Assessing the Role of Water Resources Protection Globally

Subjects: Water Resources

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Water resource protection is central to sustainable water supply management for human wellbeing and for the ecological ecosystem to flourish. Water resources protection plays a critical role in policy practice to mitigate water resources challenges and in mitigating social wellbeing. Such practice is central to sustainable water supply management for human wellbeing and for the ecological ecosystem to flourish. Appropriate implementation and monitoring of water resources protection practice has received much attention on the international agenda. Approaches such as results-oriented policy monitoring are seen as appropriate methodologies for monitoring policy implementation practice to assess policy impacts.

Keywords: water resources protection ; water resources

1. Introduction

Water resources protection is described as an activity encompassing resource and habitat protection such as securing of resource, and instream flow rights. It involves progressive reduction in discharge, emissions, and losses of pollutants, to ensure long-term protection of available water resources and aquatic ecosystems [1][2]. Although water resources protection and water resource management are often used interchangeable in practice, water resources protection focuses on measures put in place such as prevention and control of water pollution [3]. On the other hand, water resources management emphasizes on enabling policy and regulating the environment, institutional roles and responsibilities, and management instruments as prerequisites to deploying water resources to support social and economic development while ensuring sustainability of the resource [4].

Globally, surface water and groundwater resources are regarded as one of the most essential material resources necessary for human survival and development [5]. Furthermore, these resources are considered as central to natural environment sustainability and ecological ecosystem evolution. It has been pointed out that the conditions of water resources at one place can determine the local ecological environment [6]. The role of ecological ecosystems in social wellbeing such as provision of goods and services is well-documented [7]. It is in this regard that water resources protection is considered as central to socio-economic development and ecological ecosystem sustainability.

Such an argument is supported by [8] who noted that water resources are currently facing variable and unpredictable challenges globally that are mainly manifested in different aspects. It is acknowledged that water resources are an irreplaceable element of the ecological ecosystem and natural environment, which requires protection for sustainable utilization [6]. In the case of groundwater, protection measures require understanding of hydrologic characteristics of groundwater systems such as the scale, hydraulic conductivities, and effective porosities for predicting contaminant transportation [9]. Sustainable utilization of groundwater resources requires understanding of how much groundwater is available in a system, and in such practice aquifer recharge becomes a critical hydrologic parameter for consideration. As pointed out by [10], understanding of groundwater recharge assists in the conceptualization of aquifers for effective management and sustainable withdrawals. Furthermore, sustainability and availability of groundwater resources requires understanding of aquifer properties linked to groundwater pollution. Such understanding is central to the development of feasible methods that can be used to predict and track chemical concentration movement along saturated and unsaturated zones at a local, regional, and national level. For example, [11] showed that it is possible to predict regional scale loading of nitrate at the water table, a revelation which is critical for groundwater resources management. Similarly, understanding of hydrologic dynamics of groundwater is critical for ecological ecosystem sustainability and protection. For example, evolution of groundwater nitrate concentrations and nitrate loading from intensive agricultural activities can cause significant challenges in aquatic ecosystems in cases where groundwater discharges into surface water [12].

The vulnerability of both surface water and groundwater resources to pollution and over exploitation warrants adoption of water resources management approaches that seek to balance between their protection and sustainable utilization. It has

been argued that such approaches should consider river basins as “natural” units and logical units for water management [13]. Water vulnerability to climate change has dire consequences on socio-economic development. For instance, when water resources vulnerability was assessed in Nigeria, climate change was identified as one of the factors having a negative impact on water resources, giving a compromise in terms of meeting future demand [14]. In South Africa, influence of climate change on water resources has been reported to cause constraints of water resources availability, and a negative impact on economic development, livelihoods, and progress towards attainment of SDGs [15]. Such challenges require strategies and tools for mitigating potential negative impacts imposed by climate change, and it is encouraging that relevant tools are made available for measuring water resource vulnerability due to environmental and anthropogenic factors [16]. Furthermore, tools for assessing the vulnerability of water resources in China have been developed [17]. For example, [18] developed a Vulnerability Scoping Diagram (VSD) framework and System Dynamics (SDs) model as a tool for water resource vulnerability in the Pearl River Delta network in the city of Zhongshan.

Policy relevant approaches have been considered as critical in water resources protection. For example, a research study conducted in the United States of America (Florida) investigated forest conservation for ecosystem service provision as an effective strategy for protecting water resources and increasing public welfare. Using a web-based choice experiment survey, the study found that forest/water protection programs provide an annual average of USD 154–230 million in clean water benefits, and a significant portion of that value was associated with the policy process. The findings suggests that policy interventions provide relevant solutions for water resource protection [19].

Although policies for water resources protection are critical in mitigating water resource challenges [20], but if such policies are not appropriately implemented or if the implementation processed are delayed, their intended purpose are likely to be compromised. For example, development of policies that regulate the environmental quality of the waters in Chile have advanced significantly; however, it has taken the country about 22 years to implement such policies and thus, at present, water quality problems and challenges remain a major challenge in the country [21]. It has been argued that several advances and reforms of Chile’s institutional and legal framework for water management have fallen short of what is needed to address the issues that Chile faces in its current phase of development. Hence the adoption of an integrated water resources management approach has been recommended as a priority so that Chile can face its current and future water management [21].

2. Global Water Resources Protection

Over the years, there has been a brewing pressure on policy developers and water resource managers to develop and implement intervention strategies to mitigate environmental, water resources, and social impacts. This has motivated policy implementers and researchers to identify ways to better implement policies and strategies for effective protection of water resources [22][23][24]. Water resources challenges linked to ineffective policy intervention have been reported in Central Europe with a growing concern that the Water Framework Directive (WFD), which is a pioneering piece of legislation that aims to protect and enhance aquatic ecosystems and promote sustainable water use across Europe, would not be able to assist in achieving the objective of good status or higher in all EU waters by 2027 [25]. For example, devastating drought events have been reported in the areas of Western and Central Europe such Poland and Germany which has led to diminished spring discharges at a percentage between 4% and 52% [26]. Ref. [27] reported that despite extensive legislation that has been developed by the European Union to protect drinking water resources from agricultural pollution, the achievement of water quality objectives is an ongoing challenge throughout Europe. Complexities and inconsistencies of European legislation for drinking water resources protection have been cited as hampering efforts to achieve water quality objectives, and a new type of integrated management has been recommended for consideration in water protection decision making [27][28].

In Bangladesh, groundwater depth and groundwater-level deficit (drought) has been reported to be continuously increasing [29], and the decline has been linked with urbanization; as a result groundwater extraction in many locations has become unsustainable with predicted catastrophic events such as earthquakes, subsidence, and pollution being highly possible [30]. Due to current challenges related to stream low flows experienced in several countries, recommendations have been made on complementary management for high flows that occur early in the growing season with maintenance of adequate base flows to maintain ecosystem functioning in the face of hydrologic alterations induced by climate change and human water demand [31]. In terms of groundwater availability, intervention measures such as artificial recharge to the aquifers and water-saving technologies have been recommended to prevent groundwater mining as policy intervention measure [32]. In China the functions of water ecosystem of the Hainan province have been reported as degrading in the past few years, with the environmental quality of the water being inadequate. As a result, recommendations have been put forward for China’s water ecological environment protection strategy to comprehensively consider the connection between space development and protection [33].

In the African context, challenges associated with water quality deterioration, river flow regime, and ineffective policy practice towards water utilization have been reported. These challenges together with other many factors contribute to an increasing gap between water availability and demand in Africa [34]. Prior research indicates that watershed basins in Africa are prone to management challenges which may results in conflicts if not properly managed. For examples, a case study undertaken in the Nile River Basin on the roles and challenges faced in managing watersheds revealed that there is a sluggishness in the implementation of a coordinated planning and development program which leads to unsustainable utilization of water resources [35]. The author associated the challenge with a lack of coordination and detailed effective collaboration among some of the major players such as the Nile Basin Initiative and other development partners. The observation connotes that those policies developed for protection and management of water resources would not be good enough to curtail existing challenges if there are no existing plans put in place to implement policies, and in cases where there is a lack of policy implementation plans, conflict may arise.

In Nigeria, in the north central region, there are no apparent reported water challenges, which is due to water availability in water resource systems which is higher than the present use within the spatial location of rivers which also enables enough supply to all sections of the states in the region [36]. However, [37] reported that access to water within the Ado-Odo and Ogun State is mostly limited to the private sources because of the level of water quality and accessibility.

Water quality degradation has been found mostly in Lagos, Rivers, Kano, and Kaduna where most industries are located, and a need for water resource protection measures such as prosecution of water resources polluters by the Federal Ministry of Environment has been recommended [38]. Ref. [39] provided an indication that despite huge water resources in Nigeria, water resource development activities have not been efficient with the phenomenal population growth, and the researcher recommended policy reform in the country.

The Southern African Development Communities (SADCs) issues related to policy implementation and governance have been reported. For instance, in Malawi, water challenges linked with governance issues have been reported with indications that water supply and sanitation services are confined to urban populations due to governance administrative challenges [40]. A study by [41] indicated inconsistencies in the proportion of households that satisfy Malawi versus the United Nations and World Health Organization minimum water-access standards. A combination of factors including increased water demand, poor communication between stakeholders, and weak regulation and enforcement have been reported as challenges being experienced in Namibia, and as a result development of more robust and resilient strategies has been recommended [42].

It reported that groundwater [43] use for irrigation has increased above the sustainable safe yield for the aquifers in the Grootfontein Tsumeb-Otavi Subterranean Water Control Area (GTO-WCA). The study proposed specific management solutions such as amendment of the legislation and policies to ensure that the management of karst aquifers in the country including the allocation of abstraction quotas [43]. Such reported challenges call for reinforcement of existing policies and improvement on their implementation. While water scarcity and water quality deterioration seem to be common in many African countries [44][45], policy-related challenges are also apparent. For example, lack of water resource protection practices for sustainable water supply has been identified amongst other factors as a driving factor for the experienced challenges especially in the Sub-Saharan African countries [46]. This is an indication that solutions on water resource challenges should not only focus on water quality and availability, but also on other aspects such as water governance and policy implementation [36].

The prevalent water resources challenges warrant policy interventions that seek to develop suitably comprehensive plans and institutional arrangements for sustainable water resources use and protection over time. Policy interventions that are beneficial to society are critical in the identification of the most effective ways of managing water resources in response to existing challenges [20]. Water resources protection policies are prevalent around the world to alleviate global challenges such as water quality deterioration and water scarcity [47]. However, water resource protection for sustainable utilization goes beyond “mere” policy development and implementation, in that it also requires monitoring of such practice to assess policy impact. Therefore, it is necessary to monitor and report the impacts of water policies on water scarcity and resources protection [48]. For instance, when the 2010 the Federal and State school water policies were assessed for their impact on free drinking water access in California public schools, the study found that there were significant increases in public schools meeting the criteria for excellence in free drinking water access [49]. Contrary to the case of the USA, when the extended producer responsibility policy to reduce marine plastic debris in Canada was assessed for its impact on reduction in shoreline pollution levels, the study showed no reduction in pollution levels [50]. The observation suggested that the extended producer responsibility policy was ineffective in reducing plastic pollution in marine environments. Such findings suggest that policy interventions may not always provide desired outcomes, thus the need to assess policy effectiveness using the results monitoring approach.

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