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Alluvions and Flooding of Waters in Uvira (Dr Congo)

MWENYEMALI BANAMWEZI Dieudonné[1], KAHINDO NDJUNGU Joseph[1], FUNTA KYANDA Clément[1], TOMOMBWA KUMBUSA Patient[1] and AMISI MANALA Christian[2]

1. Hydrology department, Uvira hydrobiology Research Center, CRH-Uvira BP 73 Uvira, DR Congo.
2. Department of Fisheries Socioeconomics, Uvira, Research Center CRH-Uvira BP 73 Uvira

Abstract:- The present work, carried out during the years 2000 to 2020 in rainy seasons, aims to describe the impact of excessively abundant alluvium on the flooding of rivers in Uvira. From direct observation of the facts in the field, we have shown that the raising of the beds of the rivers and the obstruction of the outlets of the water of the rivers by too abundant alluvium, are two factors. Which condition the flooding of rivers observed in the city of Uvira for several years?

We have proposed reforestation, anti-erosion cultivation practices and systems, the prohibition of untimely bush fires for farmers in all watersheds of watercourses in order to limit erosion based on intense alluvial deposits that cause these river floods.

***Keywords*:-** *Alluvium, Floods, Watercourses, Uvira.*

I. INTRODUCTION

The submersion of land usually exposed by overflowing lakes or rivers is undoubtedly the major risk on all continents. The danger of human and economic loss is accentuated by the construction of numerous installations in flood-prone areas (Touchard L. 2003).

Rain and other factors cause flooding, the water of which degrades the physical environment and the living environment of populations living in periodically flooded regions (Martin A et al. 2016).

The city of Uvira is facing the problem of flooding of rivers, Lake Tanganyika and Nyangara lagoon. Flooding of rivers in the city of Uvira is old and recurrent and has already been investigated: (Mwenyemali B. et al. 2014; Mwenyemali et al 2020). This work focuses on the damage caused by flooding and the human influence in this damage.

In addition, the formation of "debris flows", "flood-alluvial" zones as well as the straying of watercourses and the digging of ravines lead to the destruction of dwellings, drainage channels and roads of Uvira (Ilunga L.2006).

Twenty-five Mitumba Massif rivers flow through the city of Uvira. In certain rainy seasons, during torrential crises, most of these rivers deposit excessively abundant alluvium in their lower sections, the region of the piedmont plains and those of the base level. Can this excessively abundant alluvium explain the flooding of rivers in Uvira? The aim of this work is to describe and explain the impact of too much alluvium on the flooding of rivers in Uvira and to make concrete proposals on how to slow these phenomena.

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II. MATERIALS AND METHOD

a. <u>Map of the study environment.</u>

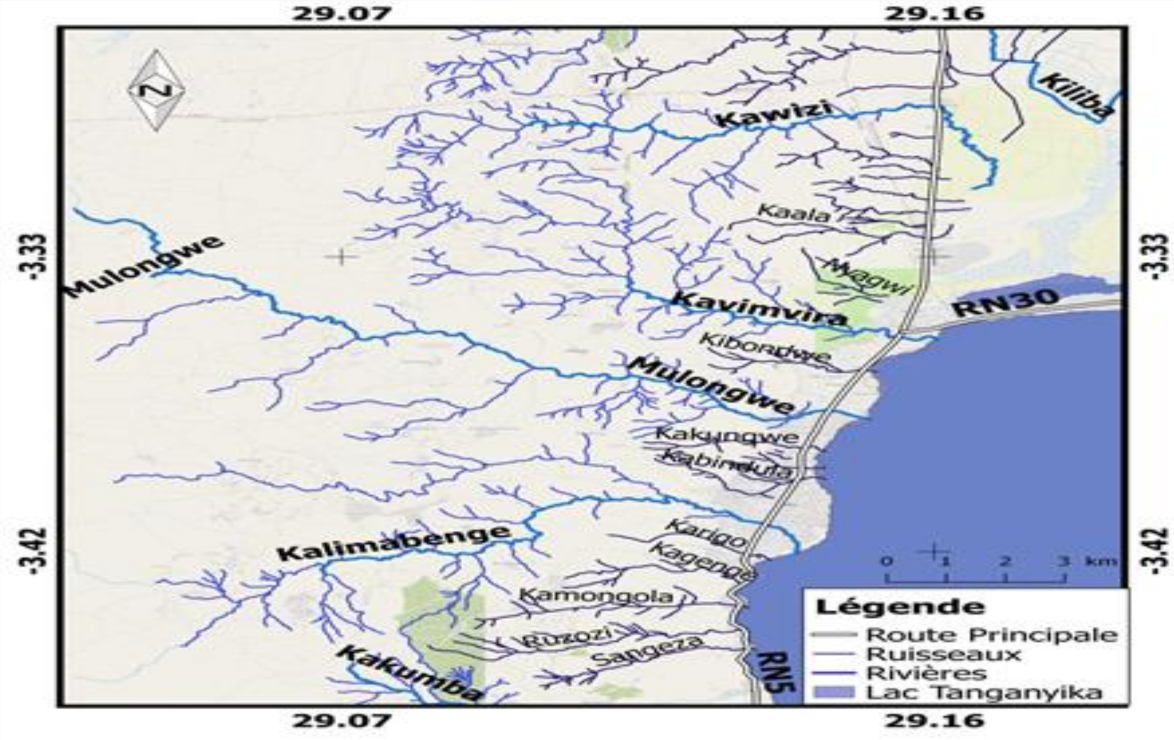

Fig.1 Rivers crossing the city of Uvira.

These streams (7 permanent and 18 temporary) from Mitumba massifs cross the city of Uvira before emptying into Lake Tanganyika or the marshes and lagoon located to the north of the lake.

The city of Uvira, located at the extreme northeast of Lake Tanganyika, is bounded on the north by the Kawizi river, on the south by the Sangeza river, on the west by the Mitumba massifs and on the east by the Lake Tanganyika and the Ruzizi river.

The city of Uvira comprises two geological and geomorphological groups:

- Mitumba mountains (2000 to 3000 m) to the west, formed by Precambrian terrain: quartzites and mica schists. There are also amphibolites, gneisses, pegmatites as well as veins of white quartz. These rocks form dipping layers of 40 ° to 90 ° (Weiss G. 1959).
- The plain (774 to 900) in the east, represented by the fluvio-lacustrine detrital formations of the Quaternary.

The population of the city of Uvira is concentrated in this plain (3º17'03'S '; 3º26'27''S and 29º7'E; 29º12'E), crossed by the lower reaches of the rivers. The city is crossed from north to south by the RN5.

The data were collected in the lower reaches of the rivers, in their riparian zones, affected by "flooding-alluvial" as well as in the regions of the middle and upper reaches of the watersheds. Data collection was carried out during the period from 2000 to 2020 during the rainy seasons, especially after floods, from December to May.

b. <u>Direct observation of the facts</u> in the field, through visits and excursions, is the general basic method.

Observations focused on: the flooding phenomenon in order to identify its direct causes and understand its mechanisms, deposited alluvium, "flood-alluvial" zones, the erosive phenomenon as well as the damage caused by flooding.

These observations were accompanied by:

- Taking geographic coordinates, using a GPS (Global Positioning system) to locate the observed facts.
- Measurements of block diameters, thickness and extent of alluvial deposits, using a decameter and a metal lath; collecting sand samples, using a shovel. This allowed us to determine the morphometry and the granulometry of the alluvium.
- Taking pictures of the observed facts, using a digital camera, in order to compensate for direct observation.
- The hydrological survey, among residents and eyewitnesses, to inquire about past floods.

III. RESULTS

The results obtained are presented in figures (2, 3, 4, 5, 6 and 7).

a. **Too abundant alluvium raises the bed, the rivers overflow and spread.**

Fig. 2 Torrent Nyarumanga (03 ° 23'99''S; 29 ° 08'12''E. 860m)

Torrent known for its recurrent flooding. Torrential alluvium still made up of blocks, pebbles and clayey mud. This alluvium was deposited during the flood of 23/04/2020, which had the effects: 8 houses buried by alluvium and 10 destroyed houses. Spreading of alluvium In May 2018, this torrent caused material and human losses including 4 deaths, children from the same family who slept in their beds.

Fig. 3 Torrent Kamongola (03 ° 25'48''S, 29 ° 07'51''E. 796m)

These blocks and pebbles were deposited during a flood in April 2020. This torrent is famous for its disaster of February 2002, the results of which were heavy: more than 50 dead, and a lot of material damage (houses destroyed, RN5 barred by big blocks for two weeks: no access to the lake port of Kalundu.

Fig.4. Rivière Kavimvira (3°32'47''S; 29°15'89, 9''E. 788m)

Intense accumulation of sand and gravel, upstream and downstream of the bridge, during the flood of 04/17/2020. Here, the human habitat and a small market are located upstream of the bridge on the left bank. Before the flood, they were at a higher level than the minor bed. After raising the bed, they were flooded and flooded with sediment. Subsequently, the market was completely buried and the habitat is at a much lower level in bed because of sedimentation. Likewise, the bridge, which was 4.50m above the water, is already at 2.40m. Spreading of alluvium.

Fig.5 Rivière Mulongwe (03°20'18, 7''S; 29°09'30''E. 787m).

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The river raised its bed by sandy-gravelly alluvium during the flood of 04/17/2020, and it is already above the level of the habitat. We observe the spreading of alluvium.

b. Too abundant alluvium clogs fluvial or torrential water flow nozzles, overflow and spreading.

Fig.6 Torrent Kaala (03°12'45, 7''S; 29°09'34, 4''E. 806,7m).

Torrent with recurrent floods. In April 2000 the alluvium (sands, gravel, pebbles and boulders) blocked the nozzle, below the RN5, and forced the water to overflow over the RN5. We observe the degradation of the RN5 and the houses located downstream of the bridge.

Fig.7 Torrent Rutemba (03°18'9, 1"S, 29°9'36, 4"E. 814m)

Torrent with recurrent floods. After obstruction of the nozzle below the RN5, by alluvium in April 2000, the water overflowed and resulted in the erosion of the RN5 and the gullying of a citrus plantation located more towards the right bank downstream . Spreading alluvium.

IV. DISCUSSION

These alluviums are characterized by two size classes: boulders and sands, varying from one stream to another and within the same stream from one point to another :

- **Blocks:** The accumulations of blocks, often associated with pebbles, dominate in certain streams above (fig. 2 and 3) and others: Ruzozi, Sangeza, Nakagonjwa,… These are quartzite blocks of decimetric size to metric: the largest of 6.90m thick was observed in the Mulongwe river, at the foot of the mountains where the latter empties into the plain. These blocks reflect the strong energies of the current of these rivers. The quantity and size of the elements transported is a direct result of the speed of the current. This depends on two main factors: the slope of the land and the volume of moving water (Laverdiere J.W. et al. 1959).
- **Sands:** Characterize other rivers, including fig. 4 and 5 and others: Kalimabenge, Kaala, Nyangwi,... Sometimes gravelly sand is observed. Particle size analysis shows that these are sands with various grains, mainly coarse sand (500µ-1mm) with a large percentage of medium sand (250µ-500µ) and very coarse sands (1mm-2mm).

This predominance of the sandy fraction in these rivers shows that mechanical disintegration outweighs chemical decomposition in watersheds (Gryzbowski K. 1984, Tricart J. 1968).

This abundance of alluvium including boulders and sands, associated with pebbles and gravel, can be explained by the very active erosion observed in the watersheds of these rivers. Indeed, it is very intense erosion, (Degree 4), according to the classification system of fluvial and torrential erosion developed by the US Forest Service (Sheng TC, 1993).
This erosion is characterized by:

- **landslides:** we have counted more than 130, most of which are located in the reception basins of these rivers: 45 in the Kavimvira watershed, 46 in Mulongwe, 1 in Nyarumanga, 3 in Kabindula , 32 in Kalimabenge, 8 in Kamongola, 3 in Ruzozi ...
- **Intense gullying:** many gullies, most of which are temporarily drained.

- **bank erosion in the beds of all rivers:**

This erosion in these watersheds is under the combined action of abundant rains (<1000 mm in the plain and> 1200mm in the mountains), linked to climate change, steep slopes (of more than 50 °.) And characterized human activities. by inadequate cultivation methods on steep slopes, deforestation, untimely fires for the farmer and stockbreeder, pasture,…. The steepness of the slopes, the weakness of the vegetation cause the rainwater to run off and concentrate very quickly, gullying the sides of the slopes and causing a significant load of mud, pebbles and large boulders (Georges P.1974 , Taillefer et al. 1965).

It should be noted that, since 2005, only the Kakungwe torrent no longer experiences this problem of intense alluvial deposits. This situation is linked to the fact that for several years its watershed has not been exposed to agricultural activities as in the past.

Indeed, the rivers, very laden with alluvium in rainy seasons, raise their beds and flow to a higher level than the surrounding regions: the water overflows and inundates the regions occupied by human habitat (2, 3 , 4 and 5). This overflow of water is accompanied by the mobility of the bed and consequently the destruction of homes (Ilunga L. 2006, Mwenyemali et al. 2020).

This migration or wandering of the bed often results in the displacement of the mouths of certain major rivers, including Kalimabenge, Mulongwe and Kavimvira.

On the other hand, the obstruction of the outlets forces the water to flow over the road and move either in all possible directions or to wander the channel. Flooding depends not only on the flow but also on the obstacles to the flow (Touchart L. op.cit.). Thus, the alluvium clogs the evacuation nozzles, overflows on the roads and will partially bury the habitat located downstream up to the height of the windows about 1.5m (Ilunga L. op.cit.). In 1988, alluvium from the Kalimabenge congested upstream of the bridge and obstructed the underside of this bridge on the RN5. After the water overflowed, this flood had caused a great deal of material and human damage.

These floods linked to the obstruction of the fluvial and torrential flow nozzles are observed in a recurrent manner in most of the rivers of Uvira (fig. 5 and 6), Karigo, Kagenge, Kibondwe.

These floods linked to the raising of the bed and the obstruction of the nozzles by alluvium have the effect of flooding and spreading alluvium: it is "flooding-alluvial" which is accompanied by the destruction of the soil. dwellings.

This spreading sometimes extends over large areas and the deposits are, in several places, more than 2 m thick following observations made in certain neighborhoods during the April 2020 floods.

These sediments mobilized during floods accumulate especially in areas where the slope decreases as well as in flared sectors (Fehri 2014) .These alluvial spreading phenomenon undoubtedly results in the undeniable modification of the morphological landscape (Lamar, 2009).).

Karigo, Kagenge, Kibondwe, Konda, Nabatumba, Nakironge, Nyange and Nalungwe.

From all the above, it emerges that the too abundant alluvium, the manifestation of which is the raising of the beds and the obstruction of the outlets constitute a problem based on flooding in the city of Uvira. We must therefore fight against this abundance of alluvium in order to smother the floods caused by material damage and sometimes human losses.

Indeed, efforts to fight against floods have been undertaken for a long time but in vain due to the intense alluvial deposits. These efforts have included dredging some streams and building dikes along others. This was the case with the dredging of the Kavimvira and Mulongwe rivers during 2008 and 2020. In addition, the dikes erected along the Nyarumanga torrents (in 1997 and 2016), by the Caritas of the Diocese of Uvira , Kaala (1919) were buried and destroyed by abundant alluvium.

V. CONCLUSION

The raising of the beds of the rivers and the obstruction of the river flow nozzles are two determining factors which condition the flooding of these rivers and the consequent damage in the city of Uvira.

To deal with this problem of too abundant alluvium which conditions river floods in the city of Uvira, we have proposed the following:

- The reforestation of all the watersheds of the rivers crossing the city, especially in the reception basins where most landslides are located.
- The sensitization of the population on anti-erosion agricultural practices and systems as well as the prohibition of bush fires in the watersheds of rivers.
- Widening of fluvial and torrential water outlets.
- The relocation of the riparian human population living in areas at high risk of river flooding.

Geological, geomorphological, hydrological and climatic studies of the watersheds of these rivers must be carried out with a view to the protection, improvement and rehabilitation of these basins located in mountainous areas.

REFERENCES

[1]. Fehri N. 2014 The Aggravation of the risk of flooding in Tunisia: elements for reflection.
[2]. Gryzbowski K 1984. The preliminary results of the granulometric analysis of the current sands of Uvira, Cahier du Ceruki, New series no 12.
[3]. Georges P. 1974. Dictionary of Geography, PUF Boulevard Saint-Germain, Paris.
[4]. Ilunga L. 2006. Study of major erosion sites in Uvira (DR. Congo) Géo-Eco-Trop 30.2.1-12.
[5]. Lahmar L. 2009. Floods and their impact on the morphological landscape: the case in the Jendouba-Bon Salem plain (North-West Tunisia).
[6]. Laverdière J.W., 1959, Initiation à la Géologie. 7th edition, 23rd thousand Montreal and Paris.

ISSN No:-2456-2165

[7]. Martin A. et al. 2006, Flood in Benin: socio-economic impacts on lake populations.
[8]. Mwenyemali B. et al. 2014. Impact of the Topography on the natural disasters observed in the city of Uvira, northwest of Lake Tanganyika, Cahiers du Ceruki, New series no16.
[9]. Mwenyemali B. et al. 2020, Effects of Bank Escapes and Floods in the Kavimvira River side Neighborhoods. International Journal of Innovative Science and Research Technology, volume 5 January.
[10]. Neuvy G. 1991. Man and water in the tropics. Masson, Paris, Milan, Barcelona, Bonn
[11]. Sheng TC. 1993. Practical guide for watershed management. Studies and planning. FAO conservation notebook 13/6.
[12]. Taillefer F. et al. 1962. General physical and human geography, second class 4th edition Armand Colin 103, Boulevard Saint Michel.
[13]. Touchard L. 2003. Hydrology. Seas, Rivers and Lakes, Armand Colin / VUEF.
[14]. Tricart J. 1968. Précis de Géomorphologie Tome 1. Géomorphologie Paris Ve.
[15]. WEISS G., 1959. Country of Uvira. Regional geographic studies on the western edge of Lake Tanganyika. Brussels, J. Duculot.