The Ruzizi River Water Management for the Ruzizi Congolese Plain Wise Farming, Livestock, Fishing and Fish Trusting Productivity, Eastern Democratic Republic of Congo

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Research Article

Received: 19-Feb-2024, Manuscript No. JEAES-24-127836; **Editor assigned**: 21-Feb-2024, Pre QC No. JEAES-24-127836 (PQ); **Reviewed:** 06-Mar-2024, QC No. JEAES-24-127836; **Revised:** 13-Mar-2024, Manuscript No. JEAES-24-127836 (R); **Published:** 20-Mar-2024, DOI: 10.4172/2347-7830.12.01.002

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Citation: Alexis BB, et al. The Ruzizi River Water Management for the Ruzizi Congolese Plain Wise Farming, Livestock, Fishing and Fish Trusting Productivity, Eastern Democratic Republic of Congo. RRJ Ecol Environ

ABSTRACT

The Ruzizi river waters management follows from our investigations in 2010-2011 in the case of our master's thesis in environment and natural resources on the theme: "The Importance of Ruzizi Congolese Plain, South Kivu, Democratic Republic of Congo for the Conservation of Birds" and 2019-2021 as part of our doctoral thesis on the theme: "The Significance of Ruzizi Delta: Rusizi Burundian Delta and Ruzizi Congolese Delta, in the African Great Lakes Region for the Conservation of Birds". These investigations aim to raise the awareness of local, territorial, provincial and national Congolese decision-makers for the creation of a protected area meeting the Ramsar criteria in the Ruzizi Congolese plain/Ruzizi Congolese Delta, for the sustainable conservation of birds and biodiversity. This article informs that the thoughtful partial channelling of part of the waters of the Ruzizi river for irrigation, the creation of fish ponds and pastures away from the 50 m free from river banks, would lead to sustainable agricultural, ichthyologic and dairy productivity in the Ruzizi Congolese plain/Ruzizi Congolese Delta.

Keywords: Partial canalization; Fish ponds; Pasture irrigation; Sustainable agricultural, fish and dairy productivity; Protected area meeting the Ramsar criteria

Sci.2024;12:002

INTRODUCTION

The study area corresponds to the cross-border catchment area of the Ruzizi River outflowing from Lake Kivu up to its inflow into Lake Tanganyika. According to GEF, Global Environment Facility (GEF) 1, formed about 12 million years ago, Lake Tanganyika lies at an elevation of about 772 m above sea level in the Western part of the Great Rift Valley. With a length of 673 km, it is the longest lake in the world. It averages 50 km in width (at its widest it is 72 km), has a surface area of 32,900 km^2 and a shoreline length of 1,828 km [1].

It is, after Lake Victoria, Africa's second largest lake and the world's second deepest (1,471 m), after Lake Baikal. Two main rivers flow into the lake: The Ruzizi River which enters the north of the lake from Lake Kivu, and the Malagarazi River which enters the east side of the lake. There is one major outflow, the Lukuga River, which empties into the Congo River drainage [1]. The Ruzizi Congolese plain extends over approximately 1,345 km^2 at an altitude of between 950 and 770 m (ABAKIR, Lake Kivu and Ruzizi River Basin Authority (Autorité des Bassins du lac Kivu et de la rivière Ruzizi) [2]. The generally very rugged relief in the north of the Ruzizi basin is reflected in the often steep slopes, frequently exceeding 60% [2]. The geological configuration of the basin of Lake Kivu and the Ruzizi River is essentially made up of Precambrian age lithostratigraphic units [2]. The main metamorphic rocks are gneiss, gneissic and micaschist complexes, as well as quartzites, quartzite, granitoid and schist metasediments, and numerous granitic intrusions [2]. In addition to these Precambrian rocks, the study area also includes fluvio-lacustrine sedimentary deposits of Cenozoic age (mainly in the plain of the middle and lower Ruzizi), as well as volcanic rocks (mainly basaltic) that have been formed from the Tertiary period to the present day through successive volcanic eruptions [3]. The Ruzizi River, 168 km long, has an average annual flow of around 80 m^3/s [3]. It drains water from Lake Kivu to Lake Tanganyika and forms a natural border between Rwanda, DRC and Burundi. On the first 50 km long section from Lake Kivu to the locality of Kamanyola (upper river), the river is embedded between the steep, heavily deforested and bare watersheds of South Kivu in DRC and the District of Rusizi in Rwanda [3].

The river crosses an escarpment and the altitude decreases from 1,450 m to 962 m with numerous waterfalls (gorges), giving it significant potential for hydroelectric power generation [3]. After the escarpment zone, the Ruzizi River extends over a length of 118 km in the plain, gradually falling from an altitude of 962 m to 770 m with a low average slope, before flowing into Lake Tanganyika [3]. Currently, the fish farming sector in Congo Basin (10 countries) is damaged. Extensive fish production in rural area is insignificant due to mismanagement of ponds: No fertilization, degenerate strain of tilapia, no feeding, etc [4]. Semi-intensive and intensive fish production systems are not yet developed by any fish farmers; only a few exceptions as BTC (Belgian Technical Cooperation) fish culture project in Katanga [4]. The main reasons are: Inappropriate development policies and lack of strategies and development plans of the sub-sector [4]. Moreover, these multiple and uncoordinated interventions (bilateral, multilateral cooperation, many and various NGOs based on donations) have all followed approaches promoting subsistence aquaculture [4]. These projects, without an exit strategy, have not tried to develop it as a profitable business capable of generating significant revenues and competitive finance themselves and create well-paying jobs [4]. With these constraints are the lack of fish feed industries, difficult access to capital investment and the lack and /or inadequacy of quality seed, lack of qualified staff and lack of control of production technologies [4]. Canalization

from the Ruzizi River for artificial ponds creation by stakeholders may create jobs, promote intensive fish production in the rural areas of the Ruzizi Congolese plain, including the Ruzizi Congolese Delta. Irrigated agriculture is mainly found in the Ruzizi plain [4]. There are a large number of irrigated areas with a total surface area of 59,287 ha, mostly split between Burundi and DRC, of which the part corresponding to functional agricultural areas is only 12,500 ha [4]. Many African countries have been slow to understand the need to develop aquaculture but in recent years, Nigeria, Egypt, Uganda, Zambia and Ghana have recently substantial productions that only grow [4,5]. So we have that DR Congo as others countries of the Congo watershed follow suit because there is no other choice given the widespread overexploitation of all natural fish stocks in fresh, brackish and marine waters [5]. Immediately and independently of any research, DRC should develop the culture of one of the world best species for aquaculture whose culture is well-known and well controlled since a long time, namely *Oreochromis niloticus*, an endemic species of Africa, introduced and produced everywhere in the world [6-8]. To do this, the DRC should first develop good strains of *Oreochromis niloticus* (Tilapia) genetically improved and thus rapid growth [4]. According to Mushagalusa, Tilapia sp is the widely cultivated species (82.6%), followed by a combination of Tilapia-Catfish (17.3%) [9]. Fish are reared in medium-sized fishponds (358.7 ± 230.4 m^2) at unknown age (60.4%), with a reproduction rate of (54.7 ± 37.7 kg) per growth cycle. The main opportunities in aquaculture in South Kivu are water availability (13.5% in Kabare, 31.1% in the Ruzizi plain, and 15.3% in Walungu), the presence of a fish market, and availability of land suitable for aquaculture (27.1% in Kabare, 10.9% in the Ruzizi plain, and 15.3% in Walungu). On the other hand, the main constraints identified are lack of quality fry; 75.5% in Kabare and the high cost of labour, 60.9% in the Ruzizi plain and 60.9% in Walungu [9]. However, the agricultural potential of the entire plain is estimated at 125,713 ha. A monthly and annual water demand was determined for each of the irrigated areas. In total, the estimated annual water needs for the areas (functional, planned and projected) amount to 486 million m^3. The annual water needs corresponding to the functional areas amount to 102 million m^3, while the annual water needs corresponding to the irrigable potential of the whole plain are estimated at 1 billion m^3 [9]. As far as hydroelectricity is concerned, the three countries bordering the Ruzizi River decided several years ago to work together on the construction of run-of-river dams along the river's steep zone. The Ruzizi I power plant, operational since 1959, is located 3 km downstream from the outflow of Lake Kivu and has an installed capacity of 29.8 MW. The Ruzizi II power plant came into service in 1989, with an installed capacity of 43.8 MW. The Ruzizi III hydropower plant, with a planned installed capacity of 147 MW, will be the third hydropower development on the same Ruzizi River for which an agreement was signed between the three countries in July 2019 in Kinshasa. Finally, the African Development Bank approved in January 2020 a project to prepare the construction of a fourth power station, Ruzizi IV, which should be located between the Ruzizi II and Ruzizi III waterfalls, with an installed capacity of 287 MW [9].

Although the hydroelectric potential on the first 50 kilometres of the Ruzizi River is considerable as mentioned above, there are other sites with potential in the basin. Thus, in total, whilst the current installed capacity of the basin is 82 MW, the potential capacity is estimated at 681 MW [9]. Average outflow from Lake Kivu to Ruzizi is around 71 m^3/s in an average year [9]. At the Kamanyola level, the average flow of the Ruzizi River is estimated at 89 m^3/s in an average year [9]. Downstream at its entry into Lake Tanganyika, the Ruzizi River has a mean flow estimated at 206 m^3/s in an average year [9]. The major problem of physico-chemical quality of water in relation to surface water quality is the massive erosion observed in the basin, with an average soil loss value of around 100 t/ ha/ year in the Ruzizi Basin [9]. This erosion generates extremely high and widespread turbidity in most of the basin's watercourses flowing into Lake Tanganyika. The phenomena of sediment transport in the Ruzizi River and sediment accumulation, with the extreme turbidity, is one of the main environmental challenges facing the Ruzizi River basin

and the northern end of Lake Tanganyika [9]. In its upper course, in addition to the waters of the lake, the Ruzizi River collects the high salinity waters from the volcanic regions of South Kivu and the waters of the thermal springs [9]. The Ruzizi River retains in its upper course many of the physicochemical characteristics of the water of Lake Kivu: pH close to 9, electrical conductivity of around 1000 µS/cm, and high ionic concentrations (above 1 g/l) [9]. After crossing the volcanic zones and entering the plain, the salinity decreases from upstream to downstream, under the effect of dilution by the tributaries of the low mean salinity of Ruzizi River [9]. In fact, the tributaries of the Ruzizi show, overall, pH values close to neutrality, and very low electrical conductivity (rarely exceeding 200 µS/cm) [9]. The major ions are also present in low concentrations compared to the Ruzizi River [9]. The most likely natural hazards in the basin are landslides, floods, volcanic eruptions and earthquakes. Landslides are directly related to steep slopes, geology and heavy rainfall [9]. Most of them occur along new roads as a result of a decrease in soil resistance, as well as a decrease in vegetation cover. Floods are directly linked to a rainy event but also depend on the size and shape of the catchment area, its land use and topography [9]. These floods, known as "flash floods", will potentially be more numerous in the future due to climate change, increasing urbanisation and the context of soil degradation linked in particular to land pressure [9]. According to Taty, OCHA, in Uvira city and Uvira territory, the results of the floods from April 16 to 18, 2020 show 52 deaths, nearly 200 injured, more than 5,500 houses destroyed, at least 80,000 people homeless, dozens damaged socio-economic infrastructures including roads and 7 bridges, 10 health centres health system flooded and out of service, 44 schools affected, destruction of the water catchment centre of the REGIDESO, water treatment and distribution plant [10,11]. In total 17 health areas out of 22 were affected, *i.e.* approximately 77% of the territory of Uvira, including the city and the outskirts. These events attest a certain weakness in prevention, preparation and protection against floods [10]. There are several factors aggravating the risk of flooding in the city of Uvira such as rural exodus or urban expansion, construction around Lake Tanganyika and rivers Kavimvira, Kalimabenge and Mulongwe, as well as on the slopes of the Mitumba mountain range, forcing residents to practice deforestation and therefore reduce the infiltration capacity of rainwater [10]. Waste management is also a real concern, without forgetting the rapid growth of the population [10]. This rapid population growth with overpopulation in the city of Uvira, 378,736 inhabitants compared to 10,000 planned, is explained by port activities, the road connection which facilitates trade with the city of Bujumbura (capital of Burundi), the lake connection with Tanzania and Zambia; as well as the displacement of the population following the atrocities of armed conflicts, in search of relative security [10]. Unfortunately, this approach does not than exposing this population to other types of risks [10]. If we stick to the legislation, article 40 of law no 15/2016 of December 31, 2015 relating to water, stipulates: “The riparian funds of a watercourse or a lake are encumbered, on each bank, with a public utility easement with a width of 100 meters from the banks, known as a free access easement, intended to allow the mobility of cleaning and maintenance equipment and the “water administration to install signalling, measuring and recording means” [12]. Also, article 48 of the forest code Law no. 011/2002 of 08/29/2002 stipulates: “All deforestation over a distance of 50 m on either side of watercourses and within a radius of 100 m is prohibited around their sources [12]. Likewise, article 51 of the same forest code Law no. 011/2002 of 08/29/2002, stipulates: "In order to protect forest biological diversity, the administration responsible for forests may, even in concessioned forest areas, set aside certain species or enact any restrictions it deems useful” [13]. The author Taty, is of the opinion that global warming influences the occurrence of flooding in Uvira but it is not the main factor [10]. For this author, the rural exodus, the pressure on the environment, the anarchic constructions reinforced by the conflicts between positive law and customary law in terms of the granting of plots to be subdivided, the absence of land development territory, disastrous waste management, flash floods and rivers

which have their sources on the Mitumba mountain range culminating between 2000 and 3000 m altitude also have something to do with it [10]. These watercourses meander down the very steep slopes of this mountain range before flowing into Lake Tanganyika [10]. In his opinion, all these factors constitute the main ingredients which increase the vulnerability and risk of flooding in the town and territory of Uvira [10]. The corollary of these phenomena is the increase in cases of cholera in this endemic area [10]. The analysis of satellite images revealed the loss of banks in favour of watercourses, but also the presence of new constructions in risk areas [10]. The political-administrative actors as well as those who manage on one side the floods and cholera on the other are all aware that floods can lead to cholera in Uvira city and Uvira territory [10].

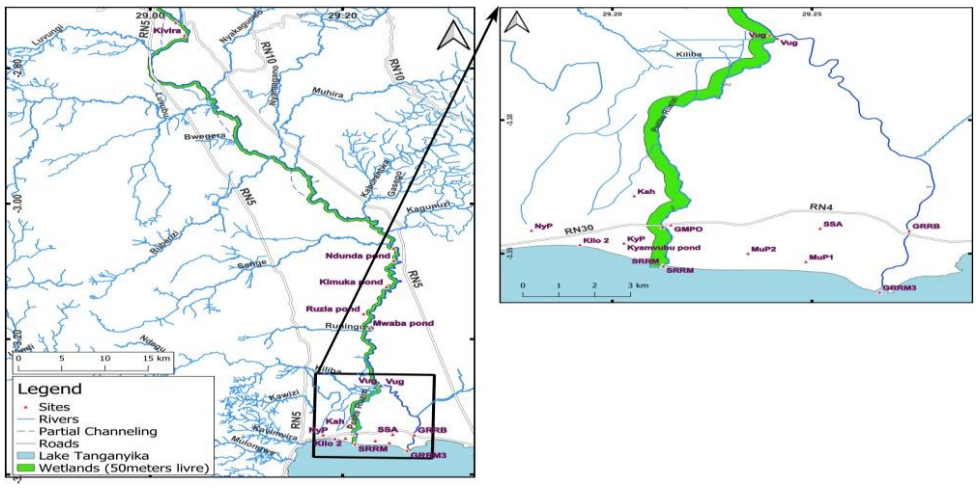
MATERIALS AND METHODS

Study areas

The ruzizi congolese plain wetlands: 50 m free from the Ruzizi river bank, and around ponds: The Ruzizi Congolese plain wetlands to protect are defined by 50 m free from the Ruzizi River bank, and around ponds: Kindava (Ndunda) Pond, Ndunda pond, Kimuka Pond, Ruzia Pond, Mwaba Pond, Kyamvubu Pond and Nyangara Pond, almost 3.4 km^2 [14]. Partial diversions of water from the Ruzizi River may affect villages such as:

1. Kafunda leaving the Ngomo escarpments. This diversion will be able to irrigate the banana plants, supply two or three fish ponds before flowing back into the Ruzizi River without crossing National Road No. 5 (RN5).
2. Bwegera, a diversion of up to two or three km with the possibility of supplying two to six fish ponds before flowing back into the Ruzizi River. It will also be able to irrigate pastures because Bwegera is one of the pastoralist villages of the Ruzizi plain.
3. Luberizi, a diversion which can range from two to five km before flowing back into the Ruzizi River. This diversion will irrigate six to 12 fish ponds and pastures before flowing back into the Ruzizi River. Other diversions may concern tributaries of the Ruzizi River such as Luvubu, Bwegera, Luberizi, Runingu, Kiliba and Kahwizi. With around twenty fish ponds, the supply of fish and their marketing will be ensured for a population which has always relied on natural plant and animal resources. The protection of wetlands necessary for the conservation of birds, crocodiles, hippos and biodiversity will surely be preserved (Figure 1).

Figure 1. Map of Ruzizi congolese plain wetlands 50 m free from Ruzizi river and small Ruzizi river. Source: Our fieldwork of 2010-201.



Ruzizi congolese delta wetlands, 50 m free from the small Ruzizi river and from ponds: The Ruzizi Congolese delta wetlands to protect are defined by 50 m free from the small Ruzizi River western bank from Vugizo, including the Kyamvubu Pond (KyP), Kilomoni 2 Fishing Beach (Kilo 2), eastern part of the Nyangara pond (NyP) and Kahorohoro flooding village (Kah) (Figure 1)

RESULTS AND DISCUSSION

We may distinguish and describe three types of ecosystem services including aquatic, forest, and urban ecosystems in the Ruzizi Congolese River basin.

1) The aquatic ecosystem is characterised by the Ruzizi basin's potential for food supply, through fishing activities (mainly in ponds) and aquaculture, the production of hydroelectric power on the Ruzizi River, and the supply of drinking water for the Ruzizi basin's populations [15]. The level of potential conflicts between drinking water and other uses remains limited to date; nevertheless, quality aspects are crucial and constitute the main problem encountered in the Ruzizi delta [2].
2) The forest ecosystem, as far as forest ecosystems are concerned, a large part of the basin is delimited by high mountains resulting from tectonic crests covered with dense primary forests at high altitude. The forests represent an area equivalent to less than 10% of the basin [2]. Many of these forests constitute the main source of wood supply for domestic energy (biomass) but also for other uses. The forest ecosystems also provide climate regulation services, making it possible to maintain a temperate climate and limit violent winds. The forests also store large quantities of carbon dioxide (CO_2), both in the above-ground vegetation and in the underground biomass. Finally, the forests play an essential role in preventing erosion on the slopes and sedimentation of the tributaries of the Ruzizi River.
3) The urbanisation ecosystem, increasing urbanisation and land use planning confront the basin with many challenges, hampered by the lack of urban development and structured land use plans. In terms of agriculture, two types of production can be identified in the catchment area, namely irrigated agriculture in the Ruzizi plain and rain-fed agriculture on the slopes. The maintenance and development of intensive irrigated agriculture in the Ruzizi plain implies the simultaneous implementation of monitoring measures and preventive and restorative actions, while agricultural practices on the slopes are a source of soil degradation that can favour erosion. Soil conservation and erosion control are essential not only to enable farmers on sensitive lands to maintain their productive capacity, but also to ensure the ecosystem services encountered downstream.

Then, the Ruzizi River goes from Lake Kivu to Lake Tanganyika which is its mouth, it has a length of 117 km [16]. The Ruzizi River crosses DR Congo, Rwanda and Burundi. All tributaries (Luvungi, Nyakagundu, Nyamagana, Muhira, Kaburantwa, Kagunuzi, Nyabundari, Mpanda and Ruhwa) have their source on the Congo slope, at the level of the ridges separating the Nile basins from the Congo basin [16]. The Ruzizi River has an average flow rate of 100 m^3/s [16]. Mineral resources mainly include alluvial minerals along the Ruzizi River, including gold, Cassiterite, Colțan, Nobium and Germanium [16].

Fauna and flora resources

A rich biodiversity of fauna and flora is very remarkable, so much so that in neighbouring Burundi, certain areas have been declared protected areas and Ramsar sites which host: Gorillas, Monkeys, hippos, crocodiles, antelopes, birds, reptiles, amphibians, macroinvertebrates and microinvertebrates (Nyembo). Natural parks and reserves have been

developed by the three countries and multilateral conservation agreements are observed by the 3 countries, the DRC, Rwanda and Burundi [16].

Fishery resources

The Ruzizi River has a diversity of fish such as tilapia and small sardines which are the main exploited species and stock management policies are observed by the 3 countries; (2) Currently another type of coastal fish is developing. These are mainly clarias (catfish) which are increasingly colonizing the bays of the plain and the Ruzizi delta; (3) Several threats have been noted impacting fisheries resources [16]. These include anthropogenic activities, natural disasters and risks arising from climate change [16].

The concern to raise the awareness of Congolese decision-makers at all local, territorial, provincial and national levels to face these disasters and these risks for the needs of community development in the region by a protected wetland area creation in the Ruzizi Congolese plain and the Ruzizi Congolese delta, led me to focus my research on the conservation of birds and biodiversity of the Ruzizi Congolese plain and delta and the publication of this scientific article.

Geology and formation of the Ruzizi river

For, the formation of the Rusizi River dates back to the Pleistocene, a rather recent age compared to that of Lake Tanganyika. Indeed, the origin of Lake Tanganyika dates back to the great fracturing of East Africa which, at the end of the tertiary, was superimposed on other collapse phenomena dating from the Jurassic [17]. The deposition of the first lacustrine and fluvial sediments in the bottom of the Graben seems to date back to the end of the tertiary [18]. At that time, Lake Tanganyika occupied a much larger area than at present and its northern shore reached at least the basalt dam resulting from lava flows from the Kivu volcanoes [18]. Other collapse phenomena in the Lower, Middle and Upper Pleistocene are responsible for the progressive over flooding of most of the Rusizi plain [18]. The over flooding of the lower Rusizi valley probably dates back a century and probably dates from 1879 [18]. At that time, following a subsidence of the Lukuga threshold, the outlet of Lake Tanganyika, the waters of Lake Tanganyika rushed into the Congo River and caused a significant drop in the water level of the lake [18]. This lowering thereby allowed the establishment of the most recent fluvial and lacustrine alluvium of the Ruzizi delta [18]. It is in these alluviums that the Ruzizi River has dug and still digs its bed each time [18]. The changing configuration of the youngest sectors of the lower Rusizi plain results from recent, or even very recent or current, geological phenomena [18]. It is notably linked on the one hand to the successive movements of the bed of the Ruzizi River from the Democratic Republic of Congo towards Burundi, on the other hand to the sometimes spectacular variations in the water level of Lake Tanganyika [18,19]. Regarding Lake Tanganyika in 1994, the water level of the lake decreased significantly, which caused the lagoons (Gatumba marshes) and the various water points to dry up [18]. An opposite phenomenon observed in 1998 was described by where the waters of the lake rose by more than a meter during the ELNIÑO phenomena [20]. El Niño is a climatic phenomenon whose origin is still poorly understood [18]. It results in an increase in the temperature at the water surface (around 10 meters at Lake Tanganyika) especially in the east of the Pacific Ocean, around the equator [18].

CONCLUSION

The main issues related to the management and preservation of the Ruzizi River's water resources are globally linked to the quality of the water resources, rather than to the quantity. The control of environmental degradation, in particular with regards to soil erosion and the resulting significant turbidity of the watercourses, is one of the major issues encountered in the Ruzizi Plain/Delta. The threats to the quality of Ruzizi River’s waters, in relation to the uncontrolled development of the urban areas bordering the river and adjacent ponds, as well as the industrial

development especially mining - which poses environmental threats to the surface waters of the Ruzizi River, are all factors that require coordinated action at the scale of the Mayor of Uvira city, the Administrator of Uvira Territory, the headquarters and the village chiefs. Then, there is a need to control natural risks in the Ruzizi Plain/Delta, which is particularly exposed to extreme events such as floods, landslides, volcanic eruptions and seismic phenomena. Faced with these threats, the challenges of sustainable management and preservation of water resources and the associated environments in the Ruzizi Congolese Plain/Delta (RCP)/(RCD) can be overcome in a coordinated manner between the four components, Mayor, Administrator, Head Quarters and Chiefs of the villages on the Ruzizi River western bank. The priority in this respect should be to supply canalisations for farming, livestock and fish breeding ponds where topography allows it on the western Ruzizi River bank and the western small Ruzizi River bank. Finally, a partial channelling of the waters of the Ruzizi River in accordance with the appropriate level curves, coupled by associated ponds in parallel or in series depending on the topography of the environments and the watering of technically implemented and secure pastures can lead to agricultural, ichthyological productivity and sustainable trade in the Ruzizi Congolese Plain/Ruzizi Congolese Delta.

SOME RESEARCH PERSPECTIVES

Our study opens up research perspectives such as: (1) Anthropological studies to identify the risky behaviours of different actors and community; (2) An experimental study on floodfarming productivity causality in Uvira; (3) A descriptive study on the flood-livestock productivity in Uvira; (4) A study either descriptive (retrospective or prospective) or analytical (case-control, cohort) or either experimental on the causality of flooding–pond ichthyologic productivity in the Ruzizi Congolese Plain/Delta; *etc*.

RECOMMENDATIONS FOR THE ELABORATION AND PRIORITISATION OF AN ACTION PROGRAMME

Measures aiming at the sustainable management, preservation and restoration of water resources and associated environments of the Ruzizi Congolese plain and Ruzizi Congolese delta are necessary, through enhanced cooperation between Village Chiefs of the Ruzizi Western River Bank. Under the coordination of CRH-Uvira, an action programme is thus proposed to achieve these objectives. A prioritisation of actions is then proposed, taking into account the main risks and issues identified in the Ruzizi Congolese plain and Ruzizi Congolese delta as following:

1. Measures to improve knowledge (hydrology, hydrogeology, withdrawals and discharges, potential sources of pollution, quality of water resources, degradation of the plain, delta, natural risks, *etc*.);
2. Resource monitoring measures and data transmission;
3. Measures to reduce pressure on the environment; 4. Natural risk management measures;
4. Institutional support measures for CRH-Uvira;
5. Measures to develop the legal bases in the Ruzizi Congolese Plain/Delta.

Among the options for the development of the legal and technical framework to present for the study, and particularly among the measures to include in the proposed action programme, the following actions are recommended to be implemented as a matter of priority:

- Setting up of CRH's internal technical units: Studies and Planning Unit, and Observatory of Water Resources and Associated Environments;
- Establishment of data exchange protocols between CRH and the Uvira Mayor and Administrator for quarters and Village Chiefs enhancement for the Ruzizi River Bank environment protection through the designation of focal points for data transfer;
- Making CRH's technical units operational by setting up and operating the proposed management tools at quarter's and villages' level;

- Implementation of communication tools, to improve the visibility of CRH within the member quarter and village Chief to share information on the Ruzizi Plain/Delta with the general public. In particular, establishment of a 50 m free delimitation from Ruzizi River and reforestation type needed;
- Setting up pilot canalisations for irrigation, fish breeding ponds implementation, and vegetation cultivation needed to combat soil degradation and erosion in sensitive areas of the Ruzizi Congolese Plain/Delta from Kamanyola to the Small Ruzizi River Mouth.

ACKNOWLEDGEMENTS

In publishing this article, I am thinking of the promoter of my doctoral thesis, Professor Eric Sand of Makerere University Kampala Uganda, supervisor of my projects on the conservation of birds of the Ruzizi plain and delta. I am also thinking of Professor Gaspard Ntakimazi, Co-Promoter of my doctoral thesis for his guidance on the channelling of research actions and composition of the doctoral thesis on the importance of the Ruzizi delta in Burundi and the DRC for the bird conservation. The constructive comments from the members of my thesis committee gave me material time to reflect on this publication. They are Professor Charles Kahindo, initiator of ornithological studies at CRH-Uvira by providing the centre with basic documentation on the study of birds since the year 2000; Professor Majaliwa Mwanjololo Jean Gilbert of Ruforum Makerere University Kampala Uganda; and Professor Sibomana Claver of the University of Burundi. May they find here the expression of my deep gratitude. Dr. Nshombo, Head of Division of Cooperation, Scientific Information and Documentation, provided needed books for bird studies. Honorable Alfred Maisha and Mr Alexandre Heshima B., my sons, provided fees for this publication paper. May they all find here my deep gratitude as well.

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