and on-Farm	Roof catchment tanks, (< 50 m^3) Farm pond (< 500 m^3)	RWH Underground tanks (<500 m^3)
Farm/Community/WRUA	Runoff harvesting to pan or dam (< 50,000 m^3), typically offline (out-stream)	Sand dams or sub-surface dams
Sub-catchment	Small – medium sized dam (< 500,000 m^3), on-course or off-course	Artificial groundwater recharge
Catchment (State Schemes)	Large multi-purpose dam, (>500,000 m^3) typically in- stream	

3. ANALYSIS OF FLOOD CHARACTERISTICS AND COUNTERMEASURES

3.1 OVERALL CONDITION ON FLOODS IN THE ISIOLO RIVER BASIN

3.1.1 Records of Flood Damages

Following table presents that floods occur in the Isiolo River Basin year by year, recently. Floods have major adverse effects on agricultural products, livestock, houses, infrastructures such as road, electric cable and etc., lives and properties, bountiful surface soil runoff, sediment deposition in farming land, stockpiled food, pollution of water resources, health problems such as waterborne diseases, increasing of conflicts on water resources, poor nutrition which is caused by damage of stockpiled food and etc.

The flood in 2012 was caused by short but heavey rain and a flash flood and inundation occurred at urban area of Isiolo town. It disrupted transportation and economic activities in the area. Therefore, the flood and damage type is categorized as type A which is the inundation in urvban area. The flood in 2011 was caused by overflow of the Isiolo River. And it caused damage of farmlands, infrastructures and number of houses along the river. Therefore, the flood and damage type is categorized as type B which is the inundation caused by overflow and dyke break. The flood in 2006 was caused by dyke break of the Isiolo River. And it forced many people to evacuate and caused 8 people dead. Therefore, the flood and damage type is categorized as type B, too.

Table 3.1.1 Recent of Flood Damages

Time	Place	Outline of flood damage	Flood Type *
Sep. 25, 2012	Urban area of Isiolo Town, Kiwanjani Sublocation	The flood is caused by a 20-minute heavy rain with high wind. Flash flood occurred and inundated to a depth of below-knee at urban area of Isiolo town and it is detrimental to public transportation and economic activities. However, its adverse effect is limited about one hour. Residential district of Kiwanjani Sublocation where is located near the airport and high altitude, most of damages were that a number of houses were collapsed due to high wind.	Type A
2011	Neighboring area of the urban area of Isiolo Town	Long-term dysfunctional farming land due to inundation, occlusion of culverts, destroyed IWACO's water intake facility and washing away a number of houses	Type B
Oct. 2006	Kulamawe, Bullapesa, Bulla Arera, Juakali, Kambiodha, Kambibulle, Kampigabra and kabiwacho villages	Embankment of the Isiolo river was broken and number of affected people is approximately 500, number of death: 8. People who were affected by flood were forced to evacuate and camp out at the Isiolo Catholic Church.	Type B
2005		Number of deaths: 10	---

*: Flood types are shown in Figure 3.2.1.

Source: Data is created by JICA Project Team based on interview with WRMA and Isiolo WRUA

3.1.2 Flood Condition Inquiring From Relevant Communities

JICA Project team conducted interviews at the local communities in the Isiolo River Basin which were affected by flood damage. Figure 3.1.1 presents a location map of local communities where interview were conducted. Table 3.1.2 presents results of interviews on flood damages at the local communities.

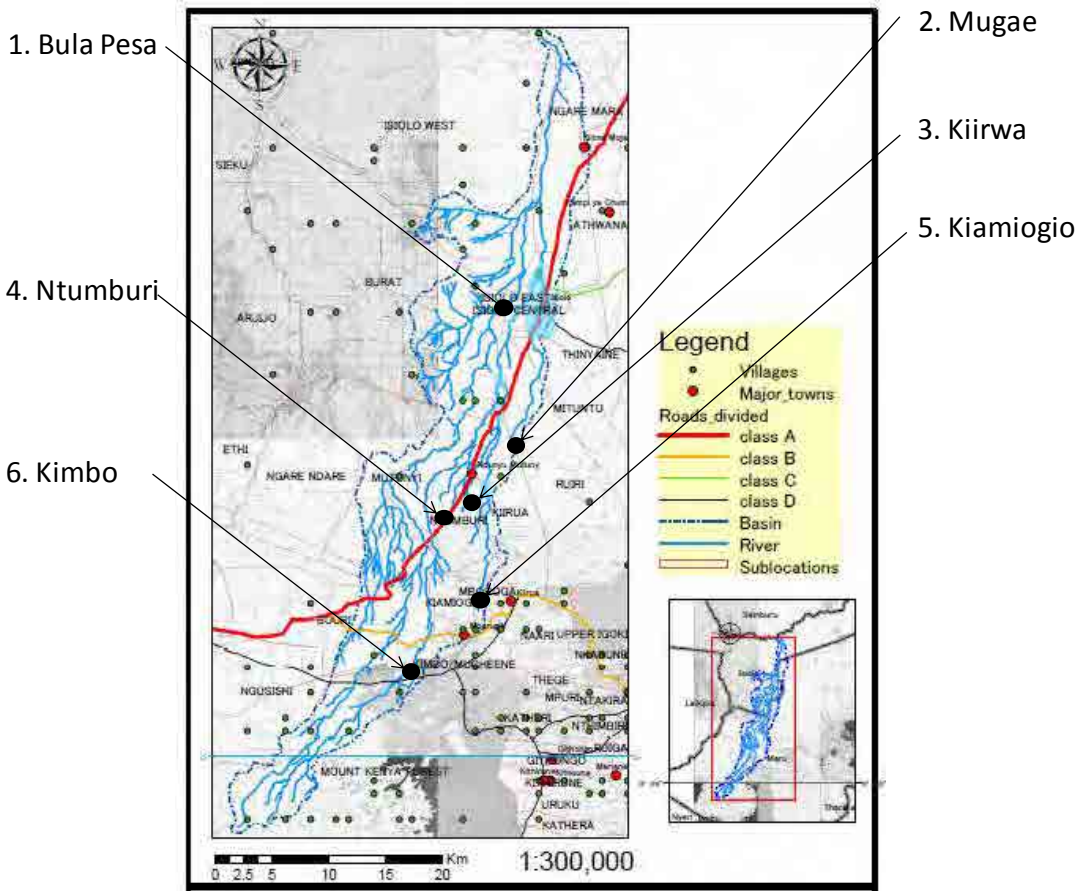


Figure 3.1.1 Map of IsioloRiver Basin and Location of Communities

Table 3.1.2 Communities in Isiolo River Basin and Each flood situation

No	Community	Population	Flood depth	Flood duration	Frequency	Flood type *
1	Bula Pesa	22, 722	Between 50 cm to 1.5 m	2-3 Hours	Erratic, but mostly expected between Oct.-Dec. every year	Inundation in urban area (A) Outflow from reivers (B)
2	Mugae	1,217	Approximately 50 cm	2-3 Hours	Erratic	Debris flow (C) Bank erosion (D)
3	Kiirwa	4,196	Between 50 cm to 1.5 m	2-3 Hours	Erratic	Debris flow (C) Bank erosion (D)

4	Ntumburi	2,847	Between 50 cm to 1.5 m	2-3 Hours	Erratic	Bank erosion (D) Outflow from reivers (B)
5	Kiamiogio	3,181	Approximately 50 cm	2-3 Hours	Erratic	Debris flow (C) Outflow from reivers (B)
6	Kimbo	4,149	Approximately 50 cm	2-3 Hours	Erratic	Bank erosion (D) Debris flow (C)

*: Flood types are shown in Figure 3.2.1.

The detailed damage situations and flood type in each community by project team's inquiring survey on the communities are shown below.

(1) Bula Pesa

- Human settlements are affected when Merire river over flows..... (Inundation in urban area)
- Houses are knocked down by the debris carried by the flooding river.... (Outflow from rivers)
- Roads are badly eroded making access to social amenities like schools and hospitals inaccessible..... (Inundation in urban area)
- In some cases there is loss of human life as a result of flooding of Merire river ..... (Inundation in urban area)

(2) Mugae

- Debris flow damaging river structures like water intakes, and bridges.....(Debris flow)

-There is erosion carrying away arable top soil leaving the farmlands infertile hence decreased agricultural production ..... (Bank erosion)

(3) Kiirwa

-Sediments overflow into farm lands burying crops .....(Debris flow)

-Access roads are eroded by flood water making accessibility to market for agricultural products difficult ..... (Bank erosion)

(4) Ntumburi

- River bank erosion reducing the size of farmlands, hence less agricultural produce ..... (Bank erosion)
- Crops are washed away by flood waters ..... (Outflow from rivers)
- Makeshift bridges are washed away when the river overflows making accessibility to social amenities difficult. ..... (Outflow from rivers)

(5) Kiamiogio

- Sediments are deposited on farmlands submerging the crops .....(Debris flow)
- Makeshift bridges are washed away makinh accessibility to the market for farm products difficult ..... (Outflow from rivers)

(6) Kimbo

- Erosion on farmlands carry away top fertile soil leaving farmlands infertile..... (Bank erosion)
- Debris flow blocks access roads to market for farm products.....(Debris flow)

3.2 FLOOD CHARACTERISTICS AND SITUATION OF DAMAGES IN THE ISIOLO RIVER BASIN

3.2.1 Concept of Flood Characteristics and SituationI of Damages in the Isiolo River Basin

There are four types of flood characteristics in the Isiolo River Basin as described below;

Mark	Flood Type	Area
A	Inundation in urban area	Isiolo Town
B	Inundation which is caused by overflow and dyke break	Midstream and tributary stream
C	Debris flow	Upstream
D	Bank erosion	Entire basin

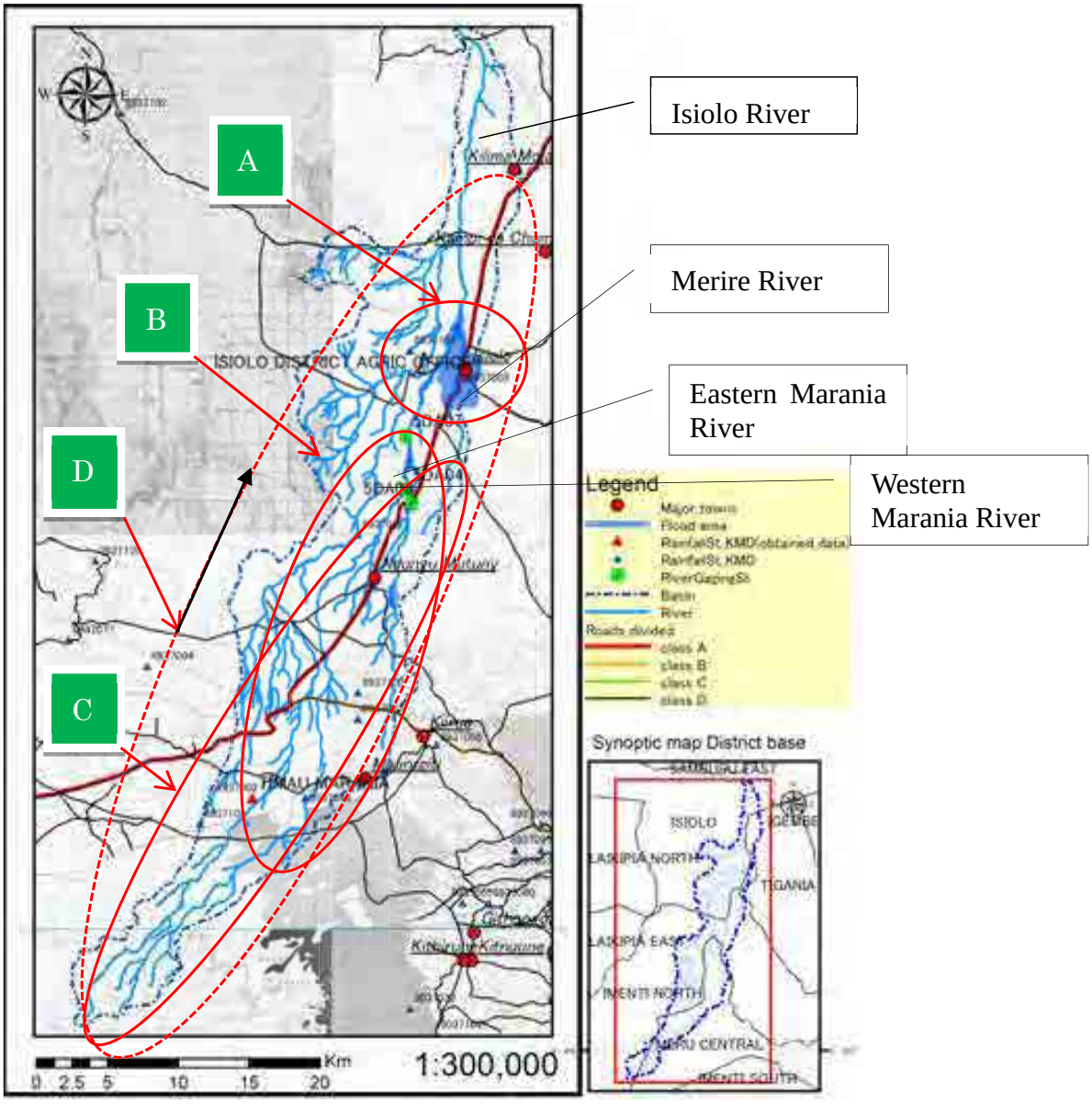
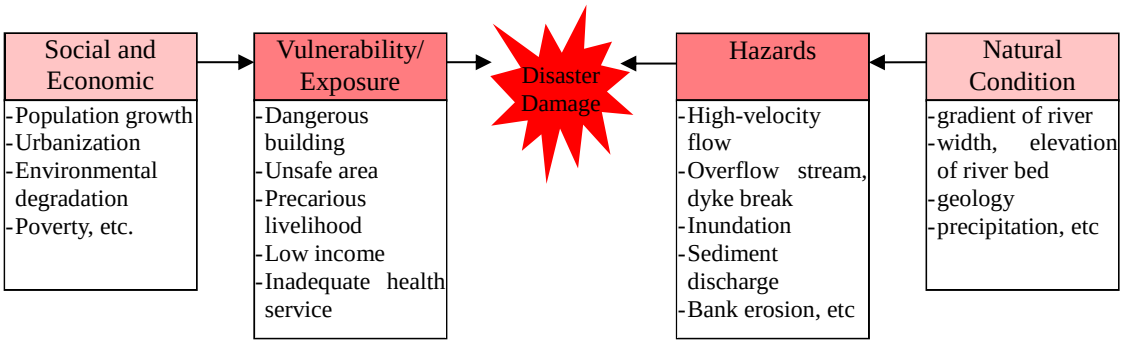


Figure 3.2.1 Flood Types and Areas in Lumi River Basin

Flood damage has a close relationship with between natural condition and social and economic condition in a local area. Natural condition defines types of Hazards in a river basin and social and economic condition defines vulnerabilities and exposures. Moreover, it could be said that disaster (flood) damage is defined from both aspects. Characteristics of flood damage are analyzed using information of last chaper (Natural condition and Socio-economic condition) about each flood characteristics of A), B), C) and D) as above-mentioned.



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

Figure 3.2.2 Mechanism of Flood Damage

3.2.2 Inundation in Urban Area of Isiolo Town (A)

Inundation near the Isiolo town area (Flood Characteristics (A)) is described in detail from the aspects of conditions on natural and socio-eco

(1) Flood Characteristics from Natural Conditions

Natural Conditions in the Isiolo River Basin that are described in the last chapter and Hazards in this area are shown as Table 3.2.1.

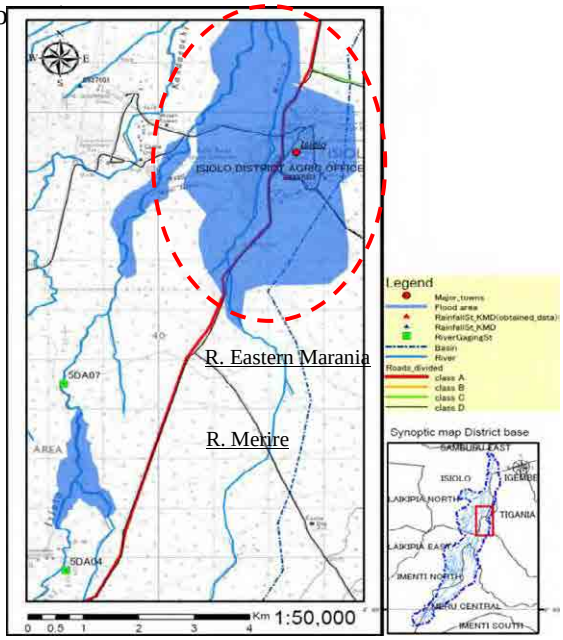


Table 3.2.1 Natural Conditions and Hazards in urban area of Isiolo town

Natural Conditions	Hazards

Approximately, geographical gradient is 1/50; gradient of river bed is 1/100	High velocity of surface and inundated water
Clayey soil	Since rain water doesn't seep underground, surface run-off occurs

- The Merire River flows in urban area and the Eastern Marania and Western Marania River flow in the western part of the town.
- As geography gradient is 1/50 and river bed gradient is 1/100, therefore, flood arrival time is short and surface and inundated water have high velocity.
- Rain water doesn't seep underground and surface run-off occurs in this basin, because surface soil is composed chiefly of clay.


Condition of inundation in the urban area of Isiolo town

- JICA Project team infers that urban area and its surroundings have high sediment runoff and high ratio of runoff. This area is located in semi-arid zone and its vegetation is shrub zone. Therefore interception of rainfall and water retention function can't be very effective.
- There is only data of daily precipitation and daily maximum rainfall of Isiolo DAO in the Isiolo town is 97mm. JICA Project team infers that characteristics of precipitation in this area are high and intensive rainfall within a few hours. Result of calculated 10-year rainfall intensity during flood arrival using rational method is 26.7mm per hour at the upstream point (h) of Isiolo town. Considering this factor, we think result of calculation is appropriate.
- 10-year probable peak flood runoff in the Merire River is calculated 80m3/s and 5-year runoff is 70m^3/s. Current capacity of flow is not enough to floods which might be occurred only once in few years and it is natural phenomenon that the Merrire River overflows.


Condition of inundation in the urban area of Isiolo town

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

Relationship between conditions on Socio-economic and Vulnerability/ Exposure to Natural disasters in urban area of Isiolo town is shown in below.

Table 3.2.2 Conditions on Socio-economic and Vulnerability/ Exposure Urban Area of Isiolo

Socio-economic conditions	Vulnerability/ Exposure
Highly-populated residential area, (60% of population in the river basin, population density; 3,000 per square kilometer)	A large number of refugees who might be affected by flood
There are 45% of houses which stand all in this river basin	A large number of houses that might to be affected by flood
Commercial capital in the region	A temporary halt in economic activities due to inundation
Key junction of transportation network	A temporary halt and/or stagnation in logistics due to inundation
Resort area and facilities for tourists are placed	Stoppage and halt of service for tourists, due to inundation
Expansion of the airport	An increased risk of flood damage

- Population in the Isiolo town area is approximately 60,000. Even urban area inundates in a short time, flood damage gives a great impact to socio-economic in this region.
- Now infrastructure development projects such as expansion of the airport and construction of roads are in progress according to the higher regional master plan. In conjunction with these developments, housing land development is also promoting. However, impacts to flood management and municipal effluent are unconsidered in these development plans.

(3) Flood Damage Mechanism

Regarding to inundation in the urban area, three contributing factors are identified as described below;

1) Lack of flow capacity in the Merire River (River Water)

Lack of flow capacity of the Merire River which flows through the Isiolo Town is one of the causes of inundation in town area. There are some problems of natural conditions and problems of socio-economic conditions which increase it.


The Merire River runs in the Isiolo town

Regarding the problems of natural conditions, the Merire River doesn't have enough width and cross-sectional area.

Merire River has approximately 5m width and 0.5m height. Therefore, if we consider that the cross sectional shape is rectangular and gradient of riverbed is 1/100, flow capaciy of the river channel is approximately 4 m^3/s.

Based on the calcuration of rational formula mentioned before, 5 years return period flood discharge is approximately 75 m3/s and 10 years return period flood discharge is

approximately 85 m3/s. Not all the amount of flood discharge will run through into the town area. Even though, the flow capacity of the Merire River is obviously not sufficient.

Main riverbed material is sand. Height of river channel is approximately 0.5~1m. Sediment accumulates in the culvert. Sediment and disposed garbage are some of causes of culvert clogging.

Culvert along the Merire River in Isiolo town

Regarding the socio-economic problems, mainly in the downstream of the Merire River, houses are built in the riprian land illegally. Consequently, it is very difficult to widen the river channel. This issue should be encountered, too.

Many houses are built near the Merire River and the walls are encroaching river channel (upstream view)

Downstream of Merire River (upstream view) squatter's houses are on the left bank of the river channel

Sediment runoff occurs in the upstream of the Merire River and accumulates in the downstream. Not only the accumulation of sediment, but also the clogging of culberts by the illegally disposed garbage is one of the causes of reduction of flow capacity. A box-culvert located at the downstream end of the town area was clogged, and the upper side water of it was dammed up and water level became very high. For that reason, the inundated water depth became 2 to 3 meters.

A box culvert bridge at the downstream end of the town of the MerireRiver (Downstream view)

10 persons were dead in 2005, and 8 persons were dead in 2006. It is said that these persons were drowned by the highly dammed up flooded water or swept away by the flooded water.

2) Poor storm drainage system in whole Isiolo town (Inland Water)

Drainage system such as drainage channels, culverts, side ditches of road and etc. have not been developed to function as a network in Isiolo town. Therefore, drainage capacity in downtown is reduced and when rain in torrents in the urban area, inundation is occurred to stay on the surface of the road without being drained away. The depth is up to 50cm like around under knee deep of adult and there is the place that is around 2.5% or 1/40 of maximum inclines geographically and flood has a rapid current in the small alley of the urban area and it is dangerous for the vulnerable people to disaster such as children, women and the aged and the report that someone comes a gutzer is heard. In addition, by the short rain like 2-3 hours, commercial district of the city central is flooded depending on time of the flood outbreak, and it is said that influence on this local economy is extremely damaged to be suspended all economic activity.

Situation of inundation in the town center where shops stand side by side

Situation of inundated house

Summarizing the above, it is found that the flood in Isiolo city exist both inland and outside water damage. Inland flood with poor drainage of similar local city is to be heard well in Kenya, in discussion with MWI and WRMA, it is found that the need of the correspondence is recognized.

3) Changing water course due to construction of airport and roads

Recent years, due to construction of airport and road in the mountainside of Isiolo town, water course changed by influences of these new facilities.

In the past rain water ran from southern part of urban area didn't flow in a direction to the town area,it traveled down to the north in the eastern slope of the town. After the construction of those facilities, rain water from the south is blocked by embankment for the airport and roads and it is leading to the town area.

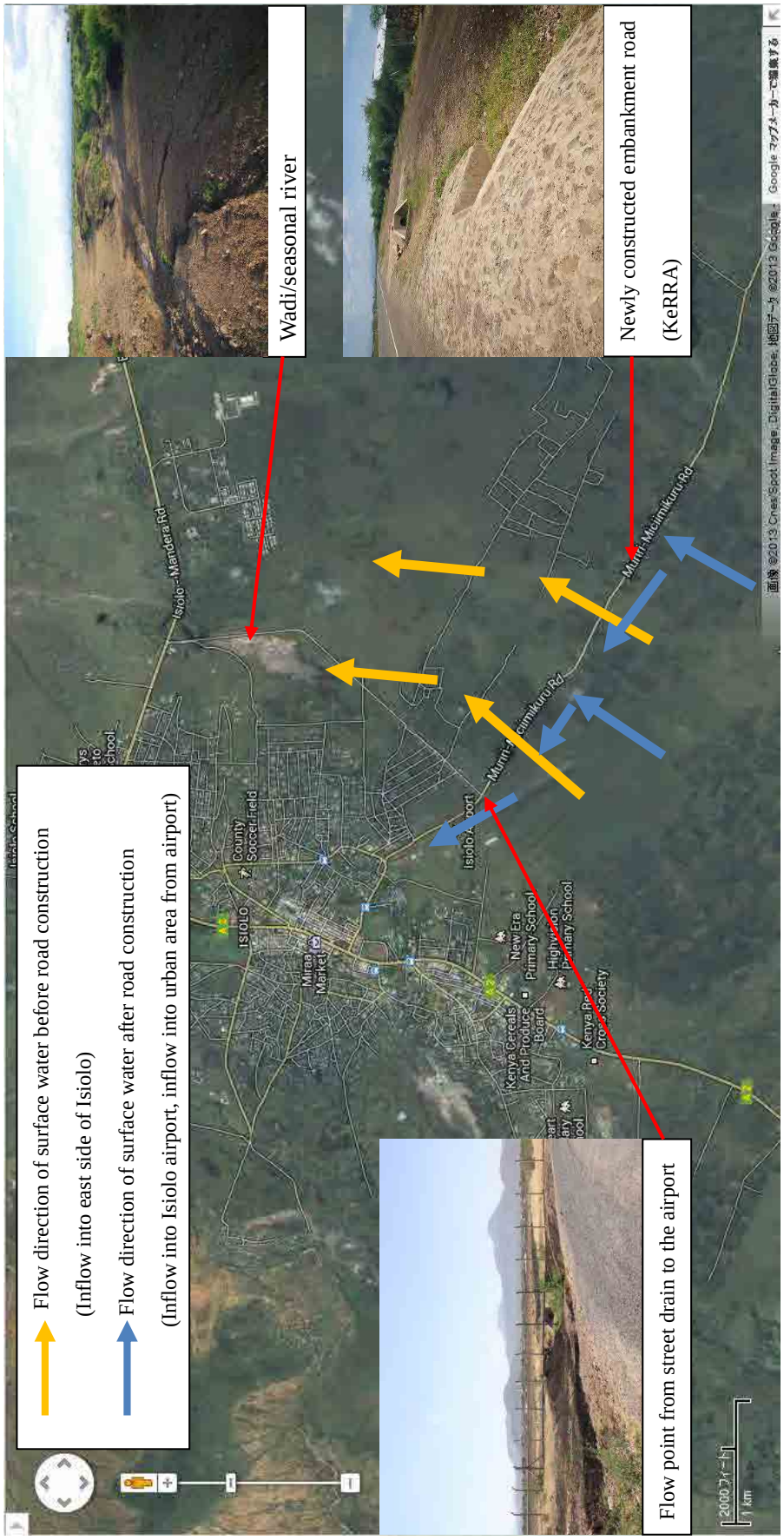
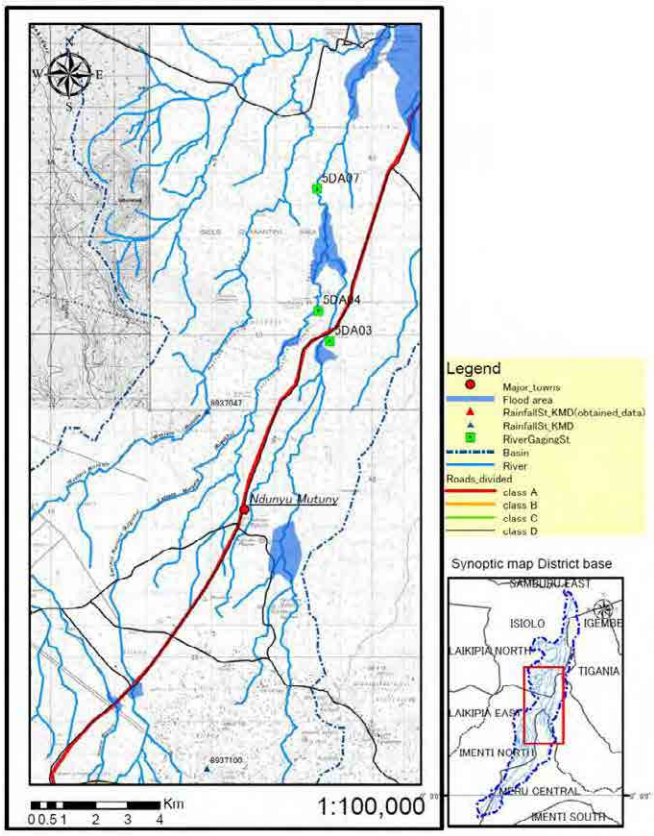


Figure 3.2.3 Direction of Rain Water from Airport Area

3.2.3 Inundation which is caused by overflow and dyke break in the middle river basin (B)

Flood Characteristics (B) in the middle of Isiolo River Basin is caused by overflow and dyke break. And it is described in detail from the aspects of natural, socio-economic conditions.



(1) Flood Characteristics from Natural Conditions

Natural Conditions in the Isiolo River Basin that are described in the Chapter-1 and Hazards in this area are shown as below table.

Table 3.2.3 Natural Conditions and Hazards in the Middle Isiolo River Basin

Natural Conditions	Hazards
Approximately, geographical gradient is 1/20; gradient of river bed is 1/50 – 1/30	High water velocity, unstable water course
Sandy soil	Vulnerable to erode

- Major rivers in the middle river basin are the Eastern Marania River and Western Marania River. In addition to these major water courses, there are many small tributaries and most of them are dry rivers normally.
- Geographical gradient is 1/20 and gradient of river bed is 1/50 - 1/30. The Isiolo River runs through the alluvial fan in the middle of its basin. The river has a sharp inclination; hence JICA Project team infers that the velocity flow is high and water course is unstable.
- Due to spreading clayey soil on surface layer in the upstream near Mt. Kenya, rain water doesn't seep underground and it accumulates in the middle river basin. Therefore JICA project team presumes that the river has much run off when floods occur.
- Calculated flood flow volume at the Eastern Marania River (g) is 260m^3/s (10-year flood) and 240m^3/s (5-year flood). Calculated flood flow volume is 250m^3/s (10-year flood) and 230m3/s (5-year flood).

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

Relationship between conditions on Socio-economic and Vulnerability/ Exposure to Natural disasters in the middle Isiolo River Basin is shown in below.

Table 3.2.4 Conditions on Socio-economic and Vulnerability/ Exposure in the Middle of Isiolo River Basin

Socio-economic conditions	Vulnerability/ Exposure
Houses are dotted around dry rivers	When flood water comes through dry rivers, it leads to damage of houses along the rivers.
Plantation Farming land and scrub forest	Agricultural damages are occurred. Lose/ threaten former's livelihood
Highway and trunk route	A temporary halt and/or stagnation in logistics due to inundation
Development of Tourist resources	Stoppage and halt of service for tourists, due to inundation
Socio-economic conditions	Vulnerability/ Exposure

- Vegetation and land use in the middle of Isiolio River Basin is mainly farming land and scrub forest. When flood occurs, there is heavy agricultural damage in this area.
- Along with extension of urban area of Isiolo town, houses are built near water course of dry rivers. Once floods occur in dry rivers, flood flow hits and washes away those houses.

House was destroyed by flood

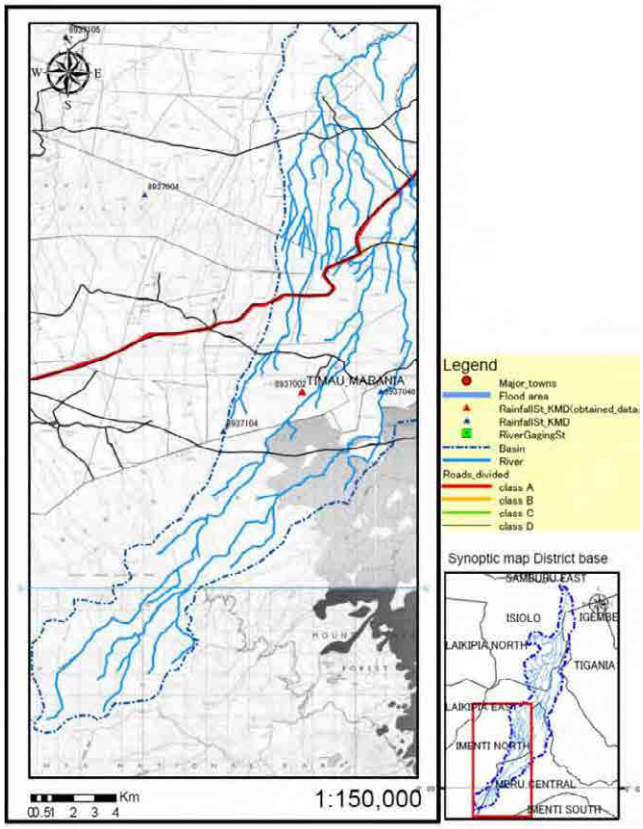
Houses were destroyed by flood

(3) Mechanism of the food damage with the overflow from the river in the middle basin

River channel is not clear because most of small branches flowing into Isiolo River midstream is dried up and ordinary flow is shallow. Flow at the time of flood is rapid and flow channel is unstable because of steep slope such as 5% (1/20) of topography inclines and 1/50-1/30 of river inclines. On the other hand, with the expansion of Isiolo urban area, house is built in the place that is dried up area and the neighborhood because river channel is not clear originally. As a result, flood streams overflow from the river channel at the time of a flood or duct changes, and damage hitting newly built house directly is occurred.

3.2.4 Debris flow in the Upstream (C)

Flood Characteristics (C) in the upstream of Isiolo River Basin is caused by debris flow. And it is described in detail from the aspects of natural, social and economic conditions.



(1) Flood Characteristics from Natural Conditions

Natural Conditions in the Isiolo River Basin that are described in the Chapter-1 and Hazards in this area are shown as following table.

Table 3.2.5 Natural Conditions and Hazards in the Upstream of Isiolo River Basin

Natural Conditions	Hazards
Approximately, gradient of river bed is 1/10	High water velocity
Clayey soil on surface layer, volcanic sediment is including	brittle geology

- Major rivers in the upstream area are the Eastern Marania River and Western Marania River.
- Gradient of river bed is 1/10 approximately. The river has an extremely sharp inclination; hence JICA Project team infers that the flood velocity flow is very high.
- Surface layer of this region is identified as clay, however there is volcanic sediment. Thus, geologically, surface soil layer is likely to be highly effective erosional agents.

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

Relationship between conditions on Socio-economic and Vulnerability/ Exposure to Natural disasters in the upstream of Isiolo River Basin is shown in below.

Table 3.2.6 Conditions on Socio-economic and Vulnerability/ Exposure in the Upstream of Isiolo River Basin

Socio-economic conditions	Vulnerability/ Exposure
Villages are not concentrated in the same area. (Number of houses and population is small.)	Number of houses and population is small. Affected people and houses are few.
The area is straddled more than one local governments	Coordination between administrations of local governments is difficult.
Land use is limited to farming	Heavy damages suffer by agricultural products due to debris flood
Plantation proceeds a part of area	Heavy damages suffer by agricultural products due to debris flood. Lose/ threaten former's livelihood
Development of sightseeing resources	Delay of development suspension of service and due to debris (However, affected area is far from resort area. Influence is small.)

- Vegetation and land use in the upstream of Isiolio River Basin is mainly bare ground, plantation and farming. When debris flood occurs, there is heavy agricultural damage in this area.
- Although damages are caused by debris flood in this area, not many people and houses are affected due to a thinly populated.

Damages by not only floods but also river bank erosion and sediment runoff appear prominently in the upstream area. Farming land erosion is forced to reduce amount of agricultural crop and sediment runoff by bank erosion becomes a problem in lower area.

Status of water course after debris flow

(3) Mechanism of the food damage by debris flow in the upper basin

In the upper basin the river bed slope is very steep as 1/10, then the flow velocity is extremely high. Although the soil is easy to break because mainly it consists of volcanic sediment, then debris flow has occurred frequently. There are agricultural damages as principal flood damages because out flowed sediments cover farmlands. However, the actual situations of debris flow damages are not comprehend in detail because of low population density.

3.2.5 Bank Erosion in the Entire Basin (D)

Flood Characteristics (D) in the entire of Isiolo River Basin is caused by bank erosion. And it is described in detail from the aspects of natural, socio-economic conditions.

(1) Flood Characteristics from Natural Conditions

Natural Conditions in the Isiolo River Basin that are described in the Chapter-1 and Hazards in the entire river area are shown as following.

Table 3.2.7 Natural Conditions and Hazards in the entire Isiolo River Basin

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

- Water courses in the entire river basin have a steep slope; there are many bank erosions at curved reach of the river.

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

Relationship between conditions on Socio-economic and Vulnerability/ Exposure to Natural disasters in the entire Isiolo River Basin is shown in below.

Table 3.2.8 Conditions on Socio-economic and Vulnerability/ Exposure in the Entire Isiolo River Basin

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

- River banks are eroded in the upper and middle river basin, however population density is not high and houses are not concentrated. Therefore, mainly farming land and transportation infrastructure such as roads and bridges suffer damage from bank erosion.
- It is likely pointed out that residential area near Isiolo town in the lower river basin suffers damage from bank erosion. Though, landowners who have estate along the river have problems.

Bank erosion near urban area

Bank erosion at the Eastern Marania River

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

Isiolo river tends that the riverbank is easy to be eroded unless river duct is steep slope and rock does outcrop in the river channel curved section. On the other hand, not only national highway A2is the highway which is demand for society, economic activities around Isiolo,but also is the most important highway to the northern part of Kenya. Therefore it is inferred that economical influence by bridge being damaged and suspended at the time of flood is extremely serious at the point of national highway A2 across the river.

3.3 ANALYSIS ON FLOOD DAMAGE AND COUNTERMEASURE

3.3.1 Analysis on Flood Damage and Countermeasure in the Urban Area of Isiolo

(1) Damage and its cause

Based on the field survey in this study, flood damage in the urban area of Isiolo was analyzed using logic tree. The following figure summarizes the specific causes of damage from the left side to the right side, i.e. kinds of damage, specific damage, condition of damage and its cause (see **Figure 3.3.1**).

In the urban area of Isiolo, damage is occurred caused by a short term inundation of the whole city. Specifically, these damages are human damage derived from the lack of mind, knowledge and information on disaster prevention, damages to logistics and people's movement due to disturbance by inundation and loss of houses and land caused by inflow of soil and flood discharge.

Inundated road in the urban area of Isiolo by flood (Place: Isiolo Town)

Road after flood (Place: Isiolo Town)

In addition to the lack of mind, knowledge and information on disaster prevention, the following three major causes are considered for the occurrence of large scale inundation as physical factors.

- Lack of discharge capacity of Merire River crossing the urban area
- Flow of rainfall has been changed by the airport and road newly constructed in the east side of the urban area and the flood hits the urban area directly, and
- Insufficient drainage system in the urban area of Isiolo.

(2) Countermeasures

To derive the countermeasures, the objective tree analysis was carried out. Issues to be solved are placed on the left side and the measures are specifically presented therefrom(see **Figure 3.3.2**).


Simple Rain Gauge (Place: Nkando Primary School)

In Isiolo River Basin, even if there is a heavy rain in the upstream by the effect of Mt. Kenya, there is a case having no rain in the middle and downstream. In such case, effective measure can be taken such as evacuation and activity to prevent flood by obtaining information on rainfall and water level in the upstream in advance. For this purpose, introduction of early flood warning system is effective. In the community too, rainfall in the upstream can be measured by simple hyetometer and the information transmitted to the downstream.


Flooded urban area due to vulnerable drainage system (Place: Isiolo Town)

As the mind on disaster prevention of the residents is very low, dangerous situations are happened such as the people suffered from injury by crossing the road overflown with the flooded discharge and/or washed away by crossing the bridge submerged under water. To avoid such a situation, it is considered effective to educate the residents on disaster prevention about how much the floods are dangerous.


Shop taking measure by sand bag (Place: Isiolo Town)

Insufficient drainage system in the urban area is one of the reasons why the flood damage spreads. Since the drainage infrastructure is not properly functioned or not well developed, inundation is occurred in the urban area with a little rainfall. Or the road is cut into pieces and the

commercial activity is suspended by the inflow of water into the shops. As countermeasures, it is considered to develop drainage network in the urban area and to protect the inflow of water by banking up sand bags in front of the shops.


Very few drain channel installed in the urban area (Place: Isiolo Town)

Besides, houses and buildings are damaged and lost by overflowing of Merire River. Countermeasure to prevent overflow is to improve the discharge capacity of Merire River by way of excavation and/or widening of the river course. In addition, the following countermeasures are considered.
Restriction on land use which sets a limit to reside in a place nearby the river bank, and Trash picking campaign to remove garbage which blocks the flow.

Further, inundation in the urban area is becoming serious as the outflow route of flood has been altered by the impact of construction of the new road and expansion of the airport in the eastern slope of the urban area. To improve such a situation, countermeasures are considered to restore the flood outflow route to the original by developing drainage channel and culvert, and to limit the outflow by flood basin.


Culvert installed near the airport (Place: Isiolo Town)

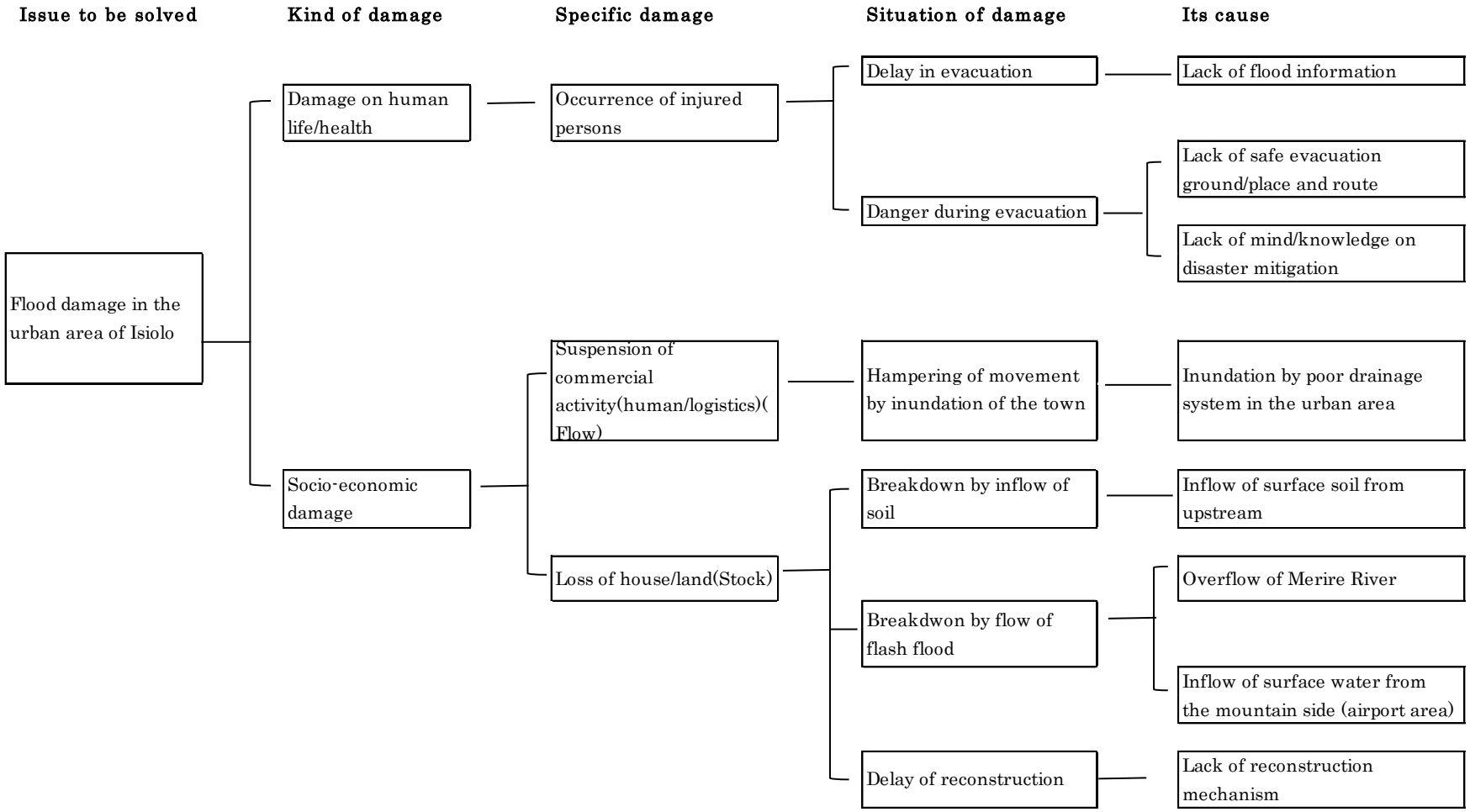


Figure 3.3.1 Analysis on Flood Damage and its Cause

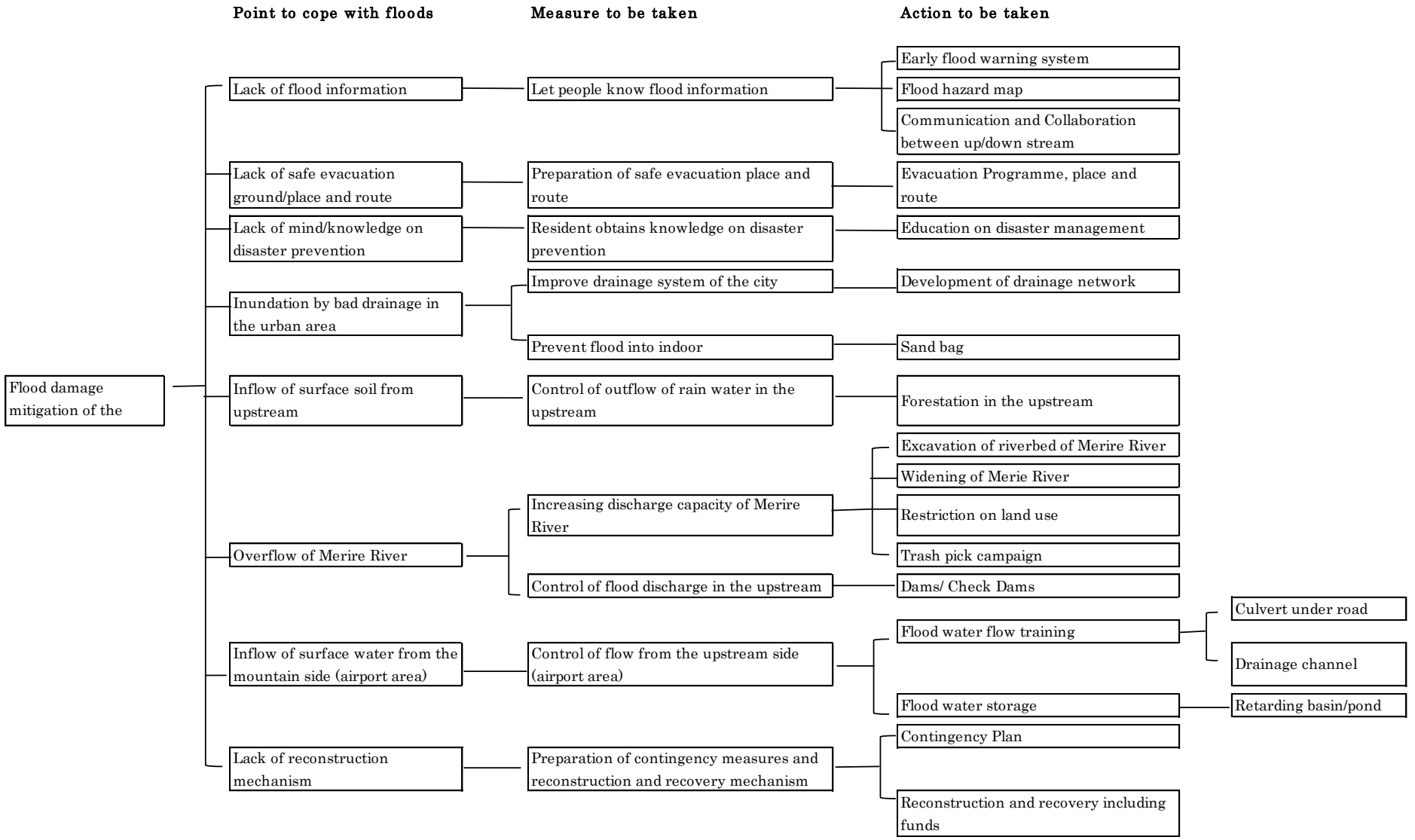


Figure 3.3.2 Analysis on Countermeasures

Considering the above, countermeasure method to be considered is summarized below.

Table 3.3.1 Countermeasure Method to be considered in the urban area of Isiolo

Countermeasure Method to be considered	Remarks	Target Area
Flood Early Warning	Collect and analyze information on flood such as rainfall and water level in the upstream of Isiolo River and transmit it to the urban area of Isiolo.	Isiolo Town
Flood Hazard Map	Flood hazard map is a tool for communicating the impact of a specific flood event in a particular community.	Isiolo Town
Communication and collaboration between up/down stream	Information sharing such as rainfall, water level, focal community members in both the upstream and downstream areas in the river basin allows for damage mitigation, evacuation, response and rescue operation	Isiolo Town
Flood evacuation programme	Establish evacuation programme including evacuation plan, safe evacuation places, route and evacuation drill	Isiolo Town
Education on disaster management	Educate the residents on how to reduce by themselves the present flood damage	Isiolo Town
Drainage network	Development in the whole urban area of Isiolo	Isiolo Town
Sand bag	Guidance on sand bag production and provision of materials	Isiolo Town
Forestation activity	Activity to promote plantation and forestation	Isiolo Town
Excavation of Merire River	Excavation of river bed of Merire River	Isiolo Town
Widening of Merire River	Widening of river width	Isiolo Town
Restriction on land use	Legislation on land use restriction	Isiolo Town
Trash picker campaign	Carrying out of trash picker campaign near Merire River	Isiolo Town
Dams/ Check Dams	Construction of dams and check dams in the upstream	Isiolo Town
Drainage canal	Development of drainage canal in the airport area	Isiolo Town
Culvert	Development of culvert in the airport area	Isiolo Town
Retarding basin/pond	Development of retarding basin/pond in the airport area	Isiolo Town
Contingency Plan	Contingency planning aims to prepare an organization to respond well to an emergency and its potential humanitarian impact.	Isiolo Town
Reconstruction and recovery including funds	A process of long-term reconstruction and economic recovery should begin while post-emergency actions aimed at restoring normality for the displaced populations returning home or settling in new places are being undertaken.	Isiolo Town

3.3.2 Analysis on Flood Damage and Countermeasure in the Outskirt excluding the Urban Area (Mainly in the upstream of urban area of Isiolo)

(1) Damage and its cause

Based on the result of field survey by this time, analysis was carried out, as the same as the urban area of Isiolo, on the damage at the outskirt area excluding the urban area, mainly in the

upstream of the urban area using logic tree (see **Figure 3.3.3**).

Damages in the outskirt area excluding the urban area are mainly caused by, as mentioned in last chapter, displacement of river course in the middle stream, occurrence of debris flow, erosions of river bank and soil. There are a lot of agricultural lands in the outskirt of Isiolo, therefore, the damage to agriculture is remarkable and destruction of agricultural land by debris flow and washout of land by river bank erosion are occurred. In addition, infrastructures such as houses and bridges are also damaged by inundation, and it gives a great impact to the living of the residents.

Flood water went up to the elbow of the man (Place: Middle of the Isiolo River)

River bank erosion along Eastern Marania River (Place: Upstream of Isiolo River)

Bridge in the outside of Isiolo Town (Place: Upstream of Isiolo River)

(2) Countermeasures

To derive the countermeasures, the objective tree analysis was carried out. Issues to be solved are placed on the left side and the measures are specifically presented therefrom(see **Figure 3.3.4**).

Production of agricultural crops is affected by the destruction of agricultural land by debris flow in this area. To prevent the outflow of debris flow, construction of check dam is considered effective. In addition, as a measure for river bank erosion, bank protection works are also effective to prevent washout of land.

Regarding the damage giving an impact to the living of residents by destruction of houses and infrastructures, there is a measure to prevent overflow by improvement of river course. If possible, upgrade or improvement of bridge is another option.

Example of check dam in Nzoia River

Example of river bank protection in Nzoia River

Countermeasures to be considered are summarized below.

Table 3.3.2 Countermeasures to be considered in the Outskirt Area excluding the Rrban Area (mainly in the upstream of the urban area of Isiolo)

Countermeasure Method to be considered	Remarks	Target Area
Check Dam	Construction of sabo dam at Isiolo River	Upstream
Bank protection and spur dike	Construction at Isiolo River	Entire basin
Improvement of river course	Improvement of river course of Isiolo River	Midstream and tributary stream
Improvement of bridge	Improvement of bridge of Isiolo River	Midstream and tributary stream

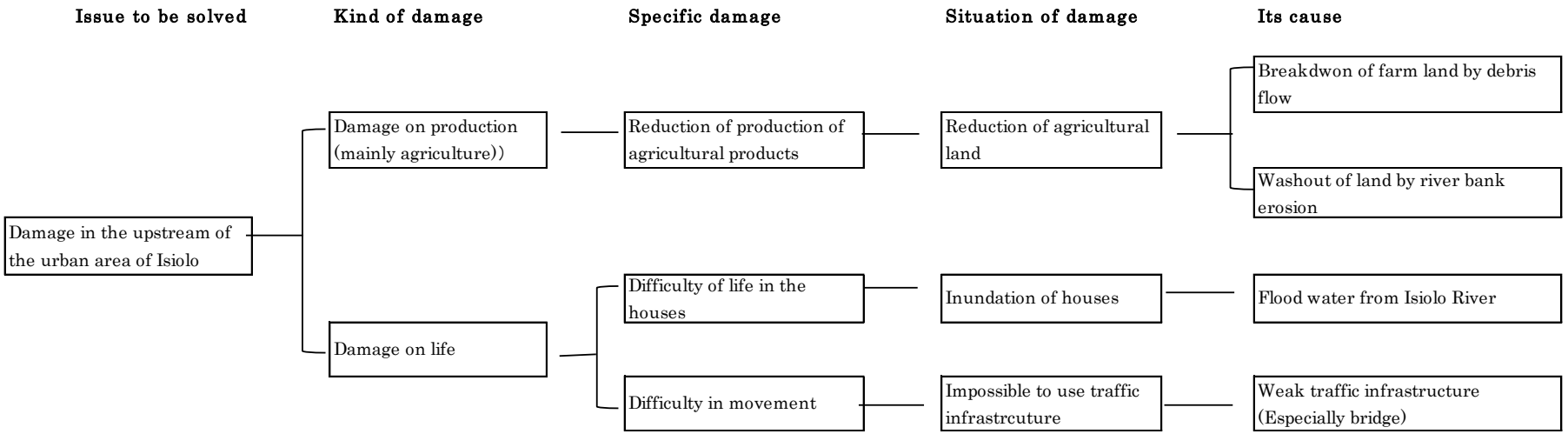


Figure 3.3.3 Analysis on Flood Damage and its Couse

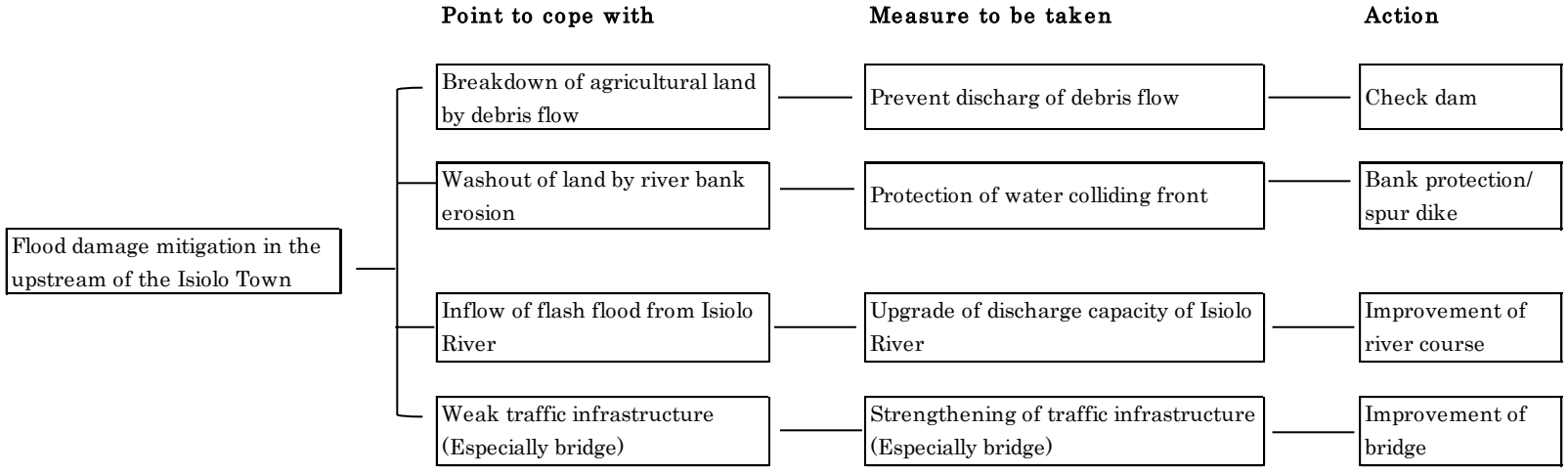


Figure 3.3.4 Analysis on the Countermeasures

3.3.3 Longlist/candidates of Countermeasures to the Flood

Longlis/candidates of countermeasures to the flood are presented as below.

Table 3.3.3 Longlist of the Countermeasures to the Flood in Isiolo River Basin

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

3.4 SELECTION OF FLOOD DAMAGE TO BE MANAGED PREFERENTIALLY

3.4.1 The Result of Workshop for Flood Damage Analysis by Community

In Isiolo river basin, the workshop was held to analyze the problems in Isiolo sub catchment with WRUA members, WRMA-SRO staff and JICA project team members on Nov. 7th, 2012

As a result of analysis, the causes of flood are pointed out as bellow.

Table 3.4.1 Analysis for the Causes of Flood by Interviewing to WRUA Members

Theme	Causes	Principal Influence from Flooding
Floods	Rainfall around the Mt. Kenya slope	Flash flood from immediate rising in "wadi"
	Sediment flow around upstream	
	Lack of capacity for drainage	City area inundation caused by poor drainage
	Developed condition of poundage in the airport	

Concerning flood damages, following analysis was done and was indicated the priority order lead by WRUA members.

Table 3.4.2 Damage Analysis and Priority Order Determined by WRUA Members

Priority order determined by WRUA members	Item	Primary Damage	Secondary Damage
①	Sediment erosion	-Soil outflow from farmland -Loss of agricultural products -Sediment outflow	-Lack of farmlands -Inefficiency of harvest -Lack of lands -Obstruction of culverts
②	Damage of infrastructures	-Transmission wire -Roads -Bridges -Water intakes -Culverts	-Black out -Beyond reach of goods to markets -Unable to go to hospital or school -Insufficient water, conflicts over water, drought -Water spilling
③	Water pollution	-An epidemic of diseases -Growing worse of sanitation	-Epidemic of Cholera, Dysentery and Typhoid fever
④	Damage in daily life or livelihood	-Trash scattering -Overflowing from toilet -Destruction of houses	-Obstruction of culverts, water leaking -Sanitary conditions -Moving enforcement
⑤	Human life	-Lost of Human life by sweeping away -Drowned livestock	

3.4.2 Selection of the Prioritized Flood Damage to be Managed

As a description in previous chapter, the flood damages along Isiolo river is principally classified 4 types such as A) Inundation in urban area of Isiolo town , B) Inundation which is

caused by overflow and dyke break, C) Debris flow in the upstream and D) Bank erosion in the entire basin .

Based on the evaluation of flood damages by communities previously described, each impact from flood damages are evaluated from the viewpoints of social impacts as "Number of affected people and houses" or economic impacts as "Losses of merchandise, agriculture, transportation and sightseeing industry", and are shown in the following table.

Table 3.4.3 Selection of The Flood Damages should be Corresponding Preferentially

Flood type	Social impacts		Economic impact				Priority order
	Number of affected people	Number of affected houses	Merchandise	Agriculture	Transportation	Sight seeing industry	
A. Inundation in urban area of Isiolo town	**High**	**High**	**High**	Low	**High**	Mid	Extremely High
B. Inundation which is caused by overflow and dyke break	Low	Low	Low	Mid	Low	Low	Slightly low
C. Debris flow in the upstream	Low	Low	Low	Mid	Low	Mid	Slightly low
D. Bank erosion in the entire basin	Low	Low	Low	Mid	**High**	Mid	Partially high in transportation

In the 4 types of flood damages, it shows that the damage by "Inundation in urban area of Isiolo town" has strongest impacts socio-economically, and the impact of damage in the point concerned to transportation by dyke brake.

According to these review, in Isiolo river basin, "Inundation in urban area of Isiolo town" is selected as the damage should be corresponding extreme preferentially, and subsequently the dyke break in the point concerned to transportation.

Therefore, selected longlist is shown in the next page.

Table 3.4.4 Selected Long List of the Countermeasures to the Flood in Isiolo River Basin

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

4. EVALUATION OF COUNTERMEASURES TO THE FLOOD

4.1 VIEW POINT OF EVALUATION

Candidate countermeasures that are extracted in last chapter are studied in detail. On the basis of the result of last chapter, 5 criteria; relevance, effectiveness, efficiency, impact and sustainability is considered.

The project team defined 5 criteria as the description on following table, and then evaluated the countermeasures by marking "A", "B" and "C" according to these 5 Items.

Table 4.1.1 Definition of 5 Items for Project Evaluation

1	Relevance	Requirements from the stakeholders, Needs of target area Dimension of economic damage and human suffering.
2	Effectiveness	Degree of damage mitigation (Number of beneficiary, Reduction of submergence period, area and number of affected people)
3	Efficiency	Cost effectiveness (It is evaluated by estimated qualitative dimension and degree of damage mitigation)
4	Impact	Spreading effect within a same basin or to other areas Indirect effects
5	Sustainability	Sustainability of maintenance and project effects (On the assumption of pilot project completion according to the design.)

*The project team defined these 5 items for the purpose of this study according to "DAC's evaluation 5 items"

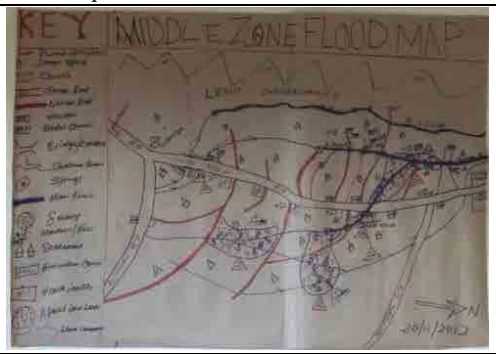
4.2 EVALUATION RESULT FOR EACH COUNTERMEASURE

Table4.2.1 Evaluation on Countermeasure against Inundation in Isiolo Town (1)

No.		**I-T1**		
Target Area		**Isiolo Town (Overflow from Merire River)**		
Countermeasure		**Flood Early Warning System (FEWS)**		
Outline		It is a system to transmit flood information based on hydrological data from upstream to downstream. People can prepare for the flood.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	FEWS is not common yet in Kenya, but lack of information on disaster prevention is recognized. It's beneficial that residents know the information as soon as possible during flood, because flow speed is fast and damage is huge.	B	2
	Effectiveness	Warning information can be transmitted extensively. However, if people don't know how to react against flood, this countermeasure doesn't make sense. Its effect becomes higher when it implement with education on disaster prevention.	B	2
	Efficiency	This can give good effect extensively with low cost.	A	3
	Impact	Application in other area is relatively easy. Supplemental effect such as activation of communication between upstream and downstream community is considered.	A	3
	Sustainability	If it is low cost equipment and simple communication system, maintenance is not difficult.	A	3
Total			13	
Merit		・ Community based FEWS can be introdueced at the low cost.		
Demerit		・ Accuracy is not so high. ・ It needs cooperation between upstream and downstream. ・ Collaboration with County Government is necessary for implementation.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Collaboration between residents living in the upstream and residents living in the downstream and flood affected area is necessary.		
Main Actor		WRUA/County/District		
Supporting Actor: NGO		KRCS		
Supporting Actor: Administrative Authority		KMD, Ministry of State for Special Programmes		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.2 Evaluation on Countermeasure against Inundation in Isiolo Town (2)

No.				
Target Area		**Isiolo Town (General)**		
Countermeasure		**Flood Hazard Map**		
Outline		Flood hazard map, in general, is a tool for the presentation and dissemination of information on flood hazard (intensity, spatial range, inundation depth, duration time, frequency, etc.) and evacuation options (location of evacuation centers, evacuation routes, dangerous spots, etc.) in aid of quick and safe evacuation in the event of flooding.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Requiirement from the residents is very high. Need of the target area is very high. Economic damage is high and human damage is also high.	A	3
	Effectiveness	Number of beneficiay is equal to the people living in the Isiolo Town. It means quite large.	A	3
	Efficiency	Cost of formulation of the flood hazard map is very low. Cost of printing of brochures is not high. Cost of signboards is not high. Effectiveness is high and cost is low, therefore, efficiency is high.	A	3
	Impact	It is easy to spread and promote the same method. Therefore, the secondary impact is high.	A	3
	Sustainability	If flood hazard map formulation will be done with disaster management education, the sustainability of it might be high.	A	3
Total			15	
Merit		・ It is easy for the residents to understand flood hazard and evacuation option.		
Demerit		・ Some particular technic and methods should be learned by the community members.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Participation in the process of formulation of the map		
Main Actor		WRUA		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.3 Evaluation on Countermeasure against Inundation in Isiolo Town (3)

No.				
Target Area		**Isiolo Town (General)**		
Countermeasure		**Communication and collaboration between up/down stream**		
Outline		Information sharing such as rainfall, water level, focal community members in both the upstream and downstream areas in the river basin allows for damage mitigation, evacuation, response and rescue operation.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Requirement from the communities in the upstream and the downstream is high.	A	3
	Effectiveness	Number of beneficiary is large. It is almost equal to the number of Isiolo Town residents. Therefore, effectiveness is high.	A	3
	Efficiency	· Cost of communication and collaboration is low. · Therefore, efficiency is is high.	A	3
	Impact	It is easy to spread and promote the same method. Therefore, the secondary impact is high.	A	3
	Sustainability	If both upstream and downstream residents get merit, collaboration might be sustainable.	B	2
Total			14	
Merit		If there is good communication and collaboration between upstream and downstream, flood management in the entire river basin might be effective in the cost and the quality.		
Demerit		Usually main beneficiary might be the downstream residents only.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Participation to the actural communication and collaboration		
Main Actor		WRUA		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		MWI, WRMA		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.4 Evaluation on Countermeasure against Inundation in Isiolo Town (4)

No.				
Target Area		**Isiolo Town (General)**		
Countermeasure		**Flood Evacuation Programme**		
Outline		Evacuation plan should be developed and evacuation drills and mock experience and evacuation centre management should be prepared and implemented.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	· Requirement from the residents especially from school pupils is high because they might suffer from the flood water on the way to and back from the school. · Not only school pupils, but also women and elder people migh suffer from the flood water.	A	3
	Effectiveness	Number of beneficiary is large. It is almost equal to the number of Isiolo Town residents. Therefore, effectiveness is high.	A	3
	Efficiency	· Cost of preparing evacuation plan is low. · Therefore, efficiency is is high.	A	3
	Impact	It is easy to spread and promote the same method. Therefore, the secondary impact is high.	A	3
	Sustainability	If flood evacuation programme will be done with disaster management education, the sustainability of it might be high.	B	2
Total			14	
Merit		· Structural measures are not perfectly to be able to prevent flood holistically, therefore non-structural measures are also applied as important part of the flood management. · Evacuation is an important part of saving lives and minimizes property damage from the flood. · Evacuation drill helps communities envisage the different stages of flood disaster cycle, preparation, mitigation plan, early warning, and evacuation plan of flood through activities.		
Demerit		Evacuation drill should be done repeatedly.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Participation		
Main Actor		WRUA		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support/ Self-help		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.5 Evaluation on Countermeasure against Inundation in Isiolo Town(5)

No.		I-T2		
Target Area		**Isiolo Town (General)**		
Countermeasure		**Education on Disaster Management**		
Outline		It is educational activity to give information to reduce damage from flood and raise awareness of disaster management.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	WRMA has a high request of enforcement of community. In addition, some damage can prevent if people have knowledge on flood management. So it importance is high.	A	3
	Effectiveness	It is expected certain effect against number of educated people. Their knowledge on disaster prevention can implement wherever and whenever they need. Its effect can be spread.	B	2
	Efficiency	It can give knowledge on disaster prevention to a large number of people at the same time. Cost is low. Effectiveness is high when the knowledge is rooted.	A	3
	Impact	Knowledge can hand down from beneficiary to their family and friends. It can expand widely.	A	3
	Sustainability	Local people such as school teacher and community leader can be a lecturer. So educational activity sustain. In addition, integration into curriculum is important.	A	3
Total			14	
Merit		· Cost is low. · Knowledge learned in childhood will last long until the child will become adult. · Knowledge learned by the school pupils will be disseminated to the parents and other related adults.		
Demerit		· Cooperation and coordination with education sector is necessary. · It is need to train school teachers at the first.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Support of school teachers		
Main Actor		School (Teachers)/ WRUA		
Supporting Actor: NGO		KRCS/ PTA (Pareents Teachers Association)		
Supporting Actor: Administrative Authority		Ministry of Education/ County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance/ Mutual support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.6 Evaluation on Countermeasure against Inundation in Isiolo Town (6)

No.		I-T3		
Target Area		**Isiolo Town (Inland Water)**		
Countermeasure		**Development of Drainage Network in the Whole Town**		
Outline		It is improvement project to develop drainage system in whole Isiolo town.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Commercial area of Isiolo concentrates in urban area of Isiolo Town. There is a lot of economic loss by flood damage. In addition, debris flow makes it more serious. The necessity of development of drainage network is urgent.	A	3
	Effectiveness	If the development proceeds in the whole Town, its effect is extensively high.	A	3
	Efficiency	Cost is extensive, but effectiveness is higher than that. It is a fundamental countermeasure against inundation at Isiolo Town.	A	3
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	Continuous maintenance is inevitable.	C	1
Total			11	
Merit		・ Bad sanitation condition after flood is related to the insufficient drainage network. If the drainage network will be improved,damage to the sanitary condition may be reduced.		
Demerit		・ Preparation before actual construction work such as discussion with stakeholders, survey, planning, design needs long term.		
Environmental Negative Impact		・ If the storm water and seweage water will be drained together, and if there is no sewage water treatment, there is a possibility of concentration of water quality contamination at the discharging point from the drainage network to the river. ・ However, sewage water is not treated at the present. Therefore, development of drainage network doesn't have negative impact to the water quality in total.		
Necessity of EIA		Yes		
Contribution by the residents		None, but the maintenance can be supported by the residents		
Main Actor		County/ District		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		Ministry of Planning		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.7 Evaluation on Countermeasure against Inundation in Isiolo Town (7)

No.		I-T4		
Target Area		Isiolo Town (General)		
Countermeasure		Sandbag		
Outline		It is obstruction to flow water and sand. People put sand in bags and bank up.		
Image				
Evaluation items				
Evaluation by Five Criteria	Relevance	Residents recognize its importance and effect. Some people already implements to sandbag. It is a simple measure against lack of infrastructure that is one of a main factors of inundation in Isiolo Town.	A	3
	Effectiveness	A large amount of sandbag is necessary to obtain a good result from this countermeasure.	B	2
	Efficiency	Cost is small and effectiveness is limited.	B	2
	Impact	It is relatively simplified measure. So application in other area is not difficult.	A	3
	Sustainability	Once people learn how to sandbag they can continue the activity. Maintenance is simple.	A	3
Total			13	
Merit		・ Preparation period is short. ・ Cost is low.		
Demerit		・ It is a temporary countermeasure. ・ It is impossible to prevent flood water from entering houses and buildings completely.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		The local contribution for the WDC has been set at a minimum of 15% of budget for sub-catchments in Alarm Status and 25% for sub-catchments in Alert or Concern Status. The local contribution may be in the form of cash, labour and materials/services.		
Main Actor		Individual/ WRUA		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Self-Help/Mutual support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.8 Evaluation on Countermeasure against Inundation in Isiolo Town (8)

No.		**I-T5**		
Target Area		**Upstream of Isiolo River**		
Countermeasure		**Forestation Activity**		
Outline		It is to protect and recover vegetation in the upstream of the mountain. Its storage effect will rise.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Residents are affected by soil erosion. Also, in "Imenti North District Development Plan" shows forestation at same area. It corresponds with higher plan.	A	3
	Effectiveness	If this countermeasure implement at appropriate scale, sedimentation from upstream would reduce.	B	2
	Efficiency	Large scale forestation is required to obtain certain effectiveness.	B	2
	Impact	Application in other area is not difficult. In addition, it contributes environmental conservation.	B	2
	Sustainability	Once main actor is aware the importance, activity can continue. Maintenance is complicate. It takes time to grow up.	B	2
Total			11	
Merit		· Preparation period is short. · Cost is low. · There are many environmental positive impacts. · It contributes to reduce global warming.		
Demerit		· It takes long term to show the effect. · Climate in Isiolo require some certain kinds of trees for forestation.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		The local contribution for the WDC has been set at a minimum of 15% of budget for sub-catchments in Alarm Status and 25% for sub-catchments in Alert or Concern Status. The local contribution may be in the form of cash, labour and materials/services.		
Main Actor		WRUA		
Supporting Actor: NGO		KRCS		
Supporting Actor: Administrative Authority		Kenya Forest Service		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.9 Evaluation on Countermeasure against Inundation in Isiolo Town (9)

No.		**I-T6**		
Target Area		**Isiolo Town (Overflow from Merire River)**		
Countermeasure		**Excavation of River bed of Merire River**		
Outline		It is a countermeasure to excavate river bed and increase flow capacity		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Inundation by Merire River is reported frequently. Lack of cross section of river channel is a main cause, so demand is high.	A	3
	Effectiveness	Overflow from Merire River reduces drastically. Damage reduction of overflow from Merire River can be expected.	A	3
	Efficiency	Both cost and effectiveness are extensive.	B	2
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	Continuous excavation is necessary. Additional cost is high.	C	1
Total			10	
Merit		・ It is certain that the excavation of riverbed improves flow capacity of Merire River.		
Demerit		・ Preparation before actual construction work such as discussion with stakeholders, survey, planning, design needs long term. ・ Excavation might be implemented continuously, because sediment from upstream might come and deposite in the river channel.		
Environmental Negative Impact		・ There might be no natural environmental negative impact. because the current status of Merire River is like a sewage channel. There is no ecological environment. ・ Involuntary resettlement might be occurred.		
Necessity of EIA		Yes		
Contribution by the residents		None, but the maintenance can be supported by the residents.		
Main Actor		NWCPC (National Water Conservation and Pipeline Cooperation)		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.10 Evaluation on Countermeasure against Inundation in Isiolo Town (10)

No.		**I-T7**		
Target Area		**Isiolo Town (Overflow from Merire River)**		
Countermeasure		**Widening of Merire River**		
Outline		It is a countermeasure to widen river width and increase flow section.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	WRMA has expectation. The importance of high, because lack of cross section of river channel is the cause of overflow from Merire river. However, there are some illegal constructions around river edge. Resettlement can be occurred.	B	2
	Effectiveness	Expected damage reduction is high. Overflow from Merire River can become less drastically.	A	3
	Efficiency	Both cost and effectiveness are extensive.	B	2
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	The cost can be lower than excavation. However, continuous maintenance is necessary.	C	1
Total			9	
Merit		・ It is certain that the widening of river channel improves flow capacity of Merire River.		
Demerit		・ Preparation before actual construction work such as discussion with stakeholders, survey, planning, design needs long term. ・ There are some houses around the river bank. Resettlement can occur. Coordination with stakeholder is difficult.		
Environmental Negative Impact		・ There might be no natural environmental negative impact. because the current status of Merire River is like a sewage channel. There is no ecological environment. ・ Involuntary resettlement might be occurred.		
Necessity of EIA		Yes		
Contribution by the residents		None, but the maintenance can be supported by the residents.		
Main Actor		NWCPC (National Water Conservation and Pipeline Cooperation)		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.11 Evaluation on Countermeasure against Inundation in Isiolo Town (11)

No.		I-T8		
Target Area		Whole Country (Overflow from Merire River)		
Countermeasure		Restriction on land use		
Outline		It is to establish a law to prohibit people from illegal construction and illegal occupation of lands near the river.		
Image		-		
Evaluation items				
Evaluation by Five Criteria	Relevance	Its importance is recognized by stakeholders. Illegal constructions are existed around river edge. So, government can't implement widening of the river. And also, people who live in illegal houses can affect directly by overflow water.	B	2
	Effectiveness	This is not a direct measure against flood. Crackdown and educational activity is required at the same time.	C	1
	Efficiency	Legislation is almost no cost to implement. However, direct effectiveness for disaster reduction is small.	B	2
	Impact	Legislation itself is nationwide.	A	1
	Sustainability	Once the law is established, validity can continue. However, certain regulation and educational activity should be implemented the same time.	B	2
Total			8	
Merit		・ Illegal occupation of riparian land can be reduced. ・ Cost is low.		
Demerit		・ Involuntary resettlement can occur. ・ Regulation and educational activity should be implemented. ・ It is government level and takes long time to establish a law.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		None		
Main Actor		WRMA / Ministry of Lands		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		Ministry of Lands		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.12 Evaluation on Countermeasure against Inundation in Isiolo Town (12)

No.		**I-T9**		
Target Area		**Surrounding of Merire River (Overflow from Merire River)**		
Countermeasure		**Trash picker Campaign**		
Outline		It is an activity to remove garbage that can be obstacle to water flow.		
Image		 (Source: City of Kurume)		
Evaluation items				
Evaluation by Five Criteria	**Relevance**	A lot of residents complain about illegal dumping. This problem makes cross section smaller. In addition, illegal dumping is a cause of blockage of culvert. Its necessity is high.	A	3
	Effectiveness	Garbage removal from river bed and culvert can make its function back. Overflow from Merire River and from clogged culvert can reduce.	B	2
	Efficiency	Effectiveness is bigger than cost.	A	3
	Impact	Introduction is simple, so activity can spread in other area. And also, it contributes environmental conservation and improvement of sanitation.	A	3
	Sustainability	If people recognize the effectiveness, they became to have a keen awareness of disaster prevention. Continuity is high.	A	3
Total			14	
Merit		・ Overflow from Merire River reduces. ・ Cost is low. ・ It is community based activity. ・ The method is simple. ・ Preparation period is short.		
Demerit		・ Disposal of trash should be considered.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Participation		
Main Actor		WRUA		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.13 Evaluation on Countermeasure against Inundation in Isiolo Town (13)

No.				
Target Area		**Isiolo Town (General)**		
Countermeasure		**Dam/Check Dam**		
Outline		Check dams are relatively small, temporary structures constructed across a swale or channel.		
Image		 (Source: WRMA, NALEPO Project in Athi CA)		
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Both upstream and downstream have damage by sediment deposition. Geology at upstream is fragile and grate is sudden, Its necessity is relatively high. However, one small scale check dam is not sufficient to reduce damage drastically. It should be large scale or small scale dam in a lot of sites.	B	2
	Effectiveness	Damage of debris flow around the check dam can reduce, but the effect of one check dam is limited.	B	2
	Efficiency	Both cost and effectiveness are medium scale.	B	2
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	Continuous maintenance is inevitable. In case WRUA implement with WSTF fund, maintenance cost is additional.	C	1
Total			8	
Merit		・ They are used to slow the velocity of concentrated water flows, a practice that helps reduce erosion. ・ As stormwater runoff flows through the structure, the check dam catches sediment from the channel itself or from the contributing drainage area.		
Demerit		・ Preparation before actual construction work such as discussion with stakeholders, survey, planning, design needs long term.		
Environmental Negative Impact		・ There might be an impact to the downstream river channel caused by stopping the sediment movement and an impact to living things caused by blocking of water flow.		
Necessity of EIA		Yes		
Contribution by the residents		The local contribution for the WDC has been set at a minimum of 15% of budget for sub-catchments in Alarm Status and 25% for sub-catchments in Alert or Concern Status. The local contribution may be in the form of cash, labour and materials/services.		
Main Actor		WRUA/ NWCPC (If the scale is large, main actor might be NWCPC.)		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual support/ Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.14 Evaluation on Countermeasure against Inundation in Isiolo Town (14)

No.		I-T10		
Target Area		**Mountainside/Airport area (Inland Water)**		
Countermeasure		**Drainage channel**		
Outline		It is a structure to gather rain water and flow toward adequate and secure direction.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Flood damage in Isiolo Town is extensive. Local government has a strong request. This is a countermeasure for inland water from airport area that is one of 3 biggest factors of flood damage in Isiolo Town. Necessity is high.	A	3
	Effectiveness	When the problem of rain water flow from airport area is resolved, inundation in Isiolo Town reduces.	A	3
	Efficiency	Cost is medium scale, but drastic improvement is expected.	A	3
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	Maintenance cost is not so expensive. Maintenance system should be established.	B	2
Total			12	
Merit		・ Flow volume from airport area is drastically reduced.		
Demerit		・ Cost is high. ・ Planning, design and construction take long time.		
Environmental Negative Impact		・ Excavation of land is necessary. ・ Heavy machinery is required for construction.		
Necessity of EIA		Yes		
Contribution by the residents		The local contribution for the WDC has been set at a minimum of 15% of budget for sub-catchments in Alarm Status and 25% for sub-catchments in Alert or Concern Status. The local contribution may be in the form of cash, labour and materials/services.		
Main Actor		WRUA/ County/ District		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		KeRRA		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutural Support/ Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.15 Evaluation on Countermeasure against Inundation in Isiolo Town (15)

No.		I-T11		
Target Area		**Mountainside/Airport area (Inland Water)**		
Countermeasure		**Culvert under the road**		
Outline		It is a structure to flow rain water safely.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Flood damage in Isiolo Town is extensive. Local government has a strong request. This is a countermeasure for inland water from airport area that is one of 3 biggest factors of flood damage in Isiolo Town. Necessity is high.	A	3
	Effectiveness	When the problem of rain water flow from airport area is resolved, inundation in Isiolo Town reduces.	A	3
	Efficiency	Both cost and effectiveness are medium scale.	B	2
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	Maintenance cost is not so expensive. Maintenance system should be established.	B	2
Total			11	
Merit		・ Flow volume from airport area is drastically reduced.		
Demerit		・ Cost is high. ・ Planning, design and construction take long time. ・ Coordination with stakeholders could be difficult.		
Environmental Negative Impact		・ The candidate site is boundary between Isiolo town and Meru town. Coordination with them can take long time. ・ Excavation of land is necessary. ・ Heavy machinery is required for construction.		
Necessity of EIA		Yes (It depends on the scale of the construction work.)		
Contribution by the residents		None. But, the maintenance can be supported by the residents.		
Main Actor		KeRRA (Kenya Rural Road Authority)		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.16 Evaluation on Countermeasure against Inundation in Isiolo Town (16)

No.		**I-T12**		
Target Area		**Mountainside/Airport area (Inland Water)**		
Countermeasure		**Retarding Basin/Pond**		
Outline		It is to impound water rain temporary and reduce peak discharge.		
Image		 (Source: Mie Prefecture)		
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Flood damage in Isiolo Town is extensive. Local government has a strong request. This is a countermeasure for inland water from airport area that is one of 3 biggest factors of flood damage in Isiolo Town. Necessity is high.	A	3
	Effectiveness	When the problem of rain water flow from airport area is resolved, inundation in Isiolo Town reduces.	A	3
	Efficiency	Both cost and effectiveness are high.	B	2
	Impact	Spreading effect is small. (The construction requires respective design and plan according to flood characteristics, climate and geological formation of the site.)	C	1
	Sustainability	Maintenance cost is not so expensive. Maintenance system should be established.	B	2
Total			11	
Merit		· Flow volume from airport area can be reduced.		
Demerit		· Coordination with Kenya Airport Authority can take long time. · Cost is high. · Planning, design and construction take long time. · Large-scale ground is necessary for retarding basin/pond. The most effective site is in the airport.		
Environmental Negative Impact		· Excavation of land is necessary. · Heavy machinery is required for construction.		
Necessity of EIA		Yes		
Contribution by the residents		None		
Main Actor		Kenya Airport Authority		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		County/ District		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.17 Evaluation on Countermeasure against Inundation in Isiolo Town (17)

No.				
Target Area		**Isiolo Town (General)**		
Countermeasure		**Contingency Plan**		
Outline		Contingency planning aims to prepare an organization to respond well to an emergency and its potential humanitarian impact. Developing a contingency plan involves making decisions in advance about the management of human and financial resources, coordination and communications procedures, and being aware of a range of technical and logistical responses.(Source: Contingency Planning Guide 2012, International Federation of Red Cross and Red Crescent Societies, 2012)		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	Currently, preparadness to mitigate the flood disaster damage is is not sufficient. Therefore, post flood disaster management including contingency plan is required by the County Government and residents.	A	3
	Effectiveness	Effective contingency planning should lead to timely and effective disaster-relief operations. Therefore, degree of damage mitigation shall be high.	A	3
	Efficiency	Cost of contingency planning is low. Therefore, efficiency is high.	A	3
	Impact	It is easy to spread and promote the same method. Therefore, the secondary impact is high.	A	3
	Sustainability	County Government has the responsibilty of formulation of contingency plan. Therefore, sustainability is high.	A	3
Total			15	
Merit		・ Contingency planning is a management tool, involving all sectors, which can help ensure timely and effective provision of humanitarian aid to those most in need when a disaster occurs.		
Demerit		・ It needs certain period to develop the contingency plan.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		Provision of information to the County Government		
Responsible Institution/Agency		County Government		
Main Actor		County/ District		
Supporting Actor: NGO		KRCS/ World Vision		
Supporting Actor: Administrative Authority		Ministry of State for Special Programmes		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Publich assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.18 Evaluation on Countermeasure against Inundation in Isiolo Town (18)

No.				
Target Area		**Isiolo Town (General)**		
Countermeasure		**Reconstruction and Recovery including Funds**		
Outline		A process of long-term reconstruction and economic recovery should begin while post-emergency actions aimed at restoring normality for the displaced populations returning home or settling in new places are being undertaken.		
Image				
Evaluation items				
Evaluation by Five Criteria	**Relevance**	People affected by floods require the assistance of reconstruction and recovery process.	A	3
	Effectiveness	Number of beneficiary depends on the amount of the fund.	B	2
	Efficiency	If fund will be large, the cost also becomes large. Therefore, efficiency is medium.	B	2
	Impact	Spreading the fund depends on the amount of the budget of County Government or National Government. Therefore, impact is medium.	B	2
	Sustainability	Sustainability depends on the continuous budget of County Government or National Government. Therefore, sustainability is medium.	B	2
Total			11	
Merit		Recovery and reconstruction from flood disaster damage might be enhanced.		
Demerit		There is a need of county governmental or national governmental budget for the fund.		
Environmental Negative Impact		None		
Necessity of EIA		No		
Contribution by the residents		None.		
Main Actor		County/ District		
Supporting Actor: NGO		KRCS		
Supporting Actor: Administrative Authority		Ministry of State for Special Programmes		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Public Assistance		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

Table4.2.19 Evaluation on Countermeasure against River Bank Erosion at Entire River Basin

No.		I-U2		
Target Area		Upstream of Isiolo River		
Countermeasure		Bank Protection		
Outline		It is a structure to prevent riverbank erosion.		
Image				
Evaluation items				
Evaluation by Five Criteria	Relevance	Population and number of houses are few at upstream. However, damage to farmland and plantation is extensive. There is a main highway near by upstream of Isiolo River. Prevention for road erosion is necessary. Stakeholder has strong request.	A	3
	Effectiveness	It also functions as protection of highway. In addition, it contributes to reduce flood damage to physical distribution and human movement. However, the effect of one construction is limited.	B	2
	Efficiency	Both cost and effectiveness are medium scale.	B	2
	Impact	If it is simple design, application in other area is not difficult.	B	2
	Sustainability	Continuous maintenance is inevitable. However, if it is simple design, maintenance is not difficult.	B	2
Total			11	
Merit		・ Bank erosion of the construction site will be prevented.		
Demerit		・ Influence for downstream and other side of bank should be considered.		
Environmental Negative Impact		・ Heavy machinery is required for construction. It can affect environment.		
Necessity of EIA		If the size of construction work is large, EIA is need. But, if the size is small, EIA is not necessary.		
Contribution by the residents		The local contribution for the WDC has been set at a minimum of 15% of budget for sub-catchments in Alarm Status and 25% for sub-catchments in Alert or Concern Status. The local contribution may be in the form of cash, labour and materials/services.		
Main Actor		WRUA		
Supporting Actor: NGO				
Supporting Actor: Administrative Authority		WRMA / County/ District/ Ministry of Roads and KeNHA		
Supporting Actor: Technical Authority		MWI, WRMA		
Public assistance/ Mutual support /Self-help		Mutual Support		

A (3 point) : Excellent / B (2 point) : Good / C (1 point) : Poor

4.2.1 Result of the Evaluation on 5 Criteria

Following figure shows the result of evaluation on 5 criteria of all candidate countermeasures. It is preferable to implement from high scored to low scored measures. However, schedule some of them require long term coordination and negotiation. JICA project team studies

Table 4.2.20 Evaluation List of 5 Criteria

Structural/ Non-structural	Countermeasure and Target Area	Score	Remarks
Structural Measure	Drainage Canal / Isiolo Town (Airport Area)	12	Study/Survey/ Discussions
	Development of Drainage Network / Isiolo Town	11	Survey and discussions
	Culvert / Isiolo Town (Airport Area)	11	Study/Survey/ Discussions
	Flood Basin / Isiolo Town(Airport Area)	11	Study/Survey/ Discussions
	Bank Protection / Entire Basin	11	
	Excavation of River bed /Isiolo Town (Merire River)	10	Study/Survey/ Discussions
	Widening of River / Isiolo Town (Merire River)	9	Study/Survey/ Discussions
	Dam/ Check Dam in the upstream /Isiolo Town	8	Study/Survey/ Discussions
Non-structural Measure	Flood Hazard Map /Isiolo Town	15	
	Contingency Plan	15	Study/Discussion
	Communication and Collaboration between up/down stream /Isiolo Town	14	Already started in the committee
	Flood Evacuation Programme /Isiolo Town	14	Study/Discussion
	Education on Disaster Management / Isiolo Town	14	
	Trash picker Campaign /Isiolo Town	14	
	Early Warning System / Isiolo Town	13	Study/Discussion
	Sandbag / Isiolo Town	13	
	Reconstruction and Recovery including Funds	11	
	Forestation Activity	10	
	Restriction on land use	8	

5. PROJECT IMPLEMENTATION PLAN OF FLOOD COUNTERMEAURES

5.1 FLOOD COUNTERMEASRES IN THE FLOOD MANAGEMENT PLAN

The Flood Management Plan defines the most prioritized flood event as inundation in urban area of Isiolo Town and the second as bank erosion at places where affects traffic facilities.

Among those countermeasures, WRUA scale project should be incorporated in the SCMP.

(1) Structural Countermeasures

Structural countermeasures should be implemented as following order.

- Study, survey and discussion on drainage network in urban area of Isiolo Town
- Study, survey and discussion on countermeasures against water inflow from airport area (drainage channel, culvert, flood basin and etc.)
- Bank protection at the transportation and farmland affetected area
- Study, survey and discussion on improvement of Merire River (excavation of river bed and widening of river)
- Study, survey and discussion on dam/check dam in the upstream of Merire River

(2) Non-structural Countermeasures

Non-structural countermeasures should be implemented as following order.

- Flood hazard map
- Contingency Plan
- Communication and collaboration between up/down stream
- Education on disaster management
- Trash picker Campaign at Merire River
- Early warning system
- Sandbag
- Reconstruction and Recovery including Funds
- Forestation activity
- Restriction on land use

5.2 DRAFT IMPLEMENTETION SCHEDULE OF FLOOD COUNTERMESUREAS

JICA project team proposes draft implementation schedule of flood countermeasures as the following page.

In this schedule, actors are defined as follows:

Main actor: A group or organization to implement the measures in practice. However, there may be multiple choices depending on the size of the measures.

Supporting Actor

NGO: NGO to support the main actor to implement the measures

Administrative Authority: A government agency to support or to provide an approval for implementation of the measures

Technical Authority: A government agency to support for implementation of the measures technically

Draft Implementation Schedule of Flood Countermeasures in Isiolo River Basin

	Countermeasures	Required Preparation	Main Actor	Support Actor			WRMA's role	WRUA's role	1st year	2nd year	3rd year	4th year	5th year	6th year or later
				NGO	Administrative Authority	Techinical Authority								
Structural Measure	Development of Drainage Canal at Airport Area	Study/Survey/Discussion	County/District/WRUA		KeRRA	MWI, WRMA	coordination with related ministries	planning/ construction/ maintenance	Study and Discussion					
	Development of Drainage Network in Whole Urban Area of Isiolo Town	Study/Survey/Discussion	County/District		Ministry of Planning	MWI, WRMA	coordination with related ministries	maintenance			Study and Discussion			
	Culvert under road at airport area	Study/Survey/Discussion	KeRRA		County/District	MWI, WRMA	coordination with related ministries	maintenance	Study and Discussion					
	Retarding Basin/Pond at airport area	Study/Survey/Discussion	Airport Authority		County/District	MWI, WRMA	coordination with related ministries		Study and Discussion					
	Bank Protection (affected area to the transportation and farmlands)		WRUA		WRMA/ County/ District, Ministry of Road/ KeNHA	MWI, WRMA	approval of construction, coordination with related ministries, techinical advice	planning/construction/maintenance						
	Improvement of Merire River (widening, etc)	Study/Survey/Discussion	NWCPC		County/District	MWI, WRMA	coordination with related ministries	maintenance			Survey and Discussion			
	Dam/Check Dam in the upstream of Merire River	Study/Survey/Discussion	WRUA/NWCPC		County/District	MWI, WRMA	coordination with related ministries	planning/ construction/ maintenance			Survey and Discussion			
Non-structural Measure	Flood Hazard Map		WRUA		County/District	MWI, WRMA	coordination with related ministries/techinical advice	cooperation/participation/enlightenment activity						
	Contingency Plan	Study and Discussion	County/ District	KRCS/World Vision	Min. of Special Programmes	MWI, WRMA	coordination with related ministries/techinical advice	cooperation/participation/enlightenment activity	Study and Discussion					
	Communication and collaboration between up/down stream	Already started in the committee	WRUA		MWI, WRMA	MWI, WRMA	coordination with related ministries/techinical advice	cooperation/participation/enlightenment activity						
	Flood Evacuation Programme	Study and Discussion	WRUA		County/District	MWI, WRMA	coordination with related ministries/techinical advice	cooperation/participation/enlightenment activity	Study and Discussion					
	Education on Disaster Prevention		Schools, WRUA	KRCS/ PTA	Ministry of Education/ County/District	MWI, WRMA	coordination with related ministries/techinical advice	cooperation/participation/enlightenment activity						
	Trash picker Campaign		WRUA		County/District	MWI, WRMA	coordination with related ministries	cooperation/participation/enlightenment activity						
	Flood Early Warning System	Study and Discussion	WRUA/County/District	KRCS	KMD/Ministry of Special Programs	MWI, WRMA	techinical advice	planning/formulation/operation/maintenance	Study					
	Sandbag		WRUA		County/District	MWI, WRMA	coordination with related ministries	cooperation/participation/enlightenment activity						
	Reconstruction and Recovery including Funds		County/ District	KRCS	Min. of Special Programmes	MWI, WRMA	coordination with related ministries	cooperation/participation/enlightenment activity						
	Forestation Activity		WRUA	KRCS	Kenya Forest Service	MWI, WRMA	coordination with related ministries	cooperation/participation/enlightenment activity						
	Restriction on land use		WRMA MOL		MOL	MWI, WRMA	coordination with related ministries	cooperation/participation/enlightenment activity						

6. RECOMMENDATION

- Observation data of rainfall and flow discharge that is utilized for detail design of works is lacking. WRMA should observe rainfall and flow discharge data steadily. In addition, they should improve the accuracy and accelerate accumulation.

- Countermeasures against inundation of whole urban area of Isiolo Town (inland water) and flood from Merire River (river water) should be considered from long term perspective.