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# Degree of Integrated Water Resources Management Implementation in Context of Climate Change in a Watershed: Case of Oueme Basin, Benin (West Africa)

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ABSTRACT

This study is based on the hypothesis that the implementation of Integrated Water Resources Management (IWRM) tools in the Oueme watershed has not led to a systematic improvement in the degree of IWRM implementation in the Oueme Valley in Benin. Methodologically, data were collected through a semi-structured survey of stakeholder families in the study area using snowball sampling. The tool used was the form developed by the United Nations to collect data to assess the level of IWRM implementation. The four (4) assessment criteria, each covering a key component of IWRM, are the enabling environment, institutions and participation, management tools and financing. The results obtained per criteria according to the stepwise methodology adopted reveal on average a degree of implementation of 40 on a scale of 0 to 100 in the Oueme basin. This value varies according to the geographical area and the factors considered. This study, which is a decision-making tool, provides a guide for governments to monitor the progress of integrated water resources management in their territory.

## 1. Introduction

Today, increasing population pressure, economic development, and climate change are among the major

changes that greatly threaten the availability and quality of the water resource<sup>[1,2]</sup>. To preserve the water resource, collegial management should be organized at the watershed scale. The rational management of water

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resources contributes effectively to the mitigation of climate change, because it reduces the pressure on these resources [3]. [4] work supported this statement to some degree by showing that climate change is altering water resources.

Reportedly, it has been estimated an average of 13.106 billion m<sup>3</sup>/year of surface water and 1.870 billion m<sup>3</sup>/year of groundwater recharge in Benin [5]. Groundwater is a prime resource for supplying drinking water to the population because it is of relatively good quality and low cost, unlike surface water, the cost of which is staggering and often beyond the reach of countries with modest economies such as Benin [6]. The decrease in the amount of water available per person due to population pressure, pollution, climate change, and the respect of the principles of the international conference of Dublin in 1992 on water and the environment, led Benin to adopt the principle of IWRM since 1998. However, the implementation of this management at the national level and in particular in the Oueme basin is quickly facing some obstacles. It is in this context that the present study aims to assess the level of IWRM implementation in the Oueme basin, the second richest valley in the world after the Nile with a lot of potentials [7].

## 2. Methods

### Presentation of the study environment

The Oueme basin is located between 1°23'47" and 3°27'54" east longitude and 6°20'54" and 10°12'59" north latitude. It extends over three countries: Benin, Nigeria and Togo. With a surface area of 52 511 km<sup>2</sup>, including 4 974 in Nigeria and 319 in Togo, the Beninese portion of this basin is estimated at 47 218 km<sup>2</sup>, for 41.14 % of the national territory [8]. It straddles eight departments and covers all or part of 48 communes out of the 77 in the country. It has an estimated population of 6 million inhabitants, the equivalent of 44 % of the total population [9]. The average farm size is 1.60 hectares [10]. According to [11], the main economic activities are fishing, agriculture, animal husbandry, trade, crafts and hunting. It has been subdivided into 4 sub-basins, namely: Upper Oueme basin, Okpara, Zou and Lower and middle Oueme valley sub-basins. Figure 1 shows the delimitation of the basin.

After describing the basin in its physical and climatic aspects, [12] defines the interannual and seasonal variations of the river flow in the upper basin as well as in the delta. The basin enjoys two types of climate. Downstream, an equatorial climate with high humidity, alternating dry seasons and rainy seasons. Upstream, a tropical climate with a dry season from November to April and a rainy

season from June to September. Temperatures are stable all year round downstream (28 to 32°) and oscillate between 30 and 38° upstream. Rainfall is abundant during the rainy seasons, with an annual average of 1300 mm downstream and 950 mm upstream. The hydrological regime of the Oueme is characterized by a minimum flow in March and a maximum flow during the high-water period in September. In Sagon, during the low-water period (February-April) its flow is 10 m<sup>3</sup>/s, whereas it reaches 900 m<sup>3</sup>/s during the high-water period (August-November) [13].

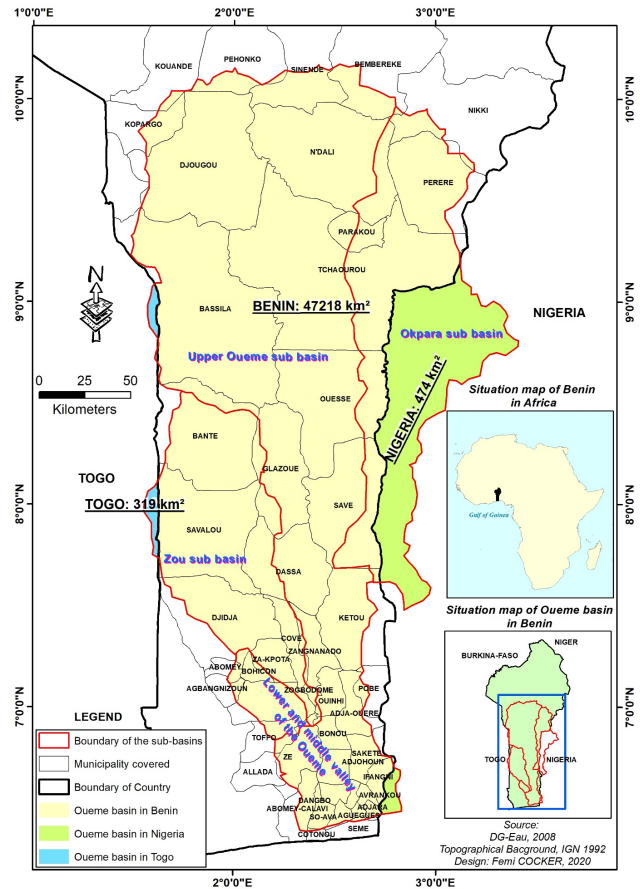


Figure 1. Presentation of the study area

### Data Collection

The assessment of IWRM implementation in the Oueme basin in Benin is based on indicator 6.5.1, which represents the degree of implementation of integrated water resources management of Goal 6 of the SDGs. This indicator is based on the IWRM implementation level assessment form used by [14] in a similar study in the lower Oueme valley, which is downstream of the basin. This step-by-step methodology developed by the United Nations is composed of several relevant questions that are grouped into four sections, each covering a key IWRM

component:

- **Enabling Environment:** This is an enabling environment, which is about creating the conditions to support the implementation of IWRM. This section includes the basic policy, legal and planning tools for IWRM.

- **Institutions and participation:** The section deals with the different institutional stakeholders and their political, social, economic and administrative roles involved in the implementation of IWRM. It includes some of the leading institutions for IWRM at various levels of society and the gender approach.

- **Management Instruments:** These are the tools and activities to help decision-makers and users make rational and informed choices when it comes to identifying and adopting the right actions to take.

- **Financing:** This section deals with the adequacy of the funding made available and used for water resources development and management and the management of these resources by the various recipient entities.

The families of actors who filled out the form are local authorities, users, decentralized state structures and civil society. The approach used was a semi-structured interview. It was supported by documentary research at the General Directorate of Water, the National Water Institute and in non-governmental organizations that work on the theme of environmental protection related to water.

## Sampling

In the study sector, the organ in charge of water resource management is the Oueme Basin Committee set up by Decree N°2018-130 of April 18, 2018. This organ gathers various public and private stakeholders of the basin, acting in the water sector or whose activities impact water resources. It is made up of 51 members, representing local authorities, Decentralized State Structures, civil society associations and users. On this basis, an exhaustive survey was carried out among the 51 structures constituting this committee. Table 1 presents a breakdown of the respondents by family of actors.

According to the decree setting up the Oueme River Basin Committee, the representatives of local authorities and users constitute 2/3 of the total seats. This provision allows the grassroots stakeholders to be better represented since they are the most concerned by the impacts of actions in the basin.

## Semi-structured interviews

The snowball survey technique was used to fill out the form with stakeholder families. The possible scores that can be assigned to each question, depending on the level of application of the IWRM aspect addressed, are between

0 and 100 with an increment of 10. Each score assigned is justified by its author with evidence in the corresponding column.

## Data analysis

The degree of IWRM implementation in the Oueme River Basin is equal to the average of the scores for each section of the evaluation form. The score for SDG indicator 6.5.1 indicates the "degree of implementation of integrated water resources management", on a scale of 0 to 100, where 0 indicates no implementation and 100 represents full implementation. This method is tested and adopted by the UN Environment to assess the level of implementation of IWRM. An interpretation according to [15] is provided as follows:

- - 0 - <=10 : Very low: Development of IWRM elements has generally not started or has stalled.

- - 10 - <=30 : Low : Implementation of IWRM elements has generally begun, but with limited acceptance and relatively low engagement of stakeholder groups.

- - >30 - <=50 : Medium-low: IWRM elements are generally institutionalised and implementation is underway.

- - >50 - <=70 : Medium-high: Capacity to implement IWRM elements is generally appropriate and elements are generally implemented through long-term programmes.

- - >70 - <=90 : High: The objectives of IWRM plans and programmes are generally achieved and the geographical coverage and commitment of different stakeholders is generally good.

- - >90 - <=100 : Very high: The vast majority of IWRM elements are fully implemented, with objectives achieved as defined and plans and programmes are periodically evaluated and reviewed.

## 3. Results

The results of this evaluation are presented by criteria. These are the sections Enabling Environment, Institutions and participation, Management Instruments and Financing.

### Enabling Environment

The enabling environment includes the basic policy, legal and planning tools to support IWRM implementation. In a chronological sequence, several documents are developed, implemented and evaluated. This is the case of the National Strategy for Rural Water Supply (SNAEPMR) which has been implemented in several phases since 1992. At the beginning, it was based on the demand approach. In 2003, it was influenced by the advent of decentralization. As a result, the communes

**Table 1.** Breakdown of the respondents by family of actors

Families of stakeholders	Structure/Organization	Headcount	Percentage
<b>Local authorities</b>	Abomey-Calavi Town Hall; Parakou Town Hall Tchaourou Town Hall; Dassa Town Hall; Save Town Hall; Bassila Town Hall; Copargo Town Hall; Cotonou Town Hall; Aguegues Town Hall; Avrankou Town Hall; Seme-Podji Town Hall; Pobè Town Hall; Bohicon Town Hall	13	25%
<b>Users</b>	Pineapple Producers' Union Allada; of oil palm Ouidah; cotton N'Dali; rice Glazoue; Market Gardeners Union Djougou; Association of Women Farmers Adjohoun; Professional Organizations of Ruminant Breeders Gogounou; Save; Kétou; Abomey; Fishermen's Union Save; Cotonou; Fish Farmers Union Djougou; Zakpota; Consumers' Association Parakou.; Drinking Water Consumers' Association Dassa Zoume; Water Farmers Association Cove ; Sand and Gravel Operators Parakou; Sugar Corporation Save; Hotel Industries Committee Djougou; Oil company Pobe	21	41%
<b>Deconcentrated structures of the State</b>	Zou Prefecture; Departmental Directorate of Agriculture, Livestock and Fisheries Atlantique; Borgou; Oueme; Departmental Directorate of the Living Environment and Sustainable Development Atlantic; Forest Inspection Borgou; Zou; Departmental Directorate of Water and Mines Atlantique; Donga; Water Service Collines; Oueme; Departmental Directorate of Health Zou.	12	24%
<b>Civil society</b>	Tropical Nature Green Coalition CONOGEDA (Environment and Sanitation) Union of the Crowned Heads of the Hills High Council of the Kings of Oueme/Plateau	5	10%
<b>TOTAL</b>		<b>51</b>	<b>100%</b>

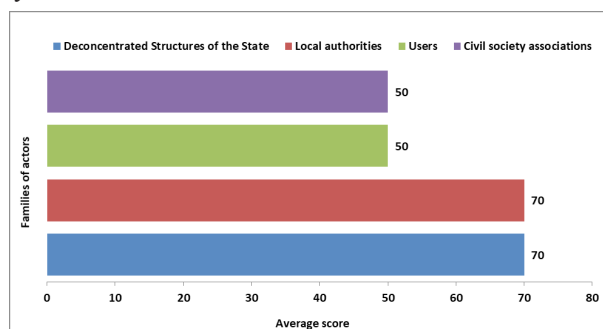
Source: Field survey, 2021

became the new project owners, who plan, implement and manage water facilities based on local needs. The evaluation showed that the management of water resources still needs to be improved.

At the policy level, the water sector has had a National Water Policy since 2008. Its strategic orientation is to ensure equitable and sustainable access to drinking water and sanitation for the population. To reinforce these provisions, the National Action Plan for Integrated Water Resources Management (PANGIRE) was adopted in 2011. This plan has a broad vision and embraces specific areas of action. These include the water governance framework, human capacity building, economic and financial aspects, knowledge, mobilization, development, conservation, protection and monitoring of water resources and the environment. This plan also aims to put in place measures for prevention, mitigation and adaptation to climate change and other water-related risks. However, these policies, although they exist, are characterized by a medium-low degree of implementation in the rating scale. Thus, according to stakeholders in IWRM implementation in the Oueme basin, these policies are based on IWRM, approved by the government, and are tentatively beginning to be used by the authorities to guide the work.

With regard to the legal and regulatory framework for water management, Benin has a large and diversified

legal arsenal that has made provisions for the protection and safeguarding of natural resources in general and water resources in particular. However, even though the country's legal arsenal is quite extensive, there are problems of implementation followed by concrete results. In fact, almost all the actors report a lack of application of the legal texts and their poor dissemination. According to the respondents, these laws exist, but are not fully implemented due to a lack of political will. The degree of implementation of national laws on water resources in the study area is also unsatisfactory. Figure 2 presents the result of the degree of the "Enabling Environment" section by the different families of stakeholders.



**Figure 2.** Degree of enabling environment

Source: Cocker, 2021

The level of implementation of basic policy, legal and planning tools to support IWRM implementation in the Ouame River Basin varies among the stakeholders interviewed. Civil society associations and users gave a score of 50 and thus consider the policy and legal environment to be halfway favorable to IWRM implementation. Better still, local authorities and decentralized state structures gave a higher score of 70, believing that, even if there is still work to be done, implementation efforts are noticeable for this criterion.

In sum, the average score for this section after the calculations according to the technique used in the methodology is 60.

### Institutions and participation

The institutional framework for water resources management includes public sector actors, in particular the ministries concerned with water management, local authorities, user groups and private sector actors through their various actions in the field. Consultation bodies have also been set up. At the basin level, we can mention the Oueme River Basin Committee (CBO) set up by decree n° 2011-621 of September 29, 2011. It is composed of local authorities, users' representatives, decentralized State structures and socio-professional organizations. Its mission is to define and plan, in a concerted manner, the axes of management and protection of water resources on the scale of the Oueme river basin. At the national level, there is the National Water Council, created by Decree No. 2011-574 of 31 August 2011. It is composed of public administration, local authorities, civil society, scientists and researchers, the National Water Fund and also the Water Agency. Its mission is to contribute to decision-making in water resources management in accordance with Benin's development policies and strategies.

All this information is proof that the institutional framework is already in place and well oriented towards IWRM. But at the operational level, the effect of all this organization is not apparent. Figure 3 confirms this observation, especially with the scores attributed by local authorities and civil society.

The analysis of Figure 3 shows that the scores given by civil society and local authorities are 35 and 30 respectively. These actors consider that the action of political, social, economic and administrative institutions involved in the implementation of IWRM is not very perceptible. On the other hand, the users and the decentralized structures of the State consider that the action of the political, social, economic and administrative institutions that participate in the implementation of IWRM is appreciable.

Finally, the institutional framework scores 45 on the 0-100 scale and is thus close to average.

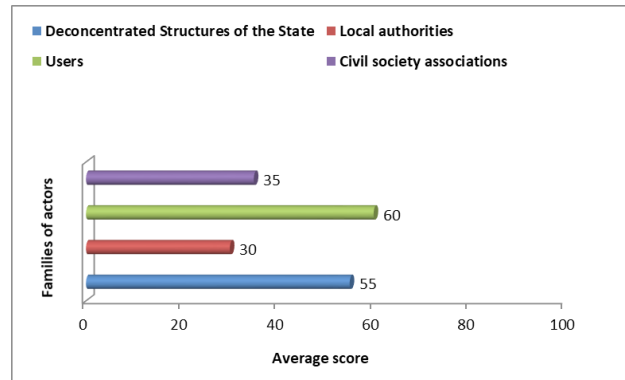


Figure 3. Degree of institutions and participation section  
Source: Cocker, 2021.

### Management Instruments

At the scale of the study area, it appears from the exchanges with the stakeholders that the Oueme River Basin Committee has already been designated and has 51 members elected by their peers from the different families of stakeholders in the basin. However, the sub-committees have not yet been set up, which has not facilitated the proper functioning of this important management instrument. The Oueme Water Development and Management Plan has been drawn up, validated and is available. It is structured in sequential intervention plans (PIS). One of these PIS, called the Oueme delta plan, is currently being developed by the National Water Institute of the University of Abomey-Calavi. Figure 4 presents the situation of the "Management Instruments" section by families of stakeholders.

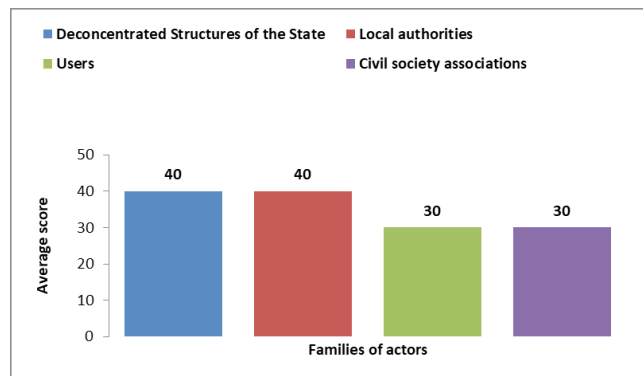


Figure 4. Degree of management instruments section  
Source: Cocker, 2021.

The "management instruments" section was poorly

rated by all actors. Indeed, civil society associations and users gave it 30 points, while decentralized State structures and local authorities gave it 40 points. On average, these scores lead to a mark of 35 for this criterion.

### Financing

Funding is more oriented towards the supply of drinking water than towards the development of IWRM, which has remained theoretical with very few concrete achievements accompanied by significant funding. The lack of funding is a limiting factor for all aspects of water resources development and management. The stakeholders we met criticized the small share often reserved for IWRM. This is reflected in Figure 5 in the scores given by the stakeholder families to the "financing" section.

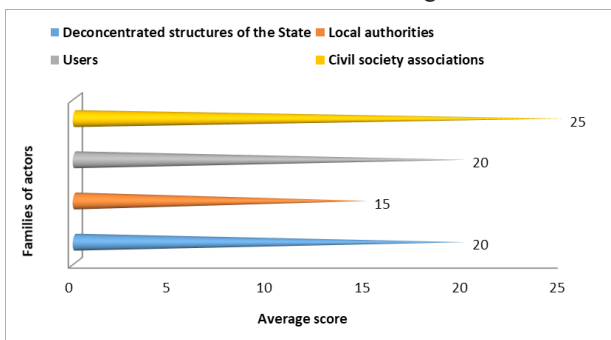


Figure 5. Degree of financing section

Source: Cocker, 2021.

The various stakeholders gave scores ranging from 15 to 25 to the funding section. The highest score was only a quarter. This is low for this section, which is very sensitive because finances play a major role in the success of a mission. At the end of the discussions with the stakeholders, the summary of the scores is 20 on a scale of 0 to 100.

### Synthesis of the evaluation

The assessment of sustainable water resource management shows that actions are already underway, but highlights several weaknesses, including the level of funding, the inadequacy of management instruments, the level of implementation of policies and legal texts. There is also a lack of information and communication on activities that could give IWRM visibility and the place it should have in the water sector. Figure 6 shows the level of implementation of IWRM in the study area.

The integrated management of water resources at the scale of a hydrological basin should be regulated by a specific law with the implementation of an organized

system of continuous monitoring. In Europe, it is the Water Framework Directive, 2000, of which the Law on Water and Aquatic Environments, 2006 is the transposition into French law. In the case of African countries south of the Sahara, such as Benin, regulatory efforts are to be noted. This has therefore been analyzed here in the case of the Oueme River basin. Numerous tools to support decision-making and resource management, based on integrative approaches, are currently being tested. However, their adequate implementation in the sense of providing a solution to the need for concerted management with a view to protecting nature in a vision of resilience to climate change is not yet mastered by the stakeholders. The assessment of the degree of implementation of IWRM then provided an idea of the state of water resources already facing management difficulties and the ravages of climate change. Although the public and private sectors, as well as civil society and users, are involved in this management process, the results are not satisfactory as they reveal that sustainable water resource management is not well implemented in the Oueme basin. These results are corroborated by the National Water Politics document [16], which recognizes that Benin's water resources are still poorly valorized and, consequently, only contribute to the country's socio-economic development to a very small extent in relation to existing potential. The overall score reflecting the degree of IWRM implementation for this study is 40, which is close to the national score of 35 obtained in 2015 by the Ministry of State for Planning and Development. These values are confirmed by the study conducted by [14] in the lower Oueme valley, which also revealed a low score of 31. As the results obtained in the present study fall within this same range, they are therefore similar to those of [17] and allow us to conclude that IWRM elements are generally institutionalized and their implementation is underway in the Oueme basin.

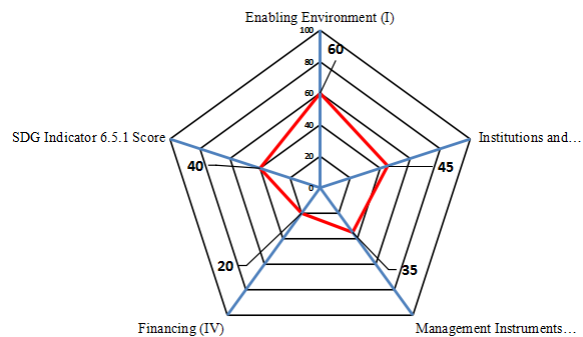


Figure 6. Degree of IWRM Implementation

Source: Cocker, 2021

In addition, according to the UN IWRM Data Portal, the main scores for Benin in 2017 and 2020 for indicator 6.5.1 of the Sustainable Development Goals are more optimistic with values of 63 and 68 respectively. An overview in a larger dimension, meaning outside Benin, shows that the issue of IWRM implementation is still relevant in Sub-Saharan Africa. According to the recent UNESCO and UN-Water (2020) report <sup>[18]</sup>, IWRM scores are still medium-low in 2018 for Cameroon with a score of 34, Ghana progresses a little more to 49 and Kenya a little more than them with a score of 53. In summary, all these scores have the same appreciation and are all qualified as medium-low in reference to the stepwise methodology for monitoring UN Indicator 6.5.1. A comparative reading of the results for these same countries shows a slight advance for the 2020 scores published in 2021 by the UN's IWRM Data Portal. Cameroon and Kenya moved up 6 points to 40 and 59 respectively, followed by Ghana, which moved up 8 points to a score of 57.

With reference to the results of the present study, (score of 40), there is still a long way to go to reach the national level, which is already very advanced compared to the reality of the sector under study. It can therefore be deduced that the overall score can be high for a country, but the same exercise, duplicated on a lower scale, can reveal a notable disparity, which can be understood by the particularities of each environment.

#### 4. Conclusions

The assessment of integrated water resources management is a complex activity that requires a lot of information to be cross-referenced and consistency in the methodology adopted to avoid biasing the data that could reduce the credibility of the results. The interest here is that a reference model exists and approved results are available. The present study therefore drew on the existing model and the results are analyzed and discussed in relation to the known values. Thus, the differences and similarities were explained and commented according to the objectives of the study. It emerges that apart from the objective criteria noted, the degree of implementation of IWRM can increase or decrease depending on the factors involved and the territory considered and the resilience to the impacts of climate change. This study is therefore positioned as a decision-making guide, since it presents a photograph of the level of IWRM implementation in a basin at a given time and highlights the points of weakness.

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#### Conflicts of Interest

There are no conflicts of interest or competing interests associated with this manuscript.

#### Ethics Approval

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

#### Availability of Data and Material

All data, models, and code generated or used during the study appear in the submitted article.

#### Code availability

ORCID: <https://orcid.org/0000-0001-9067-2211>

#### Authors' Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Femi H. Cocker, Eric A. Alamou, Bernadin M. Elegbede and Ismaïla I. Toko. The first draft of the manuscript was written by Femi H. Cocker and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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