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**Research Article**

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Water Justice and its Dynamic Links to Water Resource Management, Water Security and Conflict in Nigeria

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Climate justice is a new issue in terms of its aim to resolve an emerging and very complex set of problems, including woman empowerment, health and economic development, food and poverty, security and conflict. In addition, the added stressor of climate change is exacerbating deficiencies, particularly in the developing world. One of the key components to ensuring climate justice is the provision of safe and reliable water and sanitation services which, as agreed for the first time by the UN Congress in 2010, is a basic human right and forms part of SDG6.

This qualitative, ethnographic study explores water justice and the ethical issues that contribute to increasing water insecurity, exacerbated by climate change impacts and seeks to identify barriers to water and sanitation access and different approaches to water management, based on work carried out in Nigeria. It was identified that increasing economic water scarcity, globally and in Nigeria, is due to poor water management and resource insufficiency that has resulted from neo-liberalist policies that left governments in the developing world unable to provide water for all. Increasing populations, rapid urbanization, industrialization and deforestation, in addition to the effects of climate change have stalled efforts to modernize economies and achieve the infrastructure, technology and educational developments required to underpin climate and water justice, reduce conflict and ensure water security.

Keywords: Water resource management; Climate justice; Water security; Water conflict

Introduction

The emerging field of climate justice is concerned with the intersection of poverty and climate change. It recognizes the direct relationship between social inequity and environmental degradation, which is not confined to the global south [1,2].

Even in a modern industrialized world, underpinned by precautionary principles, industries in many countries do not manage human and environmental risks effectively and so cause harm in the pursuit of financial gain. This approach emerged due to neo-liberalist free market philosophies and politics from the post-colonial era of the 1960s [3] and left the developing countries vulnerable to fluctuations in the global prices of the goods they produced resulting in a downward trend in their values over the longer term [4].

Access to cheap primary products and raw materials enabled the developed countries to produce high-value goods that enriched themselves, but which came at the expense of the developing countries by locking them into trade relationships that prevented them from industrializing. This made it challenging for developing countries to free themselves from dependence upon the developed world and kept them too poor to pursue technological innovations in fiercely competitive markets [5]. Consequently, the developing countries had to borrow capital and technology to grow their economies. This process created a vicious cycle of dependence that prevented developing states from joining the developed world.

From a climate justice perspective, industrial activities have led to atmospheric changes that are considered to be dangerous

interference in the water cycle and water pollution levels [6]. On an international level, therefore, significant wealth and technology transfers are needed to enable developing countries to break free from adverse trade agreements with developed countries, reduce pollution burdens, and to reduce conflict. On a local scale, climate policy must facilitate sustainable development of local communities with renewable, community based energy infrastructures [7] at their core.

Increasing global water scarcity, is due to poor water management and resource insufficiency, increasing populations, rapid urbanization, industrialization and deforestation, as well as the effects of climate change, all of which are having impacts on environmental migration. Given that the main uses of water are for food and energy production and environmental security [8], there is increasing demand for it as populations increase. As economies develop, eating patterns change and diets move from vegetarian to meat eating, with the increased water footprints that result [9]. Climate justice principles [6] demand that both local communities and indigenous peoples should be made aware, be consulted and be active crafters, as well as beneficiaries of solutions to their water access issues [10,11]. If that were to happen the people would have more involvement in solving issues that lead to conflict, insecurity and migration.

This study investigates the issue of water justice, i.e. water and sanitation as a human right, its positive linkages to water resource management and negative links to water security and conflict in the context of work done by Uguru [11], Uguru & Meldrum [5] over the last ten years in Nigeria. As Nigeria is so large a country/population that the scale of water issues is also larger and worsening versus even other SSA countries [12] and this study aims to find possible solutions.

Water Access and Nigeria

Water governance and financing structure in Nigeria

Nigeria is a three tier federal republic comprising thirty-six states, the Federal Capital Territory (FCT) and 774 local government areas.

Public water and sanitation services in Nigeria are decentralized functions, but some responsibility, such as funding, is shared by the three tiers of government (Table 1).

Table 1: Cost sharing formula for water supply capital investment among stakeholders (%) [11].

	Rural	Small Towns	Urban
Federal (%)	50	50	30
States (%)	25	30	60
L.G.As (%)	20	15	10
Community (%)	5	5	0

As the lower tier of government is saddled with responsibility without the necessary capacity, there are interventions every so often from the center. This leads to waste, duplication of effort and losses due to corruption [11]. The fiscal structure in the country is such that the states and local governments depend upon the federal government for almost all their funding needs. This is usually in the form of monthly revenue sharing or direct intervention, i.e. federal government funded water projects or programmes. The current revenue sharing arrangement amongst the three tiers of government is such that the federal government gets over 50% of all accruing revenue. A little over 26% goes to the state governments, whilst the Local governments share about 21% of total national revenues [12].

In theory, the Federal Government has the overall responsibility for providing national policy and other institutional frameworks. It coordinates the National Water Resource Planning and governance strategy with other tiers of government and stakeholders. In the same vein, the first tier, with control of most of the country's resources, contributes more financially to the lower tiers, both directly and indirectly, to meet water access targets, e.g. 100% access to water by 2030 [12]. The State governments are responsible for actual water supply and sanitation in urban areas and small towns, whilst the local governments are supposed to be responsible for rural water supply and sanitation (Figure 1).

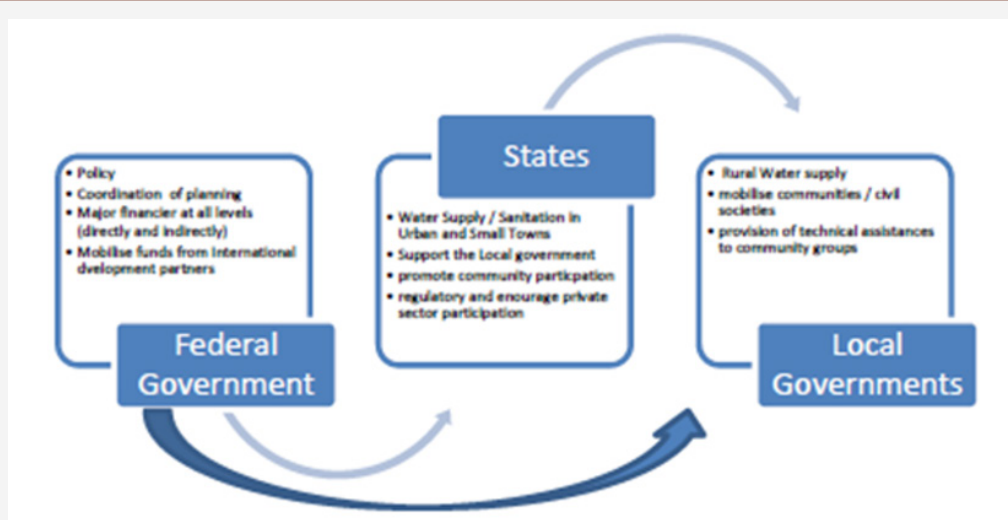


Figure 1: Illustration of the responsibility of the tiers of government [11].

Water and sanitation access in Nigeria

Nigeria has population of over 180 million people, a GDP of US\$1.053 trillion and is currently the largest economy in Africa and 26th largest in the world. Oil is the main contributor to foreign exchange (<95%) earnings and about 80% of budget revenues. Its heavy dependence upon oil revenues makes Nigeria vulnerable to market shocks and dependent upon the international oil market for its growth and development.

'The oil price collapsed in 2014 and this has badly affected the country and caused both a liquidity crisis and a huge budget deficit.... This has also affected the water sector service delivery.... in addition, 20,000 deaths and over 2 million dis-placed people due to the activities of Boko Haram in the North-East of the country... have exposed the country to a huge humanitarian situation....' [13]

Table 2: Estimate of Improved Water Coverage in Urban Nigeria 1990-2010 [11].

Estimated Coverage 2012 Update					
Year	Total Improved	Piped onto Premises	Other Improved	Other Unimproved	Surface Water
1990	79%	32%	47%	17%	4%
1995	78%	26%	52%	18%	4%
2000	77%	20%	57%	19%	4%
2005	76%	14%	62%	19%	5%
2010	74%	8%	66%	21%	5%

Table 3: Estimate of Improved Water Coverage in Rural Nigeria 1990-2010 [11].

Estimated Coverage 2012 Update					
Year	Total Improved	Piped onto Premises	Other Improved	Other Unimproved	Surface Water
1990	30%	4%	26%	29%	41%
1995	33%	3%	30%	31%	36%
2000	36%	2%	34%	33%	31%
2005	40%	2%	38%	33%	27%
2010	43%	1%	42%	35%	22%

Inequality and exclusion are politically sensitive issues in the country and because inequality intersects with regional, ethnic and gender issues, the discourse and policy responses are often politicized. Over the past 6 years the World Bank Gini Index has shown about 8% increase in inequality at national, but also urban and rural levels. This is counter to the general trends in SSA and to the aims of SDG6 [12].

Methodology

This is an ethnographic study that uses cultural, philosophical, political, NGO and international sources of information to explore the failures to provide water access and sanitation in the developing world. Papers, books and reports were reviewed and subjected to critical textual analysis to establish the key themes that describe barriers to prevent developing states from providing reliable, quality water and sanitation to their peoples.

The study investigates cross-cutting themes and nexus relationships that determine how states use their water and why. It provides explanations as to how things, especially in post-colonial states, are harder to manage in terms of water access and sanitation and require new ways of dealing with them; including the participation of marginalized groups within these societies.

Of Nigeria's 36 states, each constitutionally shares concurrent powers over water, sanitation and health (WASH), with a variety of structures and agencies having responsibility for water supply and sanitation, which has historically caused great confusion in terms of funding and service delivery in the sector [3].

Seventy-four percent of urban households have access to drinking water, whereas only 44% of rural households have access. This is exacerbated by lack of communications and shared responsibility of the water organizations at different levels of Nigerian government with local communities, whose needs may not be as perceived by the elites. Poverty, cultural beliefs and illiteracy are major drivers of improper wastewater management and unhygienic practices in most communities in Nigeria [11] (Table 2 & 3).

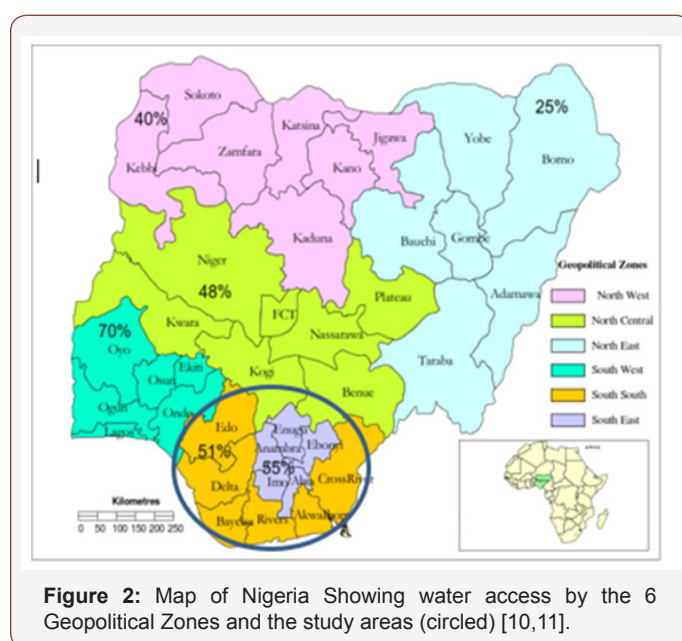


Figure 2: Map of Nigeria Showing water access by the 6 Geopolitical Zones and the study areas (circled) [10,11].

- The study also reflects upon work done in [10,11] States in Nigeria (Figure 2) over the last ten years and PESTLE analysis of water access issues [5,11], which link directly to the

consequences of neo-liberalist approaches in general, and to lack of comprehensive water access and sanitation in Nigeria, in particular.

Discussion of Findings

Nigeria

In Nigeria, PESTLE analysis of water access and sanitation was carried out [10,11] to identify the internal barriers to water and sanitation access for all in Nigeria. The analysis reveals that there are several shortcomings in the way water issues are addressed, which are the legacy of the post-colonial, neo-liberalist era.

a. Political: The legacy of neo-liberalist philosophies and policies has caused the lack of action that has been taken regarding the growing physical water scarcity issue in Nigeria. There has been a lack of political will to formulate and implement appropriately the policies and functional programmes needed to address water access issues. This is due to the many, often conflicting, water resource management agendas of successive administrations and self-interest. Hence, development of water re-sources; and indeed, water supply infrastructure in the country, has had limited effect overall. Access to safe water has not yet been integrated into government strategy to improve public health and reduce child mortality in the country over the long term. Recent elections, however, seem to have brought in a more promising regime under Buhari.

'While politicians in Nigeria hardly show commitment to their campaign promises, civil society groups across the country are making renewed efforts to hold the new government to account in its 'change' promises.' [12]

b. Economic: The provision of public water supply has remained a continual financial burden on the government. Water and environment have not been policy priorities and so socio-economic water scarcity, i.e. lack of infrastructure, skilled operators and lack of maintenance have reinforced the inadequate commitment to funding water and sanitation for all. This is because the water rate is usually fixed and is often too low to make water supply schemes viable on their own. As a consequence, there is always insufficient financial resource to invest in the sector or expand coverage and access. Another effect of this is that the country has to rely un-sustainably on foreign donors to fund many of its water programmes.

c. Social: The strong link between the consumption of unsafe water and public health in Nigeria is well known and documented [11]. However, only 58% of the population has access to safe water. Public water supply is neither reliable, nor are supplies provided by the private sector properly regulated to guarantee safety for consumers.

Similarly, corruption and, perhaps more importantly, the perception of it are also widespread and are major challenges to access. For instance, although financial allocations from the Federal government and donor funds to the sector have increased in recent years, access to safe water outcomes do not reflect financial inputs. In fact, some indicators show that water access has declined over the last decade [12]. In addition to corruption, the level of

investment in the sector does not match the combined effect of fast growing population, inflation and rising costs. The impact of these is many abandoned and uncompleted projects in different parts of the country. The propensity for political agendas to change quite rapidly may be responsible for these issues, as self-interest is said to be the driver behind many water projects, rather than the commitment to securing universal access in the country. In many cases, public services such as basic education, health, sanitation and hygiene, which directly benefit the poor, are given lower priority than capital intensive programmes, because the latter offer added opportunities for high level rent taking. As a result, lower income groups lose access to those services.

d. Technological: The required technical know-how and technologies for water purification and supply are internationally readily available. However, public water supply is intermittent, and the situation is made worse by the state's unreliable power supply. Consequently, even when water meant for public supply is available, there may not be power in the grid for the water supply companies to distribute it. As a result, the public mostly resort to water storage at household level, which could allow re-growth of pathogens, even when water may have been treated. In addition, leakage from ageing and damaged water supply pipes further increases the risk of recontamination [13].

In addition, unreliability causes household level water treatments units (Point of Use treatments - POU's) to be attractive, to remedy the doubtful quality of domestic water from public supply. However, not every household is able to afford them. These issues are compounded by lack of reliable data on water resources and capacity to maintain equipment, which undermine decision making at both governmental and community levels.

e. Legal issues: The existing legal framework for sustainable water resource management in the country is inadequate, and ineffective. There are many water sector related regulations in the country, but they have been developed in a disjointed fashion and are piecemeal in coverage. Also, the standards set by some of these regulations are not evidence based and are generally poorly enforced [11]. In addition, political uncertainties and intrigues in the country have often led to unstable government policies, laws and consequently abandonment of associated projects. This is worsening water and sanitation access as the urban refugee populations grow unchecked.

f. Environment: Urban sewerage infrastructure in Nigeria is poorly developed and is sketchy; except in Abuja. Municipal wastewater and trade effluent are usually discharged to the environment without proper treatment. In most other Nigerian cities, privately constructed septic tank systems are more commonly used. These are drained from time to time and discharged into various receiving rivers without any form of treatment. In some instances, wastewater from households is discharged into open drains, gutters and surface water bodies. The surface and ground water systems many people depend upon are at risk of contamination; especially in urban areas, as they are rapidly becoming open sewers [11].

In summary, in Nigeria, inconsistency in water policy has led to abandoned water resource development and infrastructure projects, which are badly needed across the country. Similarly, the legal framework that might support and encourage water resource management has failed to protect public health in Nigeria. Environmental degradation is rife in Nigeria due to widespread pollution of water resources, and community access to reliable potable water sources is poor. Technologies, e.g. drip irrigation, desalination and wastewater treatment are available to deal with water resource management issues. However, whereas water is directly linked to economic development and public health in developed countries, this connection is lacking in Nigeria [10,13].

Water as a human right

Without water we cannot survive and the fundamental right to life includes the right to drinking water and the duty for protecting it [14]. Water rights are derived from state, customary, local or religious laws. In Nigeria the human right to water is not yet widely recognized [10]. Certain values, which are embedded in cultures, underlie how rights are defined. It is the actualization of rights; in particular decision-making rights, that are key to water justice in developing world communities [15]. Water rights are complex and subject to change due to uncertainties mainly derived from external factors associated with neo-liberalist philosophies such as political, economic, social, technical, legal, and environmental (PESTLE) factors, as well as livelihood and knowledge uncertainties.

Actualization of water rights

The term water rights can be interpreted in two main ways. Firstly, from a legal or water management perspective it is the right to use a share of water allocated to an individual, water users' association, a company or a district by a statal or parastatal agency or community. Secondly, it can be linked to a system of water allocation. This means not just water shares but also the mechanism of allocating shares, between use rights of access and withdrawal, and decision making rights of regulation, control and decision making itself. The legitimizing institution often varies between user's groups, a village or ethnic community, a village council or a state agency. Claims accepted and validated by one institution may not be recognized by another [16,18].

A lack of strategy for managing water in Nigeria means that it is used wastefully and without regard for ethical concerns, e.g. investment in large dams and reservoirs have led to displaced people and the loss of fertile land, livelihoods and surface water systems [5,19,20]. In some countries, the effects of drought have been exacerbated by reliance upon infrastructure intended to increase water supplies. In these cases, entire watersheds have been manipulated based upon the hydraulic paradigm [2,5] and without thought for the long term impacts upon people or the needs of the environment.

Water, justice and conflict

Human rights are inextricably linked with justice. So, water justice is synonymous with the human right of access to affordable water and sanitation, as outlined by the UN [21]. However, the successful mobilization of that right raises significant challenges

in Nigeria due to increasing concerns about water security, environmental degradation and, on top of those issues, the impacts of climate change, including upon migration and conflict [22].

Economic and social development, industry, food production, human and environmental health all depend upon water, by quantity and quality, as well the reliability of access to it, which in turn depends upon the reliability of energy supplies; especially in the urban environment [23,24]. As a result, water shortage and competition between water uses and users could lead to conflict [25] between Nigeria and neighboring countries, with significant impacts upon local economies and human well-being, as well as detrimental effects upon water resources.

Water ethics

Water justice is all about equitable water distribution, fair utilization and our relationship with each other and our environment [22]. Protecting water and assuring its fair distribution are among the most critical eco-justice activities, such as providing drinking water and sanitation, agriculture and irrigation, environmental protection and preserving biodiversity. In many cases water is considered to have no intrinsic value, in the way that we value other commodities, and energy or food [25]. These situations have developed because water is considered to be a free resource that we can exploit. And yet there are ethical and technical dilemmas here. The more water we exploit, the more it is polluted and the costlier and more energy intensive are the treatments required to clean it up. The ethical issue here is that determining a fair and equitable distribution of water has a positive effect upon humans, non-humans, and the systems that sustain them alike. Coping mechanisms like water resilience, water footprint, virtual water trade and regulatory frameworks that attempt to preserve biodiversity and habitats have emerged, as a result of dramatic changes to environments in many countries around the world. However, some unintended consequences-es of developments have arisen, such as the demise of the Lake Chad Basin, a trans-boundary water resource in Africa (Figure 3).

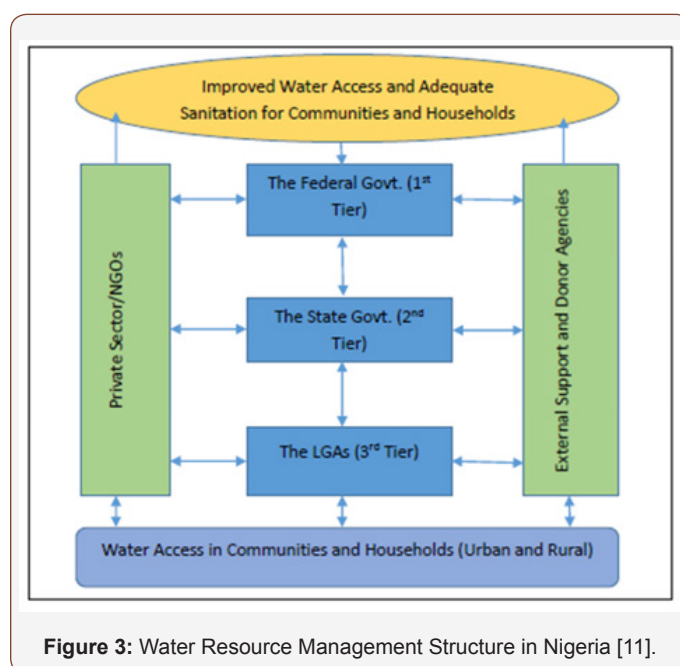


Figure 3: Water Resource Management Structure in Nigeria [11].

Demise of Lake Chad basin

The impact of climate changes and overexploitation of Lake Chad water and damming of the Chari River, which replenishes the lake basin, have impacted the extent of water in the basin over time. Since 1963, the area covered by the lake has reduced by over 90% from 25000km² to 1350 km² today. Lake Chad and the Chari River together, constitute the most important source of water in the region and massive irrigation systems built by Niger, Nigeria, Chad and Cameroon, the nations that share the basin, are seriously depleting it. This is not only a practical effect of over-exploitation but is an ethical issue regarding shared water sources and access rights.

Serving over 50 million people, the total human water uses accounts for roughly 50% of the decrease in the lake area since the 1960s (Figure 4). The rest of the decrease is due to a shifting climate pattern over the past 40 years [26]. The Lake Chad Basin relies upon monsoon rains to replenish its water and this rainfall has dropped dramatically in that period. Severe droughts in the 1970s and 1980s led to a reduction in surface area and two separate basins emerged, one in the north and one in the south. Not only that, but due to insecurity from the impact of conflict due to Boko Haram, there are nearly 2.8 million refugees that live in the area and an estimated 9.2 million dis-placed people in need of humanitarian assistance there [27,28]. In addition, climate change is also exacerbating current tensions and conflict [11].

Adequate sanitation is needed for 1.75 billion people in rural areas and 300 million in urban areas [28,29]. In general, providing large scale sanitation and water treatment services requires high energy input, often in countries where electrical power supply is neither comprehensive nor reliable. In addition, countries like Nigeria, that are beginning to industrialize, are seeing rapid growth in water demand and water pollution alike [30-32].

Responses to ethical dilemmas

Several approaches have emerged to try to tackle the issues of water scarcity, poverty and climate change impacts on water resources.

a. Integrated water resource management (IWRM)

In line with neo-liberal economic policies in the 1990s, IWRM [33-35] emerged and has gained ground as the main vehicle for growth and poverty reduction. IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare, in an equitable manner, without compromising the sustainability of vital ecosystems. There are ethical issues here of equitability and how it should be judged; by geography [36], human settlement, or the distribution of water on earth. IWRM makes judgments about correctly ordered social relationships [37]. It has not gained ground in Nigeria.

The Middle East and North Africa (MENA) is experiencing one of the fastest growing water deficits in the world. The majority of the region's countries have been consuming more than their renewable supplies for some time [38]. This is no longer an option due to high costs and negative environmental consequences that have led to a

vicious cycle, linking the deteriorating status of water resources, in terms of quality and quantity, to deteriorating livelihoods. There is a general lack of familiarity with participatory and integrated management approaches; fragmented institutional structures and conflicting mandates; outdated water pricing policies; imbalanced sectoral water allocation; persistence in solving increasing demand problems through supply augmentation; and delegation of responsibility without the necessary devolution of power and financial resources in decentralization plans. These are amongst the major problems facing water management across the region and IWRM approaches are intended to alleviate issues like these by engaging all stakeholders in finding sustainable water access solutions.

b. Adaptive water management (AWM)

AWM is a reaction to accepted views of top down management approaches that regarded large watershed issues, e.g. flooding, as predictable over long time scales (50 or 100 years). In adaptive management, assumptions of stability are replaced by learning about evolving social and ecological systems. This is in order to preserve relationships and processes, functions and feedbacks in social and ecological systems that support complexity, and which improve the system's ability to absorb and recover from disturbances, i.e. resilience. By improving resilience, managers attempt to adapt to change and strengthen relationships that are of particular value; such as those enabled by fresh water [38].

AWM analysis has been applied to Ethiopia, which is currently experiencing significant natural and socioeconomic changes, which are modifying the availability of and demand for water resources [30]. Because of its geography and climate, Ethiopia has always been characterized by a high hydrological variability, compounded by the almost total absence of water storage and a highly vulnerable watershed [39]. Climate change is expected to lead to more uncertainty and extremes in weather patterns as well as increased rainfall variability.

In addition, significant economic growth and population increases over the last decade demand good quality water resources and have given rise to significant pollution problems. In addition, Ethiopia's water sector continues to be characterized by little integrated planning, so that water resources are being allocated in ways that neither take into account competing demands nor are based on a systematic understanding of 'how much water' is available. This is already leading to instances of conflict [39].

A review of the policy and institutional framework for water management [39] suggests that Ethiopia may not be prepared to cope with these pressures. Basin planning through embryonic River Basin Authorities (RBAs) remains weak. The establishment of 'good enough' water management institutions in Ethiopia is hampered by a lack of knowledge of resource conditions, patterns of use, and drivers of change; and a lack of capacity and skills within institutions to plan water allocation, assess the impacts and trade-offs of water resources development and allocation, and ensure that planning incorporates climate justice thinking. Nigeria also has these deficits [10-12]. In addition, because provisions for water allocation and pollution reduction are not enforced, the needs of

poor and marginalized communities' risk being eclipsed by the interests of the most powerful groups and actors.

As investment in water ramps up in Nigeria, Ethiopia and other SSA countries, there is a real danger that unconstrained development and weak management will undermine the resource base, and squander opportunities for the kind of broad-based economic growth envisaged by the government. Therefore, while a minimum platform of hydraulic infrastructure is required, the equal importance of investing in an institutional framework that disciplines water resources management and hence development is important. If there is only a focus on water re-source development and no management framework, substantial difficulties and conflicts are bound to arise.

c. Water pricing

Water is a common public good which many believe should neither be bought nor sold. But nowadays individuals have the right to use, sell or recover value added costs of developed infrastructure for water supply services. This is a global and not solely a Nigerian issue. Customary rights in some cases overrule state legislation and water can be a contested issue [10,11].

There are three aspects to this: public property – water as a natural resource with free access for all; restricted private property, e.g. lakes and rivers where owners may have certain rights, but also have obligations (i.e. should not withhold surpluses); and private property, which is developed through investment in infrastructure works [40].

Water is an economic good with an economic valuation and providing adequate water to meet those basic needs must be done in an equitable manner that works in harmony with nature. Water scarcity depends upon the value of water and that varies between economic efficiency and basic welfare or human rights approaches.

Any economic instrument for water management requires a fair pricing policy to increase equity of access to water. It is thought [40,41] that the goal of full cost recovery is best reached through participation of private partners with the public sector. Irrigation is a third priority after quenching thirst and domestic use.

Poverty, environmental and social injustice

Households need water for drinking, cooking and washing to maintain dignity and health. However, food production and family-run businesses also require water to generate income and reduce poverty, while enhancing productivity and releasing women from water collection via reliable water provision at the household level, on average, globally, 70-80% of water resources are used for agricultural irrigation, 10-15% for domestic potable water provision and the remainder for industry [32]. There has been little consideration of the water needs of the environment itself in the human exploitation of water resources up to now.

Economic growth does not guarantee wider social progress, however, and the gap between rich and poor and those who have water rights and those who do not, is growing [22]. Access to safe drinking water and sanitation is a human right, but still many people do not have access to either and this has disproportionate effects upon the poor; and women and children in particular. In

Sub-Saharan Africa, these issues have arisen in part due to 35 years of structural adjustments in the continent due to neo-liberalist philosophical and political determination to give primacy to free markets over state led regimes for business and trade. Neo-liberalism is concerned essentially with the configuration and reconfiguration between states, cities and markets [3]. As states become mega-corporations, they become inextricably part of the workings of the market and hence no longer able to influence trade choices. This is, in part, why government is increasingly reduced to the technical management of capital and why ideologically founded politics have been replaced by the politics of self-interest, entitlement and identity [3].

So, apart from a few exceptions, seven decades of 'development' have left Sub-Saharan Africa (SSA) underdeveloped. As outposts of empire, producing what they do not consume, with self-serving state power and private/foreign capital moving to the epicenters of social forces, the majority of the people are pushed to the margins where they pursue their own livelihoods, often beyond either the purview or interest of the state (informal workplaces).

Despite this, evidence from Nigeria, as a representative country, shows that as regards water supply and sanitation, there has been clear improvement, albeit from a very low starting point [15]. Across this vast array of actors come different expectations, partly determined by socio-cultural values, politico-economic considerations, as well as economic needs and abilities to pay.

The large scale capture of water in the developed world, beginning especially in the early 20th century, made industrialization, wealth creation and extensive human settlement possible [5] and the leaders of development are also the greatest users of water. Even where countries do not use water directly as in local production of food, they nevertheless command the water resources of other parts of the world through their capacity to import it virtually, embedded in food, from all over the world.

The global significance of water in food supply chains has been up to now unrecognized. Governments, societies and markets have made it impossible for farmers – society's water managers – to effectively manage water security. Meanwhile, the significance of food-water is invisible to food consumers. In addition, other agents in the food supply chain, the major commodity traders and food retailers, as well as the consumers of water-intensive food commodities, are equally ignorant of the way that food choices and behaviors, and the way the agricultural industries help to meet them, affect water security.

Water and energy security

In Africa the distribution of water resources across the continent reflects the region's abiding conditions of underdevelopment; plenty of water for commodity production, industry (where it exists) and low-density urban areas being populated by those closest to the center of the powerful social forces within the state (political and economic elites) and only little water of the right quality and quantity for everyone else [21].

Agriculture and energy production rely upon water. In 2012, an estimated 2.7 billion people were affected by water shortages. This figure is set to increase as global demand for fresh water is likely to

outstrip supply by 40% [28, 30]. By 2025, up to 2/3 of the world's people are likely to live in water stressed conditions. In 2018, the World Economic Forum's Global Risk Report [32] ranks water supply amongst the top five global risks. So, it is clear that water, which underpins much of production and economic development, has a key role to play in the future security of our planet.

Water use is intimately linked with power generation and usage. Global water withdrawals for energy production were estimated in 2010 to be 583 billion m³ (~15% of the world's total withdrawals). By 2035, this could increase by 20% and consumption by 85% [31] because of increased power plant efficiency requirements that will inevitably require more water. Increased use of biofuels; the most water intensive method of energy production, could also have both regional and local impacts. Energy is big business compared with water, which has historically been considered to be more a public health and welfare issue.

The expansion of hydropower as a key source of renewable energy is a critical issue across nearly all of the world's regions due to concerns of growing conflict between various interests or over transboundary water resources. In the developing world, in particular, the rural populations in Sub-Saharan Africa rely on traditional energy supplies, mainly unprocessed biomass, the burning of which causes significant pollution and health concerns and affects land fertility. Such anthropogenic factors are causing a significant impact on speeding up the loss of wetlands that contribute to the recharging of groundwater resources. This is the only region in the world where the absolute number of people without access to energy is increasing [24].

We are at a nexus with domestic water usage, food and energy production competing for water, where all sectors and their water consumption and eco-system impacts need to be considered during development decisions.

Water sharing and insecurity

Water insecurities arise because the types of infrastructure required to deliver good quality water reliably are not considered

The key issues

coherently. So, water insecurity results not only from a lack of infrastructure to deal with water-related impacts and climate change, but also, from infrastructure/control and technology choices [24].

The close links between water and food, climate and energy must be considered if water security is to be explored [23,30]. The Ministerial Declaration on Water Security at the 2000 World Economic Forum [37] clearly identified the water/food link as being crucial to investigating interdependencies, including considering virtual water and our water footprint. The link between water and energy security is relatively less developed. The competition for water between crops for food and crops for biodiesel ('water for energy') is directly related to the demand for and cost of fossil fuels. The water footprint of biomass is 70 to 400 times larger than that of conventional fuels and this raises issues of allocation; particularly in India and China. Some states' choices about which crops to focus on do not seem to relate in any way to the water resources available to support their production [9]. In addition, concerns about energy use for treatment, production and transmission of water ('energy for water') require attention.

Lack of access to adequate quantities and qualities of water resources is a climate justice issue linked to most, if not all, development issues – poverty, poor health, diminished livelihoods, child mortality and conflict. Water insecurity undermines economic efficiency, social/gender equity and environmental sustainability, all of which are necessary for national security. Growing water scarcity and competition for shared water resources driven by population growth, expansion of human economic activity, migration and climate change are at the heart of the debate over the securitization of water, and water security itself.

So, reliance upon markets to determine beneficial use results in society making particular decisions with respect to the current usage of water resources. The resulting decisions are not necessarily efficient from social or sustainability perspectives but might be from the perspective of private individuals in the here and now.

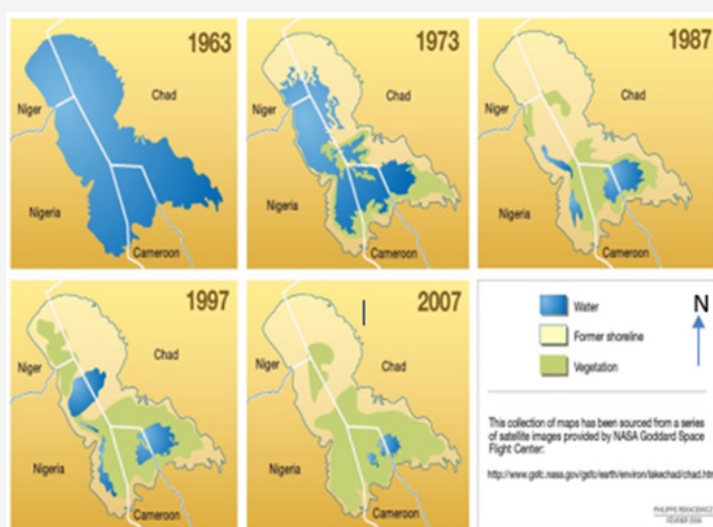


Figure 4: Unintended consequences: The demise of Lake Chad Basin and its ecosystem services [26].

Evidence from Nigeria suggests [34] that water insecurity causes generally fall into several categories. The most frequently found barriers to water access are political will, understanding of socio-economic issues and legal or institutional failures. These can also be related to PESTLE factors that tie into barriers to effective resource management, as shown in Figure 4. This is particularly true with respect to water and fits with study findings for Nigeria [5,11].

In fact, it is clear that involving societies in dealing with and solving their local water issues, explaining to them costs and benefits, and carrying out effective stake-holder engagement in water issues that engenders public acceptance of bottom up solutions [10], are perhaps the most effective ways to ensure the sustainability of water management solutions at community level

in developing countries. Communities in many developed countries are also now taking their water issues back into their own hands, for example, due to disillusionment with public/private arrangements that compromise both quality and economy of delivery [21].

Le Quesne, et al. [43] work studied the barriers to effective management of environmental services. Uguru & Meldrum [5] found similar factors arose during PESTLE analysis of water and sanitation access in Nigeria. Figure 5 combines the results of the two studies and shows that political will, understanding of socioeconomic effects and legal arrangements are the main barriers to effectively environmental and water management. This confirms findings for Nigeria, an ex-colonial state, subjected to neo-liberalist policies and explains the lack of development and provision of water for all in the country.

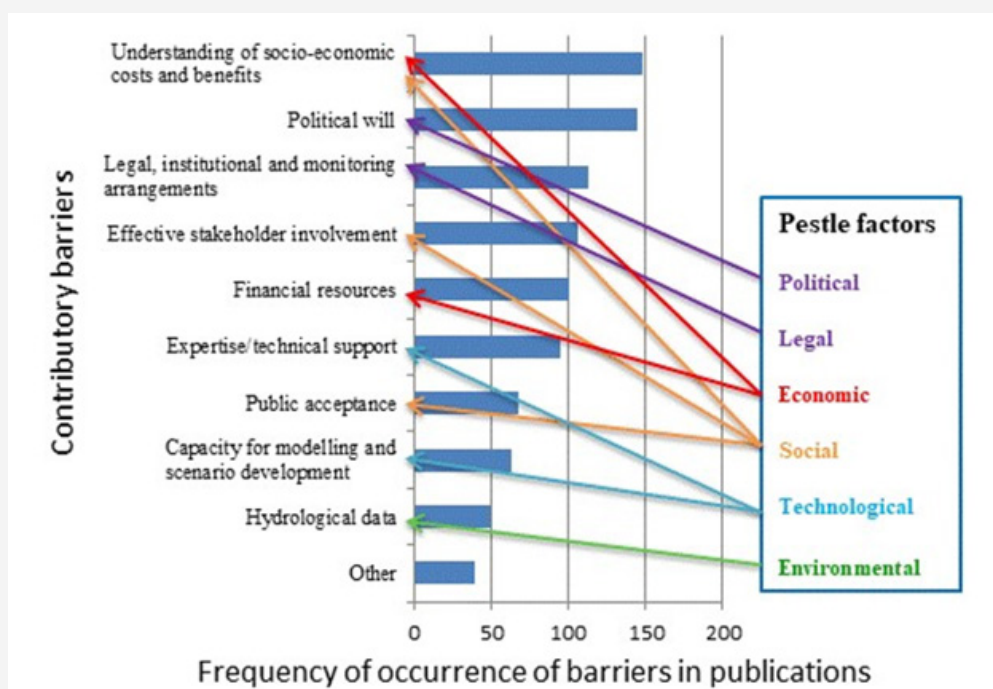


Figure 5: Barriers to understanding and managing water access issues [Adapted 5,11,41,43,44].

Growing demand for limited water supplies places increased pressure on water intensive energy producers to find alternative approaches; especially in areas where energy is competing with other water users, such as agriculture, manufacturing, domestic drinking water and sanitation services, and where water uses may be restricted to maintain healthy ecosystems. So, there is increasing potential for serious conflict between power and other water users, and environmental considerations, in the context particularly of thermal power generation.

Conclusion - Key Learning Points

A long term view of water resource management needs to be taken to ensure social and economic development, protection of the environment and appropriate use of funding. Coupled with this is the need for a consistent regime of water policy, legislation and management that continues, irrespective of political agendas, in order that water issues can be solved, and funding can be best utilized to protect public health and economic and social welfare,

sustainably, over the long term. This is true for both developed and developing countries.

Legislation needs to 'have teeth' and regulators must have the power to enforce it or the law will be flouted and rights to access will be compromised. Legislation must be consistently applied and enforced to solve pollution issues and encourage technological and/or managerial solutions to emerge. The need to consider water as an essential support to economic development, as has been applied in the developed world, is crucial, as this then would engender strategies and behaviors towards water that would ensure its sustainable use and access as a human right.

Water resource management should be directly linked to economic development and its benefits, so generating the ability to buy into technological developments, e.g. water and wastewater treatment technologies, reservoir developments and hydropower schemes that can protect water resources into the future. The mass movement/control of water (hydraulic paradigm), however,

may not be the sustainable solution to water management, due to its environmental impacts and the change in communities/social impacts it brings. This means that local, community based solutions are likely to be the most effective; particularly for rural communities. In addition, the need to manage the trade-offs and co-benefits across all sectors has become an urgent and critical issue.

The environment must be respected if water resources are to be protected long term and regional/river basin, rather than national approaches can provide resources and knowhow to do this. Water may be a right for all humans, but not to the detriment of the ecosystem, or without costing access in order to ensure treatment and protection of sensitive areas, such as wetlands and biodiversity. The right to water should come with a responsibility to protect water resources, as well as public and environmental health.

Global water ethics requires a more holistic approach to water management, including thinking in terms of water as an economic good and markets as only one means to efficient use, water as a community resource to be communally managed, non-humans as part of the eco-system and a move away from anthropocentrism (utilitarianism) and neo-liberalism (free market forces rule) towards an ethic of respect regarding all life. These need to be considered as a whole if we are to ensure sustainable water for all in the future.

Appropriate solutions may be different for urban and rural environments in the developing world, but stakeholders should be involved in the selection of the best approaches, methods and technology for their situations and needs [10]. Urban areas will benefit from the economies of scale of municipal water and wastewater treatment and provision, but rural areas will benefit most from local community oriented/point of use solutions, taking into account local climate and topography and available water resources. Community stakeholder engagement is therefore crucial to solving water security issues in Nigeria, as well as other developing countries.

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Conflict of Interest

No conflict of interest.

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