

The White Volta Basin, Climate Change and Food Security: Perspectives of Riparian Communities in Northern Ghana

Asaah Sumaila Mohammed¹, Emmanuel Kanchebe Derbile² and Musah Ibrahim Mordzeh-Ekpampo¹

1. Department of Community Development, University for Development Studies, P.O. Box UPW 3, Wa, Ghana

2. Department of Planning and Management, University for Development Studies, P.O. Box UPW 3, Wa, Ghana

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Abstract: This paper has examined how the resources of the White Volta River are enhancing food availability for riparian communities in northern Ghana despite climate change and its associated effects on food security. Using participatory methods such as focus group discussions and interviews, data was collected from households and institutions in three riparian communities. The result of the study indicates that, all things been equal, cultivation of food crops along the river bank in the rainy season gives significantly high yields as compared to yields from farms farthest from the river under rain fed agriculture. Higher organic content and moisture retention capacity of river bank soils explains the yield differential and adaptability to climate change. In addition, farmers now irrigate cereal crops which were hitherto, reserved for only rainy season production. However, inappropriate irrigation practices are accelerating erosion and sedimentation of the river and thus, threaten the sustainability of agriculture and food security in the White Volta Basin. The paper therefore, recommends the adoption of IWRM (integrated water resources management) and the participation of local communities, Government and Civil Society organisations for sustaining the productive capacity of the White Volta Basin for enabling adaptation of agriculture to climate change in the riparian communities of the basin.

Key words: Food security, northern Ghana, riparian communities, White Volta.

1. Introduction

The Volta River Basin, in which the White Volta is a sub-basin, is characterized by unpredictable rainfall patterns with perennial water shortages [1, 2]. The basin is one of the poorest watershed areas of Africa and the ninth largest river basin in sub-Saharan Africa, traversing six riparian countries, namely, Ghana, Togo, Burkina Faso, Côte d'Ivoire, Benin and Mali [3, 4]. In the White Volta sub-basin, rain-fed agriculture is becoming more precarious and less reliable under climate change and the ensuing variable precipitation. In northern Ghana for instance, historical data from 1961 to 2000 clearly show decrease in mean annual rainfall and poor distribution [2]. The increasing

variability of rainfall increases the risk associated with farming as prediction becomes almost impossible. Since total rainfall amounts are projected to fall, crop production will experience declines aided by non-climate drivers such as soil degradation, land tenure arrangements, poor technology and poverty [5, 6]. The change in the climatic conditions has deepened farmers' vulnerability to poverty and has further enhanced the process of land degradation and desertification. The increasing frequency of droughts reduces biodiversity; while low levels of rainfall, high temperatures and winds exacerbate bush fires. This has been noted to have effects on all the pillars of food security in northern Ghana—food availability through production and markets, food access through market access and income, and food utilization [7, 8].

Corresponding author: Asaah Sumaila Mohammed, master, main research field: community livelihoods. E-mail: mohammedasaah@yahoo.com; asaahuds@gmail.com.

As it is becoming increasingly difficult for successful rain-fed agriculture in the northern Ghana due to climate change and poverty, many suggestions have been made to explore the opportunities of the White Volta in northern Ghana. Although the river has a great development potential, presently the main water use is limited to hydroelectric power generation with less than 1% for irrigation [9]. The GLOWA (Global Change and the Hydrological Cycle) Volta Project reported that improved agricultural production and income in the West African savannah depends on the development and effective use of surface water resources. This study therefore takes it from this view to examine how the resources of the White Volta Basin are enhancing agricultural production and in three riparian communities of the White Volta River in northern Ghana [9].

1.1 River Basins and Livelihoods

River basins are renowned as the cradles of civilization and cultural heritage [10]. Historically, flood plains have been preferred places for human settlement and socio-economic development because their proximity to rivers guarantees rich soils, abundant water supplies and means of transport. Also, flood plains replenish wetlands, recharge groundwater and support fisheries and agriculture systems [10]. Ancient and modern communities alike have depended on rivers for livelihood, commerce and production of goods and services. Remains of water storage dams are found in Jordan, Egypt and other parts of the Middle East date to at least 3000 BC. Dams and aqueducts built by the Romans to supply drinking water and sewer systems for towns still exist today [11, 12]. In contemporary times many nations and communities use river resources for many activities, mainly for livelihood. According to the African River Initiative, over 20 million people in central Africa depend on the resources of the Lake Chad for irrigation and pastoralism which constitute to their livelihood, and this figure is expected to increase

to 35 million by 2020. The Africa River Initiative also found that the Zambezi river and its basin is home to over 38 million people who are engaged in a wide range of uses from agriculture and livestock grazing, to provision of freshwater and fish—the river further supports millions of livelihoods directly and indirectly across southern Africa [13]. In the Nile River, local communities fish and navigate its waters. Ferries and barges navigate between Aswān and Qīnā in Egypt, between the third and fourth cataracts in northern Sudan, from Juba to Kūstī in southern Sudan, and on Lakes Nasser and Victoria. Principal river ports are Luxor and Aswān in Egypt and Wādīalfā', Dunqulah, Kuraymah, Kūstī, Malakāl and Juba in Sudan. Tourism is important around ancient Egyptian sites near the river, such as Al Karnak and the pyramids at Giza [9, 13].

In the Volta River Basin, the survival of the over 50 ethnic groups from Ghana, Burkina Faso, Mali, Cote d'Ivoire, Benin and Togo is based largely on the basin's resources [14, 15]. In parts of the Basin in Ghana, riparian communities are engaged in both rain-fed and irrigated agriculture, livestock production, fishing and river transportation [5, 16]. In the Yeji area of the middle Volta basin for instance, irrigation, livestock rearing and river transportation are the main livelihood activities of the inhabitants [17, 18]. Titriku [6] notes that agriculture is the principal industry within the Volta Basin and its practice follows the general pattern of agricultural land use in Ghana. Agricultural activities within the basin fall under four major land use or land utilisation types namely: rain-fed agriculture, irrigated agriculture, livestock rearing and fishing. Titriku [6] further observed that the basin has a high potential for the production of food crops and livestock in Ghana and Burkina Faso. In the Lower Volta basin comprising parts of the Ho-Keta Plains, Titriku [6] asserted that livestock rearing constitutes a very important agricultural activity. Agriculture production in the area, however, has peculiar problems mostly relating to land degradation and

general production constraints. In spite of the vast areas in the basin suitable for irrigated agriculture, there are only a few schemes dotted along the lake especially in Ghana [6]. In Burkina Faso, however, research has shown that the irrigation potentials of the basin have been fairly exploited. About 1,500 small and large dams have been constructed at various locations in the basin in Burkina Faso [16]. In Burkina Faso the damming of the Nakembe (White Volta) at Zabre and Bagre has intensified irrigation and livestock rearing among the riparian communities [16]. Meanwhile, in the lower Volta basin particularly at Mepe and Sokpoe, the construction of the Akosombo dam profoundly affected the sources of livelihood of the riparian communities [5]. Food crop farming and fishing have been in a state of crisis in the Lower Volta area since the construction of the dam. The cessation of the floods of the Volta River meant that patterns of livelihoods constructed around the cycle of seasonal flooding were compromised. Fishing in the main river, which in the pre-dam period was a major subsistence activity, went into decline soon after a post-dam boom. Indeed, some of these impacts are common to downstream communities of large dams the world over [5, 19].

Despite the fact that livelihoods activities are flourishing in many parts of the basin, some of the activities turn to pose threats to the sustainability of the river [20]. Irrigation practices along the basin are very inefficient and tend to accelerate erosion and sedimentation in many parts of the river and flood plains. Increased erosion and sedimentation reduce infiltration and the flow of the River. This coupled with competition for scarce water and land may contribute to increased poverty and insecurity in the area [16, 20].

1.2 Climate Change and Food Security in Ghana

The Volta Basin is a climate-sensitive semi-arid to sub-humid region in West Africa. Between 1991-2000 and 2030-2039 the regional climate simulations show an annual mean temperature increase by 1.2 °C to 1.3 °C and precipitation from 20% to +50% in the Volta Basin. In the rainy season rainfall predominantly increases, whereas a strong decrease is found for April, which is connected to a delay in the onset of the rainy season. In addition, inter-annual variability in the Volta Basin increases in the early stage of the rainy season [21]. Minia also observed that historical data for Ghana from the year 1961 to 2000 clearly show a progressive rise in temperature and decrease in mean annual rainfall in all the six agro-ecological zones in the country (shown in Table 1). Climate change is manifested in Ghana through: (1) rising temperatures; (2) declining rainfall totals and variability; (3) rising sea levels; and (4) high incidence of weather extremes and disasters. The average annual temperature has increased 1 °C in the last 30 years. Based on this data, it is estimated that temperature will continue to rise on average by about 0.8 °C, 2.5 °C and 5.4 °C by the year 2020, 2050 and 2080, respectively. Rainfall is also predicted to decrease in all agro-ecological zones [2].

It has become evident that climate change is real and presents additional obstacles to ending poverty and achieving social justice. Rising temperatures, increasingly erratic rainfall, and more frequent and severe floods, cyclones and droughts all have significant consequences for the livelihood and food security of poor people [15]. Climate change will affect all four dimensions of food security: availability, accessibility, stability, and utilisation. It will reduce

Table 1 Scenarios of mean annual change in rainfall (%) for ecological zones [2].

Year	Sudan	Guinea	Transitional	Deciduous rainforest	Rainforest	Coastal Sav
2020	-1.1	-1.9	-2.2	-2.8	-3.1	-3.1
2050	-6.7	-7.8	-8.8	-10.9	-12.1	-12.3
2080	-12.8	-12.8	-14.6	-18.6	-20.2	-20.5

food availability, because it negatively affects the basic elements of food production-soil, water and biodiversity. Rural communities face increased risks including recurrent crop failure, loss of livestock and reduced availability of fisheries and forest products. Changing temperatures and weather patterns furthermore create conditions for the emergence of new pests and diseases that affect animals, trees and crops. This has direct effects on the quality and quantity of yields as well as the availability and price of food, feed and fibre. At the same time, more extreme weather events will have serious impacts on livelihood assets in both rural and urban areas and threaten the stability of food supply. Competition over increasingly scarce resources will also increase the risk of conflicts, displacement and migration, which in turn will again increase the risk of food insecurity [15].

In the Volta Basin of Ghana Owusu and Waylen [8] have observed that climate change has impacted on all the major sectors of the economy. Agriculture which is the largest employer of the Ghanaian economy suffers the most from climate change. The increasing variability of rainfall increases the risk associated with farming as prediction becomes almost impossible. Since total rainfall amounts are projected to fall, crop production will experience declines aided by non-climate drivers such as soil degradation, land tenure arrangements and poor technology [8]. In major parts of the Volta Basin, agricultural production is predominantly rain-fed and any changes in rainfall pattern would have serious impact on productivity. Current projections on climate indicate that rising temperatures and decreasing rainfall will exacerbate drought conditions and bushfires. The fluctuations in climatic conditions have created a dismal picture of agriculture upon which the livelihood of most farmers in the basin depends. The changes in the climatic conditions have, therefore, deepened their vulnerability to poverty and have further enhanced the process of land degradation

and desertification [7].

2. Material and Methods

2.1 The Study Area and Population

The author conducted study in Sapeliga, Timonde and Mognori which are riparian communities of the White Volta sub-basin in northern Ghana. Agriculture is the dominant occupation of the people of the area, accounting for about 80% of the total employment. Farm sizes range between 1 and 2 hectares as a result of high population density. Yields are very low as compared to other parts of the country due to poor soils and unreliable rainfall. Also farmers are not able to get enough organic manure or purchase chemical fertilizers. These factors, coupled with the fact that farming is predominantly undertaken by older men and women, lead to food shortages in the area [22].

2.2 Data Collection and Analysis

Three data collection tools were largely used. Questionnaires were used to conduct face-to-face interviews with household heads in the three. The questionnaire solicited information on the type of livelihood activities undertaken along the river and how the river resources are enhancing those livelihoods activities. FGD (focus group discussions) were held with representatives of various identifiable farmer groups. An average number of eight people participated in each of the focus group discussions. Key informant interviews were also held with government and non government organization working on livelihood issues. Institutional heads or their representatives were the targets for the interviews. The data from the field was processed and edited. The questionnaire was coded and entered into the Statistical Package for Social Science (SPSS version 16). Qualitative data in the form of notes and tape recordings were transcribed and analysed thematically.

3. Results and Discussion

3.1 The River Resources and Rainy Season Farming

The study found that farm lands located near the river plains give comparatively higher crop yield than those located far from the river plains. Table 2 demonstrates results of the mean differences of crops that are cultivated close to the river as against those distant from the river plains.

Result in Table 2 shows difference in mean yields between crops cultivated along the river and those cultivated distant from the river. For example when a farmer cultivates rice along the river during the rainy season he or she would gain about 5.4 bags per acre extra than when he or she cultivates the same crop distant from the river.

A farmer lamented during focus group discussion that: “My rice and maize farms located along the river produce about 11 bags per acre and 7 bags per acre respectively, and this yield far exceeds yield from my farm land located away from the river which gives me only 7 bags per acre of rice and 3 bags per acre of maize”.

The contributions of the river resources in enhancing rainy season cropping have a myriad of developmental implications. Of course, poverty is the overriding problem of development in the entire Upper East Region in which the Bawku area is a part. Eight out of ten people are considered poor in the area [23]. Even though several reasons account for poverty in the area, the outstanding causes are low agricultural production,

steaming largely from erratic rainfall and poor market for agricultural products (23). Therefore, improved crop yield along the river in the rainy season invariably is a great assurance of food security in the riparian communities. This finding confirms with other research conducted by PAGEV (Projet d’Ame’lioration de la Gouvernance de l’ Eau dans le basin de la Volta/Project for Improving Water Governance in the Volta Basin) which found that the White Volta River resources have great potential for reducing poverty in the riparian communities. The finding implies that with one rainy season and unreliable rain-fed agriculture in the communities, the management of the White Volta water resources could contribute immensely to poverty reduction.

3.2 The River Resources and Dry Season Farming

Dry season gardening is a major livelihood activity undertaken along the White Volta in the riparian communities. Even though a traditional activity, its current levels of intensity was attributed to the new hydrological regimes in Burkina Faso which have resulted in constant flow of water in the river. The study found that many households and individuals have resorted to dry season gardening as an alternative livelihood to the unreliable rain-fed cropping. A 60-year old irrigation farmer lamented: “We cultivate crops in the rainy season however; we normally face droughts and or floods leading to crops failure. As a result we have resorted to dry season irrigation for income generation and food security”.

Table 2 Mean yields of crops near the river (100 m to 1 km) and distant (over 1 km) from the river plains.

Type of crop	Location of farm	Mean yield in bags (84 kg) per acre	Average achievable yield in bags (84 kg) per acre
Guinea corn	Near to river	5.7	7
	Distant from river	3.1	
Maize	Near to river	7.3	8
	Distant from river	3.4	
Millet	Near to river	6.2	7
	Distant from river	3.1	
Rice	Near to river	10.2	12
	Distant from river	4.8	

Source: field survey 2011.

Table 3 Mean yield of crops irrigated in the dry season and those cultivated in the rainy season.

Type of crop	Season	Mean yield in bag (84 kg) per acre
Rice	Dry season irrigated	13.2
	Rainy season cultivated	10.2
Maize	Dry season irrigated	10.7
	Rainy season cultivated	7.3

Source: field survey, 2011.

One remarkable development in dry season gardening is the cultivation of some cereal crops such as rice and maize which were hitherto cultivated only under rain-fed. The research found that the mean yield of rice and maize irrigated per acre is higher than when they are cultivated under rain-fed. Table 3 shows the difference of mean yield per acre of rice and maize irrigated and those cultivated under rain-fed agriculture.

Result from Table 3 demonstrates a difference between the mean yields of rice and maize irrigated and those cultivated in the rainy season. This finding has great implications for food security in the communities. These food crops often fail during the rainy season due to irregular rainfall [15]. This therefore implies that if farmers' capacities are enhanced to irrigate these and other food crops, it would save the communities from perennial food shortage. Perennial food shortage is a major cause of poverty in the northern sector of Ghana [23].

3.3 Effects of Current Livelihood Activities on River Sustenance

Whiles livelihood activities in the river are proven to support crop yields in the era of climate change several concerns have also been raised about some of the livelihood practices that are inimical to the sustenance of the rivers. The White Volta Basin Office of the Water Resources Commission has noted that the river is seriously under threat by unapproved practices such as deforestation along the river, sand winning and farming very close to the river. These practices have led to siltation and low flow of the river especially during the dry season. The recent and frequent floods on the river have largely been

attributed to these activities. Institutional collaboration and information sharing is weak among the main agencies whose operations have impact on the river. For instance, MOFA (Ministry of Food and Agriculture) has been supporting farmers in the riparian communities to conduct farming along the river. However, no collaboration in terms of information sharing exists between MOFA and the White Volta Office to ensure that regulations regarding limits of farming along the river are adhered to. MOFA continues to support farmers with water pumping machines with holes which are shorter than the allowable limits of farming close to the river.

In order to sustainably utilize and manage the river resources, IWRM (integrated water resources management) approach is being suggested by the White Volta sub-Basin management unit of the Water Resources Commission of Ghana. IWRM approach allows for effective collaboration of all actors in the Basin. Even though initial challenges of non cooperation exist in some riparian communities, the Basin management authorities are optimistic of successful implementation of the IWRM approach in the White Volta sub-Basin in Ghana.

4. Conclusions

The study concludes that the presence of the White Volta River contributes to food security through improvement of crop yield in the rainy season and enhanced irrigated agriculture. All things been equal, cultivation of food crops along the river bank in the rainy season gives significantly high yields as compared to yields from farms farthest from the river under rain fed agriculture. Higher organic content and moisture retention capacity of river bank soils explains the yield differential and adaptability to

climate change. In addition, farmers now irrigate cereal crops which were hitherto, reserved for only rainy season production. It is however been noticed that inappropriate farming practices are accelerating erosion and sedimentation of the river and thus, threaten the sustainability of agriculture and food security in the White Volta Basin. IWRM and participation of local communities, government and civil society organisations is therefore necessary for sustaining the productive capacity of the White Volta Basin for enabling adaptation of agriculture to climate change in the riparian communities of the basin.

By implication, policy planning for the development of the Bawku area should consider enhancing livelihood activities along the river and also regulating their operations to ensure sustenance of the river resources. It is further recommended that similar researches in other riparian communities are conducted to make inform conclusions that will aid in the design of policies towards effective utilization of the basin resources for sustainable livelihoods in Ghana.

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