



# National Water Resources Management Authority for A Sustainable Water Use in Rwanda

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## ABSTRACT

The rapid population growth increases water demand and affects water allocation systems as well as water resources management plans to satisfy the basic water needs for both human and nature. This has called upon the adoption of the integrated water resources management (IWRM) approach which promotes the coordination and management of water, land and related resources to maximize the economic and social welfare in an equitable manner without compromising the ecosystem. Water management and the implementation of IWRM approach cannot be achieved without proper working institutions that can coordinate and manage the implementation strategies. The aim of this paper is to establish a national water resources management authority in Rwanda that will manage and coordinate the national water resources in a sustainable way taking the water resources management bodies in Rwanda, in comparison with the Kenyan water resources management bodies as a good example. An extensive review was conducted using governmental documents, and key institutional elements were analyzed by evaluating their performance in comparing with the Kenyan institutions. The paper revealed that Rwandan water resources management is a fragmented way and the level of control is sophisticated without taking into consideration the management of water resources at a catchment level, which affects the coordination, management and the implementation of water policies. The results show that most of the water laws and policies in Rwanda should be changed and establish the Rwandan water resources management Authority that has the power to control and coordinate the water resources implementation policies.

**Keywords:** Water allocation; IWRM approach; water policies; Kenya

## 1. INTRODUCTION

### 1.1 Water resources management in a global context

Water resources management deals with the management of water under a set of policies and regulations. Population explosion and economic growth are rapidly increasing the water demand for municipal, industrial, and agricultural uses Worldwide, which makes it difficult for water allocation system (WAS) to satisfy the needs of users without causing an environmental stress for the ecosystem (Cai, et al., 2016). Water resources management has different components to ensure the fairness of service delivery, which includes water allocation to water users by maintaining levels for social and environmental use while addressing equity and development needs of society; river basin planning that incorporates all stakeholders in the development and management of the basin; and

stakeholder participation that incorporates stakeholder into decision making process, pollution control, monitoring, economic and financial development, and information management for provision of essential data necessary to make informed and transparent decisions. However, developing a successful integrated water resources-management program requires more than just understanding the hydrology and geology of a basin. It must also be based on understanding the social, economic, political, legal and informational issues, processes and infrastructure that dictate how we protect, allocate, and utilize these resources (Sehlke, 2005).

### *1.2 The need for a water resources management institution framework*

Generally, any resource system either natural or man-made whose characteristics make it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use is considered to be a Common Pool Resource (CPR) (Ostrom, 1994). Today, many of the world's natural CPRs are facing overuse and congestion due to the increased competition over natural resources (Madani, 2011). Most people are not aware of the management and water supply to fulfill their basic needs (Sehlke, 2005). The appropriate management, planning, and analysis of water resources at a watershed level is recognized as a rational objective approach for effectiveness, efficiency and sustainability (Bulkley, 2004). So the introduction of water resources management authority in Rwanda will improve the efficiency of Rwandan government to reduce water related problems. IWRM is not a new concept, despite recent, prominent national and international attention, IWRM concept progressed in some countries under different pretexts and terminology as many as 70 years ago (Biswas, 2004), IWRM remained elusive (White, 1998). It was recommended at the 1977 United Nation Conference in Mar del Plata. The conference led to the declaration of the 1980s as the "water sanitation decade" with the objective of providing drinking water and sanitation for all by 1990. The concept has undertaken a series of evolutions and refinements during numerous regional and international conferences (New Delhi in 1990, Delft in 1991, Dublin in January 1992 and Rio de Janeiro in June 1992) (Ferragina, et al., 2002). IWRM is restricted to water quantity and quality; integrated watershed management refers to the integration of water, land, and other natural resources including water quality (Davis, 2007). Moreover, river basin management is used broadly to refer to all activities engaged within a river basin; it reflects the implementation of IWRM and other strategic natural resource planning (Dourajeanni, 2002). Activities associated with an IWRM redirect territorial and jurisdictional scales. At the national scale, a general framework that creates an enabling environment and supports macro socioeconomic objectives is appropriate, while specific outcomes in a location are appropriate at the river basin scale. Individual project level capital works, and operational and maintenance activities are most often appropriate at the sub-basin level, which in turn should be consistent with larger river basin plans (Hooper, 2005). In 2006, Cardwell makes three understanding observation about IWRM: it is a process, it is a goal-directed process, and it is a matter of degree (Cardwell, 2006).

IWRM institutions can and do take various forms. However, coordination is the key aspect of the institutional framework and its implementation both horizontal and vertical synchronization across national, regional, and local department levels including public and private entities and other related disciplines (Sabatier & F., 2005). The current international IWRM efforts try to merge two approaches, top-down and bottom up approaches. The top-down approach is either represented by the national or regional adoption of IWRM combined with the development and fostering river basin organization and governance (GWP, 2006; Hooper, 2005). The top-down approach provides an enabling environment e.g. legal participatory, education, and mechanisms for enforcement

and conflict management, and protection of under-represented sectors such as minority and indigenous groups. IWRM is best implemented operationally at the river basin or sub-basin levels, an operational unit contains hydro-geographic drainage basins, environmental management, however, it can extend beyond to what we can call problem sheds such as addressing habitat protection and this may require an additional coordination among adjacent river basins organization (Davis, 2007). Past models and planning mechanisms and implementations have been not reflecting the local needs nor were any educational provided such that locals can be included in the decision-making process. It is recognized that bottom up approach will involve much of local's participation for a successful water resources planning and projects involvement as well as decision-making at the lowest level (GWP, 2000) and (Creighton, 2004). In many less developed countries, the challenge is often to create or restructure institutions and internal capacity to manage resources, while adequately engaging stakeholders—including those in informal sectors of society. In developed countries, it is more typical that institutions are well established (Davis, 2007). Each of the institutions is governed by facilitating legislation, usually with specific and limited mandates (Davis, 2007).

IWRM also tackles the water sharing aspect. Water sharing is an important component of IWRM. A broad definition of water sharing is control and allocation of water from headwaters to sea or sinks (Davis, 2007). Rules about water sharing also involve clear mechanisms for conflict resolution, including important mediation and other methods that can be pursued prior to referral to the courts.

### *1.3 Institutions, organizations, and management*

In analyzing the arrangements of institutions in any context a clear understanding of the term institutions should be highlighted. In general sociology, an institution is “an organized, established, procedure” (Jepperson, 1991). The institutions are a combination of policies and objectives, laws, rules and regulations, organizations, Laws and core values, operational plans and procedures, incentive mechanisms, mechanisms norms, traditions, practices, and customs (Bandaragoda, 2000). The institution serves different functions based, the definitions given above highlight that the institutions are humanly devised “constraints” to shape human action (Bromley, 1987). However, the institutions inherently have dual facilities to both constrain and liberate individual and group action. The dual facilities of institutions are of importance in water management because most of the water-related rules are meant to limit the socially undesirable behavior by individuals and groups in the distribution and use of water (Bandaragoda, 2000). Institutions and performance are interlinked indisputably, however how institutions contribute or affect performance is important to identify and evaluate the needs for change in the institutions depending on the performance level (Bandaragoda, 2000).

### *1.4 Rwandan water resources scenarios*

#### *i. Water resources*

There are two main hydrological basins in Rwanda that lie in Congo and Nile River basins. The Congo-Nile divide is more-or-less perpendicular to the volcanoes that serve as a natural barrier to the catchment basins in Rwanda, North Kivu and southwest Uganda (REMA, 2011), The Congo River Basin lies to the west of the divide, covers 33% of the national territory and receives 10% of the total national waters. The rivers on the west side of the divide — the Sebeya, Koko, Ruhwa and Rubyiyo Rivers in Rwanda — drain into the Congo River basin via the Rusizi River, then into the Atlantic Ocean. Lake Kivu is part of the Congo Basin; it is shared with the DRC

and covers an area of 102,800 ha within Rwanda alone (REMA, 2015). The Nile basin lies to the east of the Congo-Nile divide, covers 67 % of the total national territory and drains 90 % of Rwandan waters, mainly through the Nyabarongo and Akanyaru Rivers, which merge and make up the Akagera River and Lake Victoria's principal tributary, which has an average flow of 256 m<sup>3</sup>/s and is the White Nile's main source, contributing 9 to 10 % of the total Nile waters with a length of 6,695 km, the Nile River is the world's longest watercourse. Its main tributaries are the White Nile and the Blue Nile (NIB, 2005).

Data on ground water and aquifers in Rwanda is incomplete. However, the available information estimates that the discharge for the available resource is 66 m<sup>3</sup>/s and there are about 22,000 recognized sources which have a discharge of 9 m<sup>3</sup>/s (REMA, 2015).

The marshlands are the most physically and chemically heterogeneous of all aquatic ecosystems in Rwanda. They are in effect seasonal wetlands. The water table is near or above the lowest ground surface during the wet season and they do not have large flood plains (generally less than 200m wide) or great length. The most recent inventory of wetlands was conducted in 2008 by REMA through the Integrated Management of Critical Ecosystems (IMCE) project funded by GEF and World Bank (2015). This inventory showed that Rwanda has 860 marshlands and 101 lakes covering a total surface of 278,536 ha (10.6 % of the country surface area), and 149,487 ha, respectively. This inventory also found 861 rivers totaling 6,462 km in length. 41% of the inventoried marshlands are covered by natural vegetation, 53 percent are under cropping, (which represents about 148 344 ha) and about 6 % are fallow fields (REMA, 2015).

#### ii. Water availability

The water availability in Rwanda, Table 1, is another issue. The National water resources management policy notes that the data on water consumption in Rwanda is scarce and incomplete (MINIRENA, 2011). Most estimations of the current water use of any catchment are based on a number of assumptions: water availability and discharge from springs or boreholes; the production capacity of piped water supply systems; the water capacity of rainwater harvesting irrigation ponds and marshlands; the different yearly supply of irrigation from surface or groundwater resources for western and eastern areas; and the different volumes of irrigation water expected from dam sites in eastern and western areas.

**Table 1:** Water Statistics 2012-2013, Source: (REMA, 2015)

Items	2012		2013	
	Status	Potentials	Status	Potentials
Surface water	101 lakes covering an area of 149.48 ha	7-6 billion m <sup>3</sup> /year	101 lakes covering an area of 149.48 ha	6.826 billion m <sup>3</sup> /year
	861 rivers of a total length of 6,462 km		861 rivers of a total length of 6,462 km	
Ground water		5-4.5 billion m <sup>3</sup> /year		4,554 billion m <sup>3</sup> /year
Rainwater		28-25 billion m <sup>3</sup> /year		27,505 billion m <sup>3</sup> /year
Water yield/ person		1,135-193 m <sup>3</sup> /person/year		670 m <sup>3</sup> /person/year
Water storage/ person		7-5 m <sup>3</sup> /person/year		447 <sup>3</sup> /person/year

*iii. Pressure and impacts*

There are a number of challenges to water provision and threats include poor water resources management, population growth, urbanization, droughts and floods that will be increased by the climate change and the lack of water resources management education. Industrial water users including coffee industries need 30 m<sup>3</sup> to produce one ton of a fully washed coffee, mineral processing, tanning and other industries are pressuring water resources in Rwanda. The tourism and increase in irrigation and other activities that involve water retention affect fish and aquatic biodiversity as well as water from human consumption (REMA, 2015). Land use practices consider also threats to water resources in Rwanda, Wetlands in Rwanda are mainly threatened by reclamation and degradation, especially those outside national parks. Human activities threatening wetlands in Rwanda include settlements and road construction, drainage, unplanned conversion to agriculture, industrial pollution sewage and excessive harvest of products. A study on water quality conducted by the National University of Rwanda in 2002 confirmed that water quality is an issue in this country (REMA, 2015). Water resources have been subjected to a heavy pollution due to the untreated wastewaters (both domestic and industrial). Inadequate institutional framework contributes to the degradation of water resources (REMA, 2015).

Climate change predictions show that with increasing rainfall variability, Rwanda will experience extreme weather patterns (flooding and droughts) (Meene & Brown, 2007). Rwanda is a densely populated country made up of hills and valleys, and erosion is a problem. Flood and drought constitute the major part of natural disasters in Rwanda; the north western is highly affected due to its topography, high rainfall intensity and degradation of land cover. According to a report on natural disasters and hazards in Rwanda, flood is the most occurred extreme event in Rwanda but third on the list after epidemics with regards to loss of lives, however, drought is the second on the list with regards to loss of lives but third in terms of occurrence of natural disasters in Rwanda. About 237 people out of 4.16 million people have lost their lives from 1900 to 2015 because of drought events; however, about 183 people out of almost 82,000 people lost their lives from 1900 to 2015 due to flood events (Samuel, et al., 2015). Six drought events have occurred in Rwanda because of long periods of dry season or delayed in rainy season: a long dry period from 1998-2000 and an annual drought from 2002-2005; resulting in 237 deaths and affecting almost 4.2 million people. During this period, the country's economy was affected, especially in the agricultural sector due to food insecurity: this affected crop yield and reduced livestock production especially in the Eastern and Southeastern parts of Rwanda (REMA, 2013). Due to the prolonged drought in 2005, water-levels in Burela and Ruhondo lakes declined to result in a deficit in hydropower production leading to power crisis (Samuel, et al., 2015). In May 2016, the BBC News reported that at least 53 people have been killed by landslides and floods caused by heavy rains in Rwanda, said by Government officials, and most of the victims were believed to have been children (BBC, 2016). The worst hit areas were the districts of Gakenke and Muhanga. As many as 34 people died in Gakenke, 8 in Muhanga, 4 in Rubavu and 3 in Ngororero. Around 26 injuries also were reported. The Ministry of Disaster Management and Refugee Affairs (MIDIMAR) reported that over 500 houses were destroyed, leaving thousands homeless (DAVIES, 2016). Future projections show that temperatures will increase to 2.70C and 40C in 2050 and 2080 respectively. Rainfall projections, on the other hand, show an increase of 20% by 2050 and 30% by 2080, which means that the increase in temperature and rainfall in Rwanda will result in more floods and droughts events in the future (Samuel, et al., 2015).

### 1.5 Problem statement and objective

The Government of Rwanda is doing a lot in terms of natural resources management by reinforcing the institutions in charge and developing different policies and regulations; the national water policy 2011 gives the institutional framework in charge of water resources management. It includes the ministries and agencies involved in water resources management and gives authority to Rwanda Natural Resources Authority (RNRA) to coordinate the implementation of all stakeholders and oversee the management of water resources. However, there is an overlap and fragmentation of roles given to Government institutions; as stated in Table 2, water is disseminated in many government institutes which make it difficult to manage in an integrated way because each ministry/agency ends up making independent decisions. There is a lack of institutional decentralization at the basin level, which leads to mismanagement of water resources when it comes to decision making. The institutional framework as stated in the national water policy, identifies a district as the smallest administration body to implement policies and laws; this has been a problem in water resources management every district plans and implements its solutions to the problems facing their district not taking into consideration the whole catchment, which led to a lack of harmonization in the catchment and conflicts between different administrative offices. The case of Sebeya catchment is a good example of how the districts of Rubavu, Nyabihu and Ngororero have failed in its management due to the fragmentation in its management and decision making. One of the problems facing the catchment of Sebeya is soil erosion and landslides which result into siltation to rivers which leads to flooding in the area. Deforestation of the Gishwati natural forest which once played a critical role in preventing the region from erosion contributes greatly; leading to increasing flood frequency events in this catchment. The flood that occurred in September-December, 2001 led to a death toll of 108 people in this region. In May 2010, another huge flood killed 13 people, destroyed 237 hectares of crops, and displaced 140 households. The district of Rubavu put a lot of effort in planting trees and protecting the river banks; this was done to protect soil erosion and river siltation in the district but other districts at the upstream like Nyabihu and Ngororero where Gishwati forest is, were not keen on protecting the environment and this resulted in flooding in the catchment and it was intense at downstream (Samuel, et al., 2015).

The main objective of this paper is to propose an institutional water framework to be a sort of water management authority in Rwanda by:

- a. Assessing the coordination of the existing institutional framework for water resources management in Rwanda;
- b. Comparing the Rwandan institution coordination with the Kenyan Water resources management authority;
- c. Analyzing the proposed institutional framework.

## 2. METHODOLOGY

The methodology used to conduct this study is based on the comparable-cases strategies. The comparative methodology focuses on rationale rather than statistical significance in nature (Ferragina, et al., 2002). The extensive policy research is usually restricted to policy inputs and outputs. Secondary data was used through desk reviews of water resources management policies and the existing institutional framework in Rwanda, and the comparable study that was conducted on the water resources management authority in Kenya (WRMA).

Institutional framework and governance strategies were reviewed and assessed. This study carried out an extensive review of certain water resources documents in Rwanda and Kenya. The documents reviewed were the:

- National policy for water resources management,
- Water resources management sub-sector strategic plan 2011-2015,
- Rwandan Water law of 2010, and
- Integrated water resources management and water efficiency plan of Kenya.

Much emphasis was placed on the policies at the national level while also considering the roles and responsibilities of the implementing institutions. As a basis for this assessment, this study used the two key elements of institutional analysis for examining the coordination by evaluating their performance in comparing with the Kenya water institute. Kenya was chosen because it is an advanced stage in terms of establishment of policies and legal frameworks for water resources management in the region (E.A.C, 2016). Institutional roles and responsibilities: the study assessed how responsibilities are distributed within implementing institutions and how they are synchronized, this is important for efficient policy implementation and for accountability. Legal framework: the study assessed laws, policies, and regulations and their linkage to the implementing institutions.

For the economic analysis of the proposed institution framework, a cost-benefit analysis tool was used. Two projects aiming to solve key issues in one of the catchment were analyzed. The catchment was selected considering it is the most vulnerable in the country.

### **3. RESULTS AND DISCUSSION**

#### *3.1 Current water resources management status in Rwanda*

Rwanda is a scarce water country. Water is the most valuable of the natural resources of the country. Due to the population and the economic growth development of Rwanda, the Government of Rwanda has put in place the institutional framework for the conservation, protection, and management of the country's water resources resulted in the formulation of the water and sanitation policy of 2004 revised in 2011 and became the National Policy for Water Resources Management, and the Water Law No. 62/2008 to strengthen the water resources management sub-sector. The 2008 Water Law provides an institutional framework for the coordination of water resources management, a key ingredient of integrated water resources management; devolves water resources management functions to District based and user organizations, as required by the principle of stakeholder and user participation; and provides for charges to be levied on the use of water, which is an important tool for giving effect to the widely accepted principle 'water has an economic value'.

Rwanda's water sector is governed under a complex institutional framework, Table 2. The institutions are categorized into policy and oversight institutions, management and implementation institutions, service provision institutions and regulatory institutions. The institutional framework operates through the sector wide approach, which applies in the planning and budgeting process.

**Table 2:** Institutional framework in water sector (MINIRENA, 2011)

No	Institutions	Function and responsibilities related to WRM
<b>Policy and Oversight Institutions</b>		
1	Ministry of Natural Resources (MINIRENA)	Formulation of Water resources management policy, strategic planning, coordination, quality assurance, monitoring, evaluation, and capacity building. Put in place legal and regulatory framework.
2	Ministry of Local Government (MINALOC)	Establishment, development, and facilitation of the management of efficient and effective decentralized government systems capable of law enforcement and delivery of required services to the local communities.
3	Ministry of Agriculture, Animal Resources (MINAGRI) and affiliated agencies	Development, planning, and coordination of the implementation of agricultural development policy in the country including irrigation, fishery and livestock.
4	Ministry of Infrastructure (MININFRA)	Development of institutional and legal frameworks, national policies, strategies and master plans relating to water supply and sanitation, energy and transport subsectors.
5	Ministry of Health (MINISANTE)	Policy formulation and promotion of hygiene and public health.
6	Ministry of Family and Gender Promotion (MIGEPROF)	Coordination of gender, promotion, and mainstreaming and family planning activities.
7	Ministry of Education (MINEDUC)	Promotion of education including/capacity building and curricula development relating to water sciences and research on water resources management in schools and other educational institutions.
8	Ministry of Commerce (MINICOM) and affiliated agencies	Policy formulation and promotion of investments by the private sector in water resources management/industries and manufacturing.
9	Ministry of Foreign Affairs and Cooperation (MINAFFET)	Foreign and diplomatic relations including regional and international cooperation over shared waters.
10	Ministry of Disaster Management and Refugee Affairs (MIDIMAR)	Coordination and policy formulation on disasters preparedness including flooding, landslides, droughts.
11	Ministry of Defense (MOD)	Coordination and policy formulation on all issues related to the country security including water resources
<b>Financing Institutions</b>		
12	Ministry of Finance, Planning and Economic Development (MINECOFIN)	Mobilization and allocation of financial resources for water resources development.
13	Development partners	Provision and mobilization of financial and technical resources for implementing water resources management and development sector activities.
<b>Regulatory Institutions</b>		
14	Rwanda Environment Management Authority (REMA)	Develop regulations and ensure protection and conservation of the Environment and natural resources across the Country.
15	Rwanda Utilities Regulatory Agency (RURA)	Enforcement of compliance by public utilities with the laws governing their activities.
16	Rwanda Bureau of Standards (RBS)	Provision of standards-based solutions for Consumer Protection and Trade promotion for socio-economic growth in a safe and stable environment.
17	Rwanda Natural Resources Authority (RNRA)	The autonomous agency responsible for management of natural resources including water resources management and allocation
<b>Management/service Institutions</b>		
18	Water and Sanitation Corporation (WASAC, 2016)	Autonomous agency responsible for the delivery of water supply and sewerage services in the major towns and large urban centers including a provision of oversight and support services to the local communities and other water supply service providers.
19	Rwanda Development Board (RDB)	Facilitation of investment and support services to investors.
20	User Communities	Management of water resources on a day to day basis
21	Districts	Implementation of the government policies and laws
22	Private Sector	Design, construction, operation and maintenance of water resources management infrastructure. Conduct training and capacity building for both central and local government staff. Provision of other commercial services.
23	Non-Governmental Organizations (NGOs)	Supplement the public-sector efforts in water resource management and development.

In 2010, the Government of Rwanda has put in place the Law No 53/2010, establishing the Rwanda Natural Resources Authority (RNRA). The institutional framework lacked a coordinating mechanism and the functions related to water resources management were not fully developed as well as the role and responsibilities of each sector based institution regarding water resources management were not clearly articulated, leading to confusion, uncoordinated action and overlap in implementation. Additionally, there was no institution with overall authority with a capacity to regulate the use and management of water resources by other sector based institutions. Capacity gaps arose mainly from limited technical and financial resources available for water resources management. These capacity limitations are even more acuter within the decentralized institutions at a district level. In consequence, there has been a high degree of degradation of water resources arising from activities within the various sectors (MINIRENA, 2011).

With the promulgation of a law establishing the RNRA with the mandate to lead the management of natural resources across sectors, there is potential to achieve a coordinated approach to water resources management, in line with the Integrated Water Resources Management concept. To address the capacity limitations being faced by the sector, it will require concerted efforts in resource mobilization, human resource development and institutional capacity building (MINIRENA, 2011).

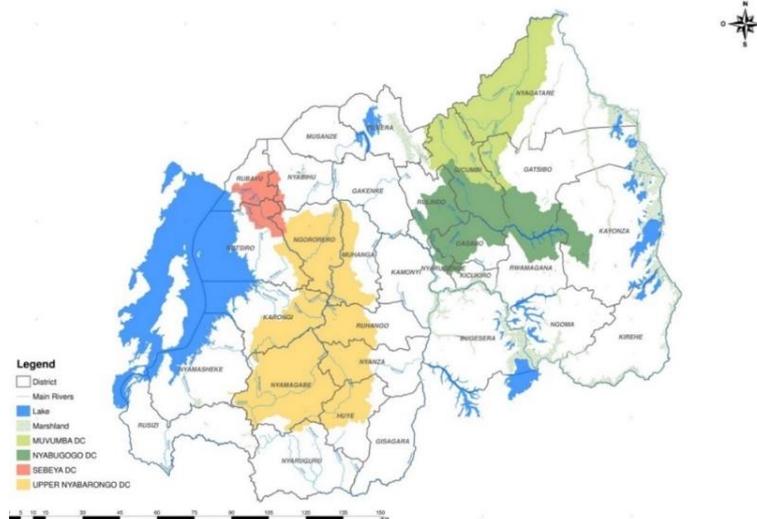
### *3.2 Establishment of catchment plans*

National Policy for Water resources management of 2011 outlined nine policy principles of water resources management and conservation upon which Rwanda shall base the management of its water resources. These principles are Water is a finite resource, the human right to water, Water resource is an economic good, Water is a social good, IWRM, Participatory management, Catchment-based water resources management, Impacts of climate change on the water resource, and Internationally shared water resources. One of the Policy Principles of National Policy for Water resources management of 2011 recognized the catchment-based water resources management approach as essential to dealing comprehensively with water resources management issues, based on the obvious community of interest for users living within such a geographical area, was supposed to be elaborated in the implementation strategy of the National Policy for Water resources management. Since 2015, the Government of Rwanda supported by the Embassy of the Kingdom of the Netherlands has begun the development of catchment plans through Water for Growth Rwanda in an effort to introduce integrated land and water management within hydrological units (catchments) with technical assistance from an international IWRM support unit within the Rwanda Natural Resources Authority (RNRA). In the National Water Resources Master Plan, Rwanda is divided into 9 first order catchments (and numerous second or further order catchments, which jointly constitute the first order catchments); seven of these are part of the Nile Basin, and two (in the West, on the shores of Lake Kivu) are part of the Congo Basin. But the RNRA targeted activities in four (4) demonstration catchments: Muvumba, Nyabugogo, Sebeya and Upper Nyabarongo (RNRA, 2015). The plan development process for the catchment plans for the demonstration catchments commenced in September 2015. These demonstration catchments cover the total area of 6,939.96 km<sup>2</sup> and are within 19 Districts as described in Table 3 and shown in figure 1. The Muvumba catchment is part of the most upstream parts of the Nile Basin, with its ultimate outflow into the Mediterranean Sea. It is composed of Nyagatare, Gicumbi and Gatsibo District, and located in the Kagera sub-basin. The Nyabugogo catchment is part of the Nile basin and a tributary of the lower Nyabarongo River. It is rather centrally located with a wedge extending into the eastern and dryer part of Rwanda.

It is composed of Gicumbi, Gatsibo, Kayonza, Rwamagana, Kicukiro, Gasabo, Rulindo, and Nyarugenge District. The Sebeya Catchment is part of the most upstream parts of the Congo River Basin, with its ultimate outflow into the Atlantic Ocean. It is composed of Ngororero, Rutsiro, Nyabihu and Rubavu District, and is located on the Western flanks of the Congo-Nile divide. The Upper Nyabarongo catchment is in the Nile basin and runs from South to North in the western part of Rwanda. The districts located in the Upper Nyabarongo Catchment are Karongi, Ngororero, Rutsiro, Huye, Ruhango, Muhanga and Nyamagabe (RNRA, 2015).

**Table 3.** Catchments repartition in Districts and their occupied areas (RNRA, 2015)

Catchment		Districts		Overlap between district & Catchment		
Name	Area km <sup>2</sup>	Name	Area km <sup>2</sup>	Area km <sup>2</sup>	% Catchment	% District
Muvumba catchment	1 568	Nyagatare	1 920	940	60.0%	49.0%
		Gicumbi	830	455	29.0%	54.9%
		Gatsibo	1 582	152	9.7%	9.6%
		<b>Total</b>		<b>1 547</b>	<b>98.7%</b>	
Nyabugogo catchment	1 661.36	Gasabo	429.21	304.50	18.33%	70.95%
		Gatsibo	1582.32	293.80	17.68%	18.57%
		Gicumbi	829.52	339.64	20.44%	40.94%
		Kayonza	1934.96	174.57	10.51%	9.02%
		Kicukiro	166.71	19.88	1.20%	11.93%
		Nyarugenge	133.95	44.20	2.66%	33.00%
		Rulindo	566.98	294.12	17.70%	51.87%
		Rwamagana	681.96	190.29	11.45%	27.90%
<b>Total</b>		<b>1 661.00</b>	<b>99.98%</b>			
Sebeya catchment	363	Ngororero	679	37	10%	5%
		Rutsiro	1,157	139	38%	12%
		Nyabihu	532	38	11%	7%
		Rubavu	388	150	41%	39%
		<b>Total</b>		<b>363</b>	<b>100%</b>	
Upper Nyabarongo catchment	3,347.60	Karongi	993.03	426.26	13%	43%
		Ngororero	678.99	560.11	17%	83%
		Rutsiro	1,157.29	96.49	3%	8%
		Huye	581.53	293.59	9%	51%
		Nyanza	672.14	295.34	9%	44%
		Ruhango	626.78	316.05	9%	50%
		Muhanga	647.71	319.49	10%	49%
		Nyamagabe	1,090.36	1,016.58	30%	93%
<b>Total</b>		<b>3,323.91</b>	<b>99%</b>			
<b>Total</b>	<b>6,939.96</b>			<b>6,894.91</b>	<b>99.35%</b>	



**Figure 1:** Demonstration catchments and their location (RNRA, 2015).

### 3.3 *Water resources management in Kenya*

The management structure of water resources management Authority (WRMA) in Kenya is divided into catchment areas called region offices, each regional office has sub-regionals. The regional level identifies its catchment status that describes the catchment characteristics such as coverage area, climatic conditions, rainfall availability and population diversity within the catchment, it also describes the key issues and priority actions to be undertaken by different stakeholders. The Kenya water Act 2002 given effect in 2003, underlines the role and lively participation of local communities in water resources management. Catchment advisory committees oversee the use, control, development, protection, and conservation of water resources within each catchment area. It involves water resources users and stakeholders. Catchment advisory committee is a composed of representatives of ministries, public bodies, regional development authorities, local authority, farmers, pastoralist, the business community, NGOs, and other persons who have demonstrated competence in matters relating to the management of water resources. Water resources association is involved in the implementation of the sub-catchment management plans which are aligned with the catchment management strategies. Within each regional office, the permit status and application forms are provided, describing the different types of permits that are provided and the requirements needed for each stakeholder to pursue a permit of undertaking any project within the catchment. WRMA has three departments that work together to achieve the functions: Finance and administration, cooperate services, and technical coordination. The finance administration advises the Governing Board on the preparation and execution of the strategic plan and the preparation of the performance contract and work plan and ensures the budget allocation at different levels. Technical coordination deals with a database, ground water and surface water, operations of water resources management, water conservation, water rights and water quality in general (Republic of Kenya, 2009).

### 3.4 *Comparison between Rwanda institutional coordination to Kenya water resources management authority*

Table 4 shows that many institutions are involved in the planning and policy formulation of water resources management in Rwanda which makes it difficult to take an integrated decision since every ministry looks at this resource (water) from its interest and the fact that the policy does not clearly state the institution in charge of monitoring and evaluation of the whole process, this threatens the proper management of water resources and coordination of implementing institutions. Four agencies are in charge of regulations, but none of them is given a responsibility of issuing permits and there is no specification on which one that oversees and coordinates this activity. This becomes a problem on enforcing the regulations in place because of lack of coordination. However, the national policy of Kenya indicates that water is a cross-cutting resource which is why a water resources management agency was established to come up with principles and guidelines to be used in water allocation, water use permits, water quality, and water management at a catchment level. The structure and the distribution of the roles and responsibilities are clear which makes it easy to coordinate the institutions involved in water resources management.

**Table 4:** Comparison between Rwanda Institutional coordination and Kenya Water Resources Authority

Institutional responsibilities	Rwanda	Kenya
<b>Planning/Policy formulation</b>	<ul style="list-style-type: none"> <li>- Ministry of Natural Resources</li> <li>- Ministry of Local Government Ministry of Agriculture, Animal Resources and affiliated agencies - Ministry of Infrastructure</li> <li>- Ministry of Health</li> <li>- Ministry of Family and Gender Promotion</li> <li>- Ministry of Education</li> <li>- Ministry of Commerce and affiliated agencies</li> <li>- Ministry of Foreign Affairs and Cooperation</li> <li>- Ministry of Disaster Management and Refugee Affairs</li> <li>- Ministry of Defense</li> </ul>	<ul style="list-style-type: none"> <li>- Ministry of Water and Irrigation</li> <li>- Water Resources Management Authority</li> </ul>
<b>Financing</b>	<ul style="list-style-type: none"> <li>- Ministry of Finance, Planning, and Economic Development</li> <li>- Development partners</li> </ul>	<ul style="list-style-type: none"> <li>- Ministry of Finance</li> <li>- Development partners</li> </ul>
<b>Regulation</b>	<ul style="list-style-type: none"> <li>- Rwanda Environment Management Authority (REMA)</li> <li>- Rwanda Utilities Regulatory Agency (RURA)</li> <li>- Rwanda Bureau of Standards (RBS)</li> <li>- Rwanda Natural Resources Authority (RNRA)</li> </ul>	<ul style="list-style-type: none"> <li>- Water Resources Management Authority</li> <li>- Water Services Regulatory Board (Issuing permits)</li> </ul>
<b>Implementation</b>	<ul style="list-style-type: none"> <li>• Water and Sanitation Cooperation (WASAC)</li> <li>• Rwanda Development Board(RDB)</li> <li>• User Communities</li> <li>• Districts</li> <li>• Private Sector</li> <li>• (NGOs)</li> </ul>	<ul style="list-style-type: none"> <li>• Water Resources Management Authority(WRMA)</li> <li>• Water Service Providers</li> <li>• Ministries that have activities linked to water</li> <li>• Local authority</li> <li>• NGOs</li> <li>• CBOs</li> </ul>
<b>Monitoring and Evaluation</b>		<ul style="list-style-type: none"> <li>• Ministry of water and irrigation</li> </ul>

### 3.5 The proposed sustainable water resources management institutional framework

For Rwandan Water Resources Management Authority (RWRMA) to undertake its stipulated responsibilities, the Act provides for decentralized and stakeholder involvement. This will be implemented through District offices of the Authority based on catchment areas assisted by catchment advisory committees representing each District shared the same catchment. At the users' level, stakeholder engagement will be through water resource user groups. Table 5 describes how the proposed institutional framework for water resources management will work.

**Table 5:** Proposed institutional framework of water resources management

	<b>Department</b>	<b>Function and Responsibilities</b>
National level	Rwanda Water resources management authority (RWRMA)	<ul style="list-style-type: none"> <li>• It will develop principles, guidelines, and procedures for the allocation of water resources;</li> <li>• Assess and reassess the potential of water resources;</li> <li>• Receive and determine applications for permits for water use;</li> <li>• Monitor and enforce conditions attached to the permits for water use;</li> <li>• Regulate and protect the quality of water resources from adverse impacts;</li> <li>• Manage and protect catchment areas; determine charges and fees to be imposed for the use of water from any water source;</li> <li>• Gather and maintain information on water resources from time to time in order to publish forecasts, projections, and information on water resources; and</li> <li>• Work with other bodies for the better regulation and management of water resources.</li> </ul>
	Transboundary Unit	<ul style="list-style-type: none"> <li>• responsible for any conflict that would rise between shared resources between counties.</li> </ul>
Catchment-level	RWRMA District offices unit	This will consist of government officials, water users, and communities.
	Catchment advisory committees' unit	Their role includes advising RWRMA officers at catchment level on: <ul style="list-style-type: none"> <li>• water resource conservation, use, and apportionment;</li> <li>• the granting, adjustment, cancellation, or variation of any permit; and</li> <li>• any other matter pertinent to the proper management of water resources.</li> </ul>
	Water resources user groups unit	These will provide a forum for conflict resolution and cooperative management of water resources in designated catchment areas. They will be responsible for conserving the watershed and advising the Catchment advisory committees on the available water that may be allocated or re-allocated to other water users.

#### 4. CONCLUSION

Rwanda has its responsibilities to manage and develop water resources in an integrated and sustainable way ensuring the full participatory of all stakeholders to maximize the utilization of its resources equitably for sustainable development. To be able to implement this, appropriate institutions should be put in place with clear roles and responsibilities to ensure efficient and effective implementation. This is not totally met in Rwanda because of the overlap of roles among stakeholders and the centralization of the decision-making process. The results show that restructuring and decentralization of water institutions are needed in the Rwandan water sector. The solution of the increased pressure on water resource and environment throughout the country is undeniable therefore water laws and policies must be put in place to facilitate the establishment of Rwandan Water Resources Management Authority that has the power to control and coordinate the national water resources.

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