

Article

Governance and Institutional Drivers of Ecological Degradation in Urban River Ecosystems: Insights from Case Studies in African Cities

Oghenekaro Nelson Odume ^{1,*} , Blessing Nonye Onyima ² , Chika Felicitas Nnadozie ¹, Gift Ochonogor Omovoh ^{3,4} , Thandi Mmachaka ⁵, Blessing Odafe Omovoh ^{4,6}, Jude Edafe Uku ⁴, Frank Chukwuzoke Akamagwuna ¹ and Francis Ofurum Arimoro ⁴ 

¹ Centre for Environmental Water Quality, Institute for Water Research, Rhodes University, Makhanda 6140, South Africa

² Department of Sociology / Anthropology, Nnamdi Azikiwe University, Awka 420110, Nigeria

³ Department of Environmental Assessment, Federal Ministry of Environment, Environment House, Independence Way South, Central Business District, Abuja 900211, Nigeria

⁴ Department of Animal and Environmental Biology (Applied Hydrobiology Unit), Federal University of Technology, Minna 920101, Nigeria

⁵ Department of Water and Sanitation, Port Elizabeth 6001, South Africa

⁶ Department of Forestry, Federal Ministry of Environment, Plot 393/394, Augustus Aikhomu Way, Utako, Abuja 900108, Nigeria

* Correspondence: n.odume@ru.ac.za



Citation: Odume, O.N.; Onyima, B.N.; Nnadozie, C.F.; Omovoh, G.O.; Mmachaka, T.; Omovoh, B.O.; Uku, J.E.; Akamagwuna, F.C.; Arimoro, F.O. Governance and Institutional Drivers of Ecological Degradation in Urban River Ecosystems: Insights from Case Studies in African Cities. *Sustainability* **2022**, *14*, 14147. <https://doi.org/10.3390/su142114147>

Academic Editor: Alejandro Javier Rescia Perazzo

Received: 18 August 2022

Accepted: 24 October 2022

Published: 29 October 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: The degradation of rivers in urban landscapes is alarming and impaired their ecological functions and the services they provide to society. In African cities, urban rivers are among the most degraded ecosystems, yet ecologically sustainable utilisation of river resources can contribute to and support sustainable urban development. In this paper, we identify and analyse key governance and institutional drivers of ecological change in urban river systems in the Swartkops catchment in South Africa and the Federal Capital Territory (FCT) in Nigeria. Our results indicate that poor ecological conditions of rivers in the two urban landscapes can be attributed to: (1) a lack of system view of the water value chain and associated infrastructure, (2) ambiguity in roles, responsibilities, and poor accountability, (3) prioritizing short-term social-economic-political agenda over long-term environmental sustainability goals, (4) institutional silos and failure of cooperative governance, and (5) over-centralised, top-down, state-centric governance processes. Strengthening the interactions between actors in the science, policy and practice domains, mainstreaming planning with rivers in integrated urban development plans, and strengthening cooperative and polycentric governance across administrative scales are key governance and institutional processes needed to address the trajectory of urban ecological degradation. Our paper sheds light on the fundamental role of strengthening governance and institutional processes for steering urban rivers toward sustainable paths for city resilience.

Keywords: Abuja; cities; Nigeria; policy; urban ecology; Swartkops river

1. Introduction

Rivers and streams are among the most threatened ecosystems globally [1]. Land use change, industrialisation, human population growth, urbanisation and agriculture are key drivers of the structural and functional degradation of rivers and streams on a global scale [1,2]. As the Anthropocene steadily takes off, rivers and streams continue to suffer the effects of human dominance of major planetary systems. A recent study by Brauns et al. [2] provides evidence of human impact on the multifunctionality of streams and rivers, indicating that wastewater effluent, agriculture, and urban land use are the main drivers of the functional degradation of streams and rivers globally. Of particular concern are rivers in cities, which continued to suffer the most from human impact [3].

Many of the world's cities are built along river courses, and the interaction between rivers and cities is complex, with multiple feedback loops [2,4]. As cities expand, river corridors become built up, increasing risk of flooding, pollution, habitat degradation, and biodiversity losses. In return, ecosystem services that benefit people are compromised, with negative consequences for human wellbeing. This trajectory can be reversed through good governance and management strategies that recognise the complexity of river–people relationality in cities. However, the governance and sustainable management of urban rivers proved challenging in many parts of the world [3,4]. Poor coordination and partnership among the often many and diverse stakeholders and interests in cities, low investment in river corridor restoration, and rehabilitation, uncentric, or centralised governance approaches, and infrastructure failure, such as wastewater, are often cited as major impediments to the revitalisation of river systems in cities [4]. In Africa, for example, over the past five decades, a rapid urbanisation rate, escalating rural–urban migration, a growing population of urban poor, and the mushrooming of informal settlements in cities negatively impacted rivers and stream systems [5–8]. These realities present a formidable challenge to policymakers, planners, and implementers responsible for the sustainable governance and management of urban rivers. As a continent that is developing, urban policymakers are further confronted by the difficult task of balancing social-economic development imperatives with those of environmental and ecological sustainability. Empirical evidence suggests that in the face of dwindling financial resources, the social-economic agenda, such as job creation, provision of housing, and health care facilities, often take central stage over long-term ecological goals, yet sustainable utilisation of urban river resources is fundamental to the realisation of the UN sustainable development goals (SDGs) [9–11].

As in many parts of the world, urban rivers in Africa are among the most degraded ecosystems [12], yet ecologically sustainable utilisation of river resources can contribute to and support sustainable urban development [13]. The continuing degradation of urban rivers in African cities implies that many ecosystem services are compromised, negatively impacting river-dependent livelihoods. As in most African cities, rivers in the Nelson Mandela Bay Metro (NMBM) in South Africa and the Federal Capital Territory (FCT), in Nigeria, suffer over-exploitation, unsustainable utilisation, and ecological degradation [14–16]. The consequences of the degradation of rivers within the two metropolises manifest in the entire urban systems. For example, biodiversity loss, reduction in habitat complexity, and high levels of chemical pollutants in the Swartkops River and its estuary in the NMBM reduced the number of recreational visitors [17]. In the FCT, for example, pollution of the Usuma, Jabi, Mpape, and Gwagwalada Rivers contributed to high incidences of water-borne diseases among riparian communities, negatively impacting their economic productivity [18,19]. Given the current trajectories, the degradation of rivers in African cities presents a potentially wicked and intractable challenge to the realisation of the SDGs. Governance innovation is identified as a critical pathway to realising the SDGs. However, systemic natural resource governance failure constitutes a formidable barrier to sustainable natural resource management in Africa [20,21].

In this paper, we identify and analyse key governance and institutional drivers of the ecological degradation of urban river systems. We draw insights from two case studies in two cities located in two African countries, South Africa, and Nigeria. The two case studies are the Swartkops catchment in the NMBM in South Africa and the Usuma River and its tributaries in the Federal Capital Territory (FCT) in Nigeria. We also identify key governance and institutional innovations for reversing the trajectory of the ecological degradation of urban rivers. The paper fills an important gap because it provides an empirical foundation for appreciating the nexus and complex interactions between urban river governance and urban river health.

2. Materials and Methods

2.1. Theoretical Foundation

In this paper, we took urban rivers as complex social-ecological systems (SES). The conceptualisation of rivers and their catchments as complex SESs implies that the ecological and social systems and their components, together form an integrated, dynamic, and coupled unitary system [22]. Therefore, governance and institutional processes, which are part of the social system, may have an impact on river biophysical and ecological structure, function, and processes. The influences of the social system on the river ecology are outcomes of governance decisions, rules, values, and practices [22].

Given the complexity of SES, we used a transdisciplinary research (TDR) approach, drawing on both academic and practice-based knowledge systems [23,24]. To this end, the research began with a co-identification and co-structuring of the research problems with the relevant government officials both in South Africa and in Nigeria, in early 2018. In South Africa, problem co-identification and co-structuring involved actors from the Nelson Mandela Bay Metro (NMBM) and the Department of Water and Sanitation (DWS), whereas in Nigeria, the main actors came from the Federal Ministry of Environment (FME), the Nigeria Hydrological Services Agency (NIHSA), Abuja Environmental Protection Board (AEPB), and the National Environmental Standards Regulatory and Enforcement Agency (NESREA).

2.2. Case Study Description

2.2.1. Swartkops River Catchment

The Swartkops River catchment is located in the Eastern Cape Province of South Africa (Figure 1). The catchment is about 1555 km², with a population of about 1.2 million people. The city of Port Elizabeth, and the industrial town of Uitenhage, residential towns of Despatch and Perseverance, Motherwell, Zwide, and KwaNobuhle are all within the Swartkops catchment. The Elands and KwaZunga Rivers are the two main tributaries of the Swartkops River, whereas the Brak and Chatty are regarded as subsidiary tributaries. The Swartkops River discharges into the Algoa Bay via its 16 km-long estuary. The estuary is permanently open, having the third largest inter-tidal salt marsh of South African estuaries [25]. The estuary is ecologically important, as it serves as a critical breeding ground for many important bird and fish species.

Within the Swartkops River catchment, poverty is a major challenge and is spatially distributed. For example, in the Zwide–Uitenhage areas, more than 60% of households depend on less than USD 300 per month, compared to counterpart households in the Port Elizabeth area with a much higher household income (Nelson Mandela Bay Municipality 2011).

Poor water quality and ecological degradation were previously reported from the Swartkops River catchment, and these were largely attributed to stormwater return flows via stormwater canals, discharges of untreated/poorly treated wastewater effluent, illegal discharges of wastes into the river, run-off from farmlands, removal of riverbed materials, as well as the presence of alien invasive plant species [26,27]. Population growth and informal settlements within the catchment were implicated as important contributors to observed ecological degradation in the catchment [28].

2.2.2. Federal Capital Territory (FCT)

The Federal Capital Territory (FCT) is situated within the Middle Belt of Nigeria, in a Guinea–Savanna zone. The FCT covers an area of 7315 km² and it is politically administered via six area councils: Abuja, Gwagwalada, Kuje, Bwari, Kwali, and Abaji (Figure 2). The FCT is collectively administered through the Federal Capital Territory Administration (FCTA) headed by a minister appointed by the president of Nigeria. The Abuja Environmental Protection Board (AEPB) is responsible for environmental management, including solid waste and wastewater management, while the Federal Capital Development Authority (FCDA) is responsible for spatial planning. Since its establishment, the FCT experienced an escalating population growth and urbanisation. The urbanisation rate is estimated at 8.3% per annum, and its population grew from less than 350,000 people in 1979 [29] to more

than 3 million people, with a daytime population of 7 million people [14,30]. As the city continues to urbanise, so does the proliferation of informal settlements [14]. Because of the growing human population and urbanisation, natural resources, including rivers within the FCT are being unsustainably utilised and degraded [31].

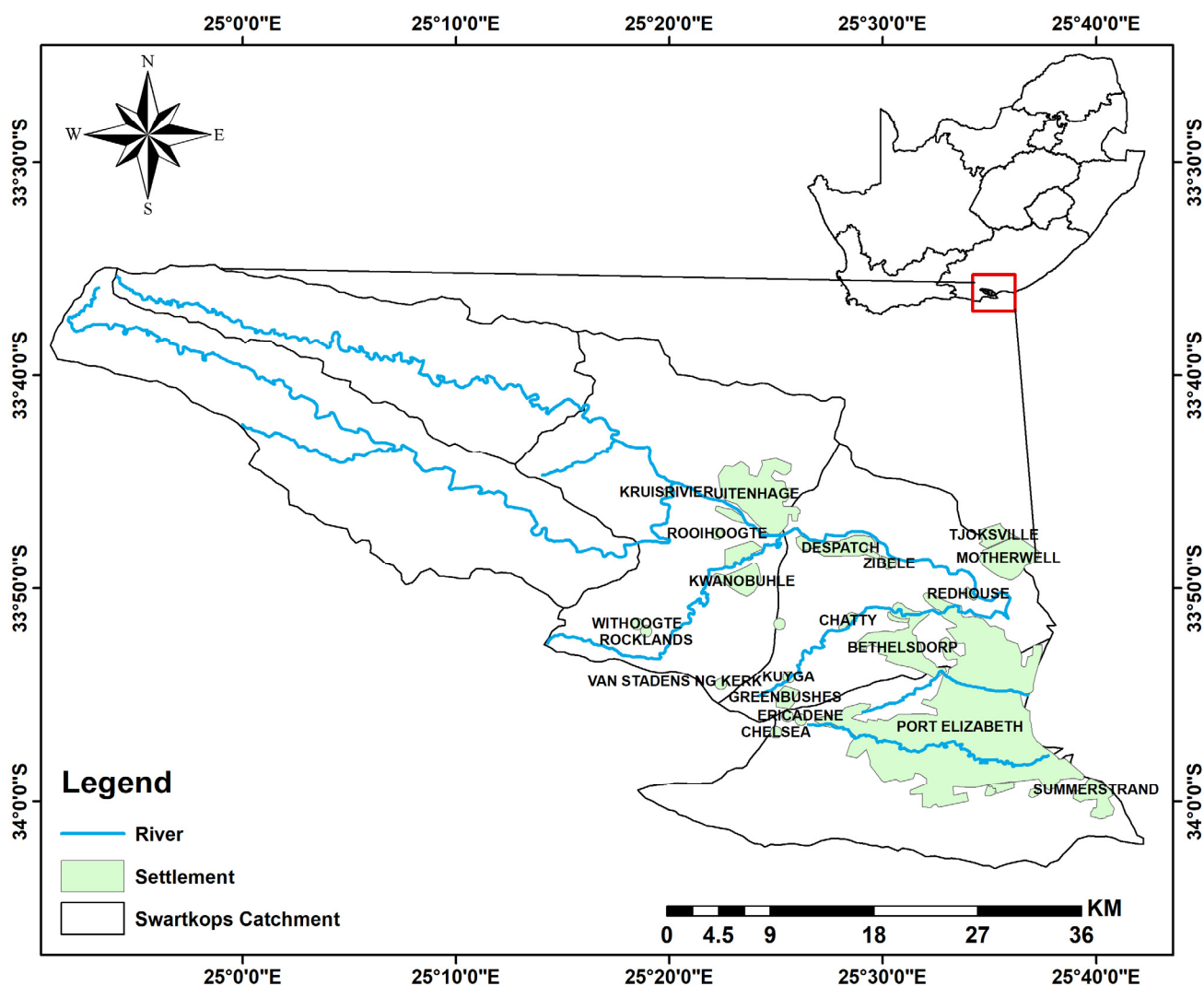


Figure 1. Map of the Swartkops catchment showing major settlements and the location of the catchment within South Africa.

The Usuma River and its tributaries are the main river networks within the FCT. The river has two primary tributaries, one that flows westward and the other flows eastward. The river is the primary water source for the Lower Usuma Dam, which serves part of the FCT. The eastward flowing tributary forms the Ndawuse River, which flows from Aso-buari, through the Mpape dumpsite. The Usuma River flows through several suburbs and villages, including Wuye village, Hulumi, Brazil, Gosa villages, the proposed Centenary City, Buwari, Ushafa, Kubwa, and Gwagwa before emptying into the main Gurara River and then into the River Niger.

As an urban river, several land use activities greatly impact the river ecology. In the upper reaches of the river networks, a built-up area comprising formal, informal, and mixed settlements are the main impactors. In the middle reaches of the river catchment is the Idu District, in which the Idu Industrial Area (IIA) is situated. The IIA is composed of fast-growing heavy, light, and small to medium size industries. The Idu solid waste dumpsite and the Idu wastewater treatment works are key drivers of water quality change

within the river networks. The lower reaches of the river networks are dominated by farms and the proliferation of informal settlements.

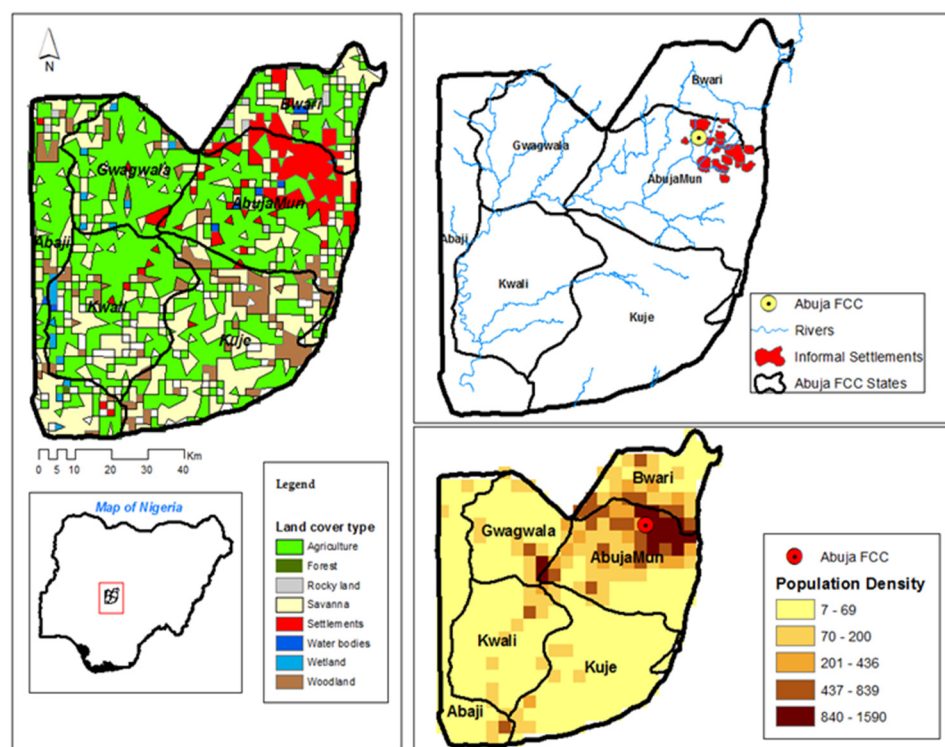


Figure 2. Map of the Federal Capital Territory (FCT) showing rivers, land cover type and population density, and the location of the FCT in Nigeria.

2.3. Data Collection and Analysis

We employed workshops and focus group discussions as the primary means of data collection. In South Africa, the first workshop, termed “knowledge co-production workshop” was held on 2 December 2019 in Port Elizabeth, and this was followed on the same day by three focus group discussions. Invitation to workshop participants was through purposive sampling. Since the workshop was aimed at exploring and distilling governance and institutional dimensions of drivers of ecological degradation, we intentionally invited participants from key government and non-governmental entities, as well as representatives from communities and researchers active in the catchment. The workshop had 20 participants drawn from NMBM, DWS, non-governmental organisations (e.g., Zwartkops Nature Conservancy), research institutions (Rhodes University and Nelson Mandela University), industries operating in the catchment, and representatives of communities. To allow for productive engagement during the workshop, the invitation was sent at least two months before the workshop, accompanied with guiding questions on institutional and governance dimensions of observed ecological degradations in the Swartkops River catchment.

To gain in-depth insights into the research topic, the workshop participants formed four focus groups (FG), each comprising five participants representing different organisations, where possible. Each FG was moderated by a trained member of the research team, and the guiding questions were co-developed by the research team, comprising of academics and practitioners. In the beginning, the moderator introduced the questions, with a discussion of rules for the FG, which included equality of opinion and voices, respect and sensitivity to other people’s views, and openness to diverse ideas, perspectives, and insights. These rules were necessary to mediate issues of power, which may undermine the group dynamics [32]. Even though the FG was audiotaped after consent was sought, a

co-moderator took notes, and where necessary, participants made drawings to illustrate a particular point of discussion. Recorded workshop discussions and focus group discussions (FGD) were transcribed verbatim and analysed. Each FGD session lasted for 2 h, with 30 min breaks in between.

In Nigeria, a similar approach to that of the South Africa case study was followed. A knowledge co-production workshop was held on 23 January 2020 at the Department of Forestry, Federal Ministry of Environment in Abuja. The workshop had 32 participants drawn from the Federal Ministry of Environment, Abuja Municipal Area Council (AMAC), AEPB, FCDA, NIHSA, NESREA, Federal Ministry of Water Resources, Gwagwalada Area Council, Kuje Area Council, research institutions (University of Abuja and Federal University of Technology, Minna), and community leaders. Similar to the knowledge production workshop in the South African case study, participants possessed the guiding questions, and presentations were made by representatives of the various government ministries, departments, and agencies (MDAs). Presentations were followed by interactive and reflective sessions, in which workshop participants asked questions, reflected on, and clarified the key issues that emerged. As with the South African case study workshop, participants went into FGD sessions. Each focus group had between 8 and 10 members, and care was taken to ensure diversity of members in terms of the organisation they represented, and years of experience. Just as in the FGD in South Africa, consent was sought, the discussion audiotaped, notes were taken, and drawings were made where necessary. Each FGD lasted for 2 h, with 30 min breaks in between.

2.4. Data Analysis

Following the Braun and Clarke [32] framework for thematic analysis, the collected data were subjected to reiterative reading, coding, and thematic analysis by two separate team members, one for the South African data and the other for the Nigerian data. The reiterative readings led to the creation of initial codes, which were subsequently merged into minor and major thematic categories. After the data for both countries were analysed by the first two coders, two other coders analysed the data separately, subjecting the transcripts to an inter-coder reliability test to ensure rigour.

To ensure that the analysed data captured the complexity and diversity of views expressed by all research participants, two online feedback workshops were organised in both South Africa and Nigeria on 16 September 2020, and 23 September 2020, respectively. The purpose of the feedback workshops was two fold: (i) to present the analysed results to participants for discussion, reflection, and further interrogation, and (ii) to collect additional data, where gaps were identified.

The feedback workshop in South Africa had 29 participants, whereas that in Nigeria had 77 participants. Following the feedback workshops, the research team reflected on the analysed data, and made changes to the themes, where necessary. Overall, the various processes and steps followed during the data collection and analysis ensured the credibility, reliability, and validity of the results.

3. Results

Table 1 shows the key negative drivers accelerating the deterioration of urban river health, as well as the identified governance processes and strategies for improvement. These negative drivers and strategies for improvement are presented in detail. It must be noted that the negative drivers and improvement strategies are not linear correlates; instead, an improvement strategy could impact one or more negative driver(s).

3.1. Governance and Institutional Drivers of Ecological Deterioration of the Urban River Systems

3.1.1. A Lack of System View of the Water Value Chain and Associated Infrastructure

To manage and govern urban water systems (including rivers) holistically, a system view of the entire hydrological cycle, water value chain and associated infrastructure, is critical. Our analysis suggests that governance actions in the two case studies do not reflect

systemic thinking and practices within key government institutions responsible for the management of rivers. For example, in the South African case study, at the municipal level, for instance, different sub-divisions are responsible for drinking water and wastewater. While this is not necessarily problematic, it led to systematic prioritisation of drinking water infrastructure over those for wastewater, manifested in higher budgetary allocation for the formal. Practices that suggest a lack of appreciation of the nexus between drinking water and wastewater were identified as key contributors to the ecological degradation of rivers within the case study areas. Examples of such practices are: (i) performance assessments and reward systems that discourage interactions between actors across the entire water value chain and infrastructure, and (ii) poor budgetary allocation to the wastewater and urban stormwater sectors, which undermine long-term infrastructural integrity, and thus the release of potentially poorly treated effluent into the receiving rivers and streams.

Table 1. Negative governance drivers of urban river health deterioration and identified governance strategies for improving urban river health.

Negative Governance Drivers of Urban River Health Deterioration	Governance Strategies for Improving Urban River Health
A lack of system view of the water value chain and associated infrastructure.	Strengthening the interactions between actors in the science, policy, and practice domains.
Ambiguity in roles, responsibilities, and accountability.	
Prioritising short-term, social-economic-political agenda over long-term environmental sustainability goals.	Mainstreaming planning with rivers in integrated urban development plans.
Institutional silos and failure of cooperative governance.	
Over-centralised, top-down, and state-centric governance processes.	Strengthening cooperative and polycentric governance.

3.1.2. Ambiguity in Roles, Responsibility, and Accountability Mechanisms

Clear roles and responsibilities, as well as good accountability mechanisms, are indicators of good water governance [33,34]. However, when roles and responsibilities are not clearly spelt out in standard operating procedures, or in policy and regulatory frameworks, this can have severe consequences during emergency incidences. Our results suggest that a lack of clarity in roles, responsibility, and poor accountability measures has acute effects on urban river health, particularly during emergency pollution incidences. For example, one of the actors in the South African case study remarked:

“In the case of pollution incidences, sometimes mobilizing to site to deal with the pollution is delayed because often the different divisions may see such incidences as falling outside their mandates because it is easy to have a blame game. Let’s take for example when a canal is polluted with waste, the stormwater people would say, no, no, that is human waste, it’s the waste management division that is responsible, but the waste management people, would also say no, no that it’s stormwater that is responsible. Let’s clearly define these roles, and with a budget allocation, so that when it happens, we know who is responsible, because these delays during an emergency are causing pollution in our rivers in the city.”

The implication of this assertion is the need to clarify roles and assign responsibilities in ways that do not create problems, especially during pollution incidences.

The regulatory agencies across administrative scales are mandated to hold polluters accountable through compliance monitoring and enforcement tools, such as municipal bylaws, national environmental guidelines and standards, licensing of waste discharges, and the application of the polluter pays principle [35,36]. However, the empirical evidence in our case studies suggests that monitoring and enforcing the provisions of these tools proved difficult as industries and other water users continue to discharge waste into water

bodies. In Nigeria for example, NESREA is responsible for enforcing compliance with environmental laws [37,38], but as one of the actors in the Nigeria case study puts it: *“we know a lot of waste goes into our rivers, so compliance and enforcement monitoring is poor, or I can say non-existent”*. This assertion suggests that there are serious challenges regarding compliance with and enforcement of environmental laws. This challenge poses a serious threat to the ecological sustainability of urban rivers. While the situation seems better in the South African case study, there are challenges to effective enforcement of municipal bylaws, as well as illegal discharges of waste into river systems, as reflected by this remark: *“We have had a situation of illegal discharges of waste into the Swartkops River by industries. The industries mostly do this during long holidays and at night, but we still can trace them because we know who is producing certain waste in the catchment.”* Apart from illegal discharges of waste into the Swartkops River, which highlights the need for strengthening enforcement measures, there were instances where industries discharged untreated waste into the municipal wastewater treatment works. (WWTWs). By law, industries are required to pre-treat their effluent to prescribed standards before such effluents are sent to the municipal WWTWs. This practice ensures that industrial effluent does not cause operational challenges at the WWTWs.

3.1.3. Prioritising Short-Term Social–Economic–Political Agenda over Long-Term Environmental Sustainability Goals

Our analysis suggests that within the two catchments, short-term social, economic, and political imperatives were being prioritised over the long-term environmental sustainability agenda. This manifests in a variety of ways, including: (i) allocating less budget to environmental goals, (ii) poor attention to environment-related issues, particularly among the political elites, (iii) inadequate consideration of rivers and river corridors in integrated development plans, and (iv) a perception that environmental issues have little electoral value compared to social-economic needs. For example, one of the actors in the Nigerian case study remarked: *“that there is a lack of political will, political leaders are not interested in addressing environmental issues, therefore, our rivers are getting polluted, and sedimentation is happening as well.”* In the South African case study, for example, it was indicated *“councilors are often more interested in-service delivery issues (e.g., water supply, health-related services etc.) that are perceived to have electoral values over long-term environmental agenda (e.g., maintaining the ecological health of rivers).”* As a result, urban rivers and river corridors are given less attention compared to social-economic matters in both case studies.

3.1.4. Institutional Silo and the Failure of Cooperative Governance

In South Africa and Nigeria, the principles of cooperative governance and inter-governmental relations across administrative scales are enshrined in relevant policy and operational documents [39]. However, in the two case studies, there was clear frustration regarding silo practices among government departments, divisions, and units responsible for the management and governance of water and water-related resources, service delivery, and infrastructure. The failure of cooperative governance and silo practices within the two case studies is manifest in the form of (i) delay procurement processes that impact infrastructural repairs, integrity, maintenance, and refurbishment, with attendant consequences for urban river health, (ii) performance assessment and (dis)incentives that encourage silo mindsets, (iii) inadequate appreciation of system and relational thinking in daily operations, (iv) poor data and information sharing among technical sister ministries, departments, agencies, divisions, and units.

Our results suggest that silo practices and the failure of cooperative governance have serious consequences for urban river health. For example, as one workshop participant in the Nigerian case study puts it: *“there is a lack of synergy, especially among authorities that regulate and authorise land use activities, and what we see is, one authority approves an activity that is not good for nearby rivers and streams, because they are not looking at it from that perspective”*. In the South African case study, one of the workshop participants highlighted

the consequences of a poor appreciation of the interdependence between sister technical divisions as follows: *“we’ve had a situation of sewage spill some years ago, the community wanted this incident to be attended to urgently, the technical guys were ready, but because of the procurement process, there is nothing they could do, and the spills continue for some time before it was addressed.”* What this suggests is the importance of strengthening co-cooperative governance across scales, both horizontally and vertically, within and outside the relevant institutions.

3.1.5. Over-Centralised, Top-Down State-Centric Governance Systems

In South Africa and Nigeria, the importance of decentralisation in the management and governance of water and environmental resources is foregrounded in the relevant legal frameworks [39]. The foregrounding seemed to be anchored in the realisation that achieving sustainable utilisation and protection of water resources, including urban river systems, would require some forms of decentralisation and democratisation of institutions responsible for managing and governing water resources. The intention is to deepen citizens’ participation in decision making. However, our analysis indicates that in practice, decision making about water resource governance and management is over-centralised, top-down, and hierarchical. The consequences of over-centralised, state-centric governance systems for the two catchments manifest in the form of: (i) a slow pace in decision making, particularly during pollution emergencies, (ii) misalignment of decisions with local realities, and (iii) low institutional adaptive capacity to deal with the complexity of urban river governance. Over-centralisation tends to present low opportunities for learning and experimentation among local institutions due to poor delegation of authority, and a failure to draw on diverse knowledge sources and systems across administrative scales.

3.2. Strengthening Governance and Institutional Processes for Improving the Ecological Health of Urban River Systems

We analysed and reflected on strategies that can be implemented to strengthen governance and institutional processes to improve urban river health. These strategies are presented below.

3.2.1. Strengthening Interactions between Actors in the Science, Policy, and Practice Domains

The governance of urban rivers is complex [3,39]. It implies that to halt and potentially reverse the trajectories of ecological degradation of urban river systems, there is a need to strengthen science–policy–practice interactions [38,40]. Our results indicate that strengthening the interactions between actors in the science, policy, and practice domains at the catchment scale could potentially lead to (i) research-informed, evidence-based decision making, (ii) opportunity to draw on diverse knowledge systems (academic, practice-based, and community-situated knowledge) to effect solutions to ecological degradations in urban river systems, and (iii) a better understanding of value systems that underpin people–river relationality in urban landscapes.

For example, regarding research-informed, evidence-based decision making, one of the participants in the South Africa case study asserted that, *“we need the universities, municipalities, Department of Water and Sanitation, and communities to work together. For the municipality, the results of research from the universities can help inform how we review our municipal bylaws and other regulatory instruments.”* The importance of working with communities is also stressed: *“we need to start working closely with our communities, we need to understand why they pollute and what we can do to help to minimise the pollution, this is the only way we are going to solve the problem”*. It is thus clear that strengthening the science–policy–practice interface is an important strategy towards addressing complex sustainability challenges, such as degrading urban river systems.

3.2.2. Mainstreaming Planning with Rivers in Integrated Urban Development Plans

The importance of systemic, integrated planning that features river ecological objectives in urban planning is emphasised [14]. Such an approach to planning will not

only view rivers as essential landscape features in cities, but would stress the importance of budgetary allocation, and administrative and political support for the realisation of river-related ecological goals. In both case studies, our results indicate that planning for social-economic development, infrastructure, and social amenities often takes precedence over rivers and other ecological assets. Several reasons can be deduced from our data to explain the situation: (i) a perception that environmental goals, including those for urban rivers, do not lend themselves to short-term political gains, and (ii) environmental goals are not vested in people at the appropriate administrative levels with the requisite authority to influence organisation-wide decision making. Our results indicate three important steps that can be taken to reverse this trajectory. These are: (i) political support, (ii) budget ringfencing for ecological goals, and (iii) the vesting of environmental goals in people with authority to influence organisation-wide decision making across administrative scales.

3.2.3. Strengthening Cooperative and Polycentric Governance across Administrative Scale

The research participants in the two case studies identified the importance of strengthening polycentric and cooperative governance to address the challenges associated with ecological degradation of river systems. Regarding cooperative governance, establishing cooperative platforms and instruments, such as catchment forums and committees, memorandum of understanding (MOU) and service level agreement between the relevant government entities, and integrative catchment planning processes that bring all stakeholders together, were identified as critical to addressing the degradation of urban rivers in the catchments. The idea is that these measures can strengthen accountability and ensure that a diversity of interests and voices are considered in the decision-making process, whilst paying attention to power dynamics between the actors. In addition, the participants argued that MOU and service-level agreements can spell out areas of cooperation and minimum acceptable norms in such corporations. This way, accountability will not only be strengthened, but inter-governmental relation can also be enhanced for effective and efficient governance and management of river resources.

In the Nigerian case study, the emphasis was on the importance of intergovernmental cooperation and collaboration between government and communities, as stressed by one of the research participants,

“In the FCT we need an MOU between the Department of Environmental Impact Assessments, National Environmental Standards and Regulations Enforcement Agency, Abuja Environmental Protection Board, the space agency, river basin authorities and other relevant government bodies. If we can do this, the various bodies will start working together and minimise the problem we have with degrading rivers because of human activities and other development that are not well regulated in a coordinated fashion. But we also need a local community management committee through which government can work together with communities to raise awareness, have regular dialogues, and provide some accountability”.

Similar views were echoed in the South African case study, but put forward differently: *“We should bring back the Swartkops forum, and complete the business plan through a consultative mechanism so that all interests in the catchment are reflected. We have started the catchment planning process, and we have been consulting, it’s not complete yet, but we are working on it”.*

The analysis of our data suggests that research participants realised the importance of designing institutions across scales with some measures of autonomy to make decisions, especially in an emergency. In addition, the importance of an institutional fit to local social-ecological realities was identified as critical because such institutions tend to better reflect the values, aspirations, and interests of actors and ecological realities at the local scale.

4. Discussion, Management Implications and Conclusions

In this paper, we identify and explore the key governance and institutional drivers of ecological degradation in urban rivers in two African cities. We identified negative drivers, and the strategies that can be implemented to strengthen institutional and governance

processes to address deteriorating ecological conditions of urban river systems. Improving the health of urban rivers is critical because they serve as vital ecological assets in urban landscapes. [41]. Our paper sheds light on the need to strengthen urban river governance to maintain rivers in good ecological conditions [4,42].

Fragmentation of the water value chain, in which drinking water-related services and infrastructure are managed in isolation from water resources (including rivers) and related infrastructure, such as wastewater treatment works, urban stormwater, and environmental planning, were identified as a barrier to effective governance of water systems, particularly in cities [43–50]. The fragmentation arises in part because urban planners, resource managers, and decision-makers do not often take an explicit system thinking approach in the planning process and resource allocation. The implication, as seen in the current study, is the prioritisation of short-term economic gains over a long-term environmental sustainability agenda.

The OECD identified effectiveness, efficiency, trust, and engagement as the three dimensions of water governance that are mutually complementary and re-enforcing [33–51]. These three dimensions direct and inform context-sensitive principles for managing water resources. Clear roles and responsibilities, as well as stakeholder engagement through cooperative governance, are key OECD principles of good water governance [33,50]. In the two case studies, ambiguity in roles and responsibilities during emergency is a key contributor to urban river degradation. When roles and responsibilities are poorly allocated, this can impact coordination among relevant actors (e.g., regulators, policymakers, and resource managers across scale), and in turn, can have a serious effect on governance effectiveness [51]. In addition, poor allocation of roles and responsibilities, coupled with a weak accountability mechanism, can foster a culture of blame and slow implementation of remedial actions.

The governance of water resources, including urban rivers, is complex [4]. It requires active stakeholder participation and reliance on diverse perspectives and knowledge systems for informed and outcome-oriented contributions to policy and practice. In addition, by enhancing stakeholder participation, and building trust among affected and interested actors, decisions are likely to reflect the local social-ecological realities, build redundancies, and encourage articulation of a shared catchment vision [4]. In the current study, stakeholders indicated the need to establish collaborative and participatory platforms as a way of democratising urban river governance, strengthening collaboration between the relevant regulatory agencies, and deepening citizen participation in decision making. By deepening citizens' participation in the governance process, local values and aspirations can be better understood and reflected in decision making in ways that can make meaningful contributions to improving urban river systems.

Several governance implications flow from the notion of cooperative and participatory governance for river resources. First, resource use efficiency and optimisation as the relevant regulatory agencies can better synergise and streamline their activities. Second, seamless flow of data and information among government departments and between relevant government departments and other interested and affected stakeholders and actors. Third, strengthening the interactions between science, policy, and practice actors in ways that bring about their complementary strengths. Interaction between science–policy–practice is theorised as critical to addressing complex sustainability challenges because each domain plays an important role concerning knowledge, actions, values, and perspectives that are necessary to effect solutions to such challenges [41]. Fourth, mainstreaming of all three governance modes: hierarchical, network, and market-based governance [52]. All three governance modes need to operate efficiently and effectively to strengthen accountability and transparency. Fifth, strengthening cooperative and participatory governance of river resources addresses the problem of institutional silos, which were identified in the present study as a critical contributor to urban river degradation. Sixth, by strengthening cooperative and participatory governance, the risk of natural resource governance failure can be mitigated through redundancy via overlapping functions and structures. Seventh,

cooperative and participatory governance can create room for a diversity of knowledge sources and knowledge sharing across scales [53,54], thus enhancing the knowledge base for steering urban rivers towards sustainability.

A critical challenge that confronts policymakers in Africa is the balance between the social-economic development agenda and natural resource protection [55]. Often, environmental goals are perceived as having little electoral and political value compared to social-economic imperatives. This perception led to a less attention being paid to the protection of natural resources, including urban river systems. In this regard, planning with rivers, particularly at sub-national and catchment levels, is emphasised as a way of recognising the contribution of rivers to urban development, and the imperatives for their protection. ICLEI [14] views planning with rivers as an approach that stresses the importance of context, and it integrates and recognises the interactions between the social, economic, environmental, institutional, and policy dimensions within urban areas. We thus advocate that much of the challenges identified in the current study are addressed by an integrated planning process that recognises the inherent interconnectedness and interdependence between rivers and social-economic goals in urban landscapes. This way, political, economic, social, and ecological agendas can be viewed as mutually supportive. In conclusion, we suggest that rivers should be seen as key urban landscape features, and important ecological, economic, and social assets.

Author Contributions: Conceptualisation, writing—original draft, supervision, O.N.O.; writing—review and editing, investigation, data analysis, O.N.O., B.N.O., C.F.N., G.O.O., B.O.O., T.M., F.C.A., J.E.U. and F.O.A.; funding acquisition, methodology, resources, and project administration, O.N.O. and B.N.O. All authors have read and agreed to the published version of the manuscript.

Funding: This work is based on the research supported wholly by the LIRA 2030 Africa Programme, which is implemented by the International Science Council (ISC) in partnership with the Network of African Science Academies (NASAC), with support from the Swedish International Development Cooperation Agency (Sida), Grant No. LIRA 2030-GR08/19.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and was approved by the Rhodes University Human Ethics sub-committee. Approval No. 2019-0808-990.

Informed Consent Statement: Informed consent was obtained from all participants involved in the study as part of the Ethics Approval process.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Feio, M.J.; Hughes, R.M.; Serra, S.R.Q.; Nichols, S.J.; Kefford, B.J.; Lintermans, M.; Robinson, W.; Odume, O.N.; Callisto, M.; Macedo, D.R.; et al. Fish and macroinvertebrate assemblages reveal extensive degradation of the world's rivers. *Glob. Chang. Biol.* **2022**, *1*–20. [CrossRef] [PubMed]
2. Brauns, M.; Allen, D.C.; Boechat, L.G.; Cross, W.F.; Ferreira, V.; Graeber, D.; Paterick, C.J.; Reipoch, M.; von Schiller, D.; Gucker, B. A global synthesis of human impacts on the multifunctionality of streams and rivers. *Glob. Chang. Biol.* **2022**, *28*, 4783–4793. [CrossRef] [PubMed]
3. Walsh, C.J.; Roy, A.H.; Feminella, J.W.; Cottingham, P.D.; Groffman, P.M.; Morgan, R.P., II. The urban stream syndrome: Current knowledge and the search for a cure. *J. N. Am. Benthol. Soc.* **2005**, *24*, 706–723. [CrossRef]
4. Lerner, D.N.; Holt, A. How should we manage urban river corridors? *Procedia Environ. Sci.* **2012**, *13*, 721–729. [CrossRef]
5. Meissner, R.; Jacobs, I. Theorising complex water governance in Africa: The case of the proposed Epupa Dam on the Kunene River. *Int. Environ. Agreem. Politics Law Econ.* **2014**, *16*, 21–48. [CrossRef]
6. Heintz, J.; Valodia, I. Informality in Africa: A review. In Women in Informal Employment: Globalizing and Organizing (WIEGO). 2008. Available online: https://www.wiego.org/sites/default/files/publications/files/Heintz_WIEGO_WP3.pdf (accessed on 20 August 2022).
7. Cobbinah, P.B.; Erdiaw-Kwasie, M.O.; Amoateng, P. Africa's urbanisation: Implications for sustainable development. *Cities* **2015**, *47*, 62–72. [CrossRef]

8. Thieme, T.A. The hustle economy. *Prog. Hum. Geogr.* **2017**, *42*, 529–548. [\[CrossRef\]](#)
9. Scott, C.; Varady, R.; Meza, F.; Montaña, E.; Raga, G.; Luckman, B.; Martius, C. Science-Policy Dialogues for Water Security: Addressing Vulnerability and Adaptation to Global Change in the Arid Americas. *Environ. Sci. Policy Sustain. Dev.* **2012**, *54*, 30–42. [\[CrossRef\]](#)
10. McHale, M.R.; Bunn, D.N.; Pickett, S.T.; Twine, W. Urban ecology in a developing world: Why advanced socioecological theory needs Africa. *Front. Ecol. Environ.* **2013**, *11*, 556–564. [\[CrossRef\]](#)
11. Wichelns, D. The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective? *Environ. Sci. Policy* **2017**, *69*, 113–123. [\[CrossRef\]](#)
12. Sado-Inamura, Y.; Fukushima, K. Considering Water Quality of Urban Rivers from the Perspectives of Unpleasant Odor. *Sustainability* **2018**, *10*, 650. [\[CrossRef\]](#)
13. ICLEI—Local Governments for Sustainability’s Cities Biodiversity Centre. *Sustainable River-Based Urban Planning Guidelines for Sub-Saharan Africa*; ICLEI—Local Governments for Sustainability’s Cities Biodiversity Centre: Cape Town, South Africa, 2018.
14. Abubakar, I.R. Abuja city profile. *Cities* **2014**, *41*, 81–91. [\[CrossRef\]](#)
15. Melariri, P.; Steenkamp, L.; Williams, M.; Mtembu, C.; Ronaasen, J.; Truter, I. Water, sanitation and hygiene practices in early childhood development (ECD) centres in low socio-economic areas in Nelson Mandela Bay, South Africa. *J. Water Sanit. Hyg. Dev.* **2019**, *9*, 164–171. [\[CrossRef\]](#)
16. Ogwueleka, T.C.; Christopher, I.E. Hydrochemical interfaces and spatial assessment of Usuma River water quality in North-Central Nigeria. *Sci. Afr.* **2020**, *8*, e00371. [\[CrossRef\]](#)
17. Du Preez, M.; Lee, D.E.; Hosking, S.G. The Recreational Value Of Beaches In The Nelson Mandela Bay Area, South Africa. *Stud. Econ. Econ.* **2011**, *35*, 85–102. [\[CrossRef\]](#)
18. Ojutiku, R.O.; Kolo, R.J.; Mbanaso, C.A. Composition and Dynamics of Some Nutrient and Physic-Chemical Pa-rameter in Lower Course of Gwagwalada River in Federal Capital Territory, Abuja, Nigeria. *Am. J. Exp. Agric.* **2014**, *4*, 1480–1491. Available online: www.sciencedomain.org (accessed on 20 August 2022).
19. Youngu, T.T.; Azua, S.; Aliyu, Y.A.; Abubakar, A.Z.; Bala, A.; Aliyu, A.O.; Joel, M.A. Geospatial Mapping and Multi-criteria Evaluation of Surrounding Flood Risk Communities of Usuma Dam Abuja-Nigeria. *FUTY J. Environ.* **2020**, *14*, 87–101.
20. Falayi, M.; Gambiza, J.; Schoon, M. A scoping review of environmental governance challenges in southern Africa from 2010 to 2020. *Environ. Conserv.* **2021**, *48*, 235–243. [\[CrossRef\]](#)
21. Larson, A.M.; Soto, F. Decentralization of Natural Resource Governance Regimes. *Annu. Rev. Environ. Resour.* **2008**, *33*, 213–239. [\[CrossRef\]](#)
22. Odume, O.N.; De Wet, C. A systemic-relational ethical framework for aquatic ecosystem health research and man-agement in social-ecological systems. *Sustainability* **2019**, *11*, 5261. [\[CrossRef\]](#)
23. Lawrence, R.J. Advances in transdisciplinarity: Epistemologies, methodologies and processes. *Futures* **2015**, *65*, 1–9. [\[CrossRef\]](#)
24. Reed, M.G.; Abernethy, P. Facilitating Co-Production of Transdisciplinary Knowledge for Sustainability: Working with Canadian Biosphere Reserve Practitioners. *Soc. Nat. Resour.* **2017**, *31*, 39–56. [\[CrossRef\]](#)
25. Odume, O.N.; Palmer, C.G.; Arimoro, F.O.; Mensah, P.K. Chironomid assemblage structure and morphological response to deteriorating water quality in an effluent-impacted river, Eastern Cape, South Africa. *J. Ecol. Indic.* **2016**, *67*, 391–402. [\[CrossRef\]](#)
26. Odume, O.N.; Palmer, C.; Arimoro, F.; Mensah, P. Influence of selected biotopes on chironomid-based bioassessment of the Swartkops River, Eastern Cape, South Africa. *Water SA* **2015**, *41*, 343. [\[CrossRef\]](#)
27. Tshithukhe, G. Assessing Invasive Alien Aquatic Plant Species’ Phytoremediation Effects Using Biological Indicators in the Swartkops River [Rhodes University]. 2020. Available online: <https://commons.ru.ac.za/vital/access/services/Download/vital:41501/SOURCE1?view=true> (accessed on 20 August 2022).
28. Odume, O.; Muller, W.; Palmer, C.; Arimoro, F. Mentum deformities in Chironomidae communities as indicators of anthropogenic impacts in Swartkops River. *Phys. Chem. Earth Parts A/B/C* **2012**, *50–52*, 140–148. [\[CrossRef\]](#)
29. IPA (International Planning Associates). *The Master Plan for Abuja, the New Federal Capital of Nigeria*; FCDA: Abuja, Nigeria, 1979.
30. Iro, I. Demographic pressure and the application of GIS in land reforms: The case of restoration of Abuja Master Plan and sanitization of cadastral and land registry. In Proceedings of the Map Middle East Conference on GIS Development, Dubai, United Arab Emirates, 8–10 April 2008.
31. Schneider, F.; Buser, T. Promising degrees of stakeholder interaction in research for sustainable development. *Sustain. Sci.* **2017**, *13*, 129–142. [\[CrossRef\]](#)
32. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [\[CrossRef\]](#)
33. OECD. *The Governance of Water Regulators*; OECD: Paris, France, 2015. [\[CrossRef\]](#)
34. Berg, S.V. Seven elements affecting governance and performance in the water sector. *Util. Policy* **2016**, *43*, 4–13. [\[CrossRef\]](#)
35. Government Gazette No. 19182; National Water Act (Act No.36 of 1998); Republic of South Africa (RSA): Cape Town, South Africa, 1998.
36. National Policy on the Environment (Revised 2016). 2016. Available online: <https://leap.unep.org/countries/ng/national-legislation/national-policy-environment-revised-2016> (accessed on 20 August 2022).
37. Ziervogel, G.; Satyal, P.; Basu, R.; Mensah, A.; Singh, C.; Hegga, S.; Abu, T.Z. Vertical integration for climate change adaptation in the water sector: Lessons from decentralisation in Africa and India. *Reg. Environ. Chang.* **2019**, *19*, 2729–2743. [\[CrossRef\]](#)

38. Andersson, E.; Haase, D.; Anderson, P.; Cortinovis, C.; Goodness, J.; Kendal, D.; Lausch, A.; McPhearson, T.; Sikorska, D.; Wellmann, T. What are the traits of a social-ecological system: Towards a framework in support of urban sustainability. *NPJ Urban Sustain.* **2021**, *1*, 14. [[CrossRef](#)]
39. Keeler, B.L.; Hamel, P.; McPhearson, T.; Hamann, M.H.; Donahue, M.L.; Prado, K.A.M.; Arkema, K.K.; Bratman, G.N.; Brauman, K.A.; Finlay, J.C.; et al. Social-ecological and technological factors moderate the value of urban nature. *Nat. Sustain.* **2019**, *2*, 29–38. [[CrossRef](#)]
40. Saviano, M.; Barile, S.; Farioli, F.; Orecchini, F. Strengthening the science–policy–industry interface for progressing toward sustainability: A systems thinking view. *Sustain. Sci.* **2019**, *14*, 1549–1564. [[CrossRef](#)]
41. Odume, O.N.; Amaka-Otchere, A.B.; Onyima, B.N.; Aziz, F.; Kushitor, S.B.; Thiam, S. Pathways, contextual and cross-scale dynamics of science-policy-society interactions in transdisciplinary research in African cities. *Environ. Sci. Policy* **2021**, *125*, 116–125. [[CrossRef](#)]
42. Francis, R.A. Positioning urban rivers within urban ecology. *Urban Ecosyst.* **2012**, *15*, 285–291. [[CrossRef](#)]
43. Herrfahrdt-Pähle, E. Applying the Concept of Fit to Water Governance Reforms in South Africa. *Ecol. Soc.* **2014**, *19*, 25. [[CrossRef](#)]
44. Turton, A. New Thinking on the Governance of Water and River Basins in Africa: Lessons from the SADC Region. 2020. Available online: www.saiia.org.za (accessed on 20 August 2022).
45. Brauman, K.A.; Daily, G.C.; Duarte, T.K.; Mooney, H.A. The Nature and Value of Ecosystem Services: An Overview Highlighting Hydrologic Services. *Annu. Rev. Environ. Resour.* **2007**, *32*, 67–98. [[CrossRef](#)]
46. Carden, K.; Armitage, N. Assessing urban water sustainability in South Africa—Not just performance measurement. *Water SA* **2013**, *39*, 345–350. [[CrossRef](#)]
47. Verlicchi, P.; Grillini, V. Surface Water and Groundwater Quality in South Africa and Mozambique—Analysis of the Most Critical Pollutants for Drinking Purposes and Challenges in Water Treatment Selection. *Water* **2020**, *12*, 305. [[CrossRef](#)]
48. Akhmouch, A.; Clavreul, D.; Glas, P. Introducing the OECD Principles on Water Governance. *Water Int.* **2017**, *43*, 5–12. [[CrossRef](#)]
49. Akhmouch, A.; Correia, F.N. The 12 OECD principles on water governance—When science meets policy. *Util. Policy* **2016**, *43*, 14–20. [[CrossRef](#)]
50. Neto, S.; Camkin, J.; Fenemor, A.; Tan, P.-L.; Baptista, J.M.; Ribeiro, M.; Schulze, R.; Stuart-Hill, S.; Spray, C.; Elfithri, R. OECD Principles on Water Governance in practice: An assessment of existing frameworks in Europe, Asia-Pacific, Africa and South America. *Water Int.* **2017**, *43*, 60–89. [[CrossRef](#)]
51. Seijger, C.; Brouwer, S.; van Buuren, A.; Gilissen, H.K.; van Rijswijk, M.; Hendriks, M. Functions of OECD Water Governance Principles in assessing water governance practices: Assessing the Dutch Flood Protection Programme. *Water Int.* **2017**, *43*, 90–108. [[CrossRef](#)]
52. Pahl-Wostl, C. The role of governance modes and meta-governance in the transformation towards sustainable water governance. *Environ. Sci. Policy* **2018**, *91*, 6–16. [[CrossRef](#)]
53. Baltutis, W.J.; Moore, M. Degrees of change towards polycentric transboundary water governance: Exploring the Columbia River and the Lesotho Highlands Water Projects. *Ecol. Soc.* **2019**, *24*, 6. [[CrossRef](#)]
54. Gruby, R.L.; Carlisle, K. Polycentric systems of governance: A theoretical model for the commons. *Policy Stud. J.* **2019**, *47*, 927–952.
55. Bajić, Z. Sustainable development: Balance of economic growth and ecosystem health. *IMK-14-Istraživanje I Razvoj* **2014**, *20*, 135–141. [[CrossRef](#)]