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Perceived stakeholder's knowledge and attitudes towards the management of the black and White Volta Basins

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Abstract
This study investigates the perceived knowledge and attitudes of stakeholders towards the management of the Black and White Volta Basins in Ghana. A sample of 400 households was selected using a combination of non-probability and probability sampling techniques across communities along the basins. Data were collected through a mixed-methods approach, employing structured questionnaires, semi-structured interviews, and focus group discussions to capture both quantitative and qualitative insights from local farmers, fishers, traditional leaders, elders, and institutional representatives. Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, with descriptive statistics such as frequencies, percentages, means, and standard deviations summarizing stakeholder responses, while qualitative data were thematically interpreted to provide contextual depth. The results indicate a strong awareness among stakeholders of integrated water resource management principles, with 82.8% agreeing or strongly agreeing on the importance of participatory approaches. The study concludes that stakeholders in the Black and White Volta Basins possess substantial knowledge and favorable attitudes that can support effective water governance if adequately harnessed. It is recommended that the Water Resources Commission, in partnership with local authorities and traditional councils, establish community-based water management committees to integrate traditional ecological knowledge with scientific methods, supported by technical training and capacity-building initiatives to enhance grassroots participation and sustainable management outcomes.

Keywords: Stakeholder Participation, Water Resource Management and Volta River Basins

1. Introductions
In the face of escalating global environmental challenges climate change, water scarcity, and ecosystem degradation effective water resource management has become a cornerstone of sustainable development. Across continents, river basins such as the Mekong, the Amazon, and the Murray-Darling have been emblematic of both the complexity and promise of integrated water resource governance. However, while global frameworks such as Integrated Water Resources Management (IWRM) and the EU Water Framework Directive offer structured models for basin-wide governance, their implementation often yields uneven results across contexts. The key differentiator frequently lies not in the frameworks themselves, but in the extent to which local stakeholders understand, accept, and participate in their governance.

This study situates itself within that tension between global aspirations and local realities by focusing on the Black and White Volta Basins in Ghana, which are critical to the ecological and economic sustainability of the Central Gonja District in the Savannah Region. These basins are lifelines for agriculture, drinking water, and transportation, but are increasingly under pressure from deforestation, pollution, population growth, and trans boundary dynamics. While the Volta Basin Authority (VBA) offers a regional mechanism for coordination among riparian states, the effectiveness of such top-down institutions is often contingent on the knowledge, attitudes, and participatory engagement of local stakeholders, including farmers, fishers, elders, traditional authorities, and district-level agencies.

Globally, the importance of stakeholder engagement in natural resource management is well-established. In the Mekong River Basin, for example, the success of the Mekong River Commission has been attributed to its emphasis on multi-stakeholder dialogue and negotiated decision-making.

In contrast, the Lerma-Chapala Basin in Mexico illustrates how institutional inefficiencies and limited local engagement can undermine IWRM principles. Similarly, in Africa, organizations such as the Niger Basin Authority and the Senegal River Basin Development Organization have demonstrated that stakeholder collaboration especially across political and cultural lines can enhance the resilience of water governance systems. Yet, the literature also cautions against overly optimistic assumptions: many of these arrangements remain vulnerable to elite capture, inconsistent funding, and uneven community involvement.

Within the Ghanaian context, particularly in the Volta system, stakeholder participation is both a necessity and a challenge. While policy frameworks advocate for participatory water governance, implementation often falls short, especially in rural and ecologically sensitive zones like the Savannah Region. The Black and White Volta Basins represent a microcosm of these broader tensions. Empirical evidence from the field shows that indigenous communities possess rich traditional ecological knowledge (TEK), often passed down through generations, which can offer context-specific insights into watershed protection, flood adaptation, and soil conservation. Yet, the extent to which this knowledge is recognized and integrated into formal management remains inconsistent. Findings from previous research in the region (Owusu *et al*., 2016; Manful & Opoku-Ankomah, 2021) [33, 24] highlight the disconnect between stakeholder awareness and institutional responsiveness. Communities express both awareness of the ecological changes affecting the basins and willingness to adapt, yet they often feel excluded from key decision-making processes. In part, this reflects enduring tensions between top-down policy approaches and grassroots realities, a pattern common across many Sub-Saharan African water governance systems.

Moreover, the challenges are not solely institutional. Socioeconomic factors such as education, gender roles, land tenure, and livelihood strategies deeply shape how individuals engage with water management. For instance, female farmers and fishmongers, who are critical users of water resources, often have limited access to forums where water governance decisions are made. The result is a form of "participation without influence," where stakeholder involvement may be symbolic rather than substantive. Interestingly, some initiatives such as community-led irrigation schemes and water user associations have demonstrated the potential for localized models of co-management. However, the success of these efforts is uneven and contingent on both external support and internal cohesion. This raises important questions for scholars and policymakers alike: What kinds of knowledge are considered legitimate in basin management? Whose attitudes are prioritized? And how can participatory processes move beyond rhetoric to meaningful influence?

This study seeks to critically examine these dynamics by assessing the perceived knowledge and attitudes of stakeholders toward the management of the Black and White Volta Basins. In doing so, it aims to bridge the persistent gap between policy design and on-the-ground implementation. The findings are expected to contribute not only to the local discourse on water governance but also to broader African and global debates on participatory natural resource management.

2. Theories of stakeholder theory and participation

Understanding stakeholder knowledge and attitudes toward the management of the Black and White Volta Basins requires a robust theoretical foundation that accounts for both power relations and participatory dynamics. Stakeholder Theory, as articulated by Freeman (1984) [17], asserts that for resource management to be sustainable and equitable, the interests of all relevant actors ranging from local communities and smallholder farmers to NGOs, government agencies, and private enterprises must be acknowledged and integrated into decision-making processes. The theory provides a useful analytical lens for assessing how divergent interests, influence, and relationships shape water governance outcomes, particularly in complex, multi-user systems like the Volta Basins (Parmar *et al*., 2010) [34].

In parallel, the principles of participation theory expand on this framework by emphasizing inclusive engagement, local empowerment, and shared responsibility. Participation theory posits that when communities are meaningfully involved in managing natural resources, their contextual knowledge and lived experiences enhance the legitimacy and effectiveness of governance outcomes (McCusker, 2020; Sanoff, 1999) [26, 37]. Empirical studies from other African basins such as Lake Victoria and the Zambezi have shown that participatory approaches can improve community ownership, strengthen water quality monitoring, and promote sustainable practices (Mbonimpa, 2017; Gartshore *et al*., 2019) [25, 18]. These examples highlight that genuine stakeholder engagement, especially at the grassroots level, is not merely symbolic but instrumental in achieving sustainable basin management.

In the context of the Black and White Volta Basins, these theories underscore the importance of understanding not only what stakeholders know about water management principles but also how they perceive their roles, rights, and responsibilities within the governance framework. This study, therefore, draws on Stakeholder and Participation Theories to examine the interplay between perceived knowledge, attitudes, and actual engagement. It further interrogates how institutional trust, power asymmetries, and recognition of traditional ecological knowledge shape stakeholder participation (Agarwal, 2001; Pretty, 1995) [4, 35]. By doing so, the research seeks to illuminate both the enablers and barriers to inclusive, adaptive, and resilient water governance in Northern Ghana.

3. Methodology

This study was conducted in the Black and White Volta Basins within the Central Gonja District of Ghana. The area is marked by a semi-arid climate and rich indigenous heritage, is heavily dependent on water from the Volta system for agriculture, fishing, and domestic use. However, it faces environmental challenges such as deforestation, agricultural runoff, and water use conflicts, necessitating integrative management strategies that respect both scientific and traditional knowledge. A mixed-methods design was applied, combining quantitative surveys with qualitative interviews and focus group discussions. This approach enabled triangulation to ensure a nuanced understanding of community perceptions and the value of indigenous knowledge in managing the basins. Local farmers, fishers, traditional leaders, elders, and representatives from government bodies and NGOs

involved in water resource governance were the target population. The sampling strategy combines non-probability and probability techniques.

The Central Gonja District was selected due to its hydrological relevance and agricultural dependency. These communities were chosen using multi-stage simple random sampling. These included Amedzirovi, Junto, Yapei, Kantanga, Gbansah (White Volta) and Bridge East, Bridge West, Dibriport, Peposu, Kikali No 4 (Black Volta).

A sample size of 400 households was determined using Cochran's formula, with proportional allocation across communities. The interviews were conducted in a manner that was intended to give a clear understanding of the key institutional stakeholders such as the Water Resources Commission, VRA, Forestry Commission, and NGOs. Structured questionnaires, semi-structured interview guides, and FGD protocols were used to collect data. Demographic data, knowledge levels, and perceptions of indigenous and modern management practices were collected in the questionnaire. Interviews explored historical and cultural contexts, while FGDs engaged community members in dialogue about traditional practices and collaborative possibilities. Instruments were pre-tested in a neighboring district to improve clarity and ensure reliability.

The quantitative data obtained from the questionnaires are analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics such as frequencies, percentages, means, and standard deviations are used to summarize the demographic characteristics and key responses. Additionally, analysis of perceived stakeholder's knowledge and attitudes statements regarding water resource management from literature was achieved by first identifying perceived stakeholder's knowledge and attitudes statements from literature. Where, a five point Likert scale responses (1=Strongly Agree, 2=Agree, 3=Not sure, 4=Disagree and 5=Strongly Disagree) were used to assess the respondents views on knowledge and attitudes statements. The responses were measured using means, frequency and percentages.

4. Results and Discussion

4.1 Demographics Characteristics of Respondents

Most respondents were male (72.8%), suggesting that rural and agricultural settings where men often dominate farming and water-related decision-making (Buechler *et al*., 2019; Kariuki *et al*., 2018) [12, 22]. This male dominance points to the need for inclusive governance that actively involves women in water resource management. The majority (83.5%) were married, with small percentages widowed (5.8%), divorced (4.5%), or never married (6.3%). Marital status can shape involvement in water governance, as married individuals typically manage broader household water needs (Ostrom, 1990) [32]. 62.7% had no formal education, and only 4.8% had secondary or vocational training. Such patterns are typical in rural sub-Saharan Africa (World Bank, 2020) [39] and highlight the importance of community education and capacity-building to strengthen participation in water management. 45.8% were engaged in fishing, 22.3% in farming, and others in trading or mixed livelihoods. Given their dependency on water-based livelihoods (Giri, 2021) [19], community members are likely to have vested interests in water quality and resource sustainability. The majority (82.3%) were indigenes, while migrants (8.0%) and settlers (9.8%) formed smaller groups. Indigenes often possess traditional ecological knowledge crucial for sustainable water management (Berkes *et al*., 2000) [10], whereas migrants may participate less in community-based efforts (Mulemi, 2018) [29]. The average age was 44, suggesting a mature, active workforce. This age group typically balances experience with openness to innovation (Sanginga *et al*., 2016) [36], making them key players in resource governance.

Table 1: Demographics characteristics of respondents on factors influencing stakeholder participation in the management of the black and White Volta Basins

Attributes	Frequency	Percentage
Sex of respondents		
Male	291	72.8
Female	109	27.3
Total	400	100.0
Marital status of respondents		
Married	334	83.5
Never Married	25	6.3
Divorced	18	4.5
Widowed	23	5.8
Total	400	100.0
Educational level of respondent		
No formal education	251	62.7
Primary School	94	23.5
Junior High School	36	9.0
Secondary/Vocational Institute	19	4.8
Total	400	100.0
Occupation of respondent		
Farming only	89	22.3
Trading only	65	16.3
Farming/Trading	42	10.5
Fishing	183	45.8
Other	21	5.3
Total	400	100.0
Status of respondent		
Indigene	329	82.3
Migrant	32	8.0
Settler	39	9.8
Total	400	100.0

Age of respondent: Minimum=19 year, Maximum =74 years, Mean= 44 years

Source: Field Survey Data (2024)

4.2 Perceived stakeholder's knowledge and attitudes towards management in the black and White Volta Basins

The results from Table 2 indicate a generally high level of awareness among stakeholders regarding integrated water resource management (IWRM) principles. Approximately 83% of respondents affirmed their awareness of participatory approaches in local water governance. This finding aligns with the work of Agyemang *et al*. (2020) [6] in the Pra River Basin, Ghana, which also revealed strong grassroots understanding of IWRM concepts. Similarly, Maganga *et al*. (2004) [23] in Tanzania observed that where participatory principles are promoted through capacity-building and decentralized structures, communities respond with increased awareness and enthusiasm. However, the 15.5% of respondents who were uncertain reflects a notable knowledge gap, suggesting uneven dissemination of water governance principles across localities. This echoes Acheampong and Dzidzornu's (2019) [2] caution that despite policy efforts, community-level awareness often varies due to literacy levels and weak institutional outreach.

On governmental efforts regarding climate adaptation and water resource management, the data reveal a more divided response, with around 50.3% expressing confidence and over 29% either uncertain or disagreeing. These mixed views are consistent with findings by Ainuson (2010) [7], who noted similar skepticism in Northern Ghana, where government efforts are often seen as reactive rather than proactive. Likewise, Golo and Yaro (2017) [20] observed that despite Ghana's water policies endorsing participatory approaches, top-down implementation limits community engagement and trust in state-led interventions. This divergence in perception points to a disconnect between policy intent and practical visibility or effectiveness on the ground.

In contrast, international agencies such as the United Nations received stronger endorsement, with over 82% of respondents acknowledging their support in managing water resources and climate adaptation. This mirrors the findings of Tindana *et al*. (2021) [38] in the White Volta sub-basin, where UN-backed projects were viewed as more inclusive and better resourced compared to local initiatives. Yet, this trend raises critical reflections about sustainability. Relying heavily on external actors may inadvertently marginalize domestic institutions, a concern raised by Ncube and Dube (2016) [30] in Southern Africa, where foreign-led programs often lacked long-term local ownership.

Stakeholders' self-reported awareness of climate change effects and adaptive responses was also high, with over 85% stating they had adjusted their farming or housing practices. This strong adaptation behavior is encouraging and affirms earlier studies by Codjoe *et al*. (2013) [14] and Zakaria *et al*. (2022) [40], who found that rural Ghanaian communities increasingly modify their practices in response to unpredictable rainfall and flooding. However, these positive responses are not uniform across Africa. In the Niger Delta, for example, Nwoko *et al*. (2019) [31] reported limited adaptation due to insufficient access to resources and competing survival needs. Thus, while awareness is high in the Volta Basin, the enabling environment for long-term adaptation still demands policy support.

The awareness of traditional water management practices presented a more varied picture. Although 57.7% acknowledged familiarity, a significant 35.3% were unsure, suggesting a weakening transmission of traditional ecological knowledge (TEK). This trend reflects the concerns of Owusu *et al*. (2016) [33], who reported that urbanization and generational shifts are eroding community-held knowledge systems. Similar concerns were raised by Moyo *et al*. (2018) [28] in Zimbabwe, where youth disengagement from traditional conservation knowledge compromises local resilience. These findings point to the need for deliberate intergenerational knowledge-sharing mechanisms that revitalize indigenous practices within modern governance frameworks.

Respondents showed strong recognition of ecological diversity in water management, with 76.5% affirming the value of habitat mosaics. This appreciation parallels research by Elshafei *et al*. (2014) [16], who linked ecological literacy with improved management in multifunctional landscapes in East Africa. However, translating this awareness into action requires more than understanding; it demands institutional platforms for participatory ecosystem monitoring, which are still nascent in Ghana (Mensah, 2019) [27].

In terms of attitudes, there was overwhelming agreement (96%) that lack of transparency erodes trust an outcome aligned with the findings of McCusker (2020) [26] and Asante & Agyeman (2022) [8], who both stress the importance of procedural fairness in natural resource governance. Moreover, over 90% of respondents supported community-led initiatives, reinforcing evidence from Acheampong (2020) [1] that local ownership correlates with higher project success and environmental stewardship.

Interestingly, when asked about the sustainability of traditional practices and indigenous knowledge, respondents showed high support (above 85%). These perceptions mirror the observations of Asare *et al*. (2021) [9], who found that traditional dry-season farming and sacred groves in Northern Ghana continue to play vital ecological roles. Comparably, Mbonimpa (2017) [25] in the Lake Victoria Basin found that communities viewed TEK as foundational to adaptive water governance. Still, integrating these into formal systems remains a challenge, as highlighted by Agyekum *et al*. (2020), due to bureaucratic rigidity and the undervaluing of non-scientific knowledge.

On education and awareness, around 76.8% believed these programs could drive pro-environmental behavior. This is consistent with the work of Adjei and Adomako (2016) [3], who demonstrated that awareness-raising campaigns in Ghana improved conservation practices. However, the 23% either unsure or dissenting suggests that access, content relevance, and delivery methods may still be inadequate or poorly localized. Finally, resistance to change and stakeholder conflict emerged as significant concerns. Roughly 48.3% of respondents agreed that cultural habits hinder the adoption of new practices, a finding echoed by Darko and Anokye (2022) [15], who found that deeply embedded traditional systems sometimes clash with external conservation prescriptions. Additionally, over 43% recognized that political or institutional conflicts hamper collaboration issues also observed by Boateng *et al*. (2019) [11] in Ghana's irrigation schemes and by Chikozho (2010) [13] in the Limpopo River Basin. These frictions underscore the need for culturally sensitive conflict resolution mechanisms embedded in local governance.

Table 2: Stakeholders knowledge and attitudes toward management in the Black and White Volta Basins

Perceptive Statements	Level of Agreement				
	SA	A	NS	D	SD
Knowledge					
I am aware of the integrated water resource management principles that involve participatory approaches at the local level in the Black and White Volta Basins.	142 (35.5)	189 (47.3)	62 (15.5)	7 (1.8)	0 (0.0)
I know that the government is taking actions to help my community adapt to climate change and manage water resources in the Black and White Volta Basins.	121 (30.3)	80 (20.0)	98 (24.5)	83 (20.8)	18 (4.5)
I am aware that international agencies like the United Nations are taking actions to help my community adapt to climate change and manage water resources in the Black and White Volta Basins.	124 (31.0)	206 (51.5)	64 (16.0)	6 (1.5)	0 (0.0)
I understand how droughts, flooding, and other climate change effects have impacted water resources in the Black and White Volta Basins, and I have made adaptations to my farming and housing practices.	178 (44.5)	165 (41.3)	33 (8.3)	0 (0.0)	24 (6.0)
I am familiar with traditional water management practices that my community in the Black and White Volta Basins employed.	116 (29.0)	115 (28.7)	141 (35.3)	27 (6.8)	1 (0.3)
Familiar with the mosaic of different habitat types in watershed management for efficient use of water resources in both the Black and White Volta Basins.	94 (23.5)	212 (53.0)	89 (22.3)	5 (1.3)	0 (0.0)
I realize the importance of traditional ecological knowledge in sustainable water resource management within the Black and White Volta Basins	116 (29.0)	214 (53.5)	69 (17.3)	1 (0.3)	0 (0.0)
Attitudes					
Lack of transparency or community involvement in decision-making processes could lead to mistrust or dissatisfaction	164 (41.0)	220 (55.0)	14 (3.5)	2 (0.5)	0 (0.0)
Community-led initiatives can harness local knowledge and resources to implement sustainable practices	212 (53.0)	147 (36.8)	40 (10.0)	1 (0.3)	0 (0.0)
Traditional practices can be sustainable and adapted to local environmental conditions.	199 (49.8)	161 (40.3)	39 (9.8)	1 (0.3)	0 (0.0)
Indigenous communities often have deep-rooted knowledge of local ecosystems and traditional water management practices.	186 (46.5)	183 (45.8)	31 (7.8)	0 (0.0)	0 (0.0)
Education and awareness programmes can lead to behaviour changes that benefit the environment.	144 (36.0)	163 (40.8)	64 (16.0)	28 (7.0)	1 (0.3)
They may involve community-driven initiatives that enhance local ownership and stewardship of natural resources	94 (23.5)	54 (13.5)	234 (58.5)	18 (4.5)	0 (0.0)
Practices					
Some community members might resist adopting new water conservation practices due to traditional habits or skepticism about their effectiveness.	101 (25.3)	92 (23.0)	137 (34.3)	68 (17.0)	2 (0.5)
Conflicting priorities and the political agenda of the local authorities or various stakeholders may completely dampen efforts for good collaborative water resource management.	83 (20.8)	73 (18.3)	103 (25.8)	139 (34.8)	2 (0.5)
Many in the community might appreciate and even actively take part in such initiatives as cleaning public drainage systems or building green spaces, knowing the health and aesthetic benefits to the local populace.	94 (23.5)	110 (27.5)	131 (32.8)	63 (15.8)	2 (0.5)
Strong collaboration among local authorities, community members, and stakeholders in the design could lead to more resilient and adaptive water management strategies under changing conditions.	172 (43.0)	159 (39.8)	52 (13.0)	16 (4.0)	1 (0.3)
Sharing traditional ecological knowledge on water management might empower younger generations to become stewards of their environment and ensure that their practices remain sustainable	107 (26.8)	114 (28.5)	88 (22.0)	90 (22.5)	1 (0.3)

SA=Strongly, Agreed, A=Agreed, NS=Not Sure, D=Disagreed and SD=Strongly Disagreed

Source: Field Survey Data (2024)

5. Conclusion and Recommendation

In conclusion, the study reveals that stakeholders within the Black and White Volta Basins generally possess a strong understanding of integrated water resource management principles and exhibit positive attitudes toward sustainable water governance. There is clear recognition of both governmental and international efforts in climate change adaptation and water resource management. Community members demonstrate awareness of the impact of climate change on their livelihoods and are adapting traditional practices accordingly. Given the strong community awareness and positive attitudes toward sustainable water governance, it is recommended that the Water Resources Commission (WRC), in collaboration with local government authorities and traditional councils, formally institutionalize community-based water management committees. These committees should be empowered to integrate traditional ecological knowledge with scientific approaches in planning and implementing localized water conservation and climate adaptation strategies. Providing technical support and capacity-building for these committees will strengthen grassroots participation and enhance the effectiveness of water governance in the Black and White Volta Basins.

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