# An Analysis of Transboundary Water Resource Governance between Burkina Faso and Ghana in the Volta Basin

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## Abstract

As transboundary river basins are important water resources, riparian states have experienced different degrees of disagreements and disputes. To prevent or solve these problems river basin organizations have taken shape. This thesis focuses on one of these transboundary water governance experiences. It examines the roles the Volta Basin Authority (VBA) has played in the Volta River Basin in western Africa. It argues that the VBA exemplifies one of the most recent efforts of collaboratively governing a major transboundary basin.

One of the fundamental questions the VBA has faced was the extent to which local communities can be mobilized and integrated in water governance. No study so far has clarified this point. Riparian communities in this Basin experienced irregular flood-drought cycles that devastated local livelihoods. Past studies have illustrated a general view that water governance inefficiencies exacerbate flood events, but local people and authorities need to know how efficient water governance can better respond to floods in this area. This question is critical as floods affect more than 24 million poor, rural, smallholder farmers and biodiversity conservation in the Volta River Basin, the 9$^{th}$ largest River Basin in the world.

More specifically this thesis examines the extent to which transboundary water governance policies in the Basin addressed recurrent flood challenges. I found that the Buffer zone byelaw policy were enacted by most riparian states, the Volta River Basin lacks a basin-wide flood management strategy while a needs assessment for flood management was conducted. The Water Charter was established to lay the legal foundation for establishing roles and responsibilities among riparian countries, but it has not been ratified.

The thesis then attempts to better understand local stakeholders' perceptions and needs regarding collaborative transboundary water governance between Burkina Faso and Ghana. For this purpose, I conducted a questionnaire survey among riparian community members in these study areas to understand their awareness about the code of conduct, the VBA, and water governance challenges they face in the Basin. I found that 84% of the respondents in Burkina Faso and 91% in Ghana did not know about the VBA. Some respondents, especially educated ones in both countries, did hear about the code of conduct for water governance there. Regarding local needs for water governance, most respondents (97%) in Ghana expressed concerns about frequent flooding due to Bagre dam spillage in upstream Burkina Faso.

The questionnaire survey also aims to assess water governance performance from the perspective of riparian communities in Burkina Faso-Ghana border areas with particular focus

on public participation, gender equity, transparency, and regulatory quality. Regarding public participation, I found that 49% of the respondents in Ghana and 42% of those in Burkina Faso thought that their communities were not sufficiently engaged. In Burkina Faso, 59% felt it difficult to access information, and 63% was not sure whether decision making processes were easily understood. With regards to regulatory quality, 58% of the respondents in Ghana were satisfied with regulatory quality whilst 54% of those in Burkina Faso were dissatisfied. On gender equity, 72% in Ghana and 78% in Burkina Faso found it challenging.

The thesis also quantifies the damage caused by the 2018 Volta River flood to the agriculture sector. I applied FAO's guideline on post-disaster agricultural damage, loss and needs assessments to determine damage to agriculture in the Basin by estimating the difference between pre-disaster and post-disaster production in the selected riparian communities. I found that more respondents in Ghana (91%) than those in Burkina Faso (69%) suffered from regular floods. The respondents attributed these to excess rainfall (30%) and lack of flood control structures (24%). Regarding damage to agriculture, 51% of the respondents in Burkina Faso and 49% in Ghana could not replant in the same cropping season. My statistical analysis shows that damage to crops, livestock and farm assets were statistically significant at 5%. In Ghana, maize was the most affected crop with 127.3 MT of maize damaged whereas in Burkina Faso, rice was the most affected crop with 126.2 MT of rice damaged. Ghana also suffered severe damage in livestock production, including 532 chicken, 516 guinea fowls, 185 goats and 168 sheep drowned in flood waters.

Overall, I found riparian communities had limited and varying knowledge and understanding about transboundary water governance policies. They were largely not engaged as water governance stakeholders. This lack of participation worsened food insecurity and poverty levels in the study areas. In the last chapter of this thesis, I propose policymakers to ratify and implement the Volta Basin Water Charter under a flood management plan for the Volta River Basin. To mitigate the effects of recurrent floods, I recommend the demarcation and enforcement of the riparian buffer zone as well as seed aid to flood victims.

Keywords: Transboundary water policy; flood management; riparian awareness; water governance performance; loss and damage; Volta River Basin.

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## List of abbreviations

| | |
|---|---|
| **CSIR** | **Council for Scientific and Industrial Research** |
| **FAO** | **Food and Agriculture Organization** |
| **GWP** | **Global Water Partnership** |
| **GWSC** | **Ghana Water and Sewage Corporation** |
| **IWRM** | **Integrated Water Resource Management** |
| **IUCN** | **International Union for Conservation of Nature** |
| **IWTs** | **International Water Treaties** |
| **MOFA** | **Ministry of Food and Agriculture** |
| **NADMO** | **National Disaster Management Organization** |
| **NGOs** | **Non-governmental Organizations** |
| **RBOs** | **River Basin Organizations** |
| **SDGs** | **Sustainable Development Goals** |
| **UNDP** | **United Nations Development Program** |
| **UNEP** | **United Nations Environment Program** |
| **UNESCO** | **United Nation Educational, Scientific and Cultural Organization** |
| **VBA** | **Volta Basin Authority** |
| **VBTC** | **Volta Basin Technical Committee** |
| **WMO** | **World Meteorological Organization** |

# Chapter 1 Introduction

## 1.1 Background

Amid a global trend of increasing water demand (FAO, 2018) and water related disasters, governance solution has gained much attention (Judeh et al., 2017; UNDP, 2013; Woodhouse and Muller, 2017). The United Nations World Water Development Report stated that "water crisis is essentially a crisis of governance" (UNESCO, 2003). Ensuring effective water governance must therefore be prioritized to achieve water security (Global Water Partnership, 2003). The FAO also included water governance as one of four components of food security (FAO, 2014).

The concept of water governance emerged at the World Water Forum in the Hague in 2000 where a ministerial declaration called for the wiser governance of scarce water resources. This call received a further boost at the 2001 Freshwater Conference at Bonn where representative ministers regarded water governance as the top priority (Global Water Partnership, 2003). Good water governance must be accountable and encourage stakeholder participation in decision-making (Hanasz, 2017; Rogers and Hall, 2003). However, international organizations and governments have been criticized for their predominant focus on technical aspects of management efficiency (e.g., socio-economic, and environmental efficiency) rather than stakeholder participation (Global Water Partnership, 2003). Therefore, transboundary water governance performance needs more in-depth examinations about community participation.

In West Africa, efforts for creating transboundary water governance mechanism took shape only in the last ten years or so. The establishment of the code of conduct (Welling et al., 2014) and the Volta Basin Authority (VBA) (Global Water Partnership, 2014; Amuquandoh, 2016) in the Volta River Basin signalled a major step toward this goal. The Basin provided water for about 24 million people in 2010 and this number is expected to reach about 34 million people by 2025. These people largely live in low-income rural farm households (UNEP/GEF-Volta project, 2013; Global Water Partnership, 2014).

Considering this economic situation along with cultural diversity, the fundamental question is how the VBA can implement its policies effectively among its members, and to what extent local participation can be achieved. The vulnerability and susceptibility of the Volta River Basin to river flooding has posed particular threat to these rural livelihoods. Floods devastate their farms on a yearly basis (Almoradie et al., 2020; World Meteorological

Organization, 2019; Yiran et al., 2017). Although the assessment of loss and damage to agriculture is critical in developing flood risk management policies, it is often overlooked in studies on disasters (Jega et al., 2018). Conducting a loss and damage assessment in the agriculture sector help formulate appropriate flood management strategies and interventions to safeguard cropped farms, farmers' livelihoods, and food security. It also helps these farmers to prepare for future climate related disaster events. Preparedness further ensures socio-economic and environmental stability. In the long-term, it helps nations achieve SDGs (Kansal et al., 2017; Rawat, 2015; Wu et al., 2015).

### 1.2 Research objectives

Considering these crucial issues, this thesis examines water resource governance policies with the focus on riparian community participation. Specifically, it examines the extent to which current transboundary water governance policies and practices in the Volta River Basin address flooding challenges in riparian communities. It also assesses the level of awareness among community members about current water governance policies, practices, and water governance challenges. Additionally, it assesses water governance performance (e.g., participation, transparency, gender equity, and regulatory quality) and community needs for better water governance. Finally, it assesses the damage caused by the 2018 floods to agriculture in the Volta River Basin.

### 1.3 Literature review

Past studies are generally agreeable that good governance is important for promoting effective development (Kaufmann et al., 1999), higher stakeholder accountability (Hanasz, 2017; Adhikari and Tarkowski, 2013), and transparent community participation (Rogers and Hall, 2003). International water organizations have similarly emphasized this point. The International Commission for the Protection of the Rhine (ICPR), for instance, noted that acclaimed transboundary governance practices in the Rhine was due partly to the long tradition of cooperation among stakeholders (Schulte-Wülwer-Leidig et al., 2018). Good water governance further ensures equity in representation and benefit-sharing among stakeholders (Rogers and Hall, 2003). Good accountability requires a regulatory mechanism that reassures the public about institutional and administrative processes to address fair, equitable, and transparent processes. Under effective regulations, water administrations can address complaints and requests from stakeholders (Adhikari and Tarkowski, 2013; Paul et al., 2013).

Some scholars identified pre-requisite conditions of good governance, including consensus-making, accountability, participation, transparency, responsiveness, equity, effectiveness, efficiency, and compliance (Hanasz, 2017; Rogers and Hall, 2003). The UNDP (1997) similarly proposed 10 criteria: public participation, consensus orientation, strategic vision, responsiveness, effectiveness, efficiency, accountability, transparency, equity, and rule of law (Paul et al., 2013). The Global Water Partnership emphasized openness, transparency, participation, accountability, effectiveness, coherence, efficiency, communication, equity, integration, sustainability, and ethics (Lautze et al., 2011). Mahon et al. (2017) assessed transboundary water governance by examining governance architecture, governance processes, social justice, ecosystem pressure, stakeholder engagement, ecosystems state, and human well-being.

Past studies on transboundary water governance in the Volta River Basin focused on coordination among riparian countries for flood risk assessment and planning (Gao and Margolies, 2009; Obrecht and Mead, 2014; World Bank, 2015; Yankey, 2019). Others studied the effect of Bagre Dam spillage on downstream watershed areas in Ghana (Amuquandoh, 2016; Yankey, 2019; Matthews, 2012; Mul et al., 2015; Ampomah, 2017). Another group of researchers focused on water allocation and institutional arrangement for undertaking integrated water resource management in this border area (Andreini, 2002; Leemhuis et al., 2009; Baah-kumi and Ward, 2020; Opoku-Ankomah et al., 2006; Agyenim, 2011). As far as I know, there is no study on stakeholder participation in water governance in this transboundary region.

Case studies on riparian farming communities in the Volta River Basin discussed irregular flood hazards on a yearly basis (Almoradie et al., 2020; Alhassan, 2020; Dos et al., 2019; Tazen et al., 2018; Yiran et al., 2017). For instance, Alhassan (2020) studied the effects of flood adaptation strategies on farm household food security and the determinants of household recovery from flood shock in Ghana. Almoradie et al. (2020) described gaps and opportunities for flood risk management and found that stakeholders had different perception about the effectiveness of flood management policy in Ghana. Yiran et al. (2017) analyzed the multi-dimensional nature of natural hazards by mapping vulnerabilities of sectors that affected livelihood activities in Ghana. In Burkina Faso, studies are rather centered on urban floods. Dos Santos et al. (2019) for instance examined risk factors to flood disasters in the capital city of Burkina Faso, Ouagadougou. Tazen et al. (2018) also examined trends of flood events and its relations with extreme rainfall in Ouagadougou. This dissertation examines the transboundary

nature of the recurrent flood experienced in the Volta River Basin by riparian communities in Burkina Faso and Ghana to understand the perceptions of upstream and downstream riparian regarding water governance with particular focus on flood risk management.

The Volta River Basin remains bedeviled with a myriad of challenges. Kansuk and Chimbar (2019) for instance pointed out the weakness of disaster preparedness and emergency response in the Volta Basin and stressed the need for the effective utilization of information and data in building resilience. Apanga et al. (2017) similarly found that the Ghana National Disaster Management Organization (NADMO) did not provide timely and adequate relief to flood victims. Gyireh and Nunbogu (2015) added that poor institutional collaboration and weak stakeholder participation was partly the cause of a gap between flood victims' needs and actual relief items. Almoradie et al. (2020) further noted that flood hazard management largely relied on international support.

Brémond et al. (2015) and Mao et al. (2016) distinguished flood damage to agriculture as direct and indirect damage. Direct damage refers to agriculture commodity that was affected by flood water. This type of damage includes crop loss, land destruction/contamination, fatalities, injuries and livestock loss, soil erosion, and property loss. Indirect damage refers to agricultural activities that were affected by flood incidents outside the hazard area. It includes agriculture related economic activities (e.g., disrupted input supply, retail services). Wijayanti et al. (2017) distinguished disaster damage as tangible from intangible based on monetary terms. In this dissertation, I focused on examining the direct and tangible impact of flood on the agriculture sector.

### 1.4 Study area

This research was conducted in the Volta River Basin. The basin is an important source of water in much of West Africa sub-region for hydroelectric power generation, irrigation, and domestic purposes. According to the past studies discussed above, one of the most critical issues the Volta River Basin people face has been related to Bagre Dam spillage. Therefore, I selected two main areas that have been reported to be most affected by the spillage. These areas are Bagre District of the Eastern Central Region in Burkina Faso and the so-called Bawku zone of the Upper East Region in Ghana. In March 2019, I conducted a preliminary field visit to these areas and interacted with some community members to understand about Bagre Dam spillage and flood impact issues. I found out that downstream communities in Burkina Faso and Ghana had frequently suffered from flooding (Gao and Margolies, 2009; IIED, 2020; WMO, 2019).

Given that there are six riparian states engaged in its management, it provides a good case study to critically examine transboundary water governance.

Bagre District is located below Bagre Dam (WikiZER, 2020). The climate is characterized by dry (harmattan) and wet (rainy) seasons. Its vegetation predominantly consists of scattered shrubs, short grasses, and acacia trees. Annual rainfall ranges from 850 to 1,100 mm (Global Water Partnership, 2009). People from various parts of the country have settled here. Agriculture employs about 80% of the population. Crop farming, livestock breeding, and fish culture mainly constitute their livelihood. Rice, maize, vegetable farming and fruits (e.g., mangoes, oranges) are produced all year round by irrigation from Bagre dam reservoir. Crop production system here is mixed cropping with both upland crops like maize, sorghum, and millet cropped together with rice on the same plain (Barry et al., 2005). This phenomenon increases the vulnerability of cropped farmland to flooding. Livestock production features the extensive system of production where herdsmen lead livestock from and to the kraals for grazing (FAO, 2018). Bagre District is known for its agribusiness projects in connection to the dam. Its total population was 19,164 in 2020 consisting of people from various ethnic groups (City Population, 2020).

The Bawku zone consists of six administrative districts, of which four districts are directly affected by Volta River flows. According to the 2010 population and housing census of Ghana, the population in this area was 290,117 (Ghana Statistical Service-Bawku Municipality, 2014). These districts are Binduri District, Garu District, Bawku Municipality and Bawku West District. These have similar climate, soil type, farming system, culture, language, and cropping pattern. About 80% of people here depend on agriculture (Ghana Statistical Service, 2014). The climate here is characterized by the wet season from May to October and the dry season from November to April. An average annual rainfall ranges from 950 mm to 1,100 mm. The vegetation here is like the study area in Burkina Faso. Major food crops grown here include maize, rice, sorghum, pepper, watermelon, and onion (Ghana Statistical Service, 2014; MOFA, 2015). There is no irrigation dam in this area. Farmers draw water from the Volta River to irrigate their farms by using motorized water pumps and water hose. Crop production systems in this area are the compound and mixed farming system. Mixed cropping is practiced with upland crops like maize, sorghum, millet, soybean and groundnuts. Rice is cultivated mainly in poorly drained soil usually in valleys (Barry et al., 2005). To adapt to drought, farmers in this area cultivate maize, sorghum, rice, and vegetables along the Volta basin to take advantage of soil moisture and high soil nutrient content (Zakaria and Matsui,

2020). Livestock production here features the free range system of production where livestock are not led for grazing but allowed to roam freely in search of feed (Adams and Ohene-Yankyera, 2014). The construction of Kpalugu multipurpose dam in downstream commenced in April 2020. Once completed, it will be the first storage dam in this part of the Basin to provide irrigation water to farmers (Construction Review Online, 2020; MOFA, 2015).

### 1.5 Methodology

This study adopted a mixed research approach which consist of both qualitative and quantitative methods. The qualitative method covers the questionnaire survey and literature review, while the quantitative method involves estimates of damaged crop, livestock and farm asset, and secondary data analysis. To better understand the historical and current transboundary water resource policy and water governance challenges for collective basin management in the Volta River Basin, I conducted an extensive literature review of journal articles, book, project documents from international donor agencies, and project reports. All policies, laws, and regulations that pertain to the Volta River Basin were collected and reviewed.

I also used a questionnaire survey among community members to understand their awareness and perceptions about water governance, water governance challenges, the nature of the floods, and the damage. FAO's post-disaster agricultural damage, loss and needs assessment guideline provides a methodology for assessing damage caused by flood disaster by looking at the difference between pre-disaster and post-disaster agricultural production (Jega et al., 2018). Other scholars estimated flood damage using the damage functions and other models. The damage function links damages to elements at risk with the characteristics of the flood event. Elements at risk refers to those social, economic, or ecological units including people, households, companies, and infrastructures affected by flood hazard in a particular area while the flood characteristics include the depth, duration, velocity, and contamination caused by the flood event. The Hazards U.S Multi-Hazard (HAZUS-MH) model, Flood Loss Estimation Model for the private sector (FLEMOps), and the Flemish model are examples of other models used in estimating flood damage (Kefi et al., 2018; Wijayanti et al., 2017; Merz et al., 2010).

Additionally, I used my ten-year work experience as an Agricultural Extension Officer in the Bawku zone. This experience allowed me to ask my contact persons in both Burkina Faso and Ghana to help me better understand the survey areas. I used my ability to speak local languages of both countries, Mossi and Kusaal, for data collection and interpretation of the results. The statistical package for social sciences (SPSS), ExcelSTAT, and Microsoft Excel aided data analysis.

In assessing flood impacts on livelihood assets, I adapted a sustainable livelihood framework (SLF). The SLF shows linkages and relationships between factors that affect people's livelihoods and how interventions contribute favorable outcomes to improve human wellbeing and ensure sustainable natural resource use (DFID, 1999). It also shows how governance structures and processes results in livelihood strategies (Figure 1.1). Through SLF, my dissertation adopts a community centered approach where public participation, transparency, equity, and regulatory quality are essential to achieve sustainable water resource management.

### 1.6 Thesis structure

This dissertation is structured under six chapters. Chapter 1 has clarified the focus, objectives, significance, and conceptual framework of this thesis. It also has placed this thesis within a larger scholarly trend in better understanding transboundary water governance. Chapter 2 provides an overview of the transboundary water resource policies in the Volta River Basin. It also reviews how flood risk management has so far been integrated into transboundary water resource policy. In chapter 3, I discuss about the awareness of riparian communities about transboundary governance frameworks. Chapter 4 examines water governance performance from the perspective of riparian community members. Chapter 5 assesses the effects of the 2018 floods on the agriculture (Figure 1.2). Chapter 6 highlights my research findings in the previous chapters. I also make some recommendations for improving transboundary water governance in the Volta River Basin.

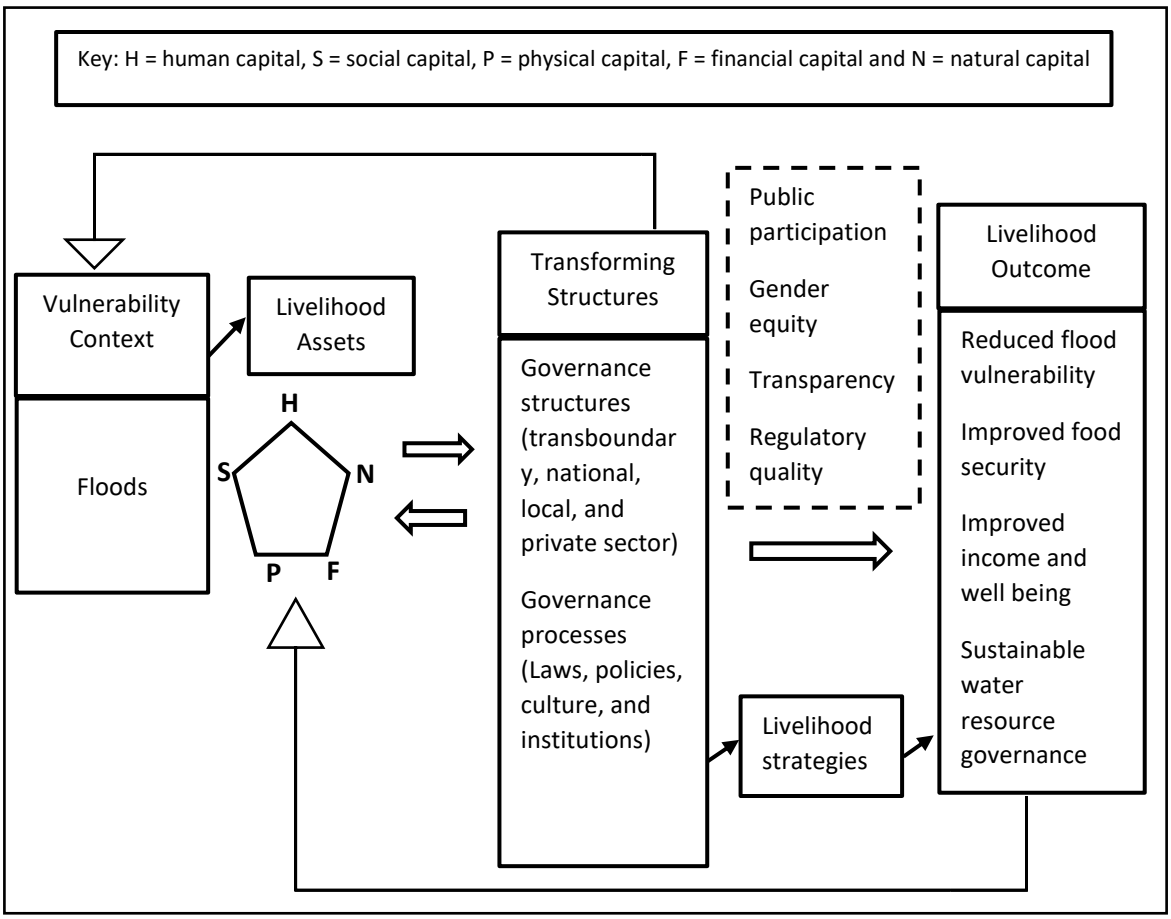


Figure 1.1 Conceptual framework (adapted from DFID, 1999).

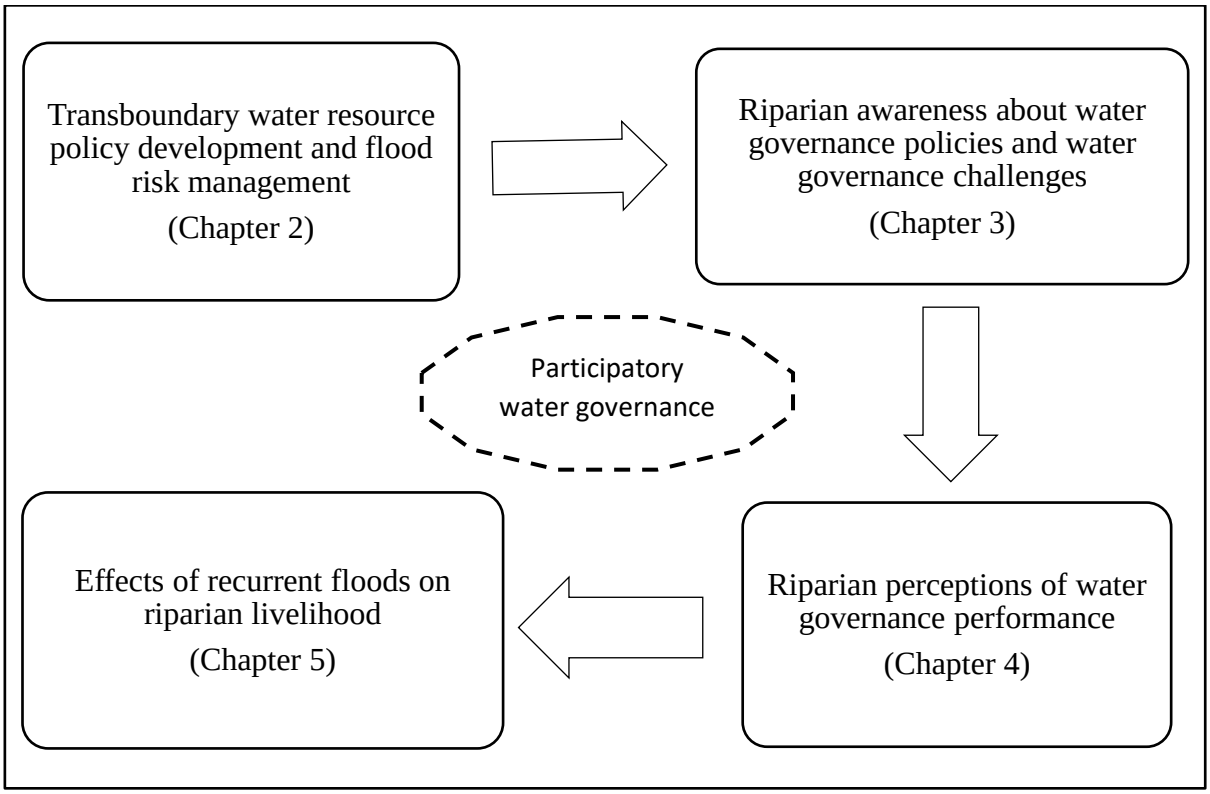


Figure 1.2 Thesis structure.

# Chapter 2 Transboundary water governance and flood management in the Volta River Basin

## 2.1 Introduction

Globally, flood risk management in transboundary river basins have evolved largely in response to flood disaster incidences. In the Rhine River Basin, for instance, the International Commission for the Protection of the Rhine River Basin (ICPR), which was established in 1950, prepared and implemented a flood risk management plan for the Rhine Basin after severe flood events in the 1990s (Schulte-Wülwer-Leidig et al., 2018).

Floods have negatively impacted riparian livelihood in the Volta River Basin and have raised tension and suspicion among riparian communities and water managers. The World Meteorological Organization (2019) observed that about two million smallholders were affected by floods in the Volta River Basin.

Transboundary water governance is guided by the do-no-harm principle (e.g., the Stockholm Declaration of 1973 and Rio Declaration of 1992) and principles on shared water resources. These principles recommend that riparian states engage in prior consultations, cooperation, and negotiation in water management practices without causing damage to other states (Ampomah et al., 2008).

This chapter examines the extent to which transboundary water governance policies in the Volta River Basin address flood issues. Much of the discussion below is based on my review of academic journal articles, books, and theses. I attempt to clarify how transboundary water governance policies have addressed flood risk reduction in the Basin.

## 2.2 Overview of the Volta River Basin

With a surface area of about 400,000 $km^2$, the Volta River Basin is shared by Burkina Faso, Ghana, Benin, Côte d'Ivoire, Mali, and Togo. It is the $9^{th}$ largest river basin in the world and extends from latitude $50^o$ 30' N in Ghana to $140^o$ 30' N in Mali, with the widest part stretching from longitude $50^o$ 30' W to $20^o$ 00' E (Figure 2.1). It is drained by four major sub-basins namely the Black Volta, White Volta, Lower Volta and the Oti rivers. Burkina Faso (43%) and Ghana (40%) share the largest portion of the basin with Togo (6%), Benin (4%), Mali (4%) and Cote d'Ivoire (3%) occupying remaining 17% (Mul et al., 2015).

The White Volta watershed, where my sampled communities are located, originates from the Nakanbé River in northern Burkina Faso and flows south-eastward into Ghana. About

53% of its total area (106,742 km²) lies in Burkina Faso. In total, the river is 1,136.7 km long. Its tributaries are the Red Volta and Sissili rivers. Yankey (2019) showed that the basin countries experience massive floods usually once in every 10 years, including 1989, 1999 and 2007 in Ghana, and 1988, 1992, 1994 and 1999 in Burkina Faso.

Akosombo Dam is the only hydrological infrastructural development on the White Volta in Ghana. Burkina Faso constructed Bagre (officially called Barrage de Bagre) and Kompienga dams on the White Volta River (Global Water Partnership, 2014; Fiasorgbor et al., 2018; Kansuk and Chimbar, 2019). Ghana has proposed to build Pwalugu, Daboya, and Kulpawn dams on the White Volta River. Burkina Faso plans two hydroelectric schemes: Bagre Aval and Bandongo dams (McCartney et al., 2012).

The climate of this basin consists of the tropical transition zone, humid southern zone, and tropical northern zone. Annual mean temperature ranges from 27°C to 30°C. A maximum daily temperature of about 45°C can be observed in March and April while minimum daily temperature is 12.8°C, usually in August. Average annual rainfall ranges from 400 mm to 1400 mm. A unimodal rainfall season in the north starts in May to June and ends in September to October. A bimodal rainfall in the south starts in April to May and ends in June to July in the major season, and September to October and ends in November in the minor season. The maximum monthly rainfall in this area occurs in September. River flow is highly sensitive to rainfall with small annual rainfall variations causing huge runoff discharge volume (Barry et al., 2005; Mul et al., 2017).

The economy of this basin mainly depends on agriculture. Water usage in Ghana and Burkina Faso are mainly for cereal cultivation. In Ghana, 62.3% of the population depends on the Volta River whereas in Burkina Faso 92.4% does (Yankey, 2019). Animal husbandry provides another important source of livelihoods in this basin. Farmers typically keep cattle, goats, chicken, sheep, guinea fowls and pigs. The rich savannah grassland here provides good fodder for grazing. In Burkina Faso, smallholders are largely nomadic livestock herders who move around the basin in search of feed and water (Matthews, 2012; Global Water Partnership, 2014; Yankey, 2019). Conflicts over water consumption and crop damage occur between herders and crop farmers (Matthews, 2012; Global Water Partnership, 2014).

Fishing is yet another critical socio-economic activity in the Basin. Fisheries in Burkina Faso are estimated to catch about 3,750 tons of fish per year. In Ghana the number ranges from 40,000 to 271,000 tons. About 90% of freshwater fish produced in Ghana comes from lakes and tributaries of the Volta River. Yearly fish catch in Bagre District was about 975 tons

between 1994 and 2004. In Ghana, fish catch from Volta Lake was 87500 tons in 2000. The Volta River also serves navigation for trading farm and other products (Matthews, 2012).

More than fifty ethnic groups share the Volta Basin. The Akan, Dagomba, Mossi, and Boba are some of the most visible groups. They have different traditional land tenure systems, but the communal ownership to land largely persists. Land acquisition evolved on the basis of the "first-in-time-first-in-right" principle where land ownership right accrues by virtue of a person being the first occupant. These first occupants thereafter lease or give outright land ownership titles to others (Matthews, 2012).

### 2.3 Transboundary water governance before and during the colonial era

Before the colonial era, water usage and management in the Volta River Basin were directed by religious leaders, such as local chiefs and priests. Rivers, lakes, streams, water, and land were all seen as sacred (Opoku-Ankomah et al., 2006; Matthews, 2012; Yankey, 2019). Water was collectively owned by families and individuals. Traditional communities demarcated areas for non-human activity (sacred wetland and orchard) although some water courses were set aside for human activity (Buffer zone). Certain activities were prohibited on designated days with strict compliance. Communal labor was mobilized to clear weeds, desilt river and drains. Access to water was free of charge and the collective good was preserved by the community (Opoku-Ankomah et al., 2006). These traditional water management practices can be said to have contributed to less flood events experienced in the past. Sacred orchards, marshland and buffer zone particularly served as flood protection since they helped absorb river overflow.

Britain, France, and Germany split the Volta River Basin during the colonial period. The British colonial government introduced the 1903 Rivers Ordinance in its Gold Coast colony (present-day Ghana) that partly functioned to dissolve the traditional water governance system. In Burkina Faso, however, traditional institutions and customary by-laws dominated water usage and management even under the French regime (Opoku-Ankomah et al., 2006; Matthews, 2012; Yankey, 2019).

### 2.4 Transboundary water governance after independence

After gaining independence from colonial rules, most countries in the Volta River Basin formulated water policies largely drawing on colonial practices. Ghana enacted several legislation and established institutions to manage its water resources. The Volta River Authority (VRA) was the first institution to be created for electricity transmission and Volta Reservoir

maintenance. It was established in 1961 under Volta River Development Act 46. In 1965 the Ghana Water and Sewerage Corporation (GWSC) was established to supply, distribute, and maintain water for domestic and commercial purposes. Ghana Environmental Protection Agency (EPA) Act 490 in 1994 focused more on water quality partly in response to the International Decade for Drinking Water Supply and Sanitation (IWSSD).

Burkina Faso, after independence in 1960, created the Centre for Hydraulic and Rural Supply (DHER) and the National Office of Dams and Irrigation (ONBI) in 1965 and 1976 respectively, to provide water for domestic consumption and livestock industry. In the 1970s the Rural Development Fund (FDR) and the Water Point Committees (CPE) were formulated to deal with drought conditions (Matthews, 2012; Yankey, 2019). Some critics argued that these policies and institutions did not solve water-related challenges in the basin partly due to their inefficient management (Opoku-Ankomah et al., 2006; Yankey, 2019).

At the transboundary level, in the period between the 1950s and the 1990s, Togo and Benin signed a treaty to purchase electricity from Ghana in 1962. Another international treaty was signed by all co-riparian states to control Onchocerciasis, then a prevalent parasitic disease, in 1973. The first post-colonial transboundary water agreement for effective coordination in the Volta River Basin was the Permanent Joint Commission for Co-operation in 1971. It facilitated the establishment of a permanent technical committee in 1998 to conduct research on hydropower generation, irrigation, water transport and the control of water-borne diseases in the Basin.

The 1990s ushered the Integrated Water Resource Management (IWRM) era. In this period most riparian states in the Volta River Basin went through an IWRM-oriented restructuring. This policy was to deal with the fragmented nature of water policies and institutions. The Water Resources Commission (WRC) of Ghana, the National Disaster Management Organisation (NADMO), the Ghana Hydrological Services, the Ministry of Environment and Water, and the Directorate-General for Hydraulics (DGH) in Burkina Faso took shape for this purpose. In 2001, Burkina Faso enacted yet another new Water System Law and the Water Resources Directorate (DGRE) to coordinate water resources management within the country (Yankey, 2019). The Economic Community of West Africa States (ECOWAS) initiated the formation of a regional body for governing West African's Regional IWRM Initiatives. In addition, the West African Regional Action Plan for Integrated Water Resources Management (WARAP-IWRM) was created with the support of the Danish

International Development Agency (DANIDA) in 1997 (Opoku-Ankomah et al., 2006; Yankey, 2019).

Burkina Faso and Ghana worked together on water use of the Volta when Burkina Faso initiated plans to build Ziga Dam in 2000. The World Bank funded the construction of Ziga Dam. It required any states seeking funding for transboundary waters development to notify co-riparian states in advance. Co-riparian states on the other hand needed to respond in writing. Ghana did not object to the construction of Ziga Dam. However, when Burkina Faso constructed Bagre Dam earlier in 1992, it failed to pre-inform Ghana (Gao and Margolies, 2009).

Burkina Faso and Ghana acquired knowledge about the importance of transboundary water management from EU's Water Initiative and the Johannesburg World Summit on Sustainable Development in 2002. With further technical support from the World Bank, DANIDA and the Economic Community of West African States (ECOWAS), Burkina Faso and Ghana signed a Joint Declaration in April 2004 to collaborate on water governance. In July 2004 all riparian states agreed to establish the Volta Basin Technical Committee (VBTC) in November the same year.

In December 2005, a Memorandum of Understanding to establish the Volta Basin Authority (VBA) was signed by all riparian states (Opoku-Ankomah et al., 2006; World Bank, 2015; Yankey, 2019). In 2006, Burkina Faso and Ghana established the code of conduct for sustainable and equitable water management with support from the Project for Improvement of Water Governance in the Volta Basin (PAGEV) program. In 2007, the Volta Basin Authority (VBA) was founded, and it came into effect in 2009 (Global Water Partnership, 2014; Amuquandoh, 2016; Lautze et al., 2006; Matthews, 2013). It provides a more permanent transboundary water cooperation mechanism in the Basin. The Volta River Basin Strategic Action Programme Implementation Project (VSIP) is currently being implemented (2015-2024) to enhance VBA's management capacity. It aims to formulate the Volta Basin Water Charter through dialogue (Sadieau, 2019).

International organizations have also contributed to cooperative water governance in the Basin. The GLOWA Volta project, for instance, provided a Decision Support System (DSS). The Global Environmental Facility (GEF) funded water allocation projects in the Volta River Basin in 2001 and 2002. The UNESCO, UNEP, IUCN, Green Cross International promoted cooperation, sustainability, and equitable governance (IUCN, 2003; Opoku-Ankomah et al., 2006; GEF-UNEP, 2002; Yankey, 2019).

## 2.5 Transboundary flood management policies

Although concerns about flood risks from hydroelectric dam projects existed as early as the 1970s, flood risk management was not considered during the initial stages of transboundary water policy formulation (Opoku-Ankomah et al., 2006). For instance, the National Disaster Management Organization (NADMO) of Ghana (Act 517) which is mandated to provide disaster preparedness, response and relief information including flood risk management information was only established in 1996 (Government of Ghana, 2010). Global Water Partnership (2017) noted that flood risk management was recognized in the Strategic Action Program (SAP) for the VBA. Its aim was to set up a basin-wide early flood warning system while conserving ecosystem functions, strengthening water governance, and disseminating information among watershed residents.

The VBA, however, could not effectively coordinate cooperation among several national institutions with fragmented mandates. It could not provide a basin-wide early warning system (EWS) and flood forecast even though a country specific pilot EWS project existed in the Basin (Global Water Partnership, 2017; Obrecht and Mead, 2014; World Bank, 2015; WMO, 2019). In response, the second component of the Volta River Basin Strategic Action Plan Implementation Project (VSIP) established a communication strategy in 2019 (World Bank, 2020).

For instance, information about Bagre Dam spillage occurs between SONABEL and the Volta River Authority (VRA). These organizations are hydroelectric companies in Burkina Faso and Ghana, respectively. They notify water resource directorates of Volta Basin countries. In this communication process, VBA's Expert Committee does not inform all relevant stakeholders. When the 9$^{th}$ VBA Experts Committee meeting was held in May 2019 in Ghana, it had representatives of the VBA countries, the VBA Executive Directorate, the Technical and Financial Partners, hydropower companies (VRA and SONABEL), CSIR-Water Research Institute, Environmental Protection Agency, and Community Water and Sanitation Agency (Yankey, 2019). However, it did not have representation from other critical stakeholders like the National Disaster Management Organization, the Irrigation Development Authority, and the Ministry of Food and Agriculture.

So far most riparian states have ratified the 1997 Watercourses Convention on the Law of Non-Navigational Uses of International Watercourses and the 1992 Water Convention on the Protection and Use of Transboundary Watercourses and International Lakes. These laws do

not fully provide a clear legal foundation for establishing responsibilities, protecting the rights of local communities, and strengthening flood protection in the Basin (Volta River Action Plan, 2014; World Bank, 2015). The Water Charter was initiated by the Volta Basin Authority to address these shortcomings. It would also facilitate the creation of a flood risk map. However, the Water Charter has not been ratified by all riparian states yet. As a result, there is no flood management strategy in the Volta River Basin. However, a need assessment for flood management have been undertaken under the Project Preparation for the Implementation of Integrated Flood Management (IFM) (Global Water Partnership, 2017; WMO, 2019). The Ghana Hydrological Services Directorate, the Ghana Meteorological Agency, and the Directorate-General for Hydraulics (DGH) in Burkina Faso also provide hydrological data, river water level forecast, weather forecast, and flood risk information for disaster governance in the Volta River Basin (Ghana Meteorological Agency Act, 2004; Opoku-Ankomah et al., 2006; World Bank Group, 2019; Yankey, 2019). Also, NADMO Act 927 enacted in 2016 mandates it to identify and map up disaster hazard areas in the country, among other functions (Cobbinah et al., 2019). However, there is limited understanding about the flood mechanism of the Volta Basin. Furthermore, there are no known research work on the flood mechanism of the Volta River Basin.

This much said, there are national policies and institutions in riparian states to address disaster risks in general (Global Water Partnership, 2017). The National Water Policy and the Blue Agenda in Ghana provide the foundation for flood risk management (Almoradie et al., 2020; NADMO, 2011). The National Water Law and the 2001 Water Policy Management Act in Burkina Faso address flood and ecosystem protection (World Bank, 2015; Newborne and Tucker, 2015). Burkina Faso and Ghana enacted buffer zone by-laws to protect farms within 50m from the Volta River. In Burkina Faso farmers are forbidden to cultivate in the Buffer zone (Global Water Partnership, 2017; WMO, 2019).

### 2.6 Summary

This chapter examined transboundary water governance policies in connection to recurrent flood challenges in the Volta River Basin. My research findings revealed that traditional water management practices in Ghana was replaced with the 1903 Rivers Ordinance of the Gold Coast before independence. In Burkina Faso, however, traditional water management persisted throughout the French occupation period. I also found that transboundary water governance in the Volta Basin started as a bilateral agreement between Burkina Faso and Ghana (Joint

Declaration in 2004) and later evolved and engaged all co-riparian to collaborate. These two countries also established the code of conduct for sustainable and equitable water management. Today, the Volta Basin has a permanent transboundary water cooperation mechanism, the VBA.

Though flood risk management was not considered during the initial stages of transboundary water policy formulation, the VBA included flood risk management in its Strategic Action Program (SAP). However, it has not achieved full cooperation among several national institutions. As a result, the Volta River Basin today, lacks a basin-wide flood management strategy. It also lacks an effective communication strategy for data and information dissemination among riparian states and communities about flood risks. Furthermore, the Water Charter for the Volta River Basin, which explicitly highlights flood risk management and provide the legal basis for the flood interventions, have not been ratified by all riparian states. Also, no study have clarified the flood mechanism of the Volta River Basin. However, all riparian states had national policies and institutions to address disaster risks including floods. Also, a need assessment for flood management have been undertaken. Buffer zone by-laws have also been enacted but its enforcement is only effective in Burkina Faso.

## Chapter 3 Awareness about the Volta Basin Authority and the code of conduct

### 3.1 Introduction

Cooperation in transboundary water governance have proved effective in solving problems associated with shared water resources (Islam and Susskind, 2013). Cooperation usually starts with the signing of International Water Treaties (IWTs) followed by the establishment of River Basin Organizations (RBOs) (Gerlak and Schmeier, 2018; Priscoli and Wolf, 2009). IWTs largely clarify commitments riparian states make to institutionalize cooperation in a legally binding manner and defines water use and protection principles, environmental norms and standards, and mechanisms for decision making. RBOs provide a forum for negotiation, dialogue, dispute resolution, capacity building for member states, information dissemination, and soliciting funding for development (Gerlak and Schmeier, 2018).

The establishment of IWTs and RBOs are largely influenced by water policies of the riparian states. The United States and Canada, for instance, formulated the International Joint Commission (IJC) in 1908. In Africa, the Lake Chad Basin Commission was established in 1964, the Niger Basin Authority in 1980, Okavango River Basin Commission in 1994, Zambezi Watercourse Commission in 2004, and the Volta Basin Authority (VBA) in 2009 (Chacko, 1932; Opoku-Ankomah et al., 2006; World Bank, 2015; Yankey, 2019).

As discussed in the previous chapter, the establishment of the VBA was a major step toward a collaborative water governance. The Volta River Basin houses about 24 million people (as of 2010). Many residents in this Basin engage in small-scale agriculture (UNEP/GEF-Volta project, 2013; Global Water Partnership, 2014). Considering this economic situation along with cultural diversity, the fundamental question is how the VBA can implement its policies effectively among its members, and to what extent local participation can be achieved. Gerlak and Schmeier (2018) noted that RBOs are effective when they contribute to behavioural change of riparian communities towards sustainable transboundary water resource governance.

However, for the VBA to engage in meaningful consultation and induce active participation among smallholders, it is imperative to better understand the level of awareness and needs among riparian communities (Koop et al., 2017). Awareness means a good comprehension of causative factors as well as effects and dangers associated with governance challenges. A lack of awareness of government policies on flood management by local communities in Ghana was identified as a major barrier to stakeholder participation in water resource protection (Gyireh and Nunbogu, 2015). The international water law principles on shared water resources also emphasized the need for prior consultations with all stakeholders

and the duty to cooperate and to negotiate, among others (Ampomah et al., 2008). Heeding to these suggestions and partly attempting to fill out research gaps identified above, this chapter tries to better understand riparian communities' awareness of critical water governance issues in the study areas. Specifically, it assesses riparian awareness about the code of conduct, the VBA, and water governance challenges in the Volta River Basin.

### 3.2 Methodology

In December 2019 and January 2020, I conducted questionnaire surveys in the two study areas along the Volta River. The questionnaire I administered had four parts. The first part identified the socio-demographic characteristics of the respondents. The second part tried to understand community members' awareness about the code of conduct, the VBA, and water governance challenges in the Volta River Basin. The third part covered questions regarding water governance performance perceptions of riparian community members. The fourth and final section covered questions about respondents' flood experience and loss and damage to the agriculture sector in the Volta River Basin. This chapter discusses the results of the second part. The results of the third and fourth parts will be discussed in the fourth and fifth chapters.

I randomly sampled 30 residents each at Poanga, Benkaku and Dirlakou communities from Burkina Faso's Bagre District. In the Bawku zone, I randomly administered the questionnaire among 50 residents each at Azum-Sapeliga, Gentiiga and Songo communities. My selection of the sampling sizes was based on the population differences between these two areas. The population of Bagre District was 19,164 (City Population, 2020) and that of the Bawku zone was 290,117 (Ghana Statistical Service, 2014).

Isreal (1992) provides a simplified formula for calculating sample sizes. For a 95% confidence level and an estimated proportion of an attribute present in the population, p=0.05; $n=N/1+N(e)^2$ …….(1); where n=sample size, N=population size, and e=0.05, the level of precision. For a total population of 309,281 people in my study area, the sample size, n=399 respondents. The sample size was, however, dependent on the number needed for data analysis. Isreal (1992 and 1998) notes that a sample size between 200 and 500 is necessary for multiple regression, an analysis of covariance and log-linear analysis but nearly any sample size suffices for descriptive statistics like frequencies, mode and Chi-squared.

Due to the limited reading and writing skills of my respondents, I obtained support from local enumerators and administered the questionnaire by translating English into local

languages called Mossi in Burkina Faso and Kusaal in Ghana. The response rate was 100% in Burkina Faso and 99% in Ghana. Altogether I collected 238 valid responses. The questionnaire responses were coded and entered in the Statistical Package for Social Sciences (SPSS version 23) worksheet for analysis. Descriptive statistics in the form of frequencies and percentages were largely used to discuss the results. I also used the Pearson Chi-Squared to understand correlations between respondents' socio-demographic characteristics and their awareness (Kent State University Libraries, 2020). The null hypothesis ($H_o$) of the Pearson Chi-Squared ($\chi^2$) analysis was that there is no significant difference between respondents' socio-demographic characteristics and their awareness about the code of conduct, VBA, and being key stakeholders of VBA. The alternate hypothesis ($H_a$) was that there is significant difference between respondents' socio-demographic characteristics and their awareness about the code of conduct, VBA, and being key stakeholders of VBA. The null hypothesis was tested at 0.05 level of significance. $H_o$ was rejected if the p-value is lower than the significance level. However, when the p-value is higher than the significance level, then we accept $H_o$.

### 3.3 Results and discussion

3.3.1 Socio-demographic characteristics of the respondents

Among 238 valid responses, 148 were from Ghana and 90 were from Burkina Faso (Table 3.1). In terms of gender 66% in Ghana and 50% in Burkina Faso were males. The mean age among the Ghanaian respondents was 39.7 years old whereas that in Burkina Faso was 40.5 years old. About 93% of the Ghanaian respondents belonged to either 40-59 age group (57%) or the 18-39 age group (36%). In Burkina Faso, the 40-59 age group consisted of 37% whereas the 18-39 age group had 53%. These results imply that although the mean age in the two countries did not show much difference, more Ghanaian respondents tended to be older than those in Burkina Faso. To place these age differences in a context, according to the World Bank (2020), average life expectancy in Burkina Faso is 61 years old, and that of Ghana is 64 years old (World Bank Group, 2020). Among them, 62% in Ghana and 30% in Burkina Faso were household heads.

The results on economic aspects show that the Bawku respondents (Ghana) were largely farmers (98%). In Burkina Faso, 70% was farmers. The rest was mainly engaged in trading (18%) and teaching (7%). Only 1% of the Ghanaian respondents were engaged in trading on the contrary. These differences mean that, in Bagre district, the Bagre dam irrigation project had induced occupation diversity. The residents here typically engage in fishing, rice farming

and vegetable cultivation throughout the year. This town has also attracted a small number of traders and artisans.

Regarding the duration of their residency in the study areas, I found that about 75% of the Ghanaian respondents lived for 5-20 years in the same community, whereas 65% of the respondents in Burkina Faso did so. About 5% of the Ghanaian respondents lived in the same community for more than 40 years whereas none did so in Burkina Faso.

The education level of the respondents was low in both countries as 57% in Ghana and 60% in Burkina Faso had no formal education. In Burkina Faso, a small portion of the respondents had completed primary education (20%) and junior high school education (10%). In Ghana, the percentages of primary education (16%) and junior high school (12%) did not show much difference from their Burkina Faso counterparts. Also, 5% of the respondents in Burkina Faso had tertiary education whereas 4% in Ghana did.

### 3.3.2 Awareness about the Volta Basin Authority and the Code of conduct

In the second part of the survey, I wanted to understand respondents' awareness of transboundary water governance in the Volta River Basin. First, I asked the respondents whether they knew of the Volta Basin Authority (VBA). I also asked them whether they were aware of the code of conduct between Ghana and Burkina Faso. Finally, I asked them whether they knew of their status as key stakeholders of the VBA.

In response to the first question about the awareness of the VBA, which began its operation three years after the formulation of the code of conduct, only 16% of the respondents in Burkina Faso and 9% in Ghana answered positively. With regards to the awareness of the code of conduct for the sustainable management of water resources of the basin, 69% of the respondents in Burkina Faso knew of it. In Ghana, only 11% answered positively. Among those respondents who were aware of the VBA, only 9% knew of their status as key stakeholders in both countries, indicating the low awareness level of the respondents (Figure 3.1). That only 9% in both countries recognized themselves as stakeholders means that the VBA had largely operated as a top-down institution without much public engagement or participation. Regarding the higher level of awareness about the code of conduct among the respondents in Burkina Faso than those in Ghana, the reason can be at least partially attributable to the fact that the study area in Burkina Faso houses the headquarters for the Project for Improvement of Water Governance (PAGEV) in the Volta Basin that facilitated the establishment of the code (IUCN, 2009). This agreement preceded the establishment of the VBA in 2009.

Considering these results on awareness, I conducted a Chi-squared analysis to gain further insights on correlations with socio-demographic characteristics. A crosstabulation revealed a p-value less than 0.05 ($\chi^2$=4.939, df=5 and p<0.05) for gender (Table 3.2, Appendix 1). This means that gender had a significant correlation with respondents' awareness. More males (87%) than females were aware of their status as key VBA stakeholders in Burkina Faso. Similar gender difference existed in Ghana, but it was not statistically significant. This regional deviation could partly be explained by the fact that men generally dominate in community meetings and external workshops that discuss issues about the Volta River Basin. Also, the presence of teachers and traders who are largely males in the study area of Burkina Faso might have affected this result to some extent.

About correlations between education and awareness, the analysis found a p-value of less than 0.05 in Ghana ($\chi^2$=36.181, df=5 and p<0.05). This means that among those Ghanaian respondents without formal education, 99% was not aware of the VBA. Those with senior high school and tertiary education, 35% and 75% knew of the VBA, respectively. Similarly, regarding the awareness of the code among the Ghanaian respondents, 95% of those without formal education did not know about it while 30% and 75% of those with senior high school and tertiary education did. Regarding their awareness of being key VBA stakeholders, 99% of those without formal education answered negative whereas 35% and 75% of those with senior high school and tertiary education gave positive answers. In Burkina Faso, however, we found that education had a significant correlation only with respondents' awareness of being key VBA stakeholders. Here, 98% of those without formal education did not know about their being key stakeholders, compared with 33% of those with junior high school education. Among those with tertiary education, 50% did not know of being key VBA stakeholder (Table 3.3; Appendix 2).

Years of residency also significantly influenced respondents' knowledge as being key VBA stakeholders in Burkina Faso. Among those who had lived in the study area for 11-20 and 21-30 years, 6% and 8% knew of their status as stakeholders, respectively. Also, 33% of those who had lived for 5-10 years knew about their status. Regarding the knowledge about the code of conduct, 92% of the respondents who had lived in the Basin for 21-30 years knew about it whereas 62% of those who had lived for 5-10 years were also aware ($\chi^2$=8.443, df=5 and p<0.05) (Table 3.4, Appendix 3). In Ghana however, no significant correlation was found with their years of residency regarding all three questions. This result suggests that, overall, all residents were not well-informed about the VBA.

Since stakeholder's awareness is essential for effective behavioral change (Koop et al., 2017) and appropriate and timely information dissemination enhances public awareness (Mayunga, 2007), these results may help water managers of the Volta River Basin to identify social aspects of water governance challenges to forestall possible conflict situations in the future.

### 3.3.3 Water governance challenges

In addition to awareness, I tried to identify challenges the respondents faced when they participated in water governance. Based on past studies and my field observation, I formulated a list of possible challenges and presented it to them. The respondents were asked to rank them in order of importance (i.e., important, not important, not sure). The challenges presented to the respondents were: (1) inadequate enforcement of environmental regulations, (2) poor community participation in governance, (3) insufficient flood prevention, and (4) untimely information about spillage from Bagre Dam.

The result shows that the respondents in Ghana (96%) and Burkina Faso (97%) ranked the timeliness of spillage information as the most important. My in-person interviews also revealed that farmers located downstream the Bagre Dam were left without sufficient information about the spillage. As a result, their farms were overly flooded, and their livelihoods were significantly affected. The second most important challenge was flood prevention with 92% in Ghana and 95% in Burkina Faso. The challenge of inadequate legal enforcement was also found high in Ghana (90%) and Burkina Faso (92%). Poor community participation was identified by 88% of the Ghanaian and 91% of the Burkinabe respondents (Table 3.5). Overall, these answers suggest serious governance failure in the two study areas. These findings positively correspond with past studies that found governance problems under the Volta Basin Authority (Opoku-ankomah et al., 2006; Gao and Margolis, 2009; Obrecht and Mead, 2014; The World Bank 2015; Yankey, 2019).

## 3.4 Summary

This chapter assesses the awareness and perceptions about water governance issues among Volta Basin Authority (VBA) stakeholders in Ghana and Burkina Faso. My findings revealed that only a small portion of the respondents had a knowledge of the Volta Basin Authority and the existence of the code of conduct. Concerning the awareness, most of the respondents in Burkina Faso (84%) and Ghana (91%) did not know about the VBA. Also, 89% of them in

Ghana did not know about the code of conduct. Furthermore, 91% in both countries did not know that they were key stakeholders of the VBA. The low level of awareness among the respondents can be attributed to the fact that the VBA largely operated as a top-down institution without much public participation.

Through statistical analyses, I found correlations between awareness and gender, education, and years of residency with some regional variations. More males in Burkina Faso were aware of being key VBA stakeholders. In Ghana, education appeared to have affected respondents' awareness. Years of residency in Bagre district, Burkina Faso, appeared to show a significant correlation to their awareness. Among those who had lived for 21-30 years in the study area, 92% knew of the code of conduct.

Regarding the four pre-identified challenges of water governance in the basin, more than 90% of the respondents in both countries similarly found seriousness of all these challenges. Water spillage from Bagre Dam was the most pressing concerns. The other challenges are related to inadequate flood prevention structures, and the inadequate enforcement of environmental regulations. All these suggest that the residents knew well about what challenges needed to be addressed to secure their livelihood, but they did not know how their voice can be represented on transboundary water governance matters. If properly executed, the VBA can be a powerful venue for residents to express their needs and monitor progress about the governance of the water resources of the basin to guarantee sustainability going into the future.

Table 3.1 Socio-demographic characteristics of the respondents

| Socio-demographics | Response category | Burkina Faso (Percentage) | Ghana (Percentage) |
|---|---|---|---|
| Age | 18-29 | 18 (20%) | 9 (6%) |
| | 30-39 | 30 (33%) | 44 (30%) |
| | 40-49 | 19 (21%) | 53 (36%) |
| | 50-59 | 14 (16%) | 32 (21%) |
| | 60+ | 9 (10%) | 10 (7%) |
| Gender | Male | 45 (50%) | 97 (66%) |
| | Female | 45 (50%) | 51 (34%) |
| Education | No formal education | 55 (60%) | 84 (57%) |
| | Primary | 18 (20%) | 24 (16%) |
| | Junior high school | 9 (10%) | 18 (12%) |
| | Senior high school | 4 (5%) | 17 (11%) |
| | Tertiary education | 4 (5%) | 5 (4%) |
| Occupation | Artisan | 2 (2%) | 0 (0%) |
| | Farmer | 63 (70%) | 146 (98%) |
| | Student | 3 (3%) | 1 (1%) |
| | Teacher | 6 (7%) | 0 (0%) |
| | Trader | 16 (18%) | 1 (1%) |
| How long (years) have lived in this area | 5-10 | 9 (10%) | 55 (37%) |
| | 11-20 | 50 (55%) | 55 (37%) |
| | 21-30 | 24 (27%) | 17 (11%) |
| | 31-40 | 7 (8%) | 14 (10%) |
| | 41-50 | 0 (0%) | 3 (2%) |
| | 51-60+ | 0 (0%) | 4 (3%) |
| Total | | 90 (100%) | 148 (100%) |

Table 3.2 Correlations between gender and respondents' knowledge about the VBA

| Cross-tabulation | Gender (Ghana) | Gender (Burkina Faso) |
|---|---|---|
| Are you aware of the VBA? | 0.903 (0.342) | 3.045 (0.081) |
| Are you aware you are a stakeholder of the VBA? | 0.903 (0.342) | 4.939 (0.026*) |
| Have you heard about Code of no conduct for cooperation between Ghana and Burkina Faso? | 2.014 (0.156) | 0.210 (0.647) |

P≤0.05

Table 3.3 Correlations between education and respondents' knowledge about the VBA

| Cross-tabulation | Education (Ghana) | Education (Burkina Faso) |
|---|---|---|
| Are you aware of the VBA? | 36.181 (0.000*) | 7.406 (0.116) |
| Are you aware you are a stakeholder of the VBA? | 36.181 (0.000*) | 14.771 (0.005*) |
| Have you heard about Code of no conduct for cooperation between Ghana and Burkina Faso? | 22.024 (0.000*) | 2.421 (0.659) |

P≤0.05

Table 3.4 Correlations between years of residency and respondents' knowledge of the VBA

| Cross-tabulation | How long have you lived along the Volta River? (Burkina Faso) |
|---|---|
| Are you aware you are a stakeholder of the VBA? | 0.342 (0.049*) |
| Have you heard about Code of conduct for cooperation between Ghana and Burkina Faso? | 8.443 (0.038*) |

P≤0.05

Table 3.5 Ranking of water governance challenges by the respondents

| Challenges | Burkina Faso | | | Ghana | | |
|---|---|---|---|---|---|---|
| | Not important | Important | I don't know | Not important | Important | I don't know |
| Enforcing regulation | 5 (6%) | 83 (92%) | 2 (2%) | 10 (7%) | 134 (90%) | 4 (3%) |
| Public participation | 6 (7%) | 82 (91%) | 2 (2%) | 12 (8%) | 131 (88%) | 5 (4%) |
| Flood prevention | 4 (4%) | 85 (95%) | 1 (1%) | 6 (4%) | 136 (92%) | 6 (4%) |
| Untimely information of spillage | 2 (2%) | 87 (97%) | 1 (1%) | 1 (1%) | 143 (96%) | 4 (3%) |

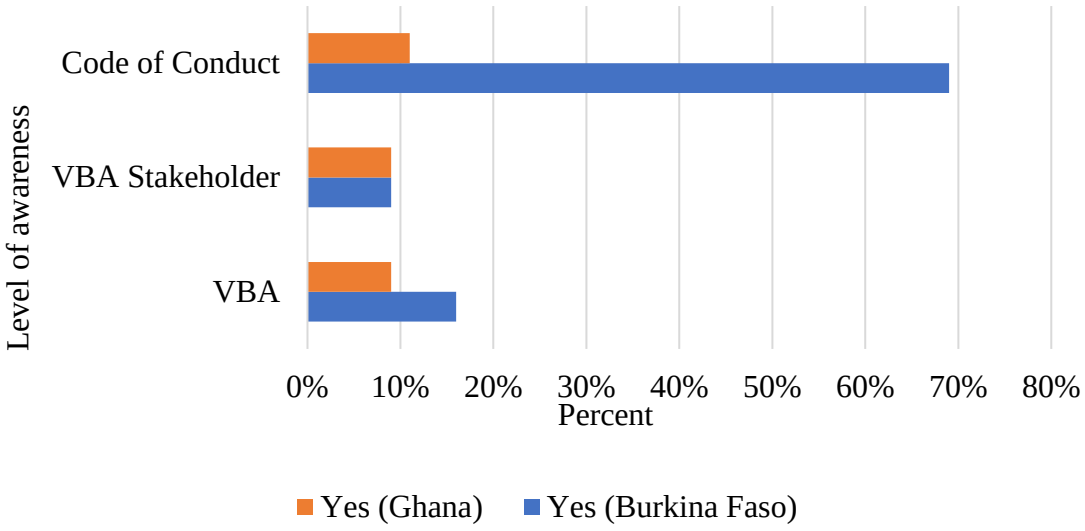


Figure 3.1 Riparian communities' knowledge about the VBA and the code

# Chapter 4 Water governance performance assessment of riparian communities

## 4.1 Introduction

Zawahri (2018) projected increased global freshwater demand due to climate change, population growth, and industrialization and that inefficient management of existing water resources will increase existing tension over shared water. Raleigh (2018) noted that Africa's main "water issue" is not water scarcity but how water is to be managed. She added that most African countries would face severe water shortages due to climate change impacts and water politics.

Global Water Partnership (2003) defined water governance as the "spectrum of political, social, economic and management structures in the development and management of water resources and water services across different levels of society" (Rogers and Hall, 2003). Governments, civil society, non-governmental organizations (NGOs), donor agencies, research institutions, the media, and local communities constitute key stakeholders that must be engaged in these processes (Karanja, 2019).

Under the second component of the Volta River Basin Strategic Action Plan Implementation Project (VSIP) (World Bank, 2020), the VBA conducted several capacity building workshops to boost riparian trust and confidence for improved water governance in the Volta Basin. Among the most contentious water governance issues is related to the development and operation of large dams that often deprive downstream regions or countries of reasonable water flow (Ampomah et al., 2008; Gao and Margolies, 2009; World Bank, 2015: Yankey, 2019). In 2013, a Transboundary Diagnostic Analysis conducted in the Volta Basin found lack of coordination as a major challenge (Sadieau, 2019).

In the last ten years rising political tensions have been observed between Ghana and Burkina Faso. We do not know much about how governance can be a solution to these rising tensions. This chapter, therefore, attempts to assess water governance performance in the Volta River Basin, especially between these two countries. As rising tensions appears to have been incubated among local communities, it focuses on the perspectives of riparian communities about public participation, transparency, gender equity and the quality of regulations.

## 4.2 Methodology

In order to understand perceptions about water governance, this chapter looks at three riparian communities along the Volta River in Burkina Faso (Poanga, Benkaku and Dirlakou) and

Ghana (Azum-Sapeliga, Gentiiga and Songo). As discussed in chapter 1, in Ghana, I look at the Bawku zone in the Upper East Region. In Burkina Faso, I look at Bagre district in the Eastern Central Region where Bagre Dam is located. My preliminary field visit to these areas informed my decision to choose these communities to focus on flood damage due to the Bagre Dam spillage. These three communities were considerably affected by dam spillage in the past.

Much of the discussion below is based on the data I collected from a questionnaire survey in Ghana and Burkina Faso. This section uses a set of Likert-type statements and questions. Boone and Boone (2012) distinguished Likert-type statements from Likert-scale statements. Likert-type statements are single questions without an intension to combine responses into a composite scale. A Likert-scale, however, comprises four or more Likert-type statements that are to be combined into a single composite score. In total 10 items comprising five statements and five questions constituted the second part of the questionnaire (Table 4.1). These statements were revolved around four key governance principles: public participation, transparency, gender equity and regulatory quality. I also used five-point Likert-scale questions to assess the degree of public participation and gender equity in decision-making. Here I asked the respondents to select the degree of their agreement to given statements. The choices for scale ranged from "not easy at all" to "very easy." To rate efforts made by water managers, five-point Likert-scale questions asked the respondents to choose from "very low" to "very high." In assessing regulatory quality, I first assessed respondents' knowledge about local government authorities responsible for water governance by using list of institutions to choose. I then asked respondents to rate their level of satisfaction.

Largely agreeing with Boone and Boone (2012), I use descriptive statistics as an appropriate method to discuss the results from the Likert-type statements and questions. The Pearson Chi-Squared ($\chi 2$) was used to understand correlations between respondents' socio-demographic characteristics and their perceptions about governance performance (Kent State University Libraries, 2020). Null hypothesis ($H_o$) was that there is no significant difference between respondents' socio-demographic characteristics and their perceptions about governance performance. $H_o$ was tested at 0.05 level of significance and was rejected if the p-value is lower than the significance level. However, if the p-value is higher than the significance level, then we accept $H_o$. I also used stack bar graphs to visualize the result of the survey. The stack bar graph plots responses with each row showing percentage breakdown at each step of the Likert scale. An agreement with Likert-type statement is represented by a bar above zero (Statgraphics18, 2017). The mode represents the response with the highest occurrence on a scale of 1 (strongly disagree) to 5 (strongly agree). SPSS version 23 and Statgraphics18 aided data analysis.

## 4.3 Results and discussion

### 4.3.1 Perceptions about stakeholder participation

To understand respondents' level of public participation in the Volta River Basin, I asked the respondents to respond to three statements (Table 4.1). The first statement was "my community is sufficiently involved in decision-making." The second statement was "customs, religion and norms of my community are recognized." The third statement was "my community has an avenue for receiving complaints or raising suggestions about the basin."

In response to the first statement, 24% of the respondents in Ghana agreed whereas 49% disagreed. Out of those who disagreed, 27% of them strongly disagreed whilst 22% disagreed. In Burkina Faso, the results are somewhat different as 42% agreed and only 17% disagreed. Out of those who agreed, 27% of them agreed whilst 15% strongly agreed. Also, 41% of them was not sure about the first statement. About the second statement, 78% of the respondents in Ghana disagreed whereas 34% of the Burkina Faso respondents did so. Another 34% agreed with the statement. Out of those who disagreed with the second statement in Ghana, 52% of them disagreed whilst 26% strongly disagreed. About the third statement, 52% of the respondents in Ghana disagreed whereas 29% did so in Burkina Faso (Figure 4.1 and 4.2). Of those who disagreed with the third statement in Ghana, 27% of them disagreed whilst 25% strongly disagreed (Table 4.2). This means that the Ghanaian respondents tended to feel alienated from decision-making processes in connection to Volta River governance. Chi-squared analyses on these results revealed that although the Burkina Faso respondents tended to have higher participation than those in Ghana, gender disparity was observed. In Burkina Faso, more men (55%) agreed with the first statement. Regarding the third statement, more women (54%) agreed.

### 4.3.2 Perceptions about gender equity

To understand respondents' opinion about gender equity in the Volta River Basin, I posed two statements (Table 4.1): (1) "women and men have equal opportunity in decision making" and (2) "women and men have equal opportunity in sharing benefits." In response to the first statement, 72% of the respondents in Ghana disagreed whereas 78% in Burkina Faso did so. Of those who disagreed with the first statement in Ghana, 24% of them strongly disagreed whilst 48% disagreed. In Burkina Faso, 11% of them strongly disagreed whilst 67% disagreed. About the second statement, 54% of the respondents in Ghana and 82% in Burkina Faso disagreed (Figures 4.3 and 4.4). Out of those who disagreed with the second statement in Ghana, 22% of them strongly disagreed whilst 32% disagreed. In Burkina Faso, 12% strongly disagreed whilst 70% disagreed (Table 4.3). Chi-squared analyses on these results, however, did not show

significant difference among women and men. These results suggest that the respondents in both countries largely acknowledged gender inequity in water governance.

### 4.3.3 Perceptions about transparency

To understand respondents' opinion about governance transparency, I asked three questions (Table 4.1): (1) "how easy was it to access information about spillage of Bagre dam water?"; (2) "how easy was it to understand decision-making processes about water governance?"; and (3) "how will you rate efforts made by water managers to make stakeholders understand the decision-making process?" In response to the first question, 53% of the respondents in Ghana found it easy to obtain information about spillage while 35% of them felt that it was difficult. In Burkina Faso, 59% of the respondents thought that it was difficult to access information whereas 15% of them did not think so. About the second question, 55% in Ghana found it easy to understand decision-making processes whereas in Burkina Faso, only 12% of the respondents found decision making process easy to understand. Also, more than half (63%) of them was not sure. Regarding the third statement, 49% in Ghana highly rated water managers' performance whereas 64% in Burkina Faso rated low. These results show different perceptions about water governance between Ghana and Burkina Faso (Figures 4.5 and 4.6). Although the Ghanaian respondents tended to indicate the existence of governance transparency, Chi-squared analysis revealed gender disparity about the second and the third statements among the respondents. I found that more men agreed with the second (72%) and third (68%) statements. This may be due to the patriarchal nature of the riparian communities of the Volta Basin where men dominate in public engagements.

### 4.3.4 Perceptions about regulatory quality

To understand respondents' opinion about regulatory quality in the Volta River Basin, I asked two questions (Table 4.1): (1) "who manages the Volta River Basin?" and (2) "how will you rate the regulatory performance of water managers?" For the first question, six multiple choice answers were presented for the respondents to identify relevant institutions. These institutions are the Volta Basin Authority, Water Resource Commission in Ghana, Ministry of Water and Sanitation in Burkina Faso, Department of Water and Sanitation in Ghana, and the Forestry and Agriculture departments in both countries. The second question used a five-point Likert-scale ranging from "very dissatisfied" to "very satisfied." In response to the first question, 57% of the respondents in Ghana identified the Department of Agriculture. Also, about 45% chose the Water Resource Commission. In Burkina Faso, the Ministry of Water and Sanitation was chosen by 40% of the respondents. Another 12% chose the Forestry Department. In stark contrast to the Ghanaian counterpart, only 9% chose the Department of Agriculture. Agricultural departments in the study areas inform farmers about good water management

practices, but they are not responsible for managing water resources of the Volta River. In Ghana, the Water Resource Commission, which was established by an Act of Parliament (Act 522 of 1996), is responsible for managing Ghana's water resources (Water Resource Commission, 2020). In Burkina Faso, the Ministry of Water and Sanitation is responsible for water governance (IRC, 2013).

Regarding the second question about rating regulatory performance, 58% of the respondents in Ghana were satisfied, whereas 36% thought otherwise. Out of those who were satisfied with the regulatory quality, 32% and 26% were highly satisfied and satisfied. In Burkina Faso, 54% of them were dissatisfied while 23% were satisfied with regulatory quality provided by water managers. Of those who were not satisfied with the regulatory quality in the basin, 9% of them were highly unsatisfied whilst 45% were unsatisfied. This result clearly show that the respondents in Ghana expressed better regulatory practice in the basin compared to what pertain in Burkina Faso. My field observation however revealed that riparian communities in Ghana engage in unsustainable agricultural practices like cultivating very close to the riverbank. This result in siltation of the riverbed and river pollution from agrichemical usage.

### 4.4 Summary

This chapter examines riparian communities' water governance perceptions with particular emphasis on possible sources of rising tensions over the use of Volta River water. By using the questionnaire survey, I attempted to understand the perceptions about degrees of their public participation, gender equity, transparency, and regulatory quality.

Regarding public participation, my findings revealed that the respondents generally had experienced limited levels of participation in water governance though the Burkina Faso respondents tended to show higher satisfaction level compared to those in Ghana. A large percentage of the Ghanaian respondents particularly had problems with discrimination against religion and norm in decision-making processes as they were minority Muslim people where Christianity tends to dominate Ghanaian society in general. As a result, 52% of the Ghanaian respondents felt being left out from governance whereas 39% in Burkina Faso, especially among males, felt involved in improving governance. The respondents generally acknowledged the existence of gender inequity in both countries.

Regarding transparency, the Ghanaian respondents tended to have somewhat sufficient information about water governance. Regarding their access to information about Volta River water use, easiness to understand water governance processes, and water managers' performance, 49-55% of the respondents in Ghana answered favorably. In Burkina Faso, however, 59-65% of the respondents had negative perceptions about these transparency related issues.

This result, however, must be placed in a context of how the respondents understood responsibilities among authorities. In Ghana 57% had a wrong perception and thought that the Agricultural Department was responsible for the Volta River Basin management. Only 45% knew correctly that the Water Resource Commission was responsible. In Burkina Faso, 40% of the respondents knew that the Ministry of Water and Sanitation was responsible for managing water in the Basin.

These results, overall, suggest a further need to communicate and equitably engage with local communities about water governance. As most of the respondents and local communities in the Volta River Basin in general depend on agriculture for livelihoods, it may not be easy for them to distinguish water governance from agricultural activities. Flooding from Bagre dam spillage is another concerning issue for those who engage in farming along the Volta River, where they tend to expect agricultural authorities to mitigate. Although this research was not designed to find cross-border communication efficiency, it is another topic to be explored in the future to help alleviate the rising international tensions over water management in western Africa.

Table 4.1 Governance principle and Likert-type statements

| Governance principles | Questions and statements |
|---|---|
| Public Participation | (1) My community is sufficiently involved in the decision-making |
| | (2) Customs, religion, and norms of my community are recognized |
| | (3) My community has an avenue for receiving complaints or raising suggestions about basin |
| Gender equity | (1) Women and men have equal participation in decision making |
| | (2) Women and men have equal access to benefits from this basin |
| Transparency | (1) How easy to access information about spillage of excess Bagre dam water? |
| | (2) How easy institution makes processes of decision making about water governance in the basin? |
| | (3) How will you rate water manager's efforts to make stakeholders understand decision making process? |
| Regulatory quality | (1) Who manages the Volta River Basin? |
| | (2) How satisfied are you with the regulatory performance of enforcing agencies? |

Table 4.2 Statements and responses on public participation in Ghana and Burkina Faso

| Statements/ | Ghana | | | | | Burkina Faso | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Likert scale | SD | DG | NS | AG | SA | SD | DG | NS | AG | SA |
| Community | 40 | 32 | 41 | 29 | 7 | 0 | 15 | 37 | 24 | 14 |
| sufficiently | 27% | 22% | 27% | 19% | 5% | 0% | 17% | 41% | 27% | 15% |
| involved | | | | | | | | | | |
| Customs, | 39 | 76 | 25 | 7 | 1 | 4 | 26 | 29 | 18 | 13 |
| religion, | 26% | 52% | 16% | 5% | 1% | 4% | 30% | 32% | 20% | 14% |
| and norms | | | | | | | | | | |
| respected | | | | | | | | | | |
| Avenue to | 37 | 40 | 41 | 26 | 4 | 1 | 25 | 29 | 19 | 16 |
| make | 25% | 27% | 28% | 18% | 2% | 1% | 28% | 32% | 21% | 18% |
| suggestions | | | | | | | | | | |
| Total | | | | | 148 | | | | | 90 |

Note: SD =Strongly disagree, DG = Disagree, NS = Not sure, AG = Agree, SA =Strongly agree.

Table 4.3 Statements and responses on gender equity in Ghana and Burkina Faso

| Statements/ Likert scale | Ghana | | | | | Burkina Faso | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SD | DG | NS | AG | SA | SD | DG | NS | AG | SA |
| Women and men equally represented in decision making | 36 | 70 | 25 | 18 | 0 | 10 | 60 | 7 | 7 | 6 |
| | 24% | 48% | 16% | 12% | 0% | 11% | 67% | 8% | 8% | 7% |
| Women and men have equal access to benefits | 33 | 47 | 30 | 37 | 1 | 11 | 63 | 9 | 5 | 2 |
| | 22% | 32% | 20% | 25% | 1% | 12% | 70% | 10% | 6% | 2% |
| Total | | | | | 148 | | | | | 90 |

Note: SD =Strongly disagree, DG = Disagree, NS = Not sure, AG = Agree, SA =Strongly agree.

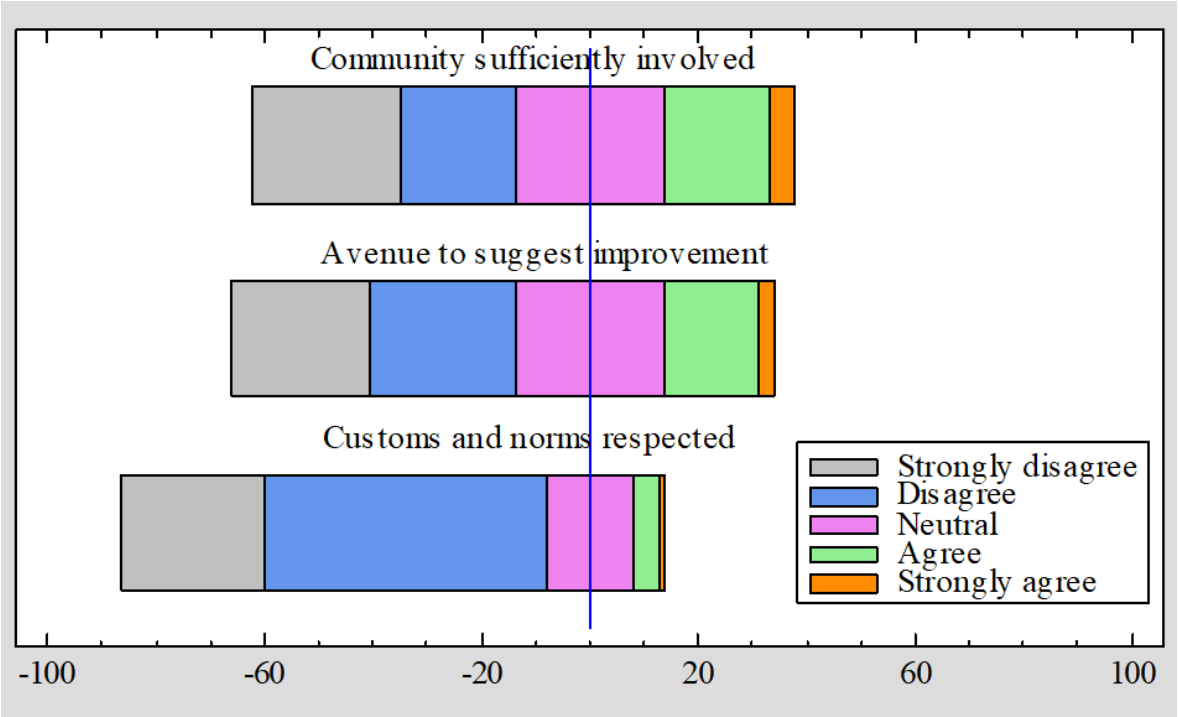


Figure 4.1 Stakeholder participation in water governance in Ghana.

Note: An agreement with Likert-type statement is represented by bars on the right-hand side.

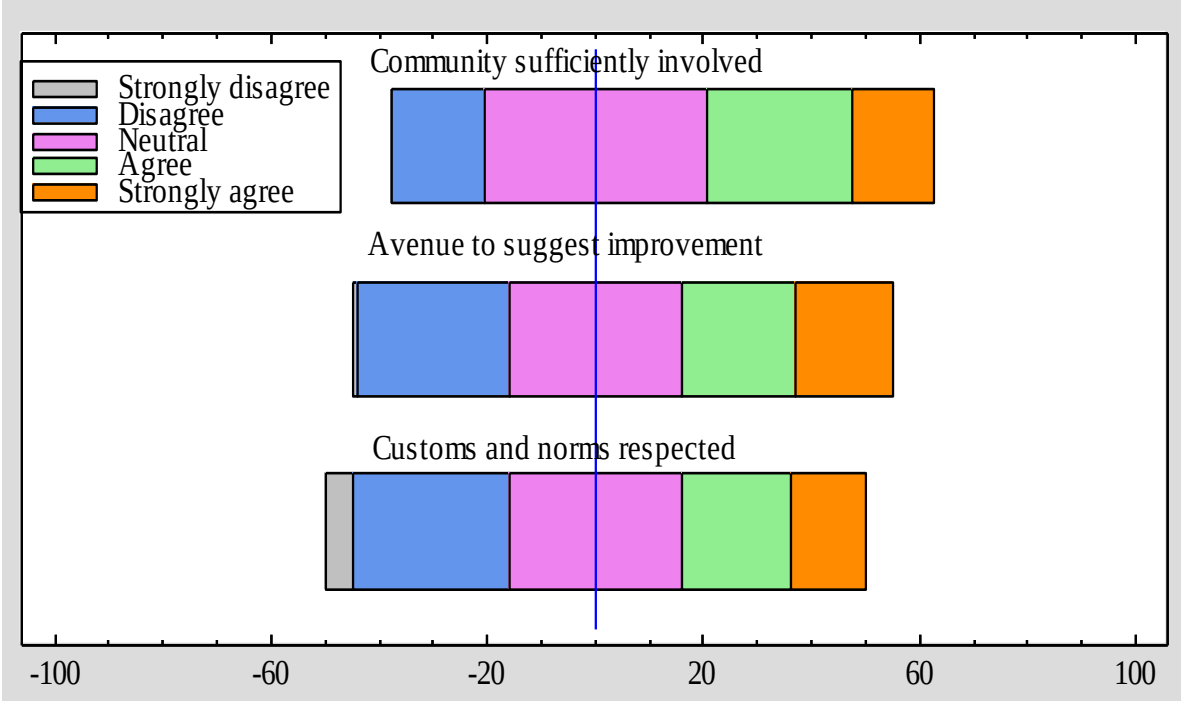


Figure 4.2 Stakeholder participation in water governance in Burkina Faso.

Note: An agreement with Likert-type statement is represented by bars on the right-hand side.

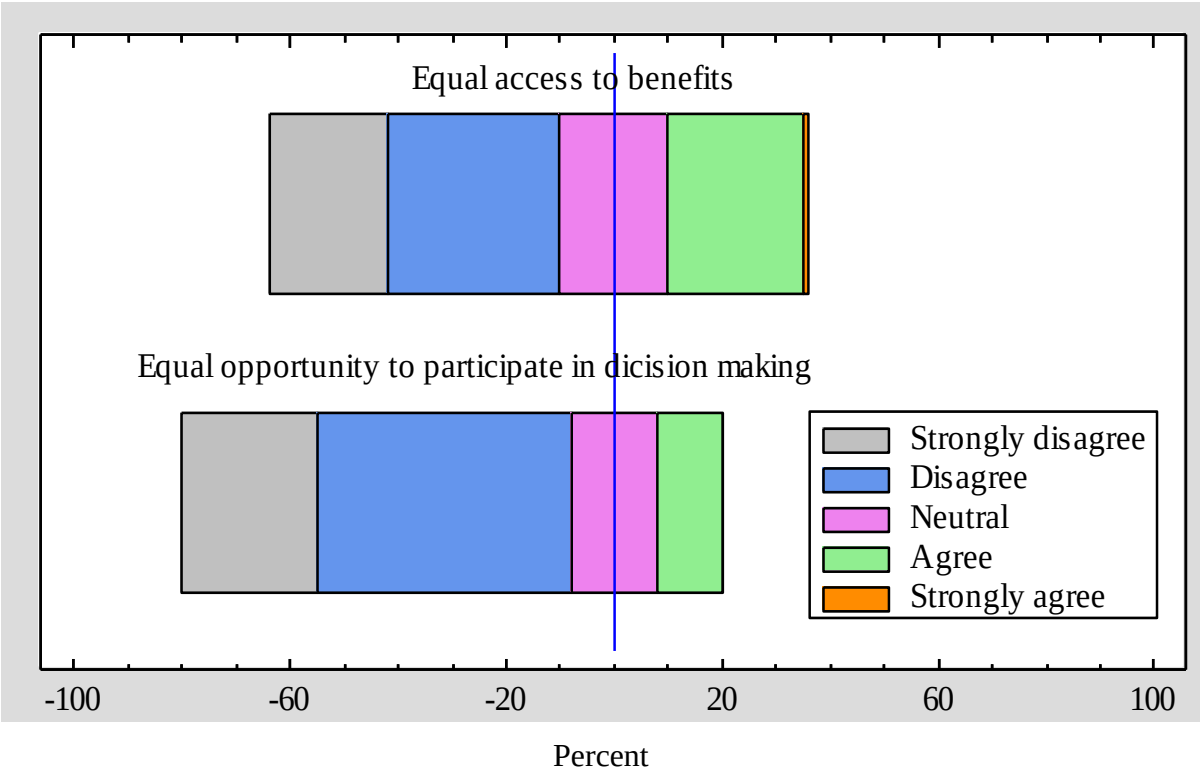


Figure 4.3 Equal opportunity for benefit sharing and decision making in Ghana.

Note: An agreement with Likert-type statement is represented by bars on the right-hand side.

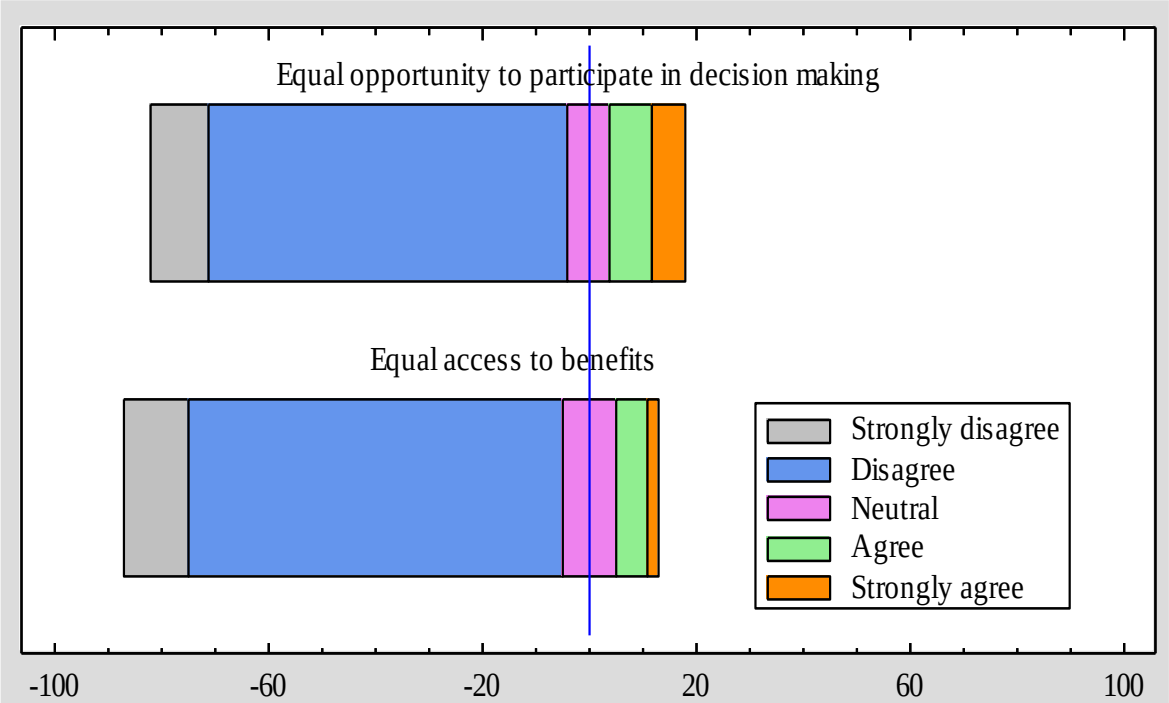


Figure 4.4 Equal opportunity for benefit sharing and decision making in Burkina Faso.

Note: An agreement with Likert-type statement is represented by bars on the right-hand side.

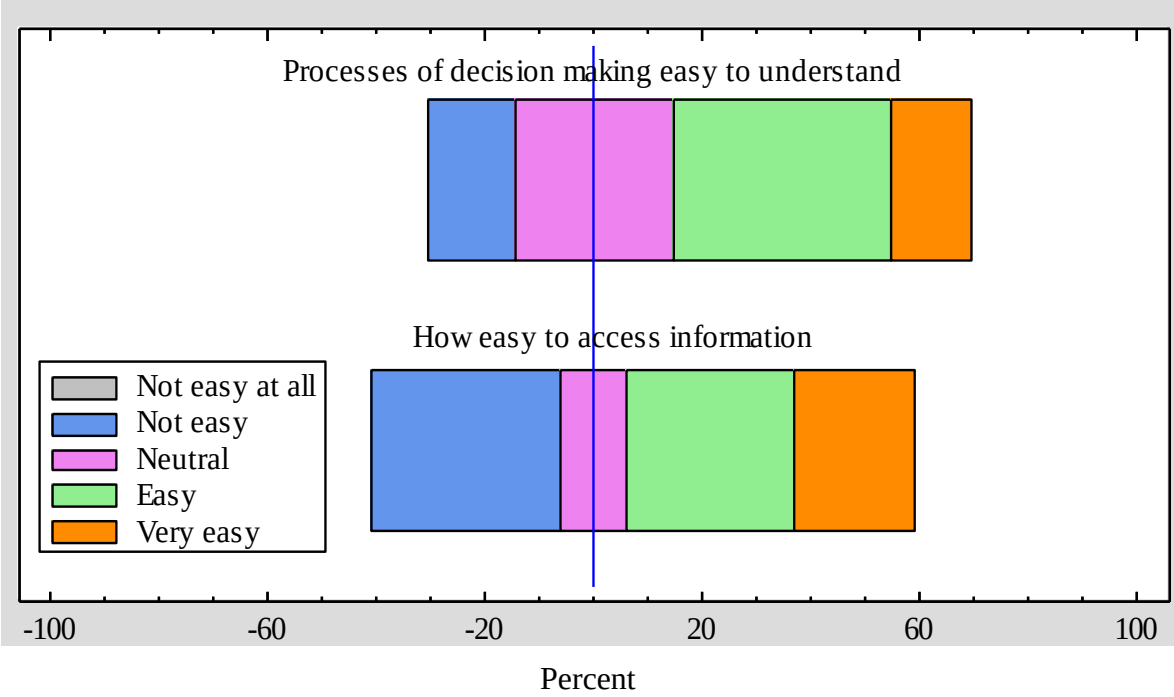


Figure 4.5 Access to information and clarity in decision making processes in Ghana.

Note: An agreement with Likert-type statement is represented by bars on the right-hand side.

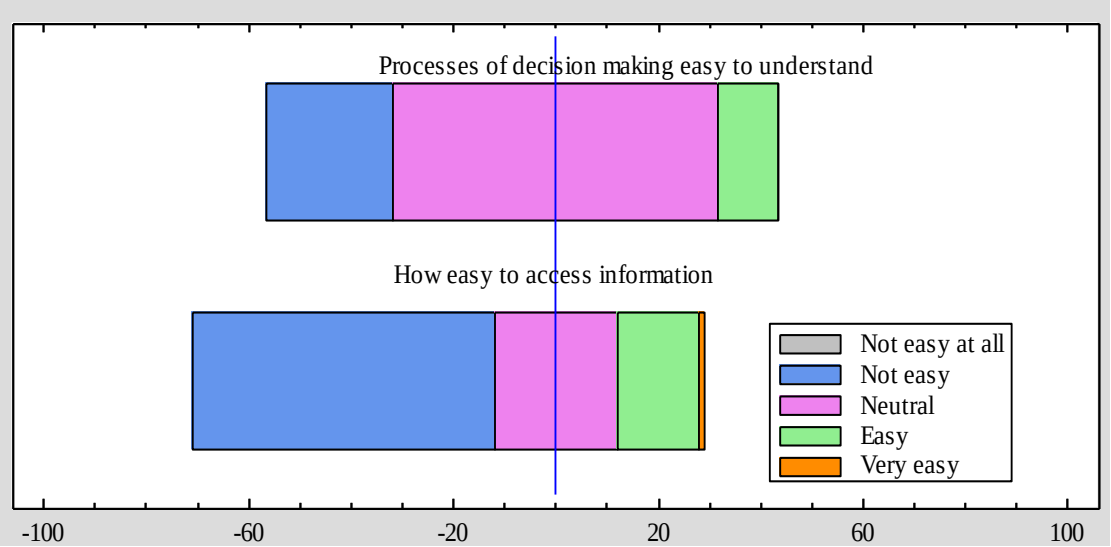


Figure 4.6 Access to information and clarity in decision making processes in Burkina Faso.
Note: An agreement with Likert-type statement is represented by bars on the right-hand side.

# Chapter 5 Effects of flooding on riparian livelihood

## 5.1 Introduction

The world has witnessed increasing disaster events like floods and droughts that inflicted huge economic damage on people. A study found that 315 disasters occurred globally in 2018 that affected 68.5 million people, including 11,804 deaths and US$132 billion of economic damages (Kansuk and Chimbar, 2019). Disaster loss and damage tend to particularly debilitate the ability of the poor and vulnerable to recuperate from damages, especially in developing countries and marginalized regions (Musah et al., 2013; Kansuk and Chimbar, 2019; FAO, 2016; Fiasorgbor et al., 2018). Between 2003 and 2013, 25% of climate-related disaster impacts in developing countries were associated with agriculture (FAO, 2016).

Disasters impact agriculture by destroying cultivated farmland, farm asset, livestock, and infrastructure. In Bihar, India, for instance, Kansal et al. (2017) noted that floods submerged and silted several hectares of farmlands that became unsuitable for cultivation. These farmlands were left fallowed for years, making many smallholder farmers landless. In Xinjiang, China, Wu et al. (2015) noted that flood disasters negatively impacted the agricultural ecosystem with worsened instability in the production system. In the Lesser Himalaya region, Rawat (2012) observed that flood disasters induced landslides, slope instability, severe erosion, and sedimentation on agricultural land, causing reduced crop yields. In Burkina Faso, most reported flood impacts were related to damage to agricultural production, houses, and livestock (Markantonis et al., 2017).

Although the assessment of loss and damage in agriculture is critical in developing flood risk management policies, it is often overlooked in studies on disasters (Jega et al., 2018). The loss and damage assessment in the agriculture sector can inform the formulation of appropriate flood management strategies and interventions and contribute to food security. It also helps prepare for future climate related disaster events (Kansal et al., 2017; Rawat, 2015; Wu et al., 2015).

Regarding the Volta River Basin, available information about flood disasters tend to focus on acreages destroyed by floods. Much information is missing about the quantity and types of damaged crops, livestock, and farm assets. As far as I know, no study has examined the transboundary nature of agricultural loss and damage in the Basin. This chapter, therefore, attempts to fill this gap and examines flood disaster impacts on agriculture in the Ghana-Burkina Faso transboundary area within the Volta River Basin. It also attempts to quantify the

damage caused by the 2018 flood on agriculture. Finally, it determines whether the damage caused by the 2018 floods was statistically significant.

### 5.2 Methodology

This part of my questionnaire tried to understand respondents' flood experience. It also contains questions that helped me estimate crop and livestock production, and farm assets in 2017 (pre-disaster) and 2018 (post-disaster) seasons. I applied FAO's guideline on post-disaster agricultural damage, loss and needs assessments. A production loss or damage was calculated as the difference between pre-disaster and post-disaster production (Jega et al., 2018). FAO (2016) defined "damage" as the complete or partial destruction of asset and infrastructure determined by its replacement or repair cost while "loss" refers to the difference in economic earnings caused by a disaster event. I examined the damage caused by the 2018 flood on the production of crops (maize, rice, sorghum), livestock (cattle, sheep, goat, chicken, and Guinea fowl) and farm assets (farm tools and water hose). Crop production was measured in metric tons (MT) while livestock production and farm asset were measured by the number of animals reared and farm assets. I analyzed damage to crop, livestock, and farm assets separately purposively to provide sub-sector specific data to inform the provision of relief interventions. Also, the crop, livestock and irrigation sectors in this basin are managed by separate directorates (crop, livestock, and irrigation directorates).

I collated the questionnaire responses using Microsoft Excel, coded, and entered it in the Statistical Package for Social Sciences (SPSS version 23) worksheet for analysis. I adopted descriptive statistics in the form of frequencies and percentages to analyze and discuss the results. I then used the paired sample t-test to understand the mean difference between the paired observations (pre-disaster and post-disaster) and to determine whether the mean difference was statistically significant. The null hypothesis ($H_o$) was that the mean difference in crop, livestock production and the available farm assets between 2017 and 2018 cropping season was not because of the flood disaster. The null hypothesis was tested at 0.05 level of significance. $H_o$ was rejected if the p-value is lower than the significance level. However, when the p-value is higher than the significance level, then I accept $H_o$. I also used data from annual reports from the Department of Agriculture in the Upper East Region to better understand the significance of the results.

## 5.3 Results and discussion

### 5.3.1 Flood experience

First, I asked the respondents whether their farm was flooded. In response, 69% and 91% of the respondents in Burkina Faso and Ghana had their farms flooded in the past. I then asked them about the cause(s) of the floods they experienced. In Burkina Faso, 43% of the respondents attributed it to the spillage of excess water from Bagre Dam and about 30% to heavy rainfalls. In Ghana, 34% of the respondents blamed it to the spillage and about 24% to a lack of flood control structures. Media reports in Ghana largely blamed the spillage of excess water from Bagre Dam as the main cause of floods (AllAfrica, 2020; GhHeadlines, 2020; Graphic online, 2018).

In the following question, I sought to understand respondents' experiences about the duration of the floods. The Center for Food Security and Public Health (2010) noted that the maize crop can survive only 12 hours of inundation if the temperature is above 32$^{o}$C and only up to 4 days if temperature is lower. My result revealed that the mean flood duration was 3.65 weeks (about 25 days) in Burkina Faso and 1.61 weeks (about 10 days) in Ghana.

I then asked the respondents if they were able to replant and harvest in the same cropping season. About 51% of the respondents in Burkina Faso and 49% in Ghana could not. The result revealed how farmers lose their livelihood due to their inability to cultivate their flooded farmlands within the same cropping year.

### 5.3.2 Damage to crop

In the third section, I asked the respondents to quantify agricultural damage in the study areas. As mentioned above, I tried to identify farmers' crop production before and after the 2018 flood disaster. I asked respondents to share their crop production data of maize, rice, and sorghum in bags. One bag is approximately 0.1 metric ton (MT). The results revealed that between 2017 and 2018 the production of maize decreased from 224.4 MT to 97.2 MT, rice from 95.1 MT to 46.3 MT, and sorghum from 15.1 MT to 3.2 MT. In Burkina Faso, between 2017 and 2018 the production of maize and rice decreased from 34 MT to 11.5 MT and 243.2 MT to117.0 MT, respectively. Under this section of the questionnaire, only seven respondents provided answers about the production of sorghum, but SPSS accepts for analysis data input not less than 10.

Another information I sought was the changes in acreage of farmland. I found that 273.5 ha of farmland was destroyed by the 2018 floods. Of this, 165.7 ha was cropped with maize

(60.6%), 84.4 ha with rice (30.8%) and 23.4 ha with sorghum (8.6%). Some farmers whose crops were ready for harvesting but was inundated by the flood used small boats and tried to salvage some of the produce (UERCC-DOA, 2018). In Burkina Faso, 10.6 ha of maize land and 59.5 ha of rice paddies were destroyed. Data on the cultivation of sorghum in Burkina Faso was inadequate for analysis.

These results suggest that the most impacted crop in Ghana was maize with 127.3 MT of damage. This translates to 0.53MT of maize damage per capita. In Burkina Faso, rice was the most affected crop with 126.2 MT of damage. Here, an average of 1.40MT of rice per capita was damaged (Figure 5.2). This per capita crop damage information can be used as baseline information for relief intervention in terms of the provision of seeds and food supply to flood victims for the next cropping season.

I then compared these results with published information in the 2018 annual progress report of the Upper East Regional Department of Agriculture. This report mentioned that 7,488.9 ha of farmland was destroyed by the 2018 floods, constituting 62% of maize land (4,678ha), 14% of rice paddies (1,019.4ha), 7% of sorghum land (510.5 ha), 11% of groundnut land (805ha), 3% cowpea (264ha) land and 3% millet land (212ha) (UERCC-DOA, 2018). This showed a positive correspondence to the damage reported by the respondents above.

To find out whether the damage recorded above was statistically significant, whether the damage reported was caused by the 2018 floods or it happened by chance, I conducted the paired sample t-test. These results revealed that the decline in maize, rice, and sorghum production in Ghana was statistically significant ($p<0.05$) with 127.3MT of maize, 48.8MT of rice, and 12.1MT of sorghum being damaged by the 2018 flood, respectively. Similarly, the decreased maize and rice production in Burkina Faso was also statistically significant ($p<0.05$) with 22.5MT of maize and 126.2MT of rice being damaged, respectively (Table 5.1).

### 5.3.3 Damage to livestock

To understand damage in livestock production, I tried to determine farmers' livestock production before and after the flood disaster. I asked the respondents to share their production data for cattle, sheep, goats, chicken, and guinea fowls before and after the 2018 floods. In Ghana, the results show that the number of possessed cattle decreased from 175 head to 154 head. That of sheep decreased from 439 to 271, goat from 482 to 298, chicken from 1048 to 516, and guinea fowl from 972 to 456 respectively. In Burkina Faso, cattle, and chicken production decreased from 10 to 3 and 10 to 0 respectively. Here, the respondents did not report

damage in the production of sheep, goat, and guinea fowl (Figure 5.4). The huge difference in the number of livestock damaged between the two countries is explained by the different production systems. Livestock production in Burkina Faso is based on the extensive pastoral and agro-pastoral system (FAO, 2018). Under this system, herdsmen lead livestock from *kraal* for grazing. They are normally protected from floods. In the Upper East Region of Ghana, the traditional free-range system is mainly practiced (Adams and Ohene-Yankyera, 2014). Here livestock is allowed to roam in search of feed. Stray livestock can be carried away and drowned in flood water since they graze in low lying areas that are most flood prone.

To find out whether damage to livestock was statistically significant, I conducted the paired sample t-test. In Ghana, I found out that damage to cattle, sheep, and goat was statistically significant ($p<0.05$) with 21 cattle, 168 sheep and 184 goats being damaged. Loss in chicken and guinea fowl production were not statistically significant ($p>0.05$).

### 5.3.4 Damage to farm asset

In the last section of the survey, I tried to determine the number of farm assets damaged by the 2018 flood. I asked the respondents to share information about the number of farm tools (hoe and cutlass), stocked input (fertilizer in-stock) and irrigation equipment (water hose) before and after the flood. In Ghana, I found that the number of hoe and cutlass decreased from 381 to 109 between 2017 and 2018. Fertilizer in-stock also decreased from 362 to 137. The number of water hose decreased from110 to 98. Likewise, in Burkina Faso, the number of hoe and cutlass decreased from 26 to 5 between 2017 and 2018. Fertilizer in-stock decreased from 510 to 168. The number of water hose decreased from 9 to 2 (Figure 5.4). Damage to farm assets was severe in Ghana with 272 hoe and cutlass, 225 fertilizer in-stock, and 12 water hoses washed away by flood waters.

Those respondents in Burkina Faso who cultivated under the Bagre irrigation scheme had access to well-developed irrigation canals. Those Ghanaian respondents who cultivated land were without irrigation ditches. Their farms were closely located to the riverbank without observing the buffer zone by-laws. This could explain the relatively lower damage to irrigation equipment recorded in Burkina Faso.

To find out whether the damage to farm assets was statistically significant, I conducted the paired sample t-test. In Ghana, the results revealed that damage to farm tools and input were significantly impacted ($p<0.05$). Similarly, damage to farm tools, input, and irrigation equipment in Burkina Faso were statistically significant ($p<0.05$).

## 5.4 Summary

This chapter clarifies the nature of floods in the the Volta River Basin and quantifies the damage caused by the 2018 flood to the agriculture sector in Burkina Faso and Ghana. The results revealed that more respondents in Ghana (91%) than those in Burkina Faso (69%) suffered from floods. Contrary to media reports that attributed the cause of those floods to the spillage from Bagre dam in upstream Burkina Faso, only 43% of the respondents in Burkina Faso and 34% of those in Ghana perceived the floods being caused by the dam spillage. In Ghana, a lack of flood control structures was another pressing matter. I also found that farmlands were inundated for more than 10 days. About half of the respondents in Burkina Faso (51%) and Ghana (49%) were not able to replant and harvest after the floods.

My assessment of the 2018 flood impact on crops, farm assets and livestock were statistically significant. The flood affected maize production most in Ghana with 0.53MT of maize damage per capita whereas rice was the most affected crop in Burkina Faso with 1.40MT of rice damaged per capita. In Ghana damages to livestock included 532 chicken, 516 guinea fowls, 185 goats, and 168 sheep drowned in flood water. Damage to farm assets was also severe in Ghana with 272 hoe and cutlass, 225 bags of fertilizer in-stock, and 12 water hoses washed away by flood water. In Burkina Faso, 21 hoe and cutlass, 342 fertilizer in-stock and 7 water hoses was washed away by flood water. These results mean that Ghana suffered most regarding damage to livestock. The amount of damage to crops, livestock and farm assets was statistically significant. This means that decreased agriculture production was largely caused by the 2018 flood. Particularly, the reduction in crop and livestock production placed heavy strains on the available food stock in the region. It further reduced the financial capital of flood victims.

Table 5.1 Paired sample t-test for crops, livestock, and farm asset

| Paired samples correlation | Ghana (p-value) | Burkina Faso (p-value) |
|---|---|---|
| (Crops) | | |
| Maize production | 0.000* | 0.000* |
| Rice production | 0.000* | 0.000* |
| Sorghum production | 0.000* | Insufficient data |
| (Livestock) | | Insufficient data |
| Cattle production | 0.000* | |
| Sheep production | 0.000* | Insufficient data |
| Goat production | 0.000* | Insufficient data |
| Chicken production | 0.530 | Insufficient data |
| Guinea fowl production | 0.445 | Insufficient data |
| (Farm asset) | | |
| Farm tools | 0.000* | 0.001* |
| Farm inputs in-stock | 0.000* | 0.000* |
| Irrigation equipment | 0.211 | 0.000* |

P≤0.05

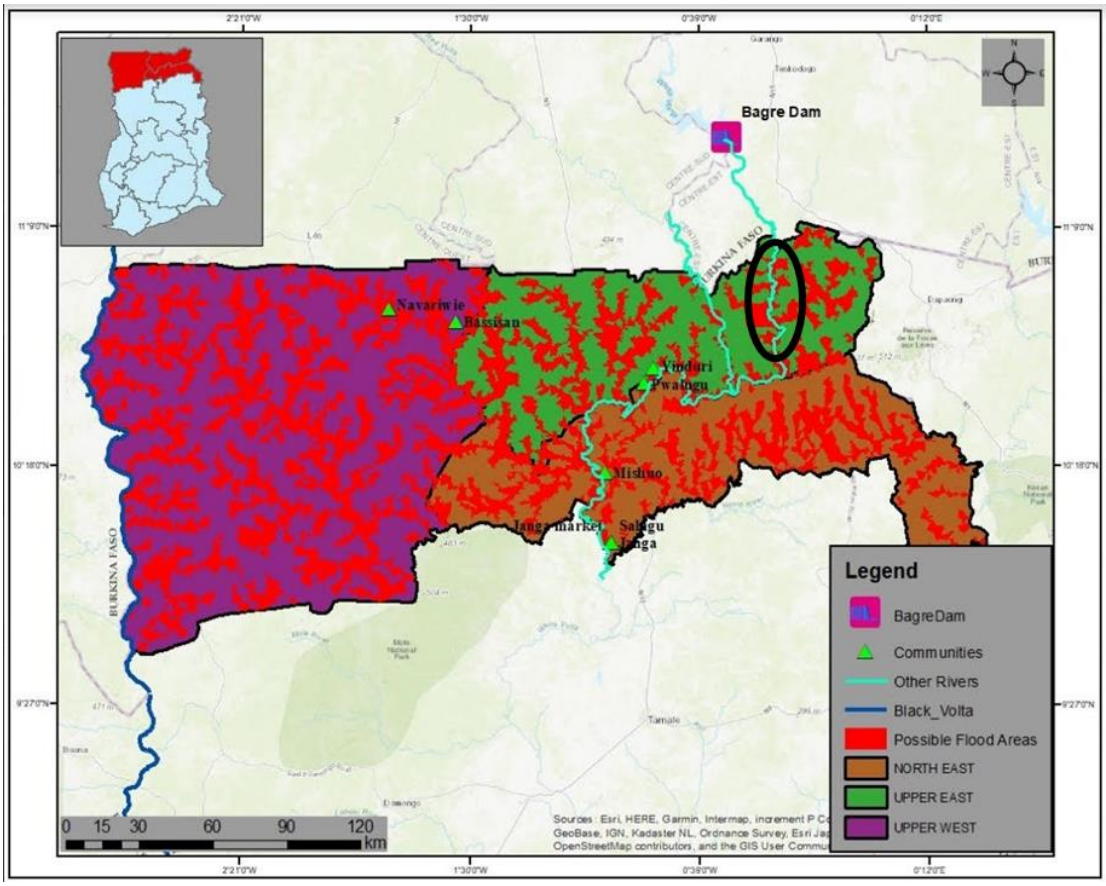


Figure 5.1 Bagre dam and potential flood prone areas in Ghana (circled in black).

(Adapted from Kansuk and Chimbar, 2019)

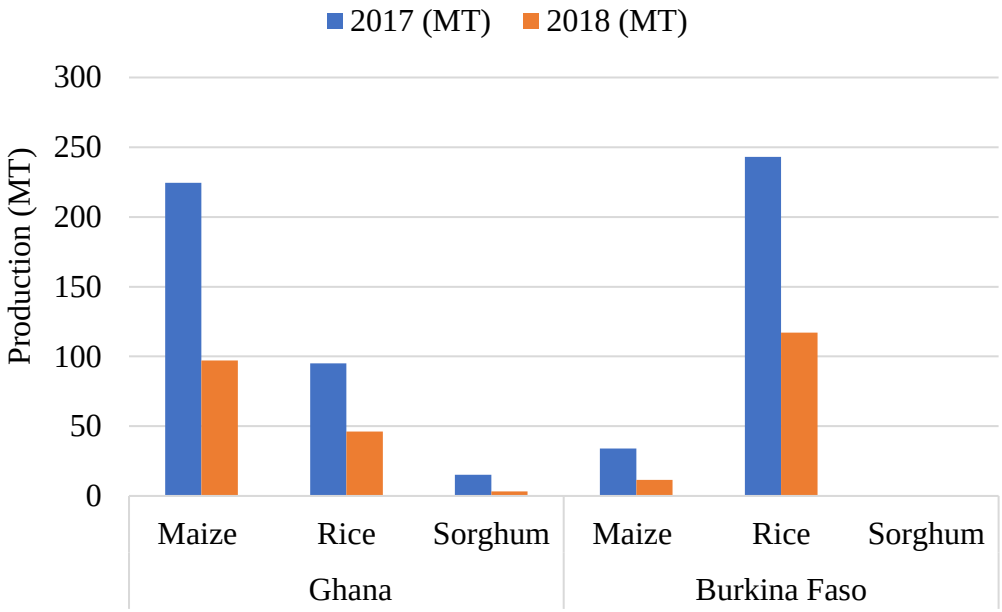


Figure 5.2 Crop production in the 2017 and 2018 cropping seasons.

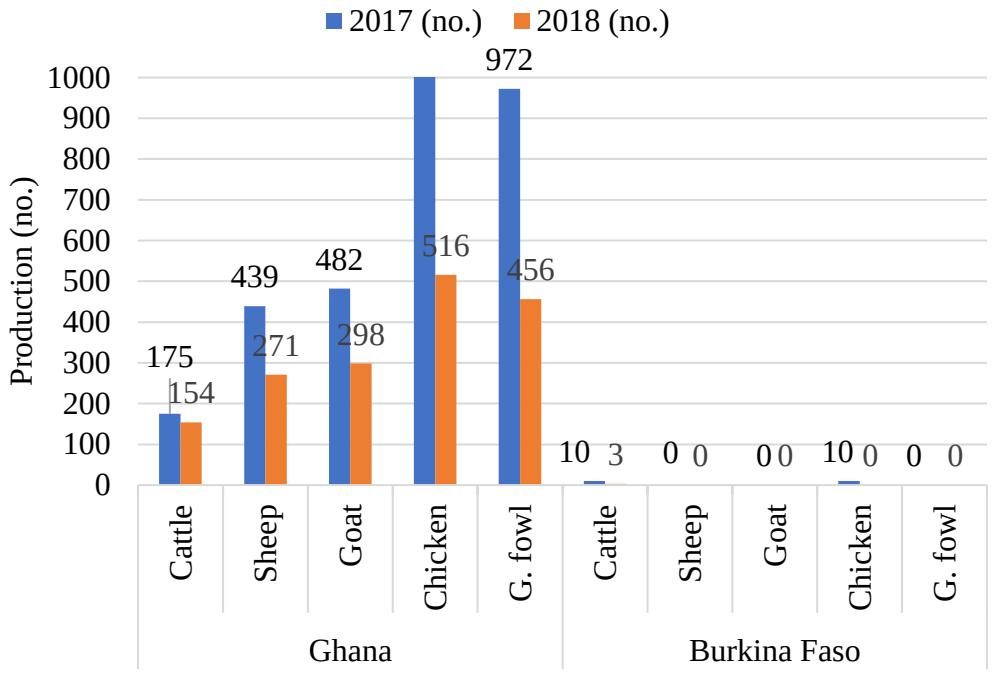


Figure 5.3 Livestock production in the 2017 and 2018 cropping season.

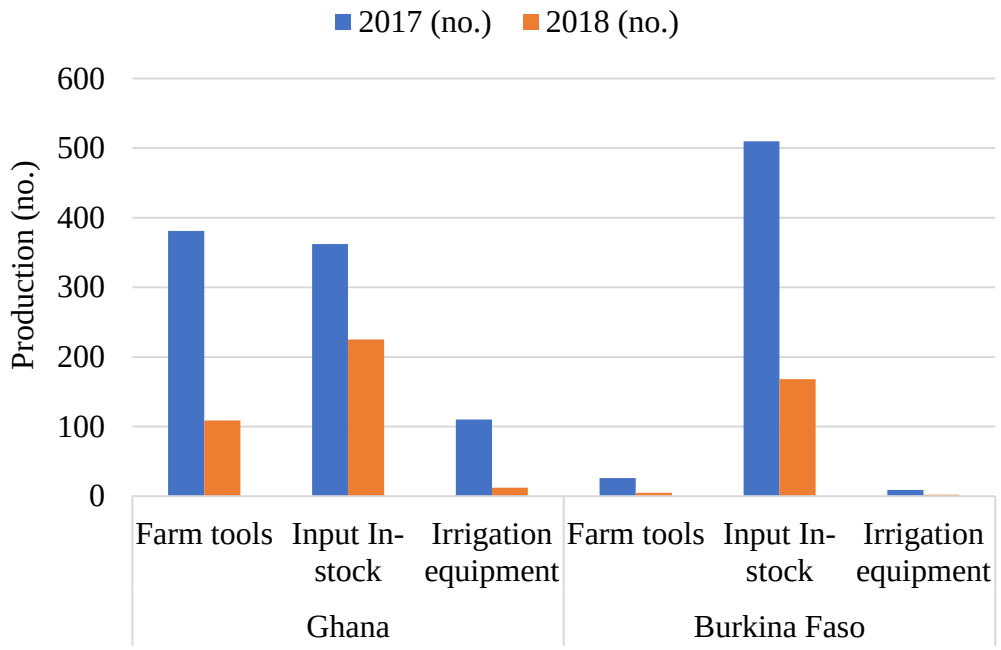


Figure 5.4 Farm asset in the 2017 and 2018 cropping season.

# Chapter 6 Conclusions and Recommendations

## 6.1 Conclusions

This research clarifies water governance inefficiencies in the Volta River Basin, an important water resource that support riparian livelihoods, provides hydroelectricity, and preserves flora and fauna in West Africa. My dissertation contributes to understanding the perceptions and knowledge of riparian communities about water governance issues in the Volta River Basin. It also assesses the effects of the recuring flood disasters on riparian communities in the basin by examining residents' experiences about the nature of the floods they experienced, and the damages they suffer on their agricultural activities. My research then proposes governance options to ensure riparian livelihoods and the water environment of the Volta River Basin are safeguarded. By ensuring sustainable water resource governance and riparian livelihood, the restoration and regeneration of ecological environment of the Volta River Basin is guaranteed for future generations. This research thereby contributes to achieving the sustainable development goals (SDGs) 1, 2, 6, and 15. It also contribute to water governance scholarship, highlighting water governance policies and practices in the West Africa sub-region. Overall, this research contributes to the sustainable development of the West African sub-region. The next section reiterates the objectives of my research, the conclusions drawn from previous chapters, and recommendations for policy redress.

Chapter 2 examines the extent to which transboundary water governance policies in the Volta River Basin addresses recurrent floods that continue to ravage riparian livelihoods and degrade the ecosystem. Chapter 3 sought to better understand riparian communities' awareness of critical water governance issues like the code of conduct, the VBA, and water governance challenges in the study area. Chapter 4 assesses water governance performance in the Volta River Basin from the perspectives of riparian communities with particular focus on public participation, transparency, gender equity and the quality of regulations. Chapter 5 examines flood disaster impacts on agriculture in the Ghana-Burkina Faso transboundary area within the Volta River Basin by quantifying the damage caused by the 2018 floods and determining whether the damage caused was statistically significant.

In chapter 2, I found that traditional water management in Ghana was replaced with the 1903 Rivers Ordinance of the Gold Coast. This could be responsible partly for today's unsustainable practices in this area. These practices include farming very close to the riverbank, water pollution from agro-chemicals, deforestation, and sand wining. The challenge here is how

the VBA can incorporate some workable traditional water management practices. I also found that most riparian states have not ratified the Volta Basin Water Charter. The tenet of good water governance largely remain recommendation to sovereign riparian nations without any legally binding repercussions for non-compliance. The Water Charter could provide the legally binding agreement in this Basin for the sustainable utilization and development of Volta Basin water resources. Furthermore, the Volta River Basin does not have a basin-wide flood management strategy. Also, no research have clarified the flood mechanism of the Volta River Basin. I therefore conclude that transboundary water governance policies have so far failed to address recurrent flood challenges in the Volta River Basin.

The results of chapter 3 revealed that most of the respondents from Burkina Faso (84%) and Ghana (91%) had no knowledge about the VBA and about their status as key stakeholders partly because the VBA operated as a top-down institution without engaging riparian communities. Level of education appeared to have affected respondents' awareness particularly in Ghana where those with senior high and tertiary education tend to be aware. This mean that most riparian community members were not aware of what they needed to know to contribute to ensuring sustainable water governance. I also found that the untimely information flow about spillage of excess water from the Bagre dam was perceived by the respondents in Ghana (96%) and Burkina Faso (97%) as the most important water governance challenge in the Volta River Basin. This finding suggest that the residents knew well about what challenges needed to be addressed to secure their livelihood, but they did not know how their voice can be represented on transboundary water governance matters.

In chapter 4, I found that public participation, transparency, and gender equity was perceived to be poor in Burkina Faso and Ghana. About half of the respondents in Ghana (52%) felt being left out from water governance whereas 39% in Burkina Faso, especially among males, felt involved in improving water governance. Majority of the respondents (90%) also acknowledged the existence of gender inequity in both countries regarding access to benefit sharing and participation in decision making. In Ghana, access to information (53%), easiness to understand water governance processes (55), and water managers' performance in enhancing stakeholder understanding of decision-making process (49%) was rated as high. In Burkina Faso, however, 59-65% of the respondents rated these transparency related issues as low.

In chapter 5, I found that less than half of the respondents in Burkina Faso (43%) and Ghana (34%) perceived Bagre dam spillage as the cause of floods somewhat contrary to media reports that blamed the dam spillage for the damage. In Ghana, a lack of flood control structures was perceived by some of the respondents (24%) to be the most pressing concern. Excess

rainfall was perceived by those in Burkina Faso (30%) as critical in managing the floods. These results show that riparian communities had knowledge about other technical issues like flood control structure and could cooperate in its establishment in future. I also found that about half of the respondents in Burkina Faso (51%) and Ghana (49%) were not able to replant and harvest after the floods. The most impacted crop by the 2018 floods in Ghana was maize. A total of 127.3 MT of maize (0.53 MT per capita) was perceived to be damaged. This translates to 5 bags of maize (100kg per bag) per capita maize damaged. In Burkina Faso, rice was most affected crop with a total of 126.2 MT of rice (1.40 MT per capita) was damaged. This is equivalent to 14 bags of rice per capita of rice damaged. The respondents in Ghana suffered most regarding damage to livestock including 532 chicken, 516 guinea fowls, 185 goats and 168 sheep drowned in flood water. Damage to farm assets was also severe in Ghana with 272 hoe and cutlass, 225 bags of fertilizer in-stock, and 12 water hoses washed away by flood water. The amount of damage described above for crops, livestock and farm assets in both countries was found to be statistically significant. These findings clearly reveal the significant reduction in food production by individual farmers which eventually affect national and regional food security.

### 6.2 Recommendations

From the above findings, I propose four areas to be improved to enhance transboundary water governance in the Volta River Basin in the future: (1) ratification of the Volta River Basin Water Charter; (2) basin-wide flood management strategy; (3) basin-wide communication strategy; and (4) enhanced water governance.

The VBA must ensure that all riparian states ratify the Volta Basin Water Charter. Its principles and obligations must be respected and honored by all riparian states. When ratified and adhered to, the Water Charter will serve as a legally binding instrument for strengthening cooperation among riparian states. The VBA may integrate past traditional water governance practices into the current water governance system. Also, the VBA should liase with the Ghana Hydrological Service department, the Centre for Scientific and Industrial Research of Ghana, and the Directorate-General for Hydraulics (DGH) in Burkina Faso to conduct research on the flood mechanism of the Volta River Basin to provide the needed technical information for the sustainable management of future floods. Particularly, research should clarify the ‘run off-cycle’, and the appropriate time period when run off triggers flood (response time). This information should be communicated in simple language for all stakeholders (especially riparian communities) to understand in order to adequately prepare for future floods. The VBA

can solicit the support of international development partners like the World Bank Tokyo Disaster Risk Management Hub in Japan for technical assistance in this regard.

I also recommend that the Volta Basin Authority should establish a basin-wide flood management strategy. It can learn from good practices of the International Commission for the Protection of the Rhine and the Mekong River Basin Commission that implemented the Flood Risk Management Plan and the Flood Risk Management and Mitigation Strategy in the Rhine and Mekong River Basin, respectively. As an immediate step, the VBA can harness and integrate lessons and resources from piloted early warning systems in the basin like the WIS-Volta, GIS-Volta and FEWS-Volta in Ghana and the NIS water forecast system of the General Directorate of Meteorology, the Integrated Food Security System (SISA), and the Burkinabe Red Cross Early Warning System in Burkina Faso into a workable flood risk mitigation strategy. This will help enhance basin-wide early warning for flood management. The VBA can also develop a project to demarcate and enforce a buffer zone by-law for flood control.

Furthermore, I recommend that the VBA institute a permanent communication plan to regularly engage with stakeholders about its responsibilities and actions. VSIP (2015-2024) phase 3 of the Volta Basin Water Charter promotes the production of communication and educational materials (Sadieau, 2019). The VBA should take advantage of the funding and logistics provided under this project to establish a permanent local communication structure.

To improve the literacy level of the respondents which tended to affect awareness, I recommend that riparian states ensure to provide at least junior high school education to all residents. For adult and elderly populations, non-formal education programs, community durbars, mosques, churches, and local chiefs (town cryer) may play important roles in better educating the people.

To enhance transparency, gender equity and public participation in water governance, I propose that the VBA establish local transboundary committees among all riparian communities. The committee can promote further engagement of residents in water governance. Special attention should be given to flood protection policies. This can be achieved by engaging all representation (youth, the physically challenged, women, and men, farmers, fishers, etc.) from local communities. More women should be purposely engaged in local transboundary water governance committees and other water governance programs to improve their participation. Riparian communities can also form Community River Basin Associations (CRBAs) to advocate for equitable, transparent, and participatory decision-making in water governance. The VBA must also work with riparian states and their communities to improve

information flow among all stakeholders, especially riparian communities and all state departments that are engaged in water resource management. Particularly, riparian community representation should be an integral part of the VBAs' decision-making body since they are the victims of the flood disaster.

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## Appendices

Appendix 1. Cross-tabulation on gender, riparian awareness of VBA, being key stakeholders and the code of conduct

| Cross-tabulation | Response | Gender (Ghana) | | Gender (Burkina Faso) | |
|---|---|---|---|---|---|
| | | Male | female | male | female |
| Are you aware of the VBA? | no | 86 | 48 | 35 | 41 |
| | yes | 10 | 3 | 10 | 4 |
| Sub-Total | | 96 | 51 | 45 | 45 |
| Are you aware you are a stakeholder of the VBA? | no | 86 | 48 | 38 | 44 |
| | yes | 10 | 3 | 7 | 1 |
| Sub-Total | | 96 | 51 | 45 | 45 |
| Have you heard about Code of conduct for cooperation between Ghana and Burkina Faso? | no | 83 | 48 | 15 | 13 |
| | yes | 13 | 3 | 29 | 31 |
| Sub-Total | | 96 | 51 | 44 | 44 |

Appendix 2. Cross-tabulation on level of education, riparian awareness about VBA, code of conduct and status as key stakeholders

| Cross-tabulation | Response | Education (Ghana) | | | | | Education (Burkina Faso) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | no formal education | JHS | SHS | Tertiary | Primary | no formal education | JHS | SHS | Tertiary | Primary |
| Are you aware of the VBA? | no | 83 | 17 | 11 | 1 | 22 | 51 | 6 | 3 | 3 | 13 |
| | yes | 1 | 0 | 6 | 4 | 2 | 4 | 3 | 1 | 1 | 5 |
| Sub-total | | 84 | 17 | 17 | 5 | 24 | 55 | 9 | 4 | 4 | 18 |
| Are you aware you are a stakeholder of the VBA? | no | 83 | 17 | 11 | 1 | 22 | 54 | 6 | 3 | 2 | 17 |
| | yes | 1 | 0 | 6 | 4 | 2 | 1 | 3 | 1 | 2 | 1 |
| Sub-total | | 84 | 17 | 17 | 5 | 24 | 55 | 9 | 4 | 4 | 18 |
| Have you heard about Code of conduct for cooperation between Ghana and Burkina Faso? | no | 80 | 16 | 12 | 1 | 22 | 14 | 4 | 2 | 1 | 7 |
| | yes | 4 | 1 | 5 | 4 | 2 | 39 | 5 | 2 | 3 | 11 |
| Sub-total | | 84 | 17 | 17 | 5 | 24 | 53 | 9 | 4 | 4 | 18 |

Appendix 3. Cross-tabulation on years of residency, riparian awareness as key stakeholders and the code of conduct

| Crosstabulation | Response | How long have you lived along the Volta River? | | | | Total |
|---|---|---|---|---|---|---|
| | | 5-10 | 11-20 | 21-30 | 31-40 | |
| Are you aware you are a stakeholder of the VBA? | no | 6 | 47 | 22 | 7 | 82 |
| | yes | 3 | 3 | 2 | 0 | 8 |
| Sub-total | | 9 | 50 | 24 | 7 | 90 |
| Have you heard about Code of conduct for cooperation between Ghana and Burkina Faso? | no | 3 | 20 | 2 | 3 | 28 |
| | yes | 5 | 29 | 22 | 4 | 60 |
| Sub-total | | 8 | 49 | 24 | 7 | 88 |