

# MAINSTREAMING CLIMATE CHANGE INTO INTEGRATED WATER MANAGEMENT PLANNING FOR UGANDA

Proposed revisions of the  
Mpanga Catchment  
Management Plan (D1)



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# Abbreviations and Acronyms

<b>CAS</b>	Country Assistance Strategy
<b>CBO</b>	Community-based organization
<b>CMO</b>	Catchment Management Organization
<b>CMP</b>	Catchment Management Plan
<b>DCDO</b>	District Community Development Officer
<b>DEA</b>	Directorate of Environmental Affairs
<b>DLG</b>	District Local Government
<b>DWD</b>	Directorate of Water Development
<b>DWO</b>	District Water Officer
<b>DWRM</b>	Directorate of Water Resources Management
<b>EIA</b>	Environmental Impact Assessment
<b>EMP</b>	Environmental Management Plan
<b>ESIA</b>	Environmental and Social Impact Assessment
<b>FAO</b>	United Nations Food and Agriculture Organization
<b>GCM</b>	Global Circulation Model
<b>GIS</b>	Geographical Information System
<b>GoU</b>	Government of Uganda
<b>GPCC</b>	Global Precipitation Climatology Centre
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IPP</b>	Independent Power Producers
<b>IPCCC</b>	International Panel on Climate Change
<b>IUCN</b>	International Union for the Conservation of Nature
<b>IWRM</b>	Integrated Water Resources Management
<b>MAAIF</b>	Ministry of Agriculture Animal Industry and Fisheries
<b>MEMD</b>	Ministry of Energy and Mineral Development
<b>MWE</b>	Ministry of Water and Environment
<b>NAADS</b>	National Agricultural Advisory Services
<b>NDP</b>	National Development Plan
<b>NELSAP</b>	Nile Equatorial Lakes Subsidiary Action Program
<b>NGO</b>	Non-Government Organization
<b>NWRA</b>	National Water Resources Assessment
<b>NWSC</b>	National Water and Sewerage Corporation
<b>O&amp;M</b>	Operation and Maintenance
<b>SSEA</b>	Strategic Social and Environmental Assessment
<b>SWC</b>	Soil and Water Conservation
<b>UWASNET</b>	Uganda Water and Sanitation Network
<b>WATSAN</b>	Water and Sanitation
<b>WMZ</b>	Water Management Zone
<b>WSDF</b>	Water Sanitation and Development Facility
<b>WUA</b>	Water Users Association

# 1. Introduction

## 1.1 CONTEXT

In 2008, the Directorate of Water Resources Management (DWRM) and the Ministry of Water and Environment (MWE) adopted a strategy to deconcentrate IWRM at the regional and river basin or catchment level with central oversight and guidance. One of the main reasons behind this strategy is that it **brings IWRM functions closer to stakeholders** (farmers, townspeople, local government officials, etc.). Doing this helps to concentrate the focus onto real problems, to improve the analytical underpinnings of programs and projects and it also provides the opportunity for stakeholders to participate in the formulation of plans and the development of new water infrastructure.

To implement this policy, DWRM created four regional units called Water Management Zones (WMZs). WMZ offices were established in each zone in July 2011, Mbale for Kyoga WMZ, Mbarara for Victoria WMZ, Lira for Upper Nile WMZ and Fort Portal for Albert WMZ. The DWRM staff in the WMZ will carry out some decentralized functions including monitoring and regional assessments, facilitating the formation of Catchment Management Organization (CMO) and the formulation of Catchment Management Plans (CMP).

Based on experience gained in piloting the various WMZ functions, including drawing up catchment management plans, especially for the Rwizi catchment, national guidelines for catchment management planning were established and became the official reference document in 2013. The Water Management Zones are now working on the development of CMPs for several areas. The guidelines describe a step-by-step approach for the development of catchment management plans and the implementation of CMOs. However, they do not include specific recommendations with respect to the mainstreaming of climate change, which is indeed one of the main recurrent issues raised by the stakeholders met when preparing such plans.

As part of the “Africa4Climate” capacity building project, funded by the French Development Agency (AFD) and the French Global Environment Facility (FFEM), Expertise France supported DWRM/MWE in developing a detailed water resources analysis for the Mpanga catchment including on the impacts of climate change and how the resources should be rationally developed to meet the various needs. This study (BRLi, 2015) provides information about the water resources that would be available under different climate change scenarios (7 different scenarios were tested). It shed light on the evolution of water resources and water resources availability, differentiating aspects on which a relatively good level of confidence exists (for which all the scenarios tested provided consistent results), and parameters for which a high level of uncertainty remains. This work also allowed identification of the areas of the sub-catchment most affected by climate change and where mitigation actions should be considered as a priority. Although the issue was not linked only to climate change, this study also stressed the importance of data collection and monitoring, which is needed not only to study climate change but also for water resources assessment and integrated water resources management planning in general.

Having a draft catchment management plan developed, as well as a detailed assessment of the impacts of climate change on its water resources makes the Mpanga catchment an interesting case study to analyse how mainstreaming of climate change can be integrated in the catchment planning process.

## 1.2 STUDY OBJECTIVES AND APPROACH ADOPTED

The objective of this part of the assignment is to provide technical support to update the Mpanga catchment management plan and the national guidelines for catchment management planning so that climate change issues are adequately mainstreamed into this planning process.

Figure 1.1 shows how the various steps of the study and deliverables are linked, sequence of activities being undertaken and the position of this Deliverable 1 (highlighted in green).

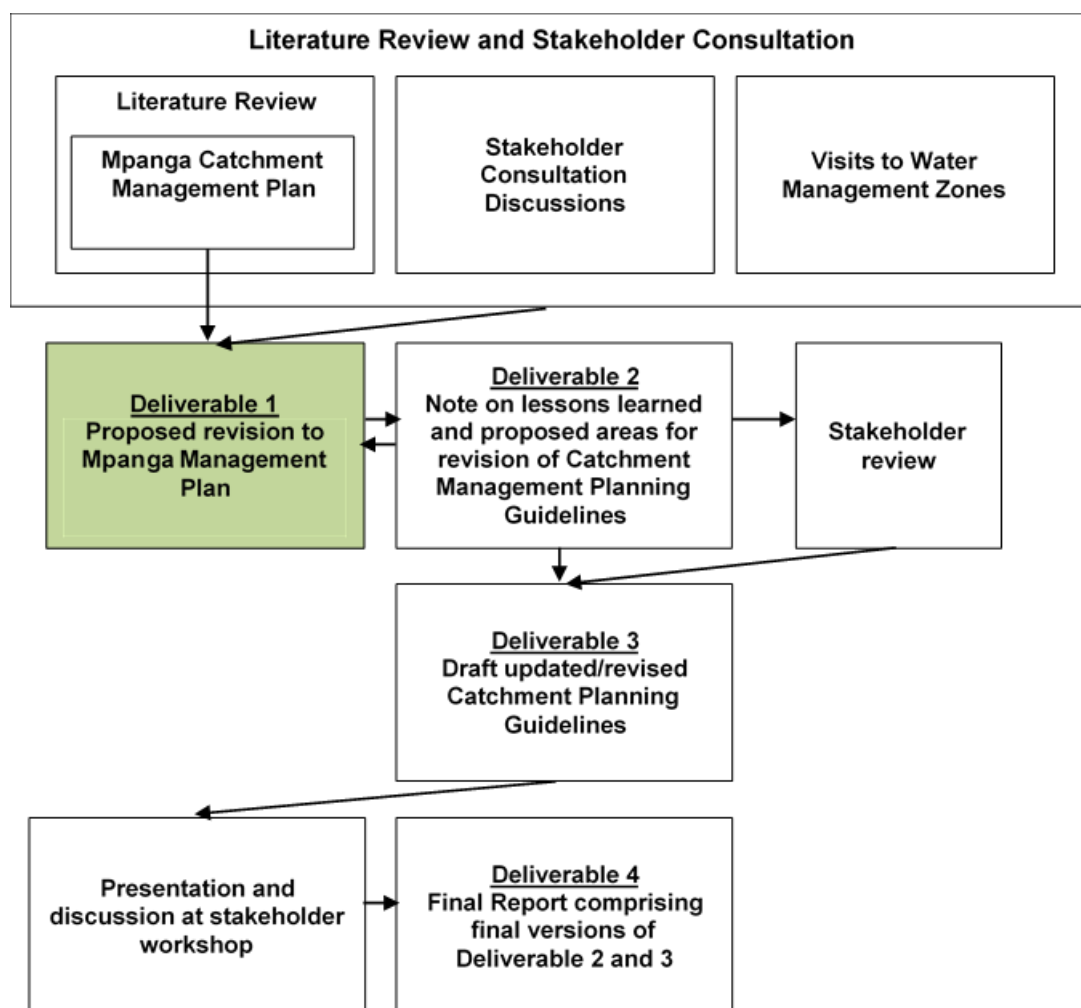


Figure 1-1: Position of Deliverable 1 within the Study

The tasks shown above can be described as follows:

- Task 1 is a review of key directly relevant documentation available and proposals for revision of the Mpanga catchment management plan. During this step, the focus is on reviewing the Mpanga catchment management plan and analysing how “mainstreaming climate change” has been taken into account. This first step will lead to the submission of this Deliverable 1 focused on proposals on how the Mpanga CMP should be revised.
- Task 2 consists in reviewing the Uganda Catchment Management Planning Guidelines to assess its gaps in terms of climate mainstreaming.

*Under task 2, a visit to the 4 water management zones in Uganda, as well as DWRM headquarters in Entebbe was undertaken. These visits were an opportunity to discuss with key decision makers about the ways climate mainstreaming has been taken into account within the recent elaboration of some CMP and lessons learnt. It was also an opportunity to discuss the gaps in the Uganda Catchment Management Planning Guidelines.*

*This task led to Deliverable 2 (this deliverable) showing lessons learnt on climate mainstreaming and proposed areas for revisions of the 2013 catchment area planning guidelines*

- *Task 3: Based on the findings presented in Deliverable 2, the Uganda Catchment Management Planning Guidelines has been revised. The proposed draft revisions are presented in Deliverable 3: a draft revised version of the guidelines, taking into account climate mainstreaming. These proposed revised guidelines were the subject of a presentation made to key stakeholders at a workshop.*
- *Task 4: Based on the comments expressed by the participants during the workshop, Deliverables 2 and 3 are revised and presented in the form of a final report.*

## 1.3 THIS REPORT

### 1.3.1 Objective of this Deliverable

The aim of this deliverable is to make clear proposals on how the existing (revised) Mpanga Catchment Management Plan (DWRM, 2015) should be revised in order to ensure that climate change considerations are adequately taken into consideration.

### 1.3.2 Contents of this report

This report is structured in three parts:

- *Section 1 of this report presents the study, its context and objectives;*
- *Section 2 consists of a review of existing key documentation. Identified key documents and reports for this study are listed and described;*
- *In Section 3, the focus is made on reviewing the Mpanga catchment management plan with respect to the mainstreaming of climate change. Firstly, a review of the Mpanga catchment management plan and a comparison to the existing guidelines for catchment management planning is made. Proposals for revisions of the catchment management plan are then presented. While the focus is on the revisions required to ensure that climate change considerations are adequately mainstreamed, proposals for other non-climate change related revisions are also made. This is in line with a request from the DWRM during the project start-up period.*

### 1.3.3 Methodology adopted

The methodology principally relies on data collection, desk work and literature review, together with interviews with the team that carried out the revised catchment management plan. With respect to the collection of data it is worth mentioning that BRLi prepared the “Study on current and future potential water resources, under different climate scenarios, for the Mpanga river basin”.



## 2. Review of the key documentation available

### 2.1 INTRODUCTION

Many documents have been reviewed, many in detail. The full list of documents relevant to the task are listed in Section 5. Many of these are discussed in more detail in Deliverable 2 which is not specific to the Mpanga catchment.

### 2.2 KEY DOCUMENTS FOR THE STUDY

In this section several important documents are described and their key contents highlighted. The list does not include the Mpanga Catchment Plan itself since this report is the main focus of Chapter 3 and indeed this report.

#### 2.2.1 Key contextual documents

##### 2.2.1.1 *Catchment Management Planning Guidelines (DWRM, 2014)*

The Ministry of Water and Environment, through the Directorate of Water Resources Management developed the Uganda Catchment Management Planning Guidelines (April 2014). This document aims at providing a common framework for catchment planning in order to guide the WMZ team and other stakeholders through the process. As indicated by the team which carried out the revision of the Mpanga Catchment Management Plan in 2015 (discussions in August 2016, Fort Portal), these guidelines provided the basis for the design of the revised Plan.

The guidelines detail a number of Steps that are to be followed in drawing up catchment management plans:

- Step 1: Describe the catchment and build the knowledge base
- Step 2 comprise three parallel parts aimed collectively at leading to Step 3:
  - 2.1: Water resources planning analysis
  - 2.2: Catchment Stakeholder participation framework
  - 2.3: Strategic social and environmental assessment (SSEA)
- Step 3: Framework for catchment water planning
- Step 4: i) Options and Scenario Analysis. ii) Agreement with the catchment management organisation on catchment plan
- Step 5: i) Implementation Plan; ii) Preparation of technical briefs for investment projects; iii) Preparation of management actions; iv) Enhance monitoring system to support management

A detailed overview of the Catchment Management Planning Guidelines is provided in Deliverable 2.



### 2.2.1.2 Nile Basin Initiative's Climate Change Strategy

The NBI's Climate Change Strategy (Nile Basin Initiative, 2013). The strategy recognises that the Nile Basin is highly vulnerable to the impacts of climate change owing to a multiplicity of factors, many of which are relevant to the Mpanga Basin. They include:

- *Basin communities have limited ability to cope with the negative impacts of climate variability.*
- *The socio-economic consequences of climate change in the basin will be severe and will exacerbate the impacts of existing challenges. These include, among others, negative impacts on agriculture, fisheries and livestock, with strong implications for food security and future economic growth*

As is the case for the Mpanga catchment, the NBI strategy highlights the fact that “a lack of long-term hydro-meteorological data in the Nile Basin, coupled with the region's strong degree of natural variability in precipitation and sensitivity to climate effects makes the precise projection of climate change impacts difficult”. Certain climate trends in the Nile Basin are seen as likely and some of them are particularly relevant for the Mpanga Catchment Plan including:

- *Higher evapotranspiration rates and rising crop water requirements leading to an increase in demand for irrigation water.*
- *Hotter and longer dry periods which will increase drought events, especially in traditionally dry regions.*
- *Higher frequency and intensity of severe rainstorms that will lead to increased flood risk and serious storm damage.*
- *Expansion of the range of vector-borne diseases such as malaria to higher altitudes due to warmer temperatures.*

The Strategy then highlights the fact that through direct effects on temperature and water availability, climate change will have a number of additional cascading effects on agriculture, fisheries, energy, health disasters, and freshwater ecosystems. A number of tangible socio-economic effects are listed including impacts on hydropower, wetlands, negative impacts on agriculture and livestock and increased rates of urbanisation triggered by the above factors are placing increased pressure on already stressed urban and peri-urban ecosystem services, health systems and food security.

### 2.2.1.3 Guidelines for the Integration of Climate Change in Sector Plans and Budgets

The Guidelines for the Integration of Climate Change in Sector Plans and Budgets is a report compiled by the Climate Change Unit (now Climate Change Department). Although written for all sectors, it is a highly relevant document for the water sector and the Mpanga catchment. It provides an outline of basic steps to be taken into consideration when integrating climate change into sector plans and budgets. These include:

- *Conduct climate change impact and vulnerability assessment*
- *Identify and analyse adaptation and mitigation options*
- *Identify and cost programmes and actions for climate interventions*
- *Design and implement a plan for mainstreaming climate change in the different sectors*
- *Monitoring and evaluation of the CCMA implementation process*

The guidelines also make reference to the importance of stakeholder participation in the CCMA process.

## 2.2.2 Completed and Ongoing catchment management plans

The Mpanga CMP has benefitted from a complete revision, the detailed study on climate change and a particularly high level of stakeholder participation. The recent water resources and/or catchment planning related work carried out for the Mpanga catchment are the following:

- *River management Plan for Mpanga River (PROTOS, 2010)*
- *Mpanga catchment area baseline assessment report (Clovis Kabaseke et al., February 2012)*
- *Study on current and future potential water resources, under different climate scenarios, for the Mpanga River Basin (Uganda) (BRLi, 2015)*
- *Economic Assessment of the Impacts if Climate Change in Uganda: Briefing Note: Water and energy sector in the Mpanga river catchment (Baastel, Metroeconomica, Makerer University, CIDT, 2014)*
- *Mpanga Catchment Management Plan (DWRM, 2015)*

Other management plans have been drawn up or are under elaboration (see Table 2-1). For some, including Mpanga and Rwizi, implementation of some measures is underway. As part of this study, these management plans have been reviewed, mainly with respect to Deliverable 2

Table 2-1: Existing catchment management plan and those under elaboration (source: DWRM)

WMZ	Catchment	Status of the Plan	When it came, or will come into effect
Albert	Mpanga	Finalised	2015
	Semliki	Finalised	2016
	Ruhenzamyenda	Finalised	2015
	Albert	Under development	2017
	Kiiha	Under development	2017
Kyoga	Awoja	Finalised	2013
	Mpologoma	Under development	2016
	Victoria Nile	Under development	2016
	Lokere	Under development	2017
	Lokok	Under development	2017
Upper Nile	Aswa	Under development	2016
	Albert Nile	Under development	2016
Victoria	Rwizi	Finalised	2016
	Maziba	Finalised	2015
	Katonga	Under development	2017

## 2.2.3 Study on current and future potential water resources, under different climate scenarios, for the Mpanga River Basin (Uganda)

### 2.2.3.1 Overview

In this study carried out for the Mpanga catchment, "Study on current and future potential water resources, under different climate scenarios, for the Mpanga River Basin (Uganda) (BRLi, 2015)", a **methodology was used to develop a revised hydrology<sup>1</sup> representing the hydrological characteristics under future climate change affected conditions.**

<sup>1</sup> A "revised hydrology" is used in the sense of a revised understanding of the hydrology and this is usually expressed in the form of a long (years) time series (with daily or monthly time step) of discharge data at selected points in the river system

The study essentially focused on the impact of climate change on low flows and the purpose of the climate change modelling was to provide a set of future climate data (especially rainfall and temperature) that could be used to investigate the impacts on water resources in the future.

All the details of this methodology are presented and discussed in Deliverable 2 of this study, where the aim has been to assess whether the approach used should be included in the Catchment Planning Guidelines as part of the climate change mainstreaming process. In this Deliverable (Deliverable 1), the methodology and its suitability is not further discussed. The main aim has been i) to see whether the various findings, conclusions and recommendations have been adequately taken into account in the revised catchment management plan and ii) to make recommendations on how shortcomings, if any, can be addressed.

### 2.2.3.2 Main conclusions and recommendations

#### POOR LAND-USE PRACTICES VERSUS CLIMATE CHANGE

Despite uncertainty attached to the findings, due to a paucity of reliable precipitation and flow data and considerable divergence between climate change models, a number of conclusions (some tentative) were drawn:

- *Total (or mean annual) runoff in Upper Mpanga may have decreased slightly, but this is difficult to state with confidence due to poor accuracy in the measurement of high flows. **Low (base) flows have significantly reduced and high flows have increased. Catchment degradation is the main cause of such changes.** This was confirmed during a visit to the upper part of the catchment in which the rapidly spreading expansion of unsustainable slash and burn agricultural into increasingly marginal areas was clearly evident. This was generally at the expense of previously forested land.*



- *Putting a stop to the continued deforestation of the source areas, improving farming practices and providing alternative rural and urban-based livelihoods should be regarded as a priority and ongoing efforts in this respect should be encouraged and further supported. This is an urgent issue.*

#### IMPROVED DATA COLLECTION EFFORTS

- *Mpanga catchment is situated in an area where the effect of climate change on precipitation is very unclear. Since this understanding is unlikely to improve in the near future there is a strong argument for **improving the quality and density of the rain gauge network.** In this way, it should gradually become possible to identify climate change trends as they develop.*
- *The most critical area of the catchment (in terms of potential water shortages), the Rushangwe sub-catchment, is also the area where there is least confidence in the river flow data. Given the potential costs that could be incurred to develop storage in the Rushangwe sub-catchment, the highest priority should be given to improving the accuracy of flow records. **The rehabilitation and operationalization of the closed station (as a minimum) on the Rushangwe should be carried out as a matter of urgency.***

### FUTURE DEFECITS

- *On an annual scale, water available will still allow satisfaction of the water demand whatever climate change scenario is considered. Looking into more detail and at a monthly time step, deficits appear.*
- *The indication is that there will be a decrease in flows between May and October. Trends during the rest of the year are not as clear (divergent results of the different scenarios, especially between November and April)*
- *Deficits in the upper and lower part of Mpanga river remain limited, even under “pessimistic” climate change scenarios. The situation in the middle Mpanga (to a lesser extent), and most of all in Rushangwe sub-catchment seems more concerning.*
- *Without mitigatory action (building of storage and/or rehabilitation and protection of the wetlands in the source areas), the worst water shortages will occur in the Rushangwe catchment (less water and higher population)*
- *There may be a need for some intra-seasonal storage in the upper parts of the Rushangwe and Mpanga sub-catchments. It would be useful to investigate potential sites. The aim should be to have relatively small storages with flexible release systems so that shortages during dry years can be mitigated against;*

### FLOW INTO LAKE GEORGE

- *All the GCMmodels point to a decrease in the mean annual runoff of the Mpanga River entering Lake George.*
- *It would be useful to investigate the potential impact on Lake George*

### ENVIRONMENTAL FLOW REQUIREMENTS

- *Work is required to investigate and better define environmental flow requirements, especially in the upper part of the basin.*
- *Satisfaction of these requirements would be a priority (over upstream uses) and would therefore provide a better level of equity between upstream and downstream users (including the environmental flow requirements downstream).*

## 3. Review of the Mpanga Catchment Management plan

### 3.1 INTRODUCTION

In this section, the revised Mpanga Catchment Management Plan is reviewed with a focus on climate change mainstreaming. The main aim of the review is to highlight where revisions are required to ensure that climate change mainstreaming considerations are adequately taken into account. However, this cannot be done without the context of a general review or at least presentation of the Mpanga Catchment Management Plan.

The Mpanga Catchment Management Plan is a planning document which proposes actions aimed at ensuring and supporting the sustainable development of the catchment surface and groundwater resources. The choice of actions is based on a clear strategy that has been developed by and agreed with the catchments stakeholders. The timeframe of the plan is 25 years (from 2015 to 2040).

Within the plan, natural resources in the basin, their economic potential and identified conservation threats are taken into consideration. The proposed integrated approach to conservation is to promote sustainable livelihoods, create new socio-economic opportunities, harness existing ones and safeguard the conservation of the key natural resources. The plan proposes management strategies that take into account the natural ecological linkages, conservation objectives and needs in designated areas and highlights targeted research to guide natural resource management and overall conservation of the basin while ensuring sustainable livelihood.

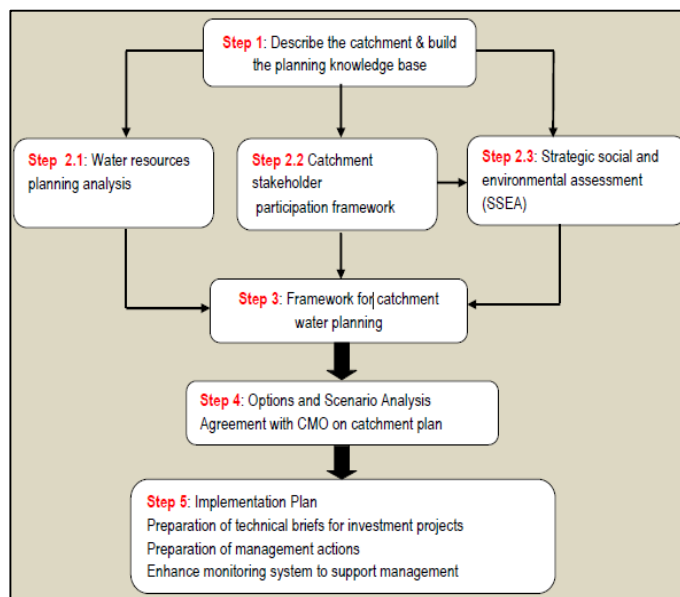
Several steps led to the development of the Mpanga Catchment Management Plan. The first of them was the realization of a Baseline study for the Mpanga catchment area (Clovis Kabaseke et al., February 2012). This research work was carried out by the Mountains of the Moon University. This baseline study was part of a wider project which consisted in “involving local communities in preparing a long-term Climate Change and Integrated Water Resource Management action plan to enhance their adaptive capacity to Climate Change, and integrate improved water management in the Mpanga Catchment Area of the Nile Basin in Uganda”. This work, through various interventions in the Mpanga catchment led by the NGO Protos, made it possible to identify a number of challenges faced by local communities, local governments, water related institutions and stakeholders in Integrated Water Resources Management. The need to develop capacity and create relevant institutions following IWRM principles were the driving forces towards the preparation of a Catchment Management Plan for the Mpanga catchment (PROTOS, 2010). Based on this first draft Mpanga CMP, a final version (DWRM, 2015) was released in 2015. In addition to a review of the first draft version, this final version of the Mpanga CMP made use of the outputs of other consultancies. Among them, the Study on current and future potential water resources, under different climate scenarios, for the Mpanga River Basin (Uganda) (BRLi, 2015) can be cited. It also makes use of the national catchment management guidelines (DWRM, 2014), which had not been available at the time of publication of the first draft.



## 3.2 OVERALL STRUCTURE AND PRESENTATION OF THE PLAN

The Mpanga catchment management plan (DWRM, 2015) has been developed in accordance with the Uganda Catchment Management Planning Guidelines (DWRM, 2014). Environmental, social and economic issues are identified through stakeholder consultation and field visits. Added to this analysis of available water resources and water demands, present and future. From these results and consultation of stakeholders, a vision and strategic objectives to be achieved by 2040 were defined. To achieve them, options and interventions to be included in the catchment management plan were then identified and analysed.

Figure 3-1: The catchment planning process (source: Mpanga CMP, 2015)



As can be seen in Figure 3-1, the applied approach involves five major steps which are in line with those stated in the national catchment planning guidelines.

- **Step 1: Describe the catchment and build the knowledge base.** The purpose of this first step was to realise a detailed description of the catchment. This description is summarized in Chapter 3 of the Mpanga Catchment Management Plan and covers a wide range of aspects of the catchment including its demography, status of economic activities, the biophysical characteristics of the catchment, etc. Due to the fact that the first draft of the Mpanga Catchment Management Plan, which was in many ways, highly detailed, covered only the Mpanga sub-catchments (i.e. not Rushangwe), there are many parts of the knowledge base which do not include the Rushangwe sub-catchment.
- **Step 2: this step comprises three major tasks:**
  - **Step 2.1: Water resources planning analysis.** Under this task, the water balance in the Mpanga catchment (at the level of its four main sub-catchments) has been assessed with the aim of identifying and evaluating existing and future water demand and development issues. This task produced a water resources assessment consisting of a catchment situational analysis, a water balance report and a simulation model. It is summarized in Chapter 4 of the Mpanga CMP;
  - **Step 2.2: Catchment stakeholder participation framework.** This task aimed at i) identifying the key stakeholders who are now (or may be in the future) involved in planning, developing and managing water resources in the catchments, and ii) understanding their interests, roles and impact on water resources. A key output of this task is the Stakeholder Engagement Report. Unfortunately, this report was not available.
  - **Step 2.3: Strategic Social and Environmental Assessment (SSEA).** The SSEA is mentioned in the flow chart for the methodology (see Figure 3-1 above), but the SSEA does not appear to be presented in the report, at least not under that name. In fact, the term “Strategic Social and Environmental Assessment” does not appear in the report other than in Figure 3-1. This is not to say that an SSEA has not been carried out. Indeed, in Chapter 5, the catchment issues and challenges are presented together with an analysis of their drivers. In this analysis climate change is mentioned quite logically in a number of places.

Steps 1 and 2 are primarily technical tasks that provide information and outputs to support steps 3,4 and 5. Indeed, step 3 and 4 aim at evaluating different options for the development of the catchments and prepares Catchment management plans taking into account the demographic, social, economic and financial characteristics and potentials of the catchments. The result of these two steps are presented in Chapters 5 and 6 of the Mpanga catchment management plan (DWRM, 2015).

Finally, the last step consisted in the elaboration of the catchment management plan itself and this is the subject of Chapter 7 of the Mpanga Catchment Management Plan report (DWRM, 2015).

### 3.3 MAINSTREAMING OF CLIMATE CHANGE INTO THE PLAN

#### 3.3.1 Introduction

This section presents the teams' findings on how climate change has been included in the Mpanga Catchment Management Plan. In general, climate change is recognized as a potential threat to which it is necessary to adapt. To this end, one of the short-term goals of the management plan is stated as to:

- *"Identify and Implement feasible strategies that can enable communities adapt to effects of climate change" is one of the short-term goals of the management plan."*

Otherwise, in the overall preparation of the catchment management plan, climate change is taken into account in three areas. It is considered in:

- The water resources assessment;
- The analysis of catchment issues (effectively the SSEA)
- The evaluation of proposed interventions.

The following paragraphs detail how climate change has been included in these three areas.

#### 3.3.2 Water resources assessment

As part of the catchment management plan, the water resources assessment is an essential step for comparing available water resources and the water demand needs for the current and future situation. This allows the identification of potential risks of deficit and to plan necessary measures to reduce this risk.

The water resources assessment comprises the following tasks:

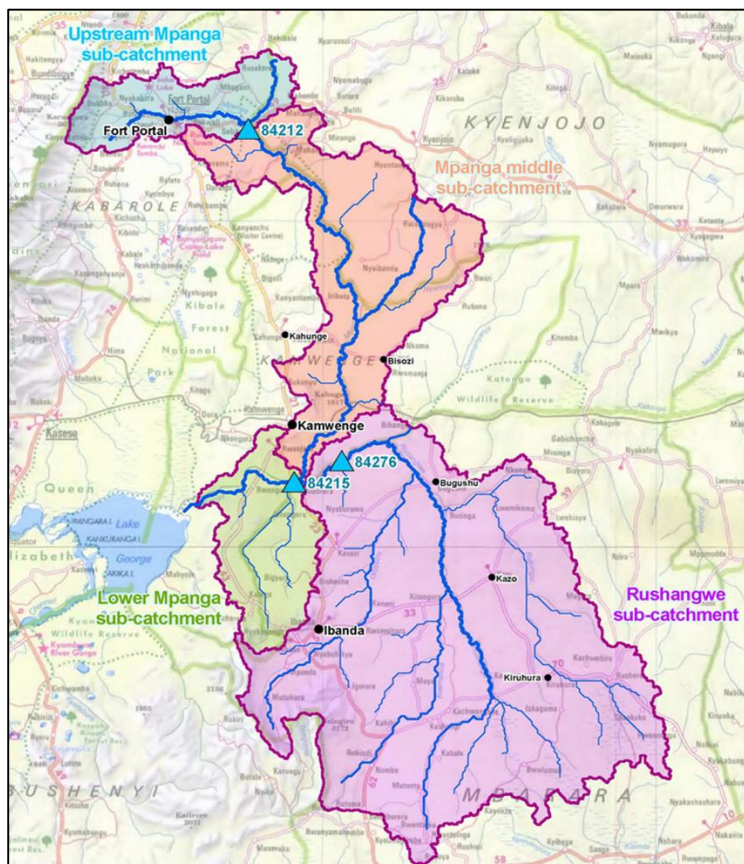
- Quantification of the current and future water resources availability;
- Quantification of the current and future water demand needs to meet various purposes (irrigation, drinking water, etc.);
- Establishment of a water resources balance between available water resources and water demand for the current and the future situation. Doing so makes it possible to see if water demands can be met.



In the revised catchment management plan, climate change has been taken into account in the assessment of the future available water resources (up to 2040). In order to do this, the results of the BRLi study (BRLi, 2015) have been used. Indeed, this project compared different outcomes for rainfall and runoff from several climate change models and developed an average of all scenarios. More details about the methodology applied are presented in section 1.3.3 of this report and in Deliverable 2.

In terms of the main units of analysis, the revised catchment management plan makes use of the same sub-catchment delineation that was used in the BRL climate change study. (see Figure 3-2)

*Figure 3-2: Four main sub-catchments of the Mpanga catchment used as units of analysis for the water resources assessment*



In the following paragraphs, the main findings, conclusions and recommendations that have been presented in the revised catchment plan are briefly summarised (italics are direct quotes):

- *“The different scenarios indicate no or little change (decrease) in annual total, but rainfall distribution during the year is likely to change. Although some scenarios lead to the opposite conclusion, the period from April to September is likely to be dryer than what it used to be, whereas October to February tend to be wetter.”*
  - COMMENT: The importance of this statement is not really highlighted. The implications are highly significant as was presented in detail in the BRLi climate change report.
- *“The fact that some GC models generate different or even conflicting results, means that the effect on runoff will also be varied. This was also shown in this study. A variation of different outcomes was generated as shown in the figure below. All the scenarios tested indicate a decrease in mean annual runoff (refer to figure 4.2), going from a 9% to a 38% decrease<sup>2</sup>.”*

<sup>2</sup>. Indicated as -9% in the CMP

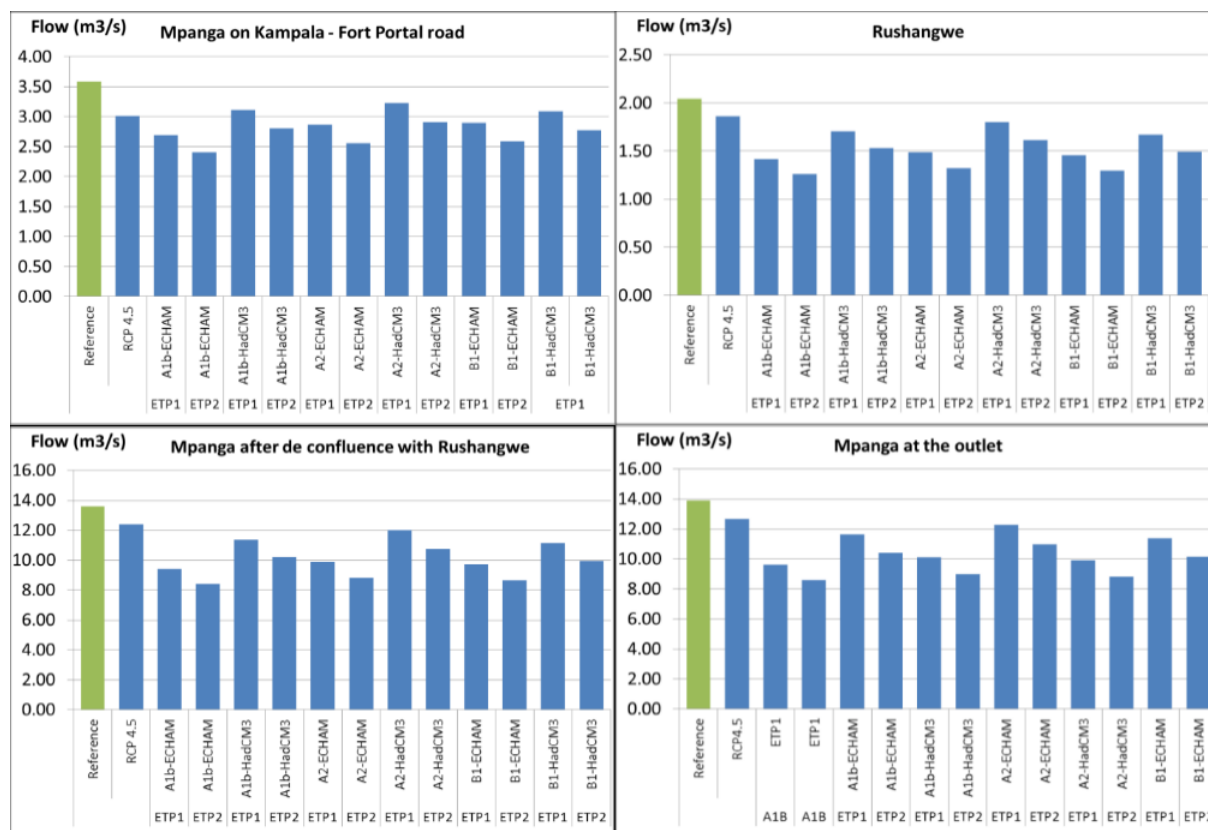


Figure 3-3: Predicted changes in mean annual flow (Source: BRL report, 2015)

- COMMENT: In the revised catchment plan, there is a misprint indicating that the decrease is "going from a -9% to a 38% decrease". This could cause some confusion. Given the importance of the monthly analysis, it would be have been useful to show how the mean monthly runoff may change
- In the water balance section, CC max and CC min are used. It is not clear which of the models is being used as CC max and CC min.
- A trend analysis is presented for Mpanga River at various points. The conclusions are not clearly summarised in the report although the discussion culminates in a flow frequency analyses for each of the gauging site locations.

- COMMENT: The trend analysis is an important part of the analysis of the hydrology and the water resources. However, since it is based on the observed historical records, it would have been more appropriate to present it before the presentation of the climate change modelling results. **The purpose of the trend analysis is not very clear.** In the BRL Climate Change study, the trend analysis was carried out in order to try and understand whether, and to what extent, trends in observed rainfall and runoff could explain the observed changes on the ground. The **very important conclusion of the BRLi study was that there was no evidence to show a decrease in catchment rainfall over the historical observation period and yet, there was significant change in the hydrology of the upper part of the catchment.** The BRLi study made it very clear that the change in runoff regime in the upper regime was due almost entirely to anthropogenic pressures and that stakeholders were mistaken to blame all observed change on climate change. This point does not come across clearly enough in the revised catchment management plan. This is of critical importance. During discussions with stakeholders for the preparation of the deliverable and Deliverable 2, the importance of trying to separate the results of climate change from the results of anthropogenic activities was stressed. This point does not come through in the revised catchment management Plan
- The impact of climate change on the monthly rainfall distribution is presented. *“Based on the results of the BRLi study, possible impacts of climate change on water resources availability (by 2040) are presented and compared to the estimated future water demand. Here, the catchment management plan concludes that under future climate scenarios, water is still largely sufficient to meet the demand (including future projected water demand) at the different level of Mpanga River itself. One must underline that, under the water resources balance for the future situation, the Mpanga catchment management plan does not focus on the monthly results. Despite the fact that water availability shall meet the water demand needs on an annual timeframe, the conclusion may be different looking on a monthly basis.”*
  - COMMENT: This is a significant omission and weakness of the analysis. A critical part of climate change mainstreaming is to take into account the likely change in temporal distribution. This has been analysed in detail in the BRLi study and used in the water resources modelling to draw concrete conclusions on where and how frequently shortfalls may occur in the future. The BRLi study makes certain recommendations related for example to the creation of intra--seasonal storage. This is based on the monthly analysis.

### 3.3.3 Analysis of catchment issues and challenges (part of SSEA)

Chapter 5 begins by stating up front that the River Mpanga catchment is increasingly facing challenges that may be summed up under the follow categorized theme areas. While these do indeed seem to be a good choice of thematic areas, it is not clear how the choice has been made. A more explicit explanation of how the SSEA process has been developed and applied may have helped to make this clearer. The five areas are:

- *Catchment degradation*
- *Water source pollution*
- *Low compliance and respect for the water resources regulations*
- *Low social capital*
- *Prolonged droughts due to natural low rainfall*

The only challenge area which would seem to be at odds with some of the conclusions of the BRLI climate change study is the fifth one, at least in the way in which it is expressed. These are the identified challenges, not their causes. It is arguable whether prolonged droughts in the catchment are the result only of natural low rainfall. While natural low rainfall is clearly a cause for drought in some parts of the catchment (particularly the Rushangwe sub-catchment), the increased incidence of hydrological drought may, to a large extent, be due to anthropogenic activities and climate change. Unlike for the first four challenges, for which a detailed analysis has been prepared in order to understand the main drivers, consequences and ripple effects (Tables 5.1 to 5.4), no analysis is presented for Challenges 5. This oversight means that the full range of causes behind “prolonged drought” are not presented or discussed. **In view of the fact that this is a key area for climate change considerations, this is a serious omission.**

Section 5.2 follows immediately on from Table 5.4 in which the Challenge of Low social capital has been analysed. The focus of Section 5.2 is on the identification of hotspots. This is both a useful and informative analysis but the linkages with the key challenges are not clearly shown. It would have been useful to have presented Section 5.2 before Section 5.1 and to have presented it in such a way that the conclusions on the five key challenge areas could be more logically presented and understood.

### 3.3.4 The evaluation of proposed interventions.

Strategic interventions and options are proposed for three of the four sub-catchments. It is not clear whether Rushangwe is included in the “downstream section”. These are provided in Chapter 6 of the report. Certain key climate change related recommendations from the BRL climate change report are not evident. Most notable these include:

- *Improved data collection efforts with a focus on climate change pertinent data*
- *Possible need for intra-seasonal storage in Rushangwe and Mpanga sub-catchments*
- *Better definition of environmental flow requirements*

Under the first steps of the catchment management planning process, environmental, social and economic issues and a number of options and interventions to address them have been identified for the Mpanga catchment. Under the evaluation of proposed interventions, a “Catchment Assessment Framework” tool is used to evaluate the identified options and interventions. *“This tool is designed to qualitatively assess management options based on their climate change adaptation potential, effects on ecosystem services, social economic outcomes, constraints and Risks involved.”*

It is commendable that climate change is now taken into account in the comparative evaluation. However, the absence of some key climate change related recommendations such as intra-seasonal storage, have been omitted and will not therefore be evaluated.



## 4. Conclusions and way forward

It should be stressed that the revised Mpanga Catchment Management Plan is a thorough and excellent report. Further revision to fully incorporate the recommendations made does not require new work in the field or a major stakeholder consultation effort.

This report has been finalised following a well-attended stakeholder workshop held in Kampala on 13 December 2016. It was agreed that the Consultant team which drew up the revised Mpanga Catchment Management Plan will proceed to incorporate the suggested modifications. The following table summarises the recommendations made in the report and the changes that should be made.

*Table 4-1: Summary of recommended revisions to the Mpanga Catchment Plan*

Subject area	Recommendations / changes proposed	See Para
Rainfall totals, monthly distribution	<ul style="list-style-type: none"> <li>This issue of potential changes in monthly rainfall distribution should be covered in as much detail as possible. The BRL analysis provided a lot of detail on this. One of the main overall findings of the assessment of water resources under climate change was that water shortages can be anticipated at the level of the monthly time step.</li> </ul>	3.3.2
Trend analysis (rainfall and runoff)	<ul style="list-style-type: none"> <li>The trend analysis of historic rainfall and runoff observed at the Mpanga catchment gauging stations is an important tool in investigating the extent to which climate change may explain changes over the past few decades. A trend analysis is included in the revised catchment management plan but no real conclusions have been drawn. This omission should be rectified and used to highlight the influence of anthropogenic activities in the basin and the resultant impacts. This does not require new work since the subject has been detailed in the BRL climate change study.</li> </ul>	3.3.2
SSEA: Analysis of catchment issues and challenges	<ul style="list-style-type: none"> <li>Chapter 5 of the report starts (5.1) with a presentation of catchment issues and challenges under 5 thematic areas. It is then followed by a section (5.2) on identified hotspots. Given that the choice of the 5 thematic areas is based on an analysis of the hotspots, the order of these sections in the report should be swapped around.</li> </ul>	3.3.3
	<ul style="list-style-type: none"> <li>The 5<sup>th</sup> thematic area presented in Section 5.1 "Prolonged droughts due to natural rainfall" should be changed to "Prolonged droughts".</li> </ul>	3.3.3
	<ul style="list-style-type: none"> <li>Table 5.5, which would have presented the issues and challenges for the 5<sup>th</sup> thematic areas, as well as the main drivers, consequences and ripple effects behind them is missing. This table should be inserted to the report and will fill a major gap</li> </ul>	3.3.3
Proposed interventions	<ul style="list-style-type: none"> <li>The following interventions are recommended for inclusion in the plan: <ul style="list-style-type: none"> <li>Clear statement of improved hydroclimate monitoring, including reinstatement of Rushangwe River gauging station and expanded network of climate (especially rainfall) stations.</li> <li>Preliminary investigations into intra-seasonal storage options in Rushangwe and Mpanga sub-catchments</li> <li>Study and eventual implementation of environmental flow requirements</li> </ul> </li> </ul>	3.3.4

## 5. References

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