CLIMATE SMART ACTIONS (CSA) AQUACULTURE, AGROFORESTRY AND RESOURCES MANAGEMENT

GLOBAL ISSUES & LOCAL PERSPECTIVES

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Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous **Climate smart actions (CSA) aquaculture, agroforestry and resources management** issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which **Climate smart actions (CSA) aquaculture, agroforestry and resources management** issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue **Climate smart actions (CSA) aquaculture, agroforestry and resources management** necessary in policy making process that will stimulate increase in food production and environmental sustainability. **Climate smart actions (CSA) aquaculture, agroforestry and resources management :** *Global Issues & Local Perspectives* is organized in three parts. Part One deals with The Concept of **Climate smart actions (CSA)**, Part Two is concerned with The Concept of **aquaculture,** and Part Three deals with the Concept of **agroforestry and resources management**

Eteyen Nyong; March 2026

Chapter 8:

Integrating Nature into Urban Planning for Climate-Resilient Fisheries Systems

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1.0 Introduction

Africa is urbanizing at an unprecedented pace, reshaping landscapes, livelihoods, and ecological systems across the continent. Major cities such as Lagos, Nairobi, Accra, and Kigali are experiencing rapid population growth alongside spatial expansion that increasingly encroaches upon wetlands, lagoons, river

corridors, floodplains, and coastal zone areas that have historically underpinned urban settlement, food production, and ecological stability (Oduro *et al*., 2024). Projections indicate that by 2050, more than 60 % of Africa's population will reside in urban areas, intensifying pressure on both natural ecosystems and already overstretched urban infrastructure (World Bank, 2021). This rapid urban transformation is occurring concurrently with escalating climate change impacts, including rising temperatures, altered rainfall regimes, frequent flooding, and sea-level rise, which collectively heighten the vulnerability of African cities and the ecosystems that sustain them (Akinsanola *et al*., 2025).

Among the most critical yet consistently undervalued components of the urban environment are aquatic ecosystems, including rivers, lagoons, wetlands, estuaries, and nearshore coastal waters. Far from being passive landscape features, these systems function as living infrastructure that supplies freshwater, moderates' floods, regulates local climates, supports biodiversity, and sustains food systems and livelihoods for millions of urban residents (Alikhani *et al.*, 2021). In many African cities, aquatic ecosystems serve as ecological buffers against climate extremes, absorbing excess rainfall, dissipating storm surges, and maintaining hydrological connectivity across urban landscapes. Despite their multifunctionality, urban aquatic systems are frequently marginalized in planning processes, treated as vacant land for reclamation or as sinks for waste rather than as strategic assets for resilience.

Embedded within this urban water landscape are urban fisheries, which represent a critical interface between human well-being and aquatic ecosystems. Urban fisheries encompass a diverse array of activities, including artisanal fishing in lagoons and rivers, peri-urban capture fisheries, small-scale coastal fisheries, and aquaculture operations integrated into urban and peri-urban spaces. These fisheries play a vital role in providing affordable animal protein, supporting household nutrition, generating income, and sustaining cultural identities, particularly among low-income and marginalized communities (Kennedy *et al.*, 2022; Anikwe & Ife, 2023). For example, artisanal lagoon fisheries in Lagos supply daily food to thousands of households, while fishing activities in Accra's Korle Lagoon combine subsistence, commerce, and long-standing cultural practices. Urban fisheries are therefore not merely ecological or economic activities; they are socially embedded systems that link urban residents to food security, livelihoods, and cultural continuity.

However, urban aquatic ecosystems and fisheries are increasingly threatened by the combined pressures of climate change and unplanned urbanization. Rising sea levels and intensified storm surges are encroaching upon wetlands and lagoons, increasing flood risks and altering aquatic habitats essential for fish reproduction and recruitment (Rezaie *et al*., 2020). Erratic rainfall patterns and increased stormwater runoff introduce pollutants, sediments, and nutrients into urban waters, degrading water quality and undermining fisheries productivity. Simultaneously, land reclamation, industrial expansion, infrastructure development, and informal settlements disrupt hydrological connectivity, fragment habitats, and accelerate biodiversity

loss (Liu *et al*., 2025). These pressures disproportionately affect urban fishing communities, whose livelihoods and food security are closely tied to the health of aquatic ecosystems.

1.1 Problem Statement

Despite their ecological, economic, and social importance, urban aquatic ecosystems and fisheries remain poorly integrated into urban planning and climate resilience strategies across African cities. Urban development policies often prioritize grey infrastructure and land-based solutions while overlooking the role of fisheries and aquatic ecosystems as nature-based solutions capable of enhancing climate resilience. This disconnect has resulted in the degradation of urban water bodies, declining fisheries productivity, increased vulnerability of coastal and riparian communities, and missed opportunities for climate adaptation and mitigation. Moreover, governance frameworks are frequently fragmented, with limited coordination between urban planners, environmental managers, and fisheries authorities, further constraining effective management. Without deliberate efforts to integrate urban fisheries into city planning, African cities risk undermining food security, livelihoods, biodiversity, and their capacity to adapt to climate change.

Against this backdrop, this chapter examines how urban planning can strategically incorporate natural aquatic systems and urban fisheries into climate resilience-building strategies. It explores the ecological, social, and economic dimensions of urban fisheries and their interactions with urbanization and climate pressures. The chapter advances conceptual frameworks and planning principles for embedding fisheries into urban design, highlights innovative nature-based solutions and blue–green infrastructure approaches, and presents illustrative African case studies from Lagos, Cape Town, and Kigali. It further identifies critical policy, governance, and research gaps, offering a forward-looking agenda that reframes urban fisheries not as peripheral or informal activities, but as central components of sustainable, inclusive, and climate-resilient African cities. By aligning urban growth with ecological stewardship, African cities can chart pathways toward urban futures in which human well-being and aquatic ecosystems coexist and thrive in a changing climate.

2.0 Urban Fisheries in African Cities: Setting the Scene

Urban fisheries occupy a unique ecological and socio-economic niche within African cities, lying at the interface of natural aquatic ecosystems and human-modified urban environments. These systems form part of the broader “blue infrastructure”, which supports urban resilience by regulating floods, maintaining water quality, and providing livelihoods (World Bank, 2021; Schipper *et al*., 2022; Herzog & Freitas, 2023). African cities have historically evolved around rivers, lagoons, estuaries, and coastal wetlands, where fish and other aquatic organisms thrive. Notable examples include Lagos Lagoon in Nigeria, Korle Lagoon in

Ghana, and the Msimbazi River in Tanzania, which sustain a combination of food provision, livelihoods, cultural practices, and ecosystem services (Mumuni *et al*., 2025; Ojo *et al*., 2025).

Urban fisheries are increasingly recognized as a critical component of sustainable urban food systems, providing affordable protein, generating employment, and contributing to biodiversity conservation. However, they face unique pressures associated with high-density human settlements, including pollution, habitat fragmentation, and land-use conflicts.

2.1 The concept of Urban Fisheries

Urban fisheries encompass both capture and culture-based fishery activities within or adjacent to urban settlements. They include:

- Inland lagoon and river fisheries
- Peri-urban aquaculture ponds
- Small-scale coastal and estuarine artisanal fisheries operating within metropolitan zones

Unlike rural fisheries, urban systems are directly influenced by industrial effluents, sewage discharge, solid waste accumulation, and high-density human activity (figure 1), which can drastically alter water quality and habitat integrity (Lemessa *et al*., 2023; Das & Raj, 2025).

Urban fisheries also present opportunities for sustainable circular economies, especially when integrated into urban planning. For instance, organic waste from cities can be repurposed as feed for urban aquaculture, linking waste management with food production and enhancing ecosystem services.

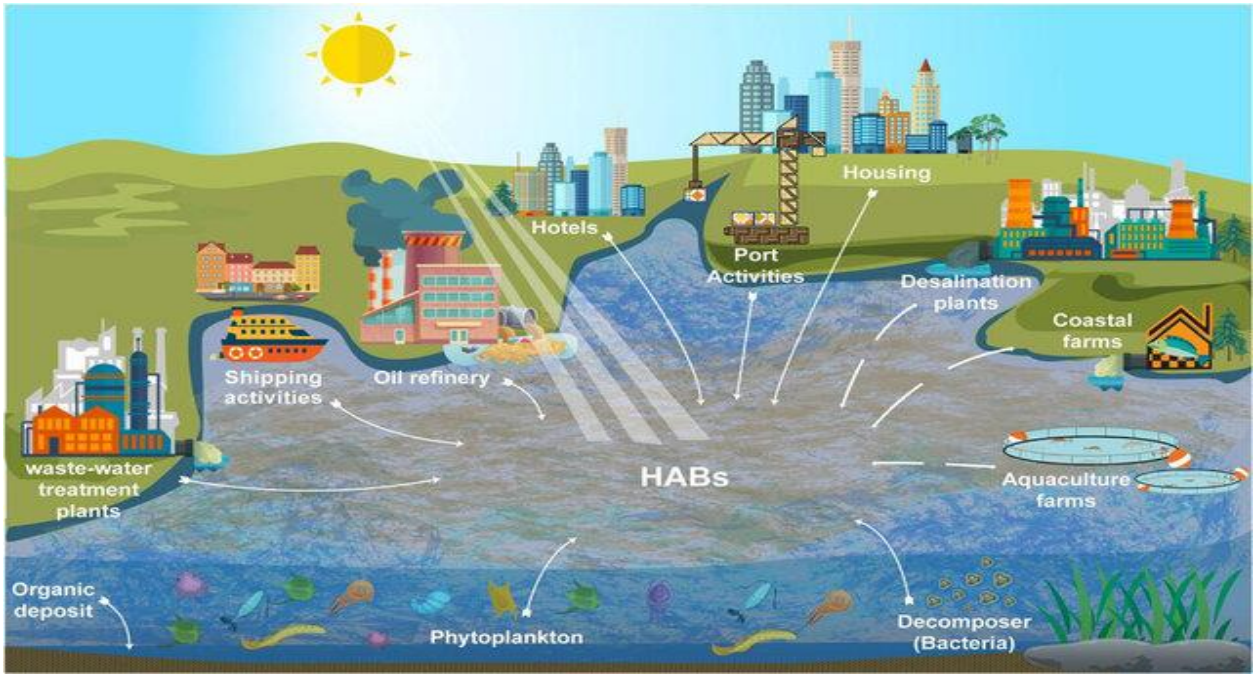

Figure 1: A conceptual diagram showing the various coastal urban developments

Source: Trottet *et al*., 2021.

2.2 Ecological and Economic Importance of Urban Fisheries

Urban fisheries are vital for food security, particularly for low-income urban populations who rely on fish as an affordable and accessible source of protein. In Lagos, fish constitutes over 60% of total animal protein intake, emphasizing the critical role of urban fisheries in nutrition (Ogunji & Wuertz, 2023).

Beyond food supply, urban fisheries create employment across the value chain, including fishing, processing, marketing, and transport which supporting thousands of urban households (Ifabiyi *et al*., 2023; Mensah & Boateng, 2023).

From an ecological perspective, urban water bodies provide multiple ecosystem services:

i. Flood regulation through wetland retention
ii. Carbon sequestration in aquatic vegetation such as mangroves and submerged plants
iii. Nutrient cycling and waste decomposition, improving water quality
iv. Biodiversity conservation, sustaining both native and adapted species in disturbed environments.

Urban water bodies also serve as urban climate buffers (table 1), reducing the impacts of heat islands and moderating stormwater flow. Without effective management, however, these habitats degrade rapidly under the pressures of urbanization, compromising their ecological and socio-economic functions.

Table 1: Ecosystem Services Provided by Urban Fisheries in African Cities.

Service Category	Description	City / Case	Impact
Food Security	Urban fisheries supply affordable, accessible animal protein and micronutrients, particularly for low-income households that cannot afford meat or imported foods.	Lagos Lagoon (Nigeria); Makoko fishing community	Enhances household nutrition, reduces vulnerability to food price shocks, and supports dietary diversity in rapidly growing cities.
Livelihoods and Employment	Provides direct jobs (fishing, fish farming, processing) and indirect jobs (trade, transport, gear repair, cold storage).	Korle Lagoon, Accra (Ghana); Kisumu fish markets, Lake Victoria (Kenya)	Strengthens economic stability, reduces urban poverty, and supports youth and women's employment in informal value chains.
Flood Regulation and Climate Buffering	Wetlands, mangroves, and floodplains associated with urban fisheries buffer storm surges, absorb excess rainwater, and reduce erosion.	Msimbazi River Basin, Dar es Salaam (Tanzania); Rufiji Delta	Lowers flood risks, improves stormwater management, and protects urban infrastructure from climate-induced hazards.
Biodiversity Conservation	Urban water bodies provide critical habitat for native fish, crustaceans, mollusks, and aquatic vegetation.	Lagos Lagoon (Nigeria); Rumuola Creek, Port Harcourt	Maintains ecological balance, promotes species diversity, and supports ecosystem productivity important for

Service Category	Description	City / Case	Impact
			long-term fishery sustainability.
Water Purification and Waste Decomposition	Aquatic organisms help break down organic matter, filter pollutants, and improve water clarity. Aquaculture ponds also support microbial nutrient cycling.	Urban aquaculture ponds in Abuja and Nairobi	Enhances water quality, reduces treatment costs, and supports healthier urban environments.
Recreational and Cultural Services	Fishing practices, waterfront activities, festivals, and cultural identity linked to fishing communities.	Kayar Fish Landing Site (Senegal); Marine fishing festivals in Ghana	Strengthens social cohesion, promotes cultural heritage, and offers opportunities for eco-tourism.
Urban Cooling and Microclimate Regulation	Water bodies moderate urban temperatures and reduce heat island effects.	Lagos and Dar es Salaam coastal zones	Improves thermal comfort and contributes to climate adaptation in densely built-up areas.
Nutrient Cycling	Fisheries and aquaculture contribute to nutrient redistribution through biological processes and sediment interactions.	Tilapia ponds in Kenya; Catfish ponds in Nigeria	Supports ecosystem productivity, reduces nutrient overload, and enhances long-term ecological stability.

2.3 Urbanization and Aquatic Ecosystem Degradation

African cities are among the fastest-growing urban areas globally, with projections indicating that over 60% of Africa's population will reside in urban areas by 2050 (World Bank, 2021). Rapid urban expansion exerts intense pressure on aquatic ecosystems through:

i. Land reclamation and wetland conversion
ii. Sedimentation from construction and erosion
iii. Plastic and chemical pollution from domestic and industrial sources
iv. Altered hydrological regimes that disrupt fish breeding cycles

In Lagos Lagoon, unregulated urban development has caused extensive mangrove loss and organic overloading, resulting in hypoxic conditions that threaten fish populations (Adewale et al., 2024). Similarly, Accra's Korle Lagoon suffers from heavy-metal contamination and untreated sewage, severely reducing fish diversity and the productivity of artisanal fisheries (Osae *et al*, 2023).

These pressures not only undermine the ecological integrity of urban aquatic systems but also threaten livelihoods, food security, and urban climate resilience, highlighting the urgent need for integrated management (Figure 2).

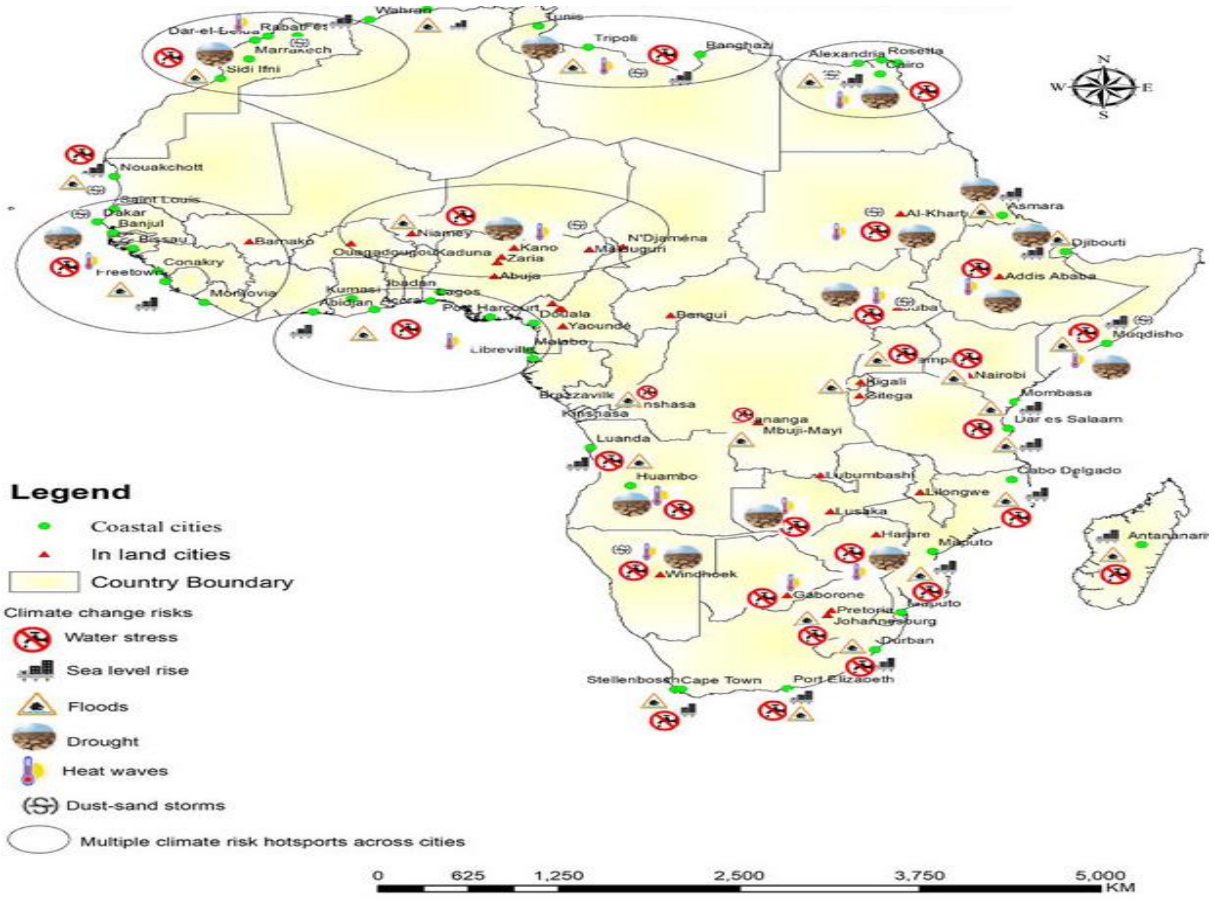

Figure 2: A map of Africa showing urban fisheries locations in major African cities with overlays of key stressors (pollution, urban expansion, wetland loss, and climate-related hazards.)

Source: Lwasa *et al*., 2020

2.4 Socio-Cultural Dimensions of Urban Fisheries

Urban fisheries also hold deep socio-cultural significance. Fishing communities within African cities often possess indigenous ecological knowledge, including seasonal fish migration patterns, water quality indicators, and adaptive strategies for coping with floods and urban change (table 2). This knowledge is crucial for designing context-specific, sustainable management strategies (Muringai *et al*., 2022).

However, these communities are frequently marginalized in urban planning decisions, facing eviction from waterfronts, loss of access to traditional fishing grounds, and exclusion from infrastructure development projects. Recognizing their role as partners in urban governance can enhance equitable, sustainable, and climate-resilient city development.

Integrating urban fisheries into city planning therefore requires multi-dimensional approaches that combine ecological protection, socio-economic benefits, and cultural inclusion. When effectively managed, urban fisheries contribute to resilient urban ecosystems, bridging human development with aquatic ecosystem health.

Table 2: Socio-Cultural Roles of Urban Fisheries in African Cities

Role	Description	African Urban Waterbody/City	Policy / Planning Implication
Indigenous Knowledge Systems	Local ecological knowledge about fish behavior, seasonal migration, spawning grounds, and water quality passed through generations.	Lagos Lagoon (Nigeria); Rufiji Delta (Tanzania)	Integrate traditional ecological knowledge into government monitoring, pollution alerts, and community co-management.
Cultural Identity & Heritage	Fishing traditions, rituals, festivals, and cultural expressions that define community identity.	Korle Lagoon (Ghana); Lamu Archipelago (Kenya)	Promote cultural heritage zones; incorporate fisheries heritage in urban cultural planning and eco-tourism.
Livelihood Security & Income Generation	Provides jobs in fishing, processing, retailing, boat building, gear repair, and transportation.	Msimbazi River (Tanzania); Dakar Canal Fishing Sites (Senegal)	Develop inclusive urban aquaculture programs; provide micro-credit and improved infrastructure for small-scale fishers.
Food & Nutrition Security	Supplies affordable animal protein, micronutrients, and essential fatty acids to urban households.	Nile River (Cairo, Egypt); Lake Victoria shoreline towns (Kenya/Uganda)	Improve fish distribution networks; support cold-chain facilities to reduce post-harvest loss.
Social Cohesion & Community Networks	Fishing communities act as social units with shared norms, cooperative labor systems, and conflict-resolution mechanisms.	Makoko (Nigeria); Kigamboni Fishing Community (Tanzania)	Support community-based organizations; integrate fisher settlements into urban upgrading initiatives.
Urban Recreation & Leisure	Angling, guided fishing tours, canoeing, and waterfront social spaces connected to fishing areas.	Cape Town Harbors (South Africa); Alexandria Coastal Waters (Egypt)	Enhance waterfront development; establish recreational fishing zones and eco-parks.
Gender Roles & Empowerment	Women's involvement in fish processing, marketing, and value-chain leadership strengthens household economies.	Takoradi Fish Markets (Ghana); Kisumu Fish Markets (Kenya)	Implement gender-responsive fisheries policies; improve market facilities and safety for women fishworkers.
Religious & Spiritual Values	Water bodies and fisheries linked to spiritual beliefs, sacred groves, and ritual offerings.	Ouidah (Benin); Mandevu Wetlands (Malawi)	Protect culturally significant waterbodies; include spiritual values in conservation planning.
Urban Environmental Stewardship	Fishing communities involved in mangrove planting, lagoon	Mombasa Creek (Kenya); Epe Lagoon (Nigeria)	Engage fishers in co-governance; expand

Role	Description	African Urban Waterbody/City	Policy / Planning Implication
	clean-ups, and conservation advocacy.		community environmental monitoring programs.
Informal Education & Skill Transfer	Passing of fishing skills, net-making, navigation, and ecological literacy from elders to youth.	Mukono Landing Sites (Uganda)	Support vocational training; integrate fisheries knowledge into urban youth empowerment programs.

3.0 Climate Change, Urban Water Systems, and Fisheries: Risks and Pathways

Urban fisheries in African cities exist within dynamic water systems that are increasingly shaped by climate change and urbanization. Changes in rainfall patterns, temperature rise, sea-level increase, and extreme weather events such as floods and storms directly affect the health and productivity of aquatic ecosystems. These changes also impact the socio-economic and cultural systems that rely on fisheries, making climate adaptation critical for urban resilience.

3.1 Climate Change Impacts on Urban Aquatic Systems

African urban water systems are highly sensitive to climate-induced stressors. For example:

i. Flooding and stormwater runoff: Increased rainfall intensity and impervious surfaces lead to frequent urban flooding, which carries pollutants into rivers, lagoons, and wetlands, reducing water quality and threatening fish populations (Li *et al*., 2024).

ii. Sea-level rise: Coastal cities like Lagos, Accra, and Maputo face inundation of estuaries and lagoons, leading to salinization of freshwater habitats and loss of breeding grounds for fish (Sadat *et al*., 2022).

iii. Temperature increases: Elevated water temperatures affect fish metabolism, growth, and reproduction, and exacerbate hypoxic conditions in heavily polluted urban water bodies.

These environmental stressors interact synergistically with urban pressures such as land reclamation, industrial effluent discharge, and solid waste accumulation, amplifying the vulnerability of urban fisheries.

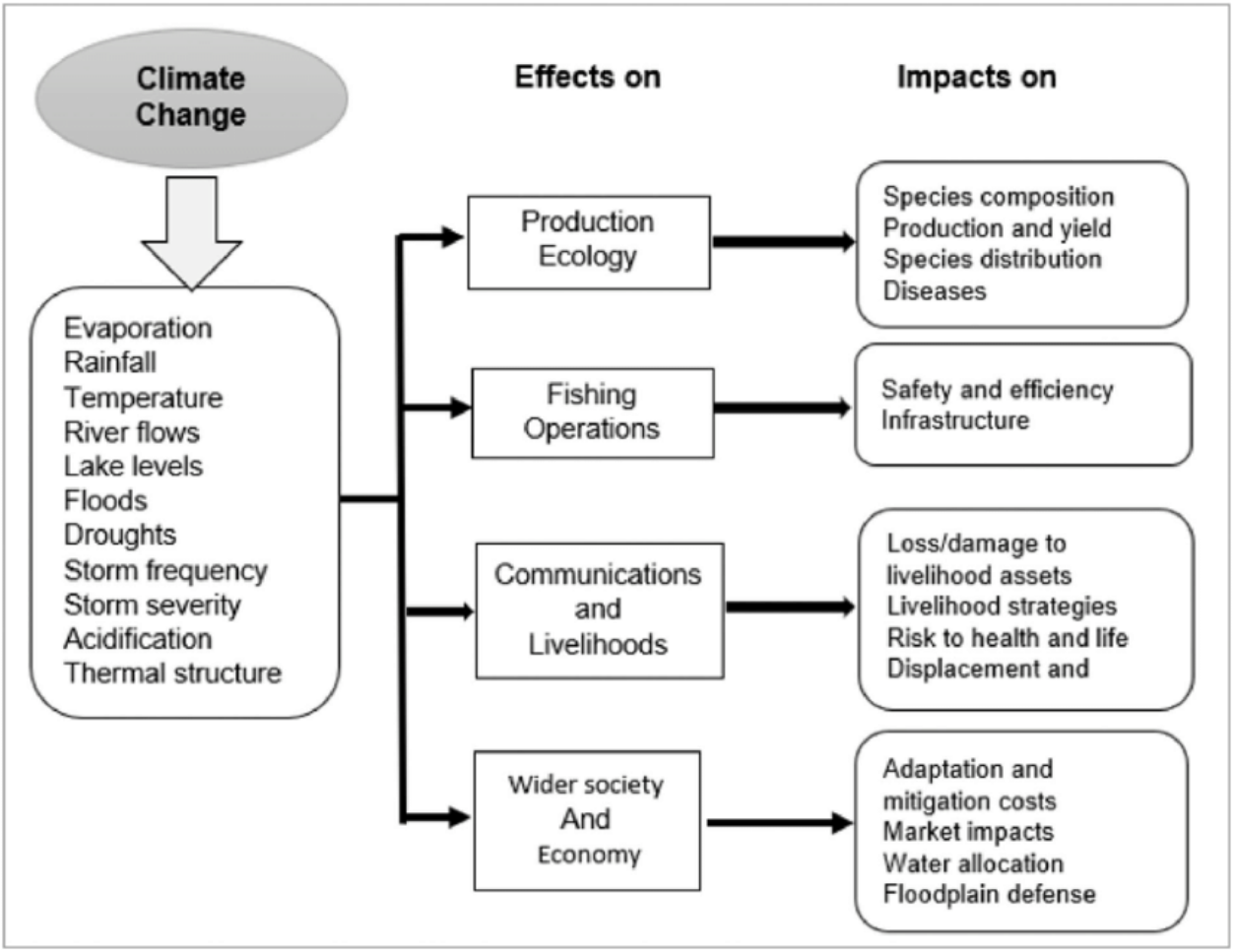

Figure 3: A schematic diagram illustrating climate change impacts on urban fisheries, showing interactions between rainfall, flooding, pollution, temperature rise, and fish population decline.
Source: Muringai *et al.*, 2021

3.2 Urban Water Systems and Fisheries Vulnerability

Urban water systems are highly modified by human activity, making them vulnerable to climate variability. These vulnerabilities include:

a) Pollution: Industrial effluents, untreated sewage, and plastic waste degrade water quality, leading to decreased oxygen levels and loss of sensitive species.

b) Habitat loss and fragmentation: Wetlands, mangroves, and riverine corridors are converted for residential or industrial use, reducing available habitat for fish and other aquatic organisms.

c) Hydrological alteration: Dams, drainage systems, and impervious surfaces alter natural flow regimes, impacting fish breeding cycles and nutrient transport.

Vulnerable fisheries often belong to low-income, informal communities who lack alternative livelihoods, exacerbating socio-economic exposure to climate hazards.

3.3 Ecosystem-Based Responses to Climate Risks

Despite the challenges, urban fisheries and aquatic ecosystems can play an active role in climate adaptation:

i. Wetland restoration and mangrove rehabilitation: Coastal and riverine wetlands buffer floods, improve water quality, and provide critical nursery habitats for fish (Sam *et al*., 2023).

ii. Floating wetlands and vegetated channels: These nature-based solutions can reduce pollutants, stabilize sediments, and provide refuge for aquatic species (Justino *et al.*, 2023).

iii. Urban aquaculture integration: Peri-urban and rooftop aquaculture can supplement food supply while mitigating pressure on natural water bodies (Baganz *et al*., 2021).

Implementing these measures requires integrated planning that combines urban design, water management, and fisheries governance.

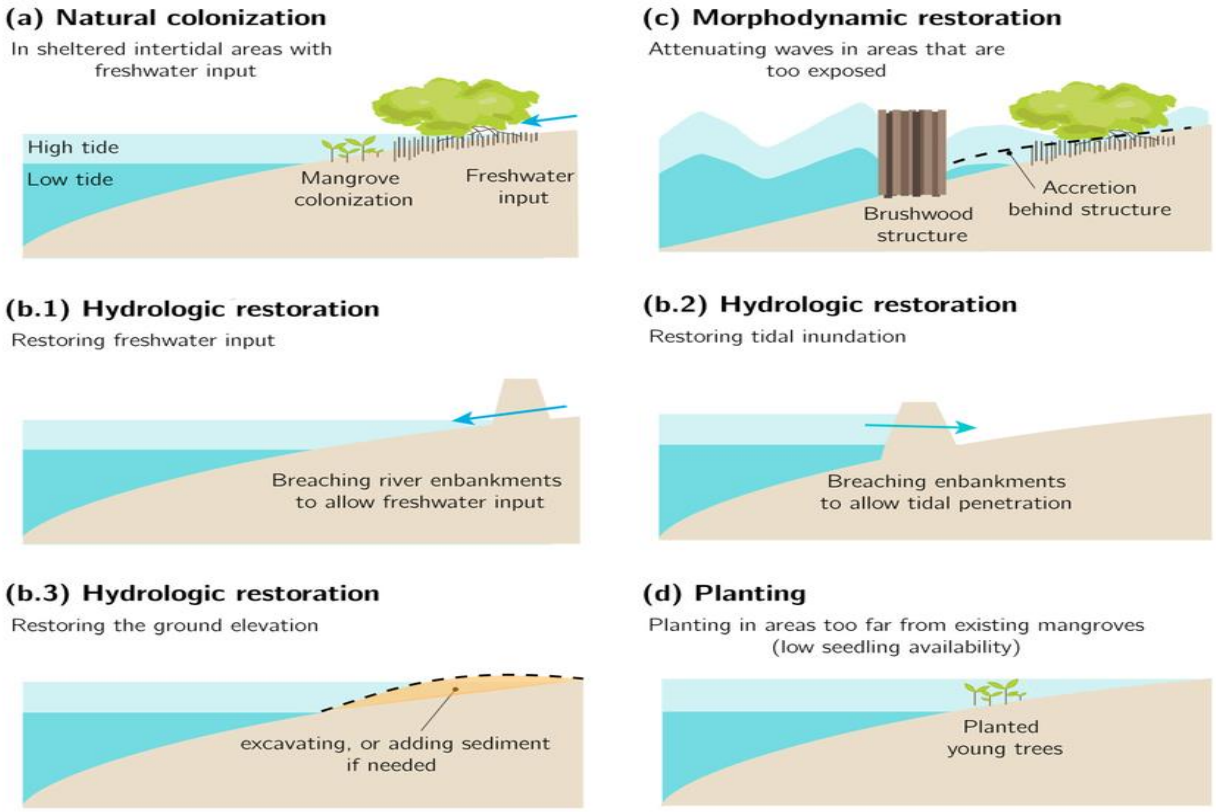

Figure 4: A diagram showing nature-based adaptation measures for urban fisheries.

Source: Gijón *et al.*, 2021

3.4 Socio-Economic Implications of Climate Risks

Climate impacts on urban water systems have direct socio-economic consequences:

a) Livelihood disruption: Floods and pollution reduce fish availability, affecting income for fishers, processors, and vendors.

b) Food insecurity: Declines in fish supply led to increased prices, disproportionately affecting low-income household's dependent on fish as a staple protein source.

c) Community vulnerability: Marginalized groups, particularly women and youth involved in post-harvest and marketing activities, are most exposed to climate and environmental shocks.

Addressing these socio-economic dimensions requires policies that link climate adaptation with inclusive urban planning and social protection mechanisms.

3.5 Integrating Urban Fisheries into Climate Resilience Planning

To build climate-resilient urban fisheries, cities must adopt integrated strategies the following strategies listed in table 3:

Table 3: Strategies for Climate-Resilient Urban Fisheries

Strategy	Description	Implementation Example	Expectation
Wetland Restoration and Protection	Rehabilitation and conservation of degraded wetlands, mangroves, and riparian zones to strengthen ecological functions supporting fisheries.	Lagos Lagoon mangrove replanting (Nigeria); Msimbazi Basin restoration (Tanzania)	Enhanced flood mitigation, improved breeding habitats for fish, shoreline stabilization, increased carbon sequestration.
Floating Wetlands (Constructed or Natural Rafts)	Use of vegetated floating structures to filter pollutants, absorb nutrients, and provide microhabitats.	Cape Town urban river floating wetland installations (South Africa); Kampala Nakivubo channel floating islands (Uganda)	Improved water quality through biofiltration, enhanced fish habitat, reduction in eutrophication, increased urban biodiversity.
Urban Aquaculture Systems	Adoption of small-scale, integrated, or intensive aquaculture models within urban spaces—ponds, tanks, recirculating systems, rooftop units.	Kigali rooftop aquaculture units (Rwanda); Abuja peri-urban catfish tank systems (Nigeria)	Increased urban food supply, reduced pressure on wild fisheries, lower GHG emissions, employment opportunities for youth and women.
Ecosystem-Based Fisheries Management (EBFM)	Integrating ecological, social, and economic factors into urban fisheries planning and harvest control.	Lake Victoria regional fisheries co-management (Kenya, Uganda, Tanzania)	Sustainable harvests, protection of nursery grounds, improved stock recovery, balanced ecosystem functioning.
Climate-Smart Infrastructure	Construction of resilient landing sites, cold chain systems, drainage networks, and erosion control structures.	Dar es Salaam coastal landing site upgrades (Tanzania)	Reduced post-harvest losses, improved food safety, enhanced resilience to storms and sea-level rise.
Community Participation and Co-Management	Engaging local fishing communities, cooperatives, and women's groups in decision-making, monitoring, and enforcement.	Accra Korle Lagoon community-led clean-up and fisheries consultation (Ghana)	Stronger social equity, greater compliance with regulations, effective adaptive management, improved local stewardship.

Strategy	Description	Implementation Example	Expectation
Pollution Control and Waste Management	Reducing industrial discharge, plastic waste, sewage inflow, and agricultural runoff into urban water bodies.	Nairobi River restoration initiatives (Kenya)	Improved water quality, reduced fish mortality, safer seafood for consumers, improved public health.
Early Warning Systems and Climate Information Services	Providing climate alerts, flood predictions, and temperature anomaly forecasts for fishers and aquaculture operators.	Nigeria Hydrological Services Agency (NIHSA) flood alert system	Increased preparedness for storms and floods, reduced asset losses, optimized aquaculture management under climate stress.
Integrated Urban Planning and Blue-Green Infrastructure	Incorporating fisheries, wetlands, waterways, and aquaculture zones into city master plans.	Durban (eThekwini) blue-green planning initiatives (South Africa)	Long-term sustainability of aquatic ecosystems, enhanced urban climate adaptation, multifunctional landscapes.

4.0 Integrating Nature into City Planning: Principles and Strategies

Urban development in Africa has historically prioritized economic expansion and infrastructure construction over ecological integrity. However, the growing recognition of ecosystem services and the climate resilience potential of urban aquatic systems has shifted attention toward ecological urbanism, a planning paradigm that integrates natural systems into the urban fabric. For urban fisheries, this approach emphasizes the preservation and restoration of rivers, lagoons, wetlands, and coastal areas as living infrastructure that supports both human well-being and biodiversity.

4.1 Principles of Ecological Urbanism for Fisheries

The principles associated with ecological urbanism for urban fisheries are listed in table 4 below.

Table 4: Principles of Ecological Urbanism for Urban Fisheries

Principle	Description	Application in Urban Fisheries
Connectivity	Enhancing ecological linkages between rivers, wetlands, estuaries, and coastal systems to support fish migration, water flow, and nutrient exchange.	Restoration of mangrove channels in Lagos Lagoon (Nigeria); reconnection of floodplains in Msimbazi River Basin (Tanzania) to improve fish breeding and movement.
Multifunctionality	Designing urban landscapes to deliver multiple ecosystem services—food production, recreation, biodiversity conservation, and flood regulation—within shared spaces.	Development of wetland parks along the Msimbazi River (Tanzania) that integrate fisheries, recreation, biodiversity areas, and stormwater management zones.
Participatory Governance	Ensuring inclusive decision-making by engaging local fishers, women's cooperatives, processors, and market associations in urban planning and resource management.	Establishment of Korle Lagoon community councils (Ghana) involving fishers in lagoon rehabilitation, waste control, and fishing regulation processes.

Principle	Description	Application in Urban Fisheries
Circularity	Promoting waste minimization and resource recovery by integrating nutrient recycling, water reuse, and circular food systems into urban aquaculture.	Adoption of bio-waste-fed aquaculture ponds in Kigali peri-urban areas (Rwanda), where organic market waste and wastewater are reused as nutrient inputs for fish production.
Resilience (Optional addition)	Building adaptive systems that withstand climate change impacts such as floods, heatwaves, and pollution shocks.	Elevated fish ponds and climate-resilient landing sites in Dar es Salaam (Tanzania).
Equity and Inclusiveness (Optional addition)	Ensuring fair access to urban water resources, markets, and livelihood opportunities for marginalized communities.	Lagos fishing settlements integrating women processors into fish value-chain planning.

4.2 Strategies for Integrating Fisheries into Urban Planning

Integrating fisheries into urban planning has become increasingly important as African cities continue to expand around rivers, lagoons, wetlands, estuaries, and coastal zones. Urban fisheries contribute to food security, livelihoods, cultural identity, and ecological stability, yet they are often overlooked in conventional planning frameworks that prioritize land-based infrastructure. As climate change, pollution, and urban development intensify pressures on aquatic ecosystems, there is a growing need for intentional strategies that embed fisheries considerations into city design, governance, and environmental management. Effective integration requires multidimensional approaches, ranging from spatial zoning and water quality regulation to community engagement and resilient waterfront design (Table 5). These strategies ensure that urban fisheries are not only protected but also enhanced as vital components of sustainable, inclusive, and climate-resilient cities.

Table 5: Strategies for Integrating Fisheries into Urban Planning

Strategy	Description	Approaches	Application	Expectation
Incorporating Blue Infrastructure	Recognizing water bodies as essential elements of urban design	Urban master plans, riparian buffer zoning, aquatic corridor mapping	Integration of lagoon edges into city green belts	Protection of aquatic habitats; improved fish movement and spawning grounds
Designating Urban Fisheries Zones	Allocating specific spaces for artisanal or small-scale fisheries	Spatial zoning, GIS-based fisheries mapping	Reserved fishing zones in peri-urban lake edges	Conflict reduction between fishers and urban developers
Integrating Aquaculture into Urban Food Systems	Embedding aquaculture within city food security strategies	Land-use planning for ponds, aquaponics zoning, rooftop/vertical aquaculture inclusion	Kigali rooftop aquaculture and integrated food parks	Increased protein supply; reduced pressure on natural water bodies
Water Quality Management Frameworks	Ensuring regulatory measures to maintain fishable waters	Urban wastewater plans, pollution control	City-wide wastewater	Reduced contamination,

Strategy	Description	Approaches	Application	Expectation
		policies, stormwater design	treatment upgrading	enhanced fish survival
Climate-Resilient Waterfront Design	Designing city waterfronts that support fisheries and reduce climate risks	Flood-resilient embankments, mangrove buffers, wetland conservation	Mangrove restoration in Lagos Lagoon	Flood mitigation; nursery habitats for fish
Participatory Planning with Fishing Communities	Including fishers in decision making	Community advisory boards, co-management councils	Korle Lagoon fisheries co-management unit	Social equity, improved compliance with regulations
Circular Urban Resource Systems	Using urban waste streams (organics, wastewater) to support fisheries or aquaculture	Resource recovery facilities, sludge-to-feed systems, aquaponics using urban nutrients	Kigali peri-urban aquaponics	Lower production costs; reduced waste; sustainable nutrient cycles
Urban Biodiversity Conservation Strategies	Ensuring that aquatic species are part of biodiversity policies	Biodiversity action plans, habitat restoration projects	Msimbazi River ecological park	Enhanced fish diversity, ecological balance
Disaster-Risk Integrated Fisheries Planning	Incorporating fisheries needs into flood, drought, and storm-risk	Climate vulnerability maps, early warning systems	Integration of fish landing sites into flood-safe zones	Protection of assets; safer working environment for fishers

5.0 Case Studies of Successful Integration of Urban Fisheries to City Planning

5.1 Lagos Lagoon, Nigeria

The Lagos Lagoon (figure 5) is one of West Africa's most heavily utilized urban water bodies, supporting thousands of artisanal fishers (Ndimele *et al*., 2024). In recent years, targeted restoration initiatives particularly the rehabilitation of mangrove forests and the establishment of buffer wetlands have played a transformative role. These actions have:

i. **Reduced flooding** in adjacent coastal communities by improving natural water retention and slowing stormwater runoff.

ii. **Improved water quality** through increased filtration of sediments and pollutants, thereby enhancing the ecological conditions required for fish breeding.

iii. **Supported artisanal fisheries**, with fishers reporting higher catches of species such as *Tilapia guineensis* and *Chrysichthys nigrodigitatus* following habitat restoration. Urban planners incorporated these ecological interventions into broader coastal resilience strategies, demonstrating how nature-based solutions can simultaneously enhance fisheries and urban safety.

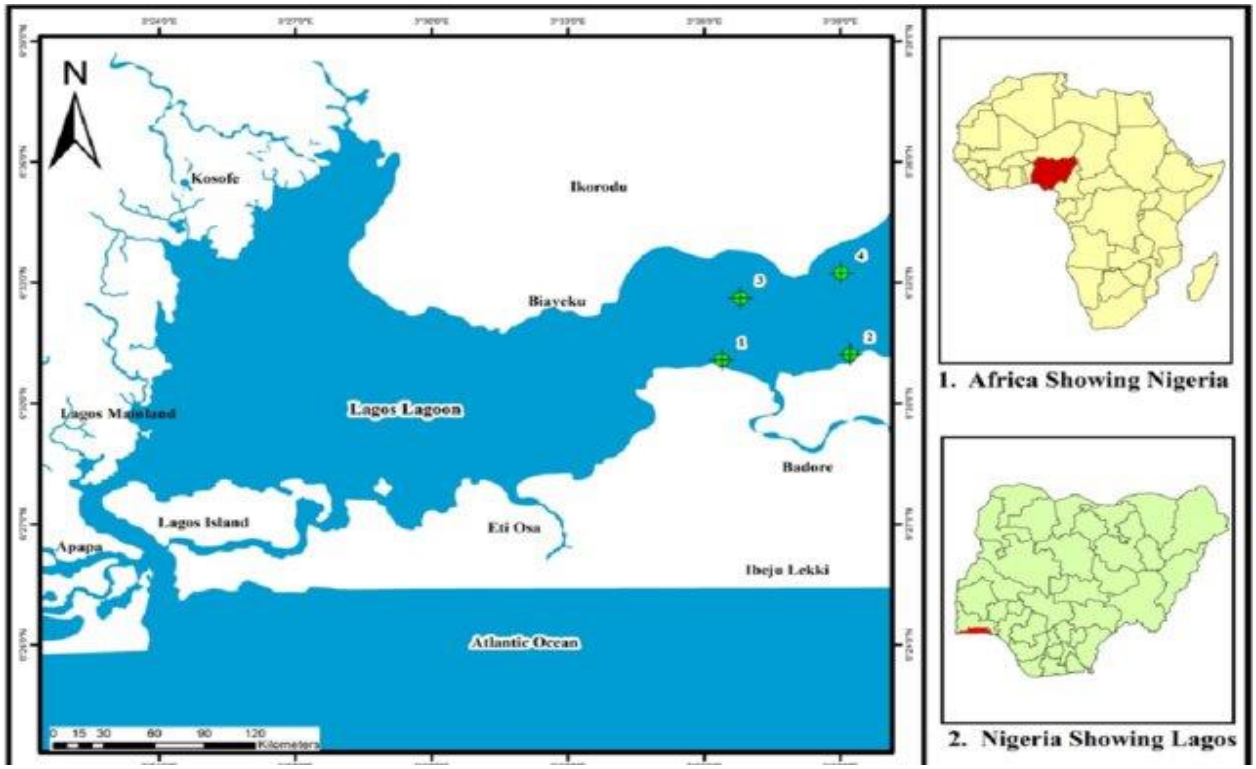

Figure 5: Map of the Lagos Lagoon

Source: Ugwumba & Esenowo, (2020)

5.2 Korle Lagoon, Accra, Ghana

Korle Lagoon (Figure 6) once considered one of the most polluted water bodies in Africa, has recently undergone progressive community-driven restoration (Adomako & Dellor, (2023). Key elements include:

i. **Community-based cleanup campaigns**, where local fishing groups participated in removing solid waste and monitoring pollution hotspots.

ii. **Wetland rehabilitation**, including replanting of native vegetation and restoring tidal flows that are essential for fish recruitment.

iii. **Participatory planning**, where fishers were involved in decision-making regarding access points, landing sites, and lagoon-use zoning. These interventions have contributed to improving fish populations, particularly estuarine species, while strengthening trust between planners and local communities. The case illustrates how social inclusion enhances the sustainability of urban aquatic ecosystems.

Figure 6: Map of Ghana showing the Korle Lagoon, Accra.

Source: Adomako & Dellor, (2023)

5.3 Msimbazi River, Dar es Salaam, Tanzania

The Msimbazi Basin (Figure 7) is a rapidly urbanizing area prone to extreme flooding. The government, in collaboration with international agencies, adopted an integrated blue – green infrastructure plan that incorporates:

i. **Constructed wetlands**, which filter pollutants, slow runoff, and provide nursery areas for shellfish and finfish species.

ii. **Vegetated river channels**, designed to stabilize banks, reduce erosion, and maintain ecological connectivity.

iii. **Zoning reforms**, relocating vulnerable settlements away from the floodplain while designating sections of the river corridor for conservation and sustainable fishing. These interventions have significantly mitigated stormwater impacts, enhanced water quality, and maintained viable urban fisheries that support both livelihoods and biodiversity conservation.

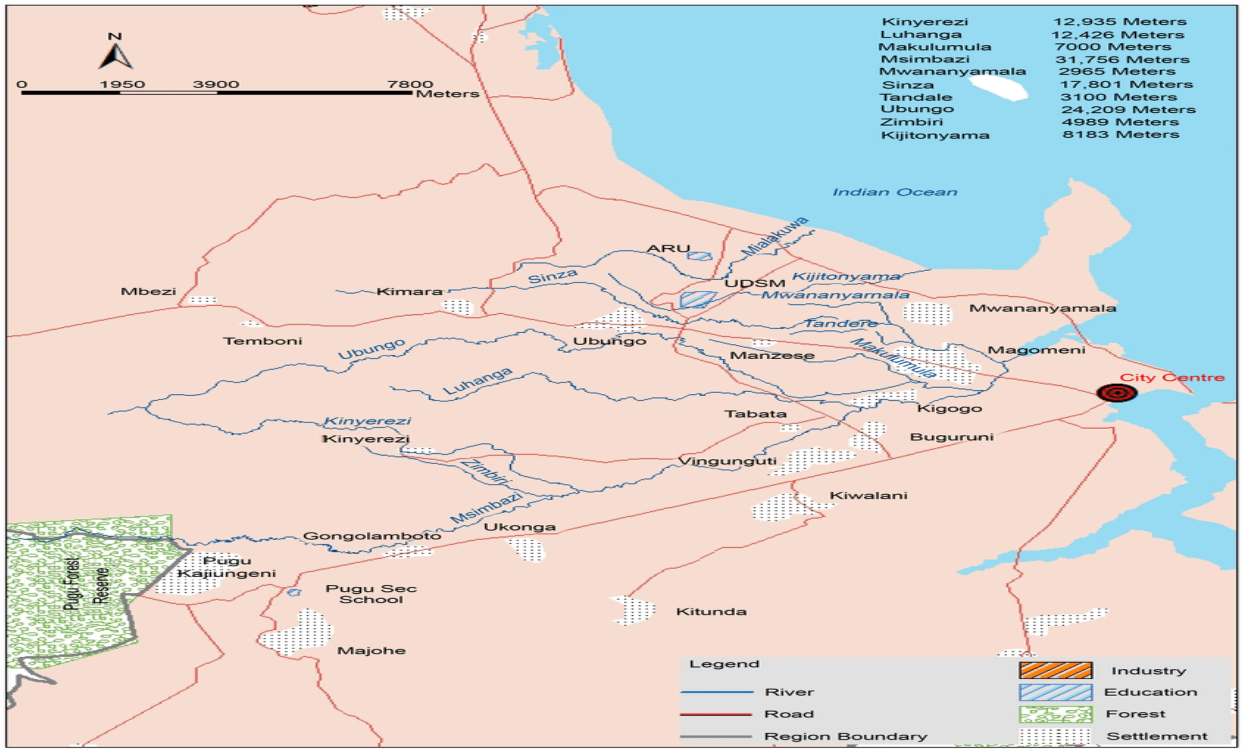

Figure 7: Msimbazi River and its main tributaries.
Source: Kironde, 2016

Together, these case studies demonstrate that urban development and ecological restoration are not mutually exclusive. When urban planning frameworks place fisheries, wetlands, and aquatic habitats at the center of design and decision-making, cities can achieve balanced outcomes, enhancing environmental resilience, supporting local economies, and strengthening food systems.

6.0 Challenges and Opportunities of Integrating Fisheries into Urban Planning

Integrating fisheries into urban planning presents a complex mix of challenges and emerging opportunities, particularly in rapidly growing African cities where water bodies play essential ecological and livelihood roles. Urban fisheries often face pressures from pollution, habitat loss, and competing land uses driven by urban expansion. Weak policy frameworks, environmental degradation, and limited representation of fishing communities further undermine their sustainability. At the same time, new opportunities are arising through nature-based solutions, improved governance, digital monitoring technologies, and climate-resilient urban design. These innovations highlight the potential for fisheries to contribute to food security, livelihoods, biodiversity conservation, and urban resilience. Understanding the challenges and opportunities side by side as presented in Table 6 enables planners, policymakers, and communities to design integrated strategies that protect aquatic ecosystems while supporting inclusive and sustainable urban development.

Table 6: Challenges and Opportunities in Integrating Fisheries into Urban Planning

Category	Challenges	Discussion on Challenges	Opportunities	Discussion on Opportunities
Governance & Policy	Weak policy frameworks for urban fisheries	Urban planning often prioritizes infrastructure development over aquatic ecosystems, leading to loss of wetlands and fishing grounds.	Development of integrated urban–fisheries policies	Cities can adopt blue economy policies that incorporate fisheries, wetlands, and coastal management into master plans.
Environmental Management	Pollution from urban runoff, sewage, and industrial waste	Degraded water quality reduces breeding grounds and affects the health of fish populations.	Nature-based solutions (NBS)	Wetland restoration, mangrove replanting, and green buffer zones improve water quality and enhance fish habitats.
Spatial Planning & Land Use	Encroachment on coastal and riverine areas	Rapid urbanization leads to displacement of fishing communities and destruction of fish landing sites.	Zoning reforms	Establishing protected aquatic corridors, fish landing areas, and designated waterfronts for fisheries.
Socioeconomic Factors	Marginalization of fishing communities	Fishers lack representation in planning decisions, leading to conflicts and inequitable resource access.	Community participation	Involving local fishers in participatory planning improves compliance, stewardship, and local ownership.
Climate Change	Increased flooding, drought, and salinity intrusion	Climate impacts reduce fish nursery areas and disrupt traditional fishing patterns.	Climate-resilient infrastructure	Blue–green infrastructure (wetland parks, vegetated channels) enhances urban resilience while supporting fisheries.
Infrastructure Deficits	Poor facilities for fish landing, storage, and processing	Lack of cold storage, packaging facilities, and hygienic landing	Investment in urban aquaculture	Well-planned aquaculture systems (ponds, cages, rooftop systems) boost

Category	Challenges	Discussion on Challenges	Opportunities	Discussion on Opportunities
		sites reduces fish quality and income.		food supply and reduce pressure on natural fisheries.
Knowledge & Data Gaps	Limited scientific data on urban aquatic ecosystems	Absence of reliable information hinders planning, zoning, and effective management.	Digital monitoring tools (AI, drones, remote sensing)	Modern technologies improve monitoring of water quality, fish stocks, and mapping of wetlands for planning.
Economic Pressures	Competing land uses (real estate, transport, industry)	Economic incentives often favor construction over the protection of aquatic ecosystems.	Blue economy financing	Carbon credits, eco-tourism, and sustainable fisheries can generate revenue, encouraging protective planning.

7.0 Conclusion

Urban fisheries are critical yet undervalued components of African cities, bridging natural ecosystems and human livelihoods. Integrating these systems into urban planning and climate adaptation frameworks requires a holistic approach that combines ecological restoration, participatory governance and policy alignment. Effective management enhances food security, biodiversity conservation and flood mitigation, while supporting socio-economic resilience among urban populations.

To achieve climate-resilient and sustainable urban futures, African cities must adopt an integrated and forward-looking approach that places aquatic ecosystems at the center of urban policy and planning. Rivers, wetlands, lagoons, and coastal waters should be recognized not merely as physical spaces but as living infrastructure that delivers essential ecosystem services, including food provision, flood regulation, and climate buffering. Embedding this perspective into urban development frameworks can help cities balance growth with ecological sustainability.

Equally important is the empowerment of local communities as active partners in fisheries and aquatic resource management. Urban and peri-urban fishing communities possess valuable indigenous knowledge and have a direct stake in the health of aquatic ecosystems. Their meaningful involvement in decision-making processes enhances stewardship, improves compliance with management measures, and strengthens social resilience in the face of climate stressors.

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Achieving long-term sustainability also requires sustained investment in research, monitoring, and innovative nature-based solutions. Robust scientific data are essential for understanding climate impacts on urban fisheries, evaluating management interventions, and guiding adaptive strategies. Nature-based solutions such as wetland restoration, mangrove conservation, and green – blue infrastructure offer cost-effective and flexible options for enhancing urban resilience while supporting biodiversity and livelihoods. Finally, climate-resilient urban futures depend on effective cross-sectoral collaboration. Strong coordination among urban planners, environmental managers, and fisheries authorities is necessary to overcome institutional fragmentation and policy silos. By fostering integrated governance frameworks, African cities can align development objectives with environmental protection and fisheries sustainability, thereby creating more resilient, inclusive, and sustainable urban systems.

Ultimately, the chapter argues that harmonizing urban growth with ecological integrity is not only necessary for resilience but also for achieving equitable and productive cities where both people and aquatic ecosystems can thrive.

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