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Water Resources Management and Integrated Water Resources Management (IWRM) in Cameroon

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Abstract Cameroon is blessed with abundant water resources. Rapid population increase, unplanned urbanisation, intensive industrial and socio-economic development have led to poor and unsustainable management of these resources. Integrated Water Resources Management (IWRM) is a promising approach in ensuring sustainable management of Cameroon's water resources. It entails management of water for various purposes and not for a single purpose which therefore involves different stake holders aiming at achieving sustainable water resources management. This paper seeks to evaluate recent efforts to implement in IWRM in Cameroon by examining the institutional framework for IWRM in Cameroon, conditions for the implementation of IWRM and proposes reforms for improving IWRM in Cameroon. The paper concludes that reforms such as public participation at local council levels, recognition of water as both an economic and a social good, putting IWRM within the larger context of Integrated Natural Resource Management (INRM) and the exploitation of mathematical models within hydrological basins will improve IWRM in Cameroon.

Keywords Water resources management · Integrated Water Resources Management · Cameroon

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1 Introduction

Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare, paving the way towards sustainable development, in an equitable manner without compromising the sustainability of vital ecosystems (GWP 2000).

Internationally it has been recognized that the most important challenge to ensuring sustainable water use is implementing IWRM. It provides the best framework for balancing the competing demands for water and facilitating collaboration between political entities and agencies. Technological advances, while important are ineffective if not implemented or if not adequately managed when implemented. IWRM starts with gathering comprehensive data on the basin (physical and socio-economic) and developing models of the physical systems (hydrology, hydrogeology and hydraulics). Analysis of the current governance and management then provides the basis for developing improvements in the socio-economic management of the resource which must be placed within the local governance and legal frameworks (Carrera-Hernandez 2008).

IWRM is a promising approach in ensuring sustainable use of water resource and aims at focusing on proper usage and development of water resources through efficient and environmentally sound manner which not only satisfy demands for water but also safeguard freshwater (UN 1992). It is documented that in most cases water resources management is based on immediate needs and interest (Abu-Zeid 1998). Also water resources management has been carried out in isolation from other resources (land and forest) which can equally impact availability of water. Management of water resources in isolation most often results to immediate needs most often results to continuous degradation of water resources and increasing water scarcity. Integrated water resource resources management will help ensure continuous devotion, since issues of sustainable water supply, sanitation, waste treatment, irrigation schemes, drainage and watershed conservation cannot be properly dealt with ad hoc measures (Dungumaro 2006). Integrated water resources management is generally concerned with the management of water resources demand and supply (GWP 2000). The aim is to use a multidisciplinary and interdisciplinary approach to achieve sustainable water resourced use. IWRM became necessary from the regular interaction, uses and interest of interdependent groups that converge around a whole (GWP 2000). Integration ensures respect and consideration of the needs and interest of each stake holder.

As stated in Agenda 21 and adopted by the United Nation's Conference on Environment and Development, Rio de Janeiro, 1992, "Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the availability of the resource, in order to satisfy and reconcile needs for water in human activities." The Conference further stated "The holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programs within the framework of national economic and social policy, are of paramount importance for action in the 1990s and beyond" (UN 1992).

In the absence of proper water management, conflict within countries often arise because of competing water uses, and from competing jurisdictional mandates of agencies dealing with water issues (Yilma and Donkor 1997). Cameroon for instance has many rivers that it shares with other countries. These are the Benoue River (shared with Nigeria). Cross River and River Munaya (shared with Nigeria). The Ngoko, Sangha and the Dja Rivers main tributaries of the Congo basin take their rise from Cameroon. It is critical therefore that the country has a successful water resource management to avoid conflict with the countries that share these rivers. Even among individuals and between institutions in the absence of effective coordination among water resources stake holders, more conflicts are likely to occur. In Cameroon, competition over water is already evident where more than 99% of installed electricity generation capacity relies on hydropower. Conflicting priorities for water in many cities coupled to the effect of climate change have created power shortages in the hydropower generation which have resulted in frequent power shortages and blackouts which affect citizens and industries in Cameroon since the 1990s. Competition over water uses for agriculture and domestic purposes is already evident in the North of the country.

With an integrated approach to water resource management there are important institutional dimensions to help avoid such conflicts related to water management. Continuous water scarcity that is experienced in the Northern part of Cameroon and in most urban cities in the country necessitates the adoption of IWRM approaches. Increasing competition of the main water uses, domestic, industrial and agriculture also calls for effective and sustainable water resources management. Dungumaro (2006) has demonstrated that agriculture has remained the largest water user in some developing countries. With increasing population, it is expected the amount of water for agriculture will increase since agriculture is the back bone of many developing countries especially Cameroon. There is also a rapid expansion in industrialisation, which when combined with the rapid unplanned population will intensify the competition and conflicts for water resources.

The urban population of Cameroon has a growth rate of 3.2% per on average mean while in the big cities like Douala and Yaoundé the annual growth rates of above 5% have been registered (Démo 1987; DSCN 1999). This therefore calls for effective and sustainable water resources management.

This paper seeks to evaluate recent efforts to implement in IWRM in Cameroon by examining the institutional framework for IWRM in Cameroon, conditions for the implementation of IWRM and proposes reforms forimproving IWRM in Cameroon.

2 Research Methodology

Data sources for the present study include bibliographic research, analysis of reports, field observations and interviews of institutional and non-institutional stake holders in the water domain.

3 Study Area

Cameroon is hinged between West and Central Africa at the extreme northeastern end of the Gulf of Guinea and is considered to be in the central Africa sub-region

(Fig. 1). It lies between latitudes 2° and 13° north of the equator, extending from the Gulf of Guinea to Lake Chad over a distance of about 1,200 km and between longitude 8° and 16° east of the Greenwich Meridian and extends over a distance of 800 km at the widest portion. It has a total surface area of about 475,650 km^2 with a mainland surface area of 466,050 km^2 and a maritime surface area of 9,600 km^2 (NIS 2001).Cameroon is bounded by Lake Chad in the north, the Republic of Chad in the northeast, and the Central African Republic in the east. In the south are the Republic of Congo, Republic of Gabon and Equatorial Guinea; and in the west by the Federal Republic of Nigeria and about 400 km of coastline with the Atlantic Ocean.

The estimated population is 18 million (WHO/UNICEF 2008), with more than half under age 25. The urban and rural populations are about the same size, although urbanization is increasing by 4.7% per year, on average. About 35% of the urban population lives in the economic capital, Douala, or the administrative capital, Yaoundé.

Cameroon has a varied landscape with many plains, plateaux and highlands. Neba (1999) distinguishes the following five main physical features of the country: the Coastal Lowlands; the Southern Plateau; the Adamawa Plateau; the Western Highlands, and the Northern Lowlands. The vegetation in the equatorial zone is dominated by equatorial forests, mangrove forests in the coastal areas, and guinea savannah in the rest of the zone. In the tropical climate zone, the vegetation is mainly Sudan savannah, and Sahel savannah in the extreme north portion of the country.

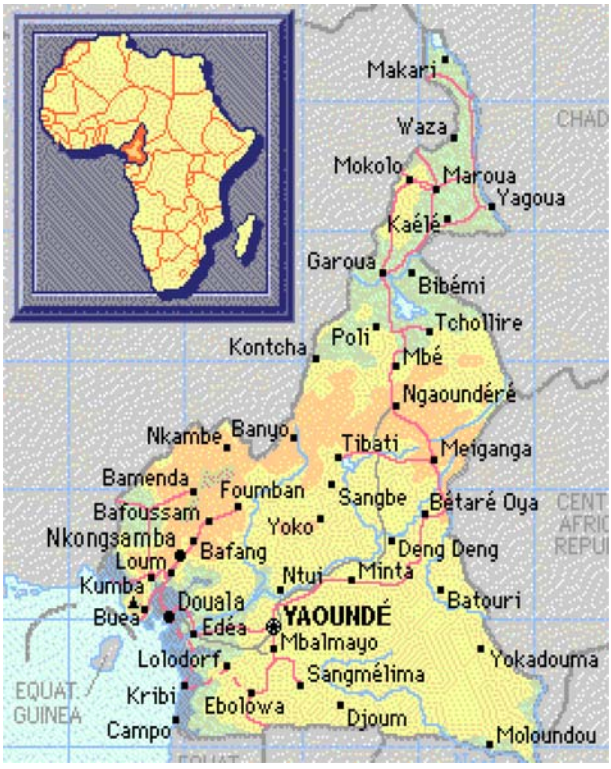

Fig. 1 Location of Cameroon

There are three main climatic zones in Cameroon: the equatorial climate extending from the coast to the Southern Plateau (green forest zone); the equatorial transition climate extends from the southern plateau (latitude 6° N) to the Adamawa Plateau; and the tropical climate extending from the Adamawa plateau to Lake Chad.

Rainfall distribution in the country is a function of the climate type. Precipitation diminishes from a maximum of more than 9,000 mm/year in the south to less than 300 mm/year in the extreme north. The average annual rainfall of Cameroon is 1,684 mm (Sigha-Nkamdjou et al. 2002). Based on a land area of 466,050 km^2, the total annual volume of rainfall in Cameroon is 784.8 km^3 with about two-thirds in the south and about a third in the north of the country.

Generally, rainfall is high and this provide for the abundant surface and groundwater resources. Cameroon is the second country in Africa (after the Democratic Republic of Congo) in terms of quantity of available water resources estimated to be 322 billion cubic meters (Mafany and Fantong 2006). This gives an annual available water per inhabitant of 21,000 m^3 in Cameroon that is three times the world's average (7,000 m^3) but water still remains a scarce resource because of inadequate management practices (Mafany and Fantong 2006).

Cameroon has a dense network of rivers most of which arise from the Adamawa Plateau at the centre of the country and flow north and southwards. There are six main river basins in Cameroon namely; the Sanaga Basin, Sanaga West Basin, Sanaga South Basin (these three constitute the Atlantic Basin), Niger, Congo and Chad basins.

Of the 322 billion cubic meters of total available water resources, groundwater constitutes 21% (57 billion cubic meters) of this resource (Sigha-Nkamdjou et al. 1998). Groundwater in Cameroon occurs in all rock types crystalline (metamorphic/plutonic), volcanic and sedimentary.

Cameroon is ranked 49th out of 182 countries in the world in terms of abundant water supply. Compared to the per capita average annual internal renewable water resources of the world of 7,044 and 5,152 m^3 for Africa (UNDP et al. 2000), as a nation, Cameroon is thus one of the countries blessed with abundant water resources. Both surface and groundwater resources are available. Many lakes of varying sizes and shapes are also present. This shows that the country is relatively rich in water resources. However these water resources are not evenly distributed due to variations in the topography, rainfall pattern and climatic changes. Demand for water exceeds supply in most rural areas (MINMEE 1997).

While Cameroon is not yet on track to meet the targets of the Millennium Development Goals (MDGs) for water and sanitation, it has made notable progress since 1990 (UNESCO 2009). In 2006, 70% of the population had access to safe drinking water. The coverage in urban centres is 88%, significantly better than the 47% in rural areas (WHO/UNICEF 2008). Of Cameroon's 300 urban centres with 5,000 inhabitants or more, only 98 have water supply networks. Moreover, rapid urbanization in smaller towns has often rendered existing infrastructure inadequate, with frequent service interruptions. Many periurban dwellers also lack access to safe drinking water. Another problem is the amount of water unaccounted for: the average rate of loss rose from 25% in 1990 to 40% in 2000, clearly indicating an aging network and poor maintenance. Hence, in reality, the supply situation is worse than the figures imply (UNESCO 2009). Sanitation coverage is also poor.

In urban areas only Sanitation coverage is also poor. In urban areas only 58% of the population has access to improved sanitation facilities, and the rate in rural areas is 42% (WHO/UNICEF 2008). The above mentioned problems, impact of climate change, population increase, industrial development and other factors which contribute to water shortages call for a good water resources management scheme in Cameroon.

The biggest problem in Cameroon is not the availability of water—it is the poor management and development of the resources, coupled with inadequate political will and commitment for the long term (MINMEE 2004). The patchiness of information available on the quality and quantity of water resources is a major constraint for successful water resources management and a handicap for poverty alleviation efforts. Although progress has been made in water supply and sanitation coverage, much more needs to be done to improve the situation, especially in rural areas. The enabling environment for application of the IWRM approach is weak, as are institutional frameworks. In this situation, Cameroon is lagging in meeting the MDG targets. Improving water information systems, as well as completion and implementation of an IWRM plan, would go a long way towards improving water security in Cameroon, in addition to contributing to poverty alleviation.

Agriculture is the backbone of Cameroon's economy, accounting for about 41% of GDP (World Bank 2007) and 55% of the workforce (WRI 2007). At about 69,750 km^2, arable land amounts to 15% of the overall surface area. About 29% of the arable land is cultivated, mostly in the west and south-west (Aquastat 2007). The share of the population working in agriculture has been decreasing since the 1970s, but as productivity has increased over the same period, food security has not been directly affected. Irrigation has contributed substantially to productivity, making cultivation possible during the dry season. In 2000, irrigated area of about 224.5 km^2 (excluding 28 km^2 of spate irrigation, where floods are diverted from ephemeral rivers to cultivate crops) corresponded to around 8% of the potentially irrigable area. Large irrigation projects (more than 2 km^2) accounted for roughly 65% of the irrigated area (Aquastat 2005).

4 Integrated Water Resources Management

The development of the idea of IWRM started following the 1992 Dublin Conference on Water and Sustainable Development intended to prepare for the Earth Summit in Rio that same year. The Global Water Partnership (GWP 2000) defines IWRM as a process, which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems. Four principles, known as the Dublin Principles, which emerged from the conference, have now become the cornerstone of the debate on international approaches to water policies (UNESCO 2003). These are:

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment
- Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels

- Women play a central part in the provision, management and safeguarding of water
- Water has an economic value in all its competing uses and should be recognized as an economic good

IWRM explicitly challenges conventional, fractional water development and management systems and places emphasis on integrated approach with more coordinated decision making across sectors and scales. Recognising that exclusively top-down, supply led, technically based and sectoral approaches to water management are imposing unsustainably high economic, social and ecological costs on human societies and on the natural environment (http://www.archive.cap-net.org/iwrm_tutorial/8_1.htm, accessed April 2009). As a process of change which seeks to shift water development and management systems from their currently unsustainable forms, IWRM has no fixed beginnings and will probably never end (GWP 2000). The global economy and society are dynamic and the natural environment is also subject to change, IWRM systems will, therefore, need to be responsive to change and be capable of adapting to new economic, social and environmental conditions and to changing human values (InfoResorces 2003).

At it's simplest, IRWM is a logical and intuitively appealing concept. It's basis is that the many different uses of finite water resources are interdependent (GWP 2000). High irrigation demands and polluted drainage flows from agriculture mean less freshwater for drinking or industrial use; contaminated municipal and industrial wastewater pollutes rivers and threatens ecosystems; if water has to be left in a river to protect fisheries and ecosystems, less can be diverted to grow crops. There are many more examples of the basic theme that unregulated use of scarce water resources is wasteful and inherently unsustainable (GWP-TAC 2000).

5 Institutional Framework for IWRM in Cameroon

Cameroon did not have a national IWRM plan nor an action plan for basins until the end of 2007. This plan was elaborated by Ministry of Water and Energy (MINEE) with support from CAfTAC and input from multi stakeholders using the Global Water Partnership as a platform for participation.

Activities were carried out to raise awareness in the public and amongst decision makers in Cameroon have been carried out by CAfTAC-GWP as part of its activities. The initiation of the Dutch Initiative project was carried out with the support of the government of Cameroon whose responsibility was to develop and implement an IWRM plan. The National Water Committee is envisaged to be the steering committee of the Project Management Team for the elaboration of the IWRM plan given its role as a consultative body of the government to define and put in place water policy in Cameroon (Fonteh 2003).

5.1 Water Legislation

The 1996 law on the environment and the 1998 law on water are the corner stones of the current legislation on water (MINEF 2000). The water law is intended to

complement the law on the environment and hence the principles contained in the law on the environment also apply to water.

- These laws adhere to the first Dublin principle of water being a finite and vulnerable resource by making provision for the protection and conservation of water resources.
- The current laws have the possibility of decentralizing part of the management role of the state to local entities and calls for the participatory approach in management. However, the participatory role of the community seems to be limited to access to information and providing opinions in public debates. The role of the community is therefore advisory and appears that the community cannot decide and implement a certain action alone.
- The current laws do not expressly single out women as central players in managing water as prescribed by the third Dublin principle.
- The economic value of water is recognized but the law does not go far enough in prescribing full cost recovery. Only major commercial and industrial users are called upon to pay an abstraction fee. Utility companies do not pay such a fee and hence the price of water to be paid by consumers for domestic use only relates to the capital and operating costs of the works needed to abstract, treat and transfer water to the point at which it is used.

5.2 Organisational Structures for Managing Water in Cameroon

The institutional framework of Cameroon's water sector is characterised by the central role played by the Ministry of Water and Energy (MINEE) and due to the transversal nature of water resources, other public institutions do intervene into the water sector. They include: Ministry of Urban Development and Housing (MINDUH), Ministry of Towns (MINVILLE), Ministry of Agriculture and Rural Development (MINADER), Ministry of Livestock, Fisheries and Animal Industries (MINEPIA), Ministry of Environment and Nature Protection (MINEP), Ministry of Economy, Planning and Regional Development (MINEPAT), Ministry of Public Health (MINSANTE), Ministry of Commerce (MINCOMMERCE), Ministry of Territorial Administration and Decentralisation (MINATD), Ministry of Finance (MINFI) and Ministry of Transport (MINTRANS).

The Ministry of Water and Energy (MINEE) is responsible for the definition and application of water policies in Cameroon and is the coordinating institution as regards water in Cameroon. It is responsible for the execution of projects on managing pollution, water supply and sanitation in both urban and rural areas in the country. This ministry is responsible for enforcing pollution control measures, determining the sanctions for defaulters and determining consumption of industrial/commercial users to facilitate the calculation of abstraction fees. MINEE has the mandate to issue abstraction and discharge licences following the text of applications signed in May 2001 to enforce the water law of 1998.

Other actors like the private sector (the national water utility company (CAMWATER) and that of electricity (AES-SONEL)) and Non Governmental Organizations (NGOs) play an important role in the mobilisation and management of water resources. International aid organisations play an essential role in the financing of hydraulic infrastructures and provide technical and financial assistance in the water sector (MINEE 2005).

5.3 Membership in Trans-Boundary River Basin Organisation

Three of the four main river basins in Cameroon are part of three main river basins in Africa. These are Niger, Lake Chad and the Congo Basin (Olivry 1986). These three river basins are among the five most important basins in Africa covering about one third of the continent and involving 23 different countries. Cameroon falls within seven international or trans-boundary basins as shown on Table 1.

6 Implementation of IWRM Principles in Cameroon

6.1 Conditions for the Implementation of IWRM

The conditions for the adoption of IWRM are thought to be favorable in Cameroon. Water resource management in Cameroon is a severe constraint to poverty alleviation and to sustainable development. This is because significant sections of the population suffer debilitating disease and economic hardship mainly due to poor management rather than actual water shortage. The country is endowed with abundant fresh water resources but the water and sanitation sectors are faced with the following problems which call the implantation of IWRM.

There is a problem of access to potable water supply in towns and villages. Based on estimations carried out by the FAO in 2002, about 18.5% of fresh water mobilized in Cameroon is used for domestic consumption. The challenge of access to potable water of the population following the Millennium Development Goals is an essential objective of the national water policy especially as about 42% of the population does not have access to adequate drinking water and particularly in rural areas with 58% and 23% in urban zones (MINEE 2005). The principal urban centres are

Table 1 Trans-boundary river basins in Cameroon

	Total area of basin, km^2	Countries in basin	Area of Cameroon in basin, km^2	% of basin in Cameroon
Akpa	4,900	Cameroon Nigeria	3,000	61.65
Benito/Ntem	45,100	Cameroon Gabon Equatorial Guinea	18,900	41.87
Congo basin	3,691,000	13 countries	85,200	2.31
Cross	52,800	Cameroon Nigeria	12,500	23.66
Lake Chad	2,388,700	9 countries	46,800	1.96
Niger (Benoue in Cameroon)	2,113,200	11 countries	88,100	4.17
Ogooue	223,000	Gabon Congo Brazzaville Cameroon Equatorial Guinea	5,200	2.34
Total			259,700	

Source: OSU (2002)

supplied with potable water by CAMWATER while the rural population makes use of groundwater resources through boreholes equipped with manual pumps, wells and springs.

There is a problem of securing agricultural production and food security through irrigation. Cameroon's agro-climatic context can be presented in two situations (1) the northern regions where better water management and the development of irrigation will provide food security in response to repeated climate change due to desertification (2) the southern parts of the country where irrigation will increase agricultural productivity. Cameroon which is the bread basket of the Central African sub-region, therefore have an opportunity to increase its potential in terms of food and cash (cacao, coffee, etc) crops production. With a hydroagricultural potential of 240,000 ha, only 23,900 ha are irrigated, i.e. about 10% (Aquastat 2007).

Problems of water supply for cattle rearing exist in the northern regions of Cameroon. The problem of pastoral hydraulics in the northern regions is less one of water availability than that of spatial distribution. There is dichotomy between the location of water points and grazing areas. For a harmonious development of cattle rearing, the two factors need to be put together to prevent migration.

Another problem is that of hydroelectric production. After the Democratic Republic of Congo, Cameroon is the second country in Africa with the highest hydroelectric potential. More than 110 sites have been identified which can have a cumulative production of electricity of more than 50,000 MW (MINEE 2005). The two most important hydroelectric plants of the country, Edea (264 MW) and Song Loulou (384 MW) are located on the River Sanaga. Due to reduction of water in the Sanaga river basin, Cameroon is currently suffering from a large deficit of electricity because AES-SONEL can only supply 480 MW while national demand stands at 535 MW. Due to the recovery of the economy after the economic crisis, there has been an increase in demand of electric power of 8% per year during the last 10 years. Hydroelectric power production represents about 75% of total electricity production while 25% is by thermal power (MINEE 2005). Only about 41% of the Cameroonian population is supplied with electricity with a lot of disparity between urban and rural areas. The current production of electricity is not sufficient to meet the demand especially in the dry season, which has resulted in power rationing in recent years. In order to ensure that energy requirements are met in a sustainable manner, there is a need to increase the developed capacity of hydro-electricity and to implement conservation measures aimed at ensuring adequate flows in the rivers.

The protection of water resources from degradation is constitutes another problem which necessitates the implementation of IWRM. The causes of degradation of water resources are: (1) climatic origin (2) anthropogenic origin. Concerning climatic causes, in the northern portion of Cameroon for about 30 years now, there has been reduction and irregularity of rainfall. This situation has resulted in persistent drought leading to the fragilisation of ecosystems and a reduction of the potential of natural resources like soils, fauna, flora, surface and groundwater resources. Also in the northern regions, due to increase in population there is over exploitation of natural resources like wood for energy, fragilisation of soils and destruction of vegetative cover due to slash and burn farming systems, forest fires which destroy vegetation and natural grazing land. The soils left bare by human activities are thus exposed

directly to agents of erosion leading to sedimentation of streams, rivers and lakes. The problems of silting and sedimentation are observed in all the streams and rivers of Cameroon. The sector of river navigation is the most affected by this phenomenon since the period of navigability of rivers is reduced from year to year. Water resources are equally subjected to increasing risks of pollution linked to human activities from (1) solid wastes and domestic wastewater which are dumped directly into water bodies (2) industrial activities with effluents from most of the industries discharged into streams and rivers without prior treatment (MINEF 1996).

Problems linked with navigation of the main rivers of the country also necessitate the implementation of IWRM. River transport constitutes a major means of transport of goods and persons in the country. Silting and sedimentation are observed in all the streams and rivers of Cameroon and river transport is the most affected by this phenomenon since the period of navigability of rivers is reduced from year to year. 80% of trade by the local populations is by river transport (MINEE 2005).

Cameroon's territory is made of three large international river basins which are: Niger, Lake Chad and Congo. The Niger River basin is made up of eight countries of the sub-region (Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Guinea, Niger, Nigeria and Chad) whiles the Congo basin is made up of four countries (Cameroon, Democratic Republic of Congo, Central African Republic and Republic of Congo). Thus, trans boundary water management should be an important factor in the implementation of IWRM in Cameroon. The problem posed is that of mutual cooperation by all the countries sharing the same hydrographic basin in the perspective of sustainable development of the basin within the norms of trans boundary water management.

Problems in the fishing sector need to be examined for sustainable resource management. The fishery sector plays an important nutritional role since fish products make up nearly a third of the animal proteins consumed in Cameroon and occupies 5% of the active production. Its contribution to the GNP of the primary sector is about 5% (MINEE 2005). For some years now, the annual production is around 125,000 tons of fish. This production is not able to satisfy the increasing national demand estimated at 200,000 tons. To fill this deficit, Cameroon imports about 60,000 tons of fish annually estimated at 15.6 billion FCFA (MINEE 2005). Fishing has great potentials for development as the country has a 360 km long maritime façade. The main constraints for the development of artisanal, continental and maritime fishing are: (a) Enclavement of production zones and absence of distribution network within the country (b) Use of rudimentary equipment and techniques of production and conservation (c) Difficult access to finances (d) Insufficiency of control and follow up mechanisms in the fishery sector (e) Lack of organization of fisher men and other actors.

This current sectorial approach of water management cannot resolve sustainably the present and future problems of availability and quality of water resources. Only a global vision like IWRM which takes into account the dynamics of water resources within hydrographic basins or aquifers, with the participation of the all the actors of the water domain within a new management framework, reconciling all development stakeholders of the country without compromising the capacity of future generations of assuring theirs.

7 Improving IWRM in Cameroon

There are a number of factors to be given due consideration in order to improve integrated water resources management in Cameroon. These factors include:

(a) Institutional framework

Effective institutional framework governing water resources is very critical for successful water resources management. Effective institutional framework should dearly define the roles and responsibility of each stake holder. In Cameroon there is no institutional framework governing water resources. Resources are managed by a multitude of institutions. The organisation is partitioned in several ministries, companies of state, Non-Governmental Organisations, universities and institutes of research, which are responsible for various aspects of the resources. All these structures work without any systematic coordination (Djeuda Tchanga et al. 2001). There is no joint action in the management of the water resources. It is the control of many ministries like the Ministry of Water and Energy, Ministry of Scientific Research and Innovation, Ministry of Higher Education, Ministries of Towns, Ministry of Agriculture and Rural Development, Ministry of Environment and Nature Protection, Ministry of Livestock, Fisheries and Animal Industries, Ministry of Public Health, Ministry of Commerce, and Ministry of Finance (MINEE 2005). This fact poses the problem of coordination in the actions of the various entities as each structure is unaware of the others functions. There is no synergy between the structures. Information is disseminated and unknown to users of the resources. There is the need for effective institutional framework that clearly defines the roles and responsibilities of each stake holder ensuring the absence of competition and overlapping organs. Effective institutional framework can enable provision of water for people while enabling conservation and protection practices.

(b) Public participation

The provision of safe drinking water and adequate water supply services to all people is one of the key development challenges faced by sub-Saharan Africa in particular. The recognition that inadequate water supply and sanitation negatively impacts public health and development has resulted in a number of international initiatives: two UN water decades from 1981 to 1990 and 2005 to 2015, World Water Forums, Millennium Development Goals. Lessons emerging from past experience are shifting efforts towards support for improvements in water governance and management devolving responsibilities to the local level and building the capacity of stakeholders to drive the decision-making process in a more inclusive and transparent manner.

A common paradigm within the context of IWRM is the relevance of the participatory approach, which is becoming a prerequisite of every legislation and plan. Public Participation (PP) is also one of the principles of the Dublin Convention (GWP 2000). According to the GWP, PP requires "that stakeholders at all levels of the social structure have an impact on decisions at different levels of water management". Only PP at all levels (international, national regional and local) may assure transparency and accountability of the policy/decision process. In the field of water management, integrated approaches to the resource imply the need for considering the social aspects of water use, as well as the economic and environmental spheres (Giupponi and Sgobbi 2008).

Public participation is very important in water resources management from the view point of the use of indigenous knowledge because the local community can also provide an important data base, experience and ideas that could lead to relevant, and achievable solutions to water related problems. Also if the local population are made to participate in public decision making process especially on issues in water resources management, it will be easier for them to realise and eventually change their practices which have negative impacts on water resources and reinforce the ones with positive results. According to Dungumaro and Madulu (2003) lack of public trust might lead to unnecessary and unavoidable protest and antagonism between water resources users and other stake holders due to varying interest and demands.

Although many researchers agree on the importance of involving local community in IWRM, the level of participation is still low in most developing countries, especially Cameroon. Several successful water resources management cases which ensured full participation of the local population exist in many rural areas of Cameroon. Many small water projects in rural areas of the Manyu Division of the South West Region of Cameroon involve the local community who protected their catchments through building of fence around the water points and regular cleaning of water point is ensured (DRAC 1998).

(c) Recognition of water as an economic good

Water for irrigation purposes, industrial use and partly also for household needs and services is an economic good. Its price and quality should be demand driven, i.e., supply and demand should control price. As a matter of principle, users should pay the full costs for water being used in excess of 50 l per capita per day (Zehnder Alexander et al. 2003). Currently, however, this is not the case in most countries, Cameroon inclusive. Because the distribution of tap water is supply driven, most of the water and/or the distribution systems are subsidized (even for industrial supply) using the public task as argument to deliver at any moment and at any place sufficient water. Distribution networks are designed to deliver much more water than the basic needs. Progressive prices, therefore, should be made in such a way that the basic needs are affordable for everyone and other uses being covered by market mechanisms. By imposing effluent charges, industrial water use drops drastically. After introducing charges in São Paulo, Brazil, water use in manufacturing declined between 42% and 62%, depending on the industry within 2 years (1980–1982). Similar results were obtained in the USA. In 1980 the industrial water consumption was 200 million cubic meters as compared to 130 million cubic meters in 1990 (Serageldin 1995). History has shown that many past failures in water resources management have been attributed to many factors which included non regarding of water as an economic good (Dungumaro 2006).

(d) Recognition of water as a social good.

Water is a special resource. Besides being an economic good, it is also a social and public good and should even become a human right. This human right should comprise the 30 to 50 l of high quality water or the “basic water requirements” as coined by Gleick (1998). Water has not been specifically included in the UN Declaration of Human rights, but it should have been. Gleick (1999) made a detailed and thoughtful plea for the Human Right to Water. The EU has enforced this view in its Water Framework Directives, which were put into effect in December 2000

(Dirksen 2002). The United Nations Committee on Economic, Cultural and Social Rights took the unprecedented step on November 27, 2002, of agreeing on a General Comment on water as a human right, saying, "Water is fundamental for life and health. The human right to water is indispensable for leading a healthy life in human dignity. It is a pre-requisite to the realization of all other human rights" (World Water Council 2002).

The following characteristics distinguish water from other goods (1) water is indispensable for human survival, without substitution (2) water is essential to produce food (3) water is essential for nature (4) water systems are large, multifunctional and require high investments (5) water assets are extremely durable, and maintenance can be neglected far longer than most industrial infrastructures (6) water and sanitation have a natural monopoly (7) water is very costly to transport, thus water markets for large quantities have been forced to remain as long as possible local. Given the above characteristics, water has to be considered a social as well as an economic good.

As stated by Gleick (1999) the access to a minimum of 30–50 l of high quality of water per day and capita at an affordable price should be a human right. Governments have the responsibility to ensure this basic requirement to be met for all. The 145 countries (including Cameroon) which have ratified the International Covenant on Economic, Social and Cultural Rights as appendix to the UN Human Rights Document (UN 2002) must progressively ensure that everyone has access to safe and secure drinking water and sanitation facilities—equitably and without discrimination. However, this does not imply that the (drinking) water has to be supplied free of charge. This is not only important for reasons of financial sustainability, but also because an appreciation of water only gets up when it costs something and care of the water supply infrastructure will be taken when water has a price. The price may be regulated within acceptable economic boundaries. Subsidies for the initial investments might be necessary and justified.

It is a problem however asking the rural poor to pay for their water consumption. DRAC (1998) has shown that most rural community put water as the number one priority development project when and if the local population are sensitised on a minimum cost that is just necessary to maintain the pipes payment of spare-points, installation, treatment plus management cost, the rural poor will be willing to pay for their water.

A common argument for low water price is that the poor cannot afford a real market price. This argument is only intuitive at best. In many places, because of lack of a tap in their houses or in the neighborhoods, the poor have to buy water from the street vendor. Thus, they are already paying market prices, which are often higher than those asked by utilities. From the 7.9 million inhabitants of Jakarta, for instance, only 14% receive water directly from the municipal system, 32% have to buy water from street vendors at a price between US$ 1.50 and 5.20 per cubic meter, depending on the distance from the public tap (Serageldin 1995). The ratio between prices charged by vendors and public utilities ranges between 4 and 100. A similar situation is also seen in many other places. In Cali, Columbia, the ratio is 10, Guayaquil, Ecuador, 20, Port-au-Prince, Haiti, 17–100, Karachi, Pakistan, 28–83 and Istanbul, Turkey, 10 (Bhatia and Falkenmark 1993).

(e) Putting IWRM within the context of Integrated Natural Resource Management (INRM) and the livelihoods approach.

Empowering poor people, reducing poverty, improving livelihoods, and promoting economic growth ought to be the basic objectives of IWRM. But as currently understood and used, IWRM often tends to focus on second-generation issues such as cost recovery, reallocation of water to "higher value" uses, and environmental conservation. Merrey et al. (2005) propose that IWRM needs to be placed in the broader context of both modern INRM and the livelihoods approach, which together take a holistic and people-centered approach. An alternative definition of IWRM as involving the promotion of human welfare, especially the reduction of poverty, encouragement of better livelihoods and balanced economic growth through effective democratic development and management of water and other natural resources in an integrated multilevel framework that is as equitable, sustainable, and transparent as possible, and conserves vital ecosystems is therefore proposed. Transparent user-friendly information and models for assisting decision making are essential features of livelihood-oriented IWRM (Merrey et al. 2005). Cameroon being part of the Congo Basin forest reserve should therefore place its IWRM policy within the broader perspective of INRM for the preservation of this important ecosystem to humanity and poverty alleviation of its population.

(f) Exploitation of Mathematical Modeling for the Integrated Management of Water Resources in Hydrological Basins.

Mathematical models are tools that can facilitate the instrumentation of IWRM (Humberto et al. 2009). It is possible today to identify, among others, two trends in the area of mathematical basin modeling: (1) hydrological models, which attempt to reproduce the behavior of components of the water cycle—through which rainfall transforms into runoff, and (2) Decision-making Support Systems (DSS), which attempt to reproduce the behavior of various physical, natural, social and economic processes that can interact in a hydrological basin. Decision-making Support Systems are used in search of an integral management focus. They can incorporate surface runoff generation, its interaction with groundwater, runoff routing models, estimation models for the water requirements of agriculture, precipitation, and soil humidity models, water quality and contaminant transport models, as well as socioeconomic factors that could affect decision-making (Lanini et al. 2004).

The fundamental demand of IWRM in hydrological basins is the creation of a participative work frame for decision making where all the water-using sectors, including the environment, are represented. In order for mathematical basin models to be compatible with this social participation framework, they must be versatile and represent not only the hydrological behavior of the basin but also the operative aspects of the infrastructure therein and the social, economic, environmental, normative and legal aspects that can affect the definition of management schemes. In addition to having this holistic approach, they must really facilitate communication and provide a level of trust, transparency and accessibility satisfactory in the opinion of those participating in the decision-making process (Humberto et al. 2009).

IWRM is a strategic planning process, with the finality of promoting the development and coordinated management of water and related natural resources, in order to achieve a better economic use and social well-being in an egalitarian way oriented towards the conservation of the environment. However, it is not limited to the management of the physical environment; it also refers to modifying social and institutional systems as necessary so that people can be benefited the most by the use of natural resources (Giupponi and Sgobbi 2008).

In IWRM, water is an essential element of the ecosystem. It is a natural resource and a social and economic commodity. Because of the complexity here involved, a variety of aspects have to be considered to take account of the interactions of water and society. In addition, stakeholders from various sectors are involved. The coordination of interests of between these groups might be very complicated. Decision-Support-Systems (DSS) support this complicated planning and decision process as was applied in the study of seawater intrusion in the Shandong Province of China (Zhang et al. 2006).

8 Conclusions and Recommendations

Given the variation in the nature and complexity of the issues and the jurisdiction of different institutions and organizations, the water and water-related problems have to be approached at different levels. Issues such as to guarantee the supply of basic water requirements, the economic allocation of water for other human purposes, the more efficient use of water by all users and the protection of water resources from pollution have to be solved primarily at the local level.

According to the Laws on Decentralization in Cameroon, councils are at the lowest institutional level of government responsible for basic service provision to the communities which include the sustainable supply, use and management of water resources. The elaboration of a council water resource management policy and strategy provides the council with a strong legal instrument to negotiate with the supervisory authority and external support agencies and is therefore a step towards self-reliance and empowerment of councils. A coherent policy and strategy are very useful instruments to plan, implement and monitor water related activities. It also facilitates the council's collaboration with different partners (civil society, private sector, state) and can be used as a sensitization and coordination tool for IWRM.

The problem that needs to be dealt with mainly at the regional level is the fair allocation of the water recourses among the different requirements and user segments in a catchment and watershed. Being a member of seven international or trans-boundary basins, transboundary water management should therefore be an integral part of Cameroon's IWRM strategy.

If well implemented in Cameroon, IWRM can serve as a mechanism for equitable use of water for growth and development, help in the reduction of poverty and hunger, increase well-being and improve sustainable environmental management thereby attaining the Millennium Development Goals.

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