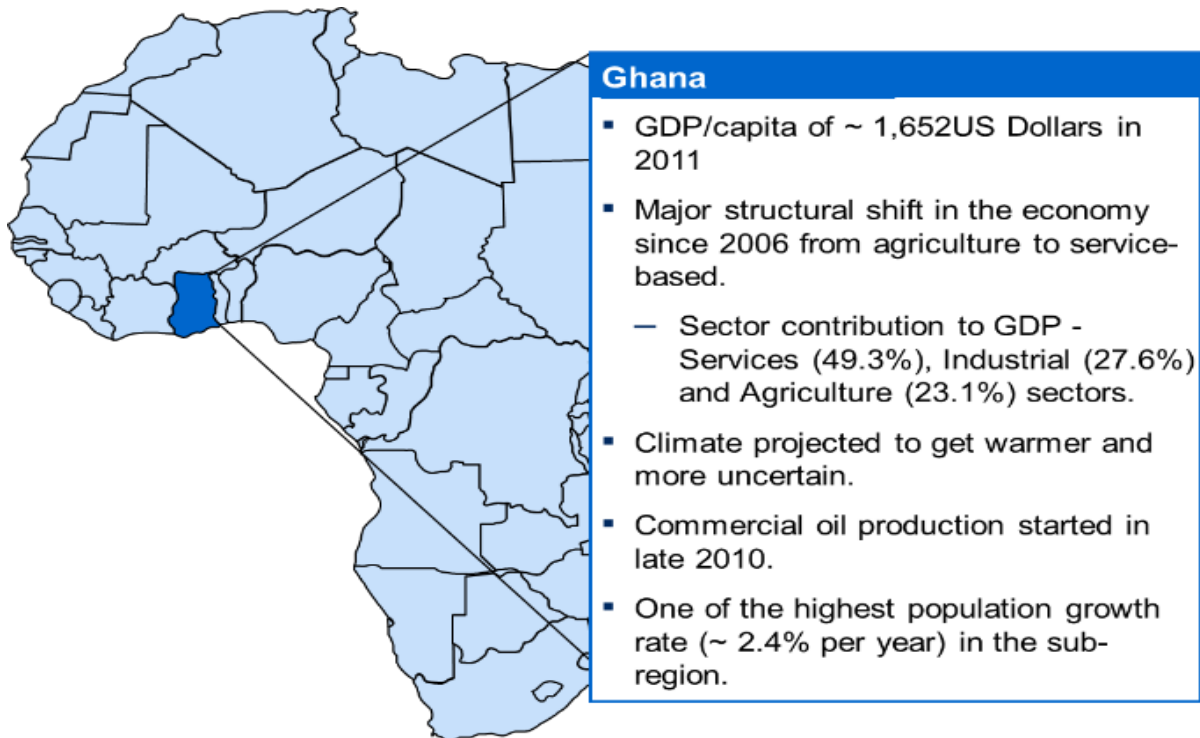


## COUNTRY LEVEL IMPACTS OF CLIMATE CHANGE (CLICC) PILOT PROJECT- GHANA

### National Circumstances: Major Developments Since 2006

Ghana's population has tripled, from 6.7million in 1960 to 24.9million in 2010 with nearly 52% living in urban areas. About a quarter (6mi) of the total population of Ghana live along coastline of Ghana (about 565km). The population is projected to double its current size by 2040.



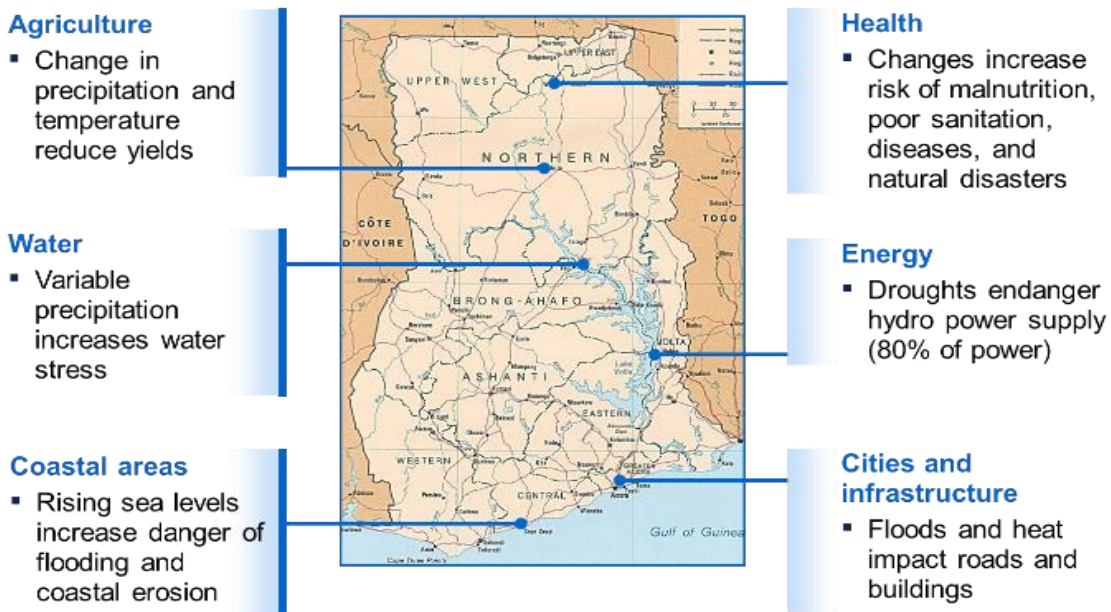
The Agriculture sector value added contribution to the economy has comparatively dominated at an average of more 45% since 1960. However, since 2006, there has been a remarkable shift to the services sector which is currently at 49.3%. Indications are that the services sector is likely to continue to dominate economy

### Climate Profile

Ghana's climate is tropical and strongly influenced by the West Africa Monsoon winds. The climate is generally warm with variable temperatures with season and elevation. Except in the northern part of the country, two rainy seasons occur from April to July and from September to November. In the north, the rainy season begins in May and lasts until September. Generally, the highest temperatures occur in March and the lowest in August

The mean annual temperature in Ghana is projected to increase by 1.0 to 3.0°C by the 2060s, and 1.5 to 5.2°C by the 2090s. The projected rate of warming is most rapid in the northern inland regions of Ghana than the coastal regions. Most projections indicate decreases in the frequency of days and nights that are considered ‘cold’ in current climate. ‘Cold’ days and nights will occur on less than 3% of days by the 2090s

Ghana is especially vulnerable to climatic risks due to a combination of frequent natural disasters (flooding, windstorms, heat spells), high population density, draught poor infrastructure and low resilience to economic shocks. The impacts are manifested extensively in the productive economics sectors (agriculture, water resources, and fisheries). Multiple adaptation challenges are defined by geographic spread and unique vulnerabilities. Sector vulnerable to the impacts of climate change are given below:



## Scope and Objective of CLICC Ghana Pilot

### i. Objective

Ghana intends to achieve the following main objectives during the CLICC pilot implementation period;

- To enhance national understanding of climate impacts by aligning the CLICC reporting framework with other climate change reporting processes such as the national communications
- To understand how the CLICC process can support technical capacity building in country to address climate change impact

In addition to the above specific objectives, Ghana intends to explore lessons learned on climate change adaptation from line ministries, departments and agencies and see how these lessons and experiences could be shared with the CLICC pilot countries.

Specifically, the project aims to:

- Collate and synthesize climate data and information using existing country data and information
- Build institutional capacity on the science of climate impacts
- Share information on impacts and vulnerabilities

ii. Scope of work

Available in-country information and data indicate that about seven sectors of Ghana's economy are climate sensitive. These sectors include; agriculture, water resources, energy, coastal systems, recreation and tourism, health and urban systems. The ideal thing is to look critically at these seven sectors holistically because they are not mutually exclusive. However, looking at the limited amount of time, financial and technical resources available in country for the CLICC pilot phase, Ghana will report on the three sectors below;

1. Agriculture and food security
2. Water resources
3. Human health


Bear in mind that Ghana reports on rainfall and temperature as crosscutting climate risks factors for climate impacts in the country due to the reliance of almost all the key sectors of the Ghanaian economy on climate. In other words, we are reporting that all the key sectors of the economy are climate dependent and this is especially so for the three sectors which have been chosen for the CLICC pilot reporting.

The CLICC templates are the result of a pilot study designed to test the feasibility of presenting country-level climate impacts information in a consistent and transparent manner. These CLICC pilot products are just the start of the CLICC process. The CLICC template is under continuous development and will improve over time.

Observed climate impacts							
Sector	Observed impacts	Global impact rating	National impact rating	Confidence rating	Data quality rating	Time	Metadata identifier(s)
Agriculture and food security	<ul style="list-style-type: none"> <li>Erratic rainfall pattern has affected cocoa yields. The observed annual total rainfall in the cocoa growing regions of Ghana is less than 2000mm</li> <li>Increased drought in certain parts of the country especially in the Northern region</li> <li>Reduction in root and tuber production due to increased temperature</li> <li>Observed increased in the population of pests and disease like variegated grasshoppers</li> <li>Increased variability of marine fish stock</li> <li>Observed reduction in fresh fish catch from both inland and marine water</li> </ul>	Low-medium	High	High	High	1961-2008	1.1
		Low	High	High	High	<50 years observation	1.1.1
		Low	High	Medium – high	High	1960-1990	
		Low	Medium	Medium	High	Baseline data not available	1.1.1A
		Low	High	Medium-high	High	Baseline data not available	
Water resources	<ul style="list-style-type: none"> <li>Observed excessive surface run-off</li> <li>Observed salt intrusion of fresh water along the cost, especially the eastern coast of Ghana</li> <li>Observed persistent dwindling of water</li> </ul>	Low	High	High	Medium		2.1
		Low	Medium	High	Medium		
		medium	High	High	High	1961-1990	2.1

Observed climate impacts							
Sector	Observed impacts	Global impact rating	National impact rating	Confidence rating	Data quality rating	Time	Metadata identifier(s)
	volume in rivers and aquifers including the main hydro-power dam of Ghana						
Human health	<ul style="list-style-type: none"> <li>Observed increase in the incidence of meningitis in the north part of the country</li> <li>High guinea worm infestation occurs in August where rainfall amount is 80.9 mm. Low guinea worm cases occur in high rainfall months.</li> </ul>	Low	Medium	Medium-high	Medium	1999-2004  1999-2004	3.1

Projected climate impacts						
Sector	Projected climate impacts	Impact rating	Confidence rating	Data quality rating	Time	Metadata identifier(s)
Agriculture and food security	<ul style="list-style-type: none"> <li>Mean temperature is projected to increase by 1.0 – 3.0°C by 2060 and 1.5 -5.2°C by 2090</li> <li>Hot days and nights are projected to rise. Hot days will occur 18-59% of days by 2060</li> <li>Rainfall is projected to show both increase and decline. Projected changes in 1 and 5 day rainfall maxima trend towards increases, but projection ranges towards increase and decrease in all seasons</li> </ul>	High	Medium-high	Medium-high	1960-2000 as baseline	1.1
		High	Medium-high	Medium-high	1960-2000	
		High	Medium-high	Medium-high	1960-2000	
			Medium-	Medium-		

Projected climate impacts						
Sector	Projected climate impacts	Impact rating	Confidence rating	Data quality rating	Time	Metadata identifier(s)
	<ul style="list-style-type: none"> <li>Scenarios of sea level changes with respect to 1999 mean, predicts an average rise of 5.8cm, 16.5cm and 34.5cm by 2020, 2050 and 2080 respectively</li> <li>Cassava productivity or yields are expected to reduce by 3%, 13.5% and 53% in 2020, 2050 and 2080 respectively</li> <li>Projected percentage reductions in cocoyam productivity are 11.8%, 29.6% and 68% in 2020, 2050 and 2050 respectively</li> </ul>	High  Medium  Low	high  Medium-high  Medium-high	high  Medium-high  Medium-high	1999  1961-2008 as baseline  1960-1990 as baseline for projections	
Water resources	<ul style="list-style-type: none"> <li>Studies at CSIR-WRI show that even without climate change considerations, Ghana is predicted to become a water stress country by 2025</li> <li>a general reduction in annual river flows in Ghana by 15-20 % for the year 2020 and 30-40 % for the year 2050</li> <li>a reduction in groundwater recharge of 5-22 % for 2020 and 30-40% for 2050</li> <li>an increased irrigation water demand of 40-150 % for 2020 and 150-1200 % for 2050</li> <li>a reduction in hydropower generation of 60 % for 2020</li> <li>by the year 2020, all river</li> </ul>	Medium-high  Medium-high  Medium-high  Medium-high	High  Medium-high  Medium-high  High	Medium-high  Medium-high  Medium-high  Medium-high	1961-1990 used as base year  	2.1

Projected climate impacts						
Sector	Projected climate impacts	Impact rating	Confidence rating	Data quality rating	Time	Metadata identifier(s)
	basins will be vulnerable and the whole country will face acute water shortage	Medium-high	Medium-high	Medium-high	1961-1990	
Human health	<ul style="list-style-type: none"> <li>Measles cases is projected to increase by 2080 due to rising temperature</li> <li>The year 2020 is projected to have a mean air temperature at 27.6 °C or higher in the months of February March and April. The year 2050 will have a mean air temperature of 27.6 °C or higher in the months of January, February, March, April, May , June, October, November and December while the year 2080, will have a mean air temperature at 27.6 °C and above in all the months. These projected changes will cause a shift in the incidence of malaria transmission.</li> </ul>	Low	Low	Medium-high		3.1
	<ul style="list-style-type: none"> <li>In 2020, 2050 and 2080 annual rainfall amounts will be 1266.6 mm, 1161.1 mm and 1060.3mm respectively showing a reduction in annual rainfall amount. Ghana will be at risk of guinea worm infestation under conditions of increased temperature and reduced rainfall amounts</li> </ul>	Low	Medium	Medium-high	1999-2004 used as baseline for projections	3.1

Metadata	
<b>Metadata identifier</b>	1.1
<b>Explanation for <i>Impact</i> rating</b> (Explanation of the impact rating given and how it relates to the specific information in question)	<p><b><u>National Impact Rating:</u></b> The overall impact rating of the sectors for the CLICC pilot study is based on the criteria used by the World Bank for the economics of adaptation to climate change (EACC) in Ghana. The study was undertaken in 2008 and was published in 2010. <a href="http://siteresources.worldbank.org/EXTCC/Resources/EACC_FinalSynthesisReport0803_2010.pdf">http://siteresources.worldbank.org/EXTCC/Resources/EACC_FinalSynthesisReport0803_2010.pdf</a></p> <p>The following indicators were used for the rating;</p> <ol style="list-style-type: none"> <li>1. Gross domestic product (GDP) and population forecast for 2010-2050</li> <li>2. Translation of the impacts of climate on various sectors (i.e. economic activities) including agriculture, water, etc. on people’s behavior e.g. consumption, health, etc., and on environmental conditions such as water availability, etc.</li> <li>3. Identifying and costing adaptation alternatives e.g. health, agriculture, water supply, etc. The cost of these actions with the cost implications of changes in the frequency of extreme weather events are then estimated</li> <li>4. Evaluation of social impacts implications</li> <li>5. GDP vs cost of adaptation: this model assumes that as GDP per capita at the national level increases, peoples vulnerability to climate events reduces.</li> </ol> <p><b><u>Qualitative and Quantitative Ratings</u></b> Impact rating for the Ghana study has been done using both qualitative and quantitative rating methodology. Qualitatively, the vulnerability of the agricultural sector in Ghana to climate change is very high due to sector’s total reliance of precipitation and temperature. Again, the exposure level of the population depending on agriculture in various forms in the country is very high across the country. The high vulnerability couple with higher exposure of the population could lead to higher impacts on the national and local economies.</p> <p><b><u>Quantitatively,</u></b> in comparison to the baseline growth path without climate change, the output of the agricultural sector is estimated to decline by between 10.1 percent (Global Wet) and 3.0 percent (Ghana Wet) by 2050. The projections for cocoa show considerable variation across the climate scenarios, regions, and decades. Under the Ghana Wet climate, cocoa production is projected to experience significant adverse effects, while under the Global Dry and Global Wet climates the impacts turn out to be predominantly positive from a nationwide perspective. The total cost of damage from flooding, land loss, and forced migration is estimated to reach \$3.7 million/year by the 2020s, rising to \$6.5 million/year by the 2040s using the high sea level rise scenarios. Damage costs are estimated at \$4.7 million/year for the 2040s using the low sea level rise scenario.</p> <p><b><u>Global Impact Rating</u></b> The global impact rating for the agriculture and water sectors was done adopting the World Bank 2008 economics of adaptation to climate change (EACC) study methodology. The projected climate impacts of the agriculture sector with the absence of adaptation, aggregate real welfare losses up to 2050 will range (in present value terms) from \$2.7 billion (Ghana Dry) to \$13.1 billion (Global Dry). In annualized values, these estimates range from \$157 million (Ghana Dry) to \$765 million. On a per capita basis, they amount to \$6.50 and \$31.46 for Ghana Dry and Global Dry, respectively. The equivalent annual value of the real welfare impacts with no adaptation range from \$157.9 million (Ghana Dry) to \$764.5 million (Global Dry). These results translate to an annual equivalent per capita impact that range from \$6.5 (Ghana Dry) to \$31.46 (Global Dry) [World Bank 2010]</p>
<b>Explanation for <i>Confidence</i> rating</b> (Explanation of the confidence rating given and how it relates to the specific information in question)	There is a very high confidence in the rating because various studies on the implications/impacts of climate change on the agricultural sector in Ghana have common agreement on the impacts. Studies from both climate practitioners and academia are coherent on this. Most of these reports used wider stakeholder involvement in the assessment process.
<b>Climate projections,</b>	Not relevant in this assignment



Metadata	
<b>Metadata identifier</b>	1.1
<b>emissions scenarios, or models used</b> (if relevant)	
<b>Source(s)</b> (e.g., document, study, report, etc.)	Information reported in this project is mainly from the National Climate Change vulnerability assessment report published in 2008. The information is also reported in various forms in Ghana's first, second and third national communication documents published by the United Nation Framework Convention on Climate Change (UNFCCC). The information could also be access from Ghana's climate change technology needs assessment report (TNA) which mainly focuses on the Agriculture and Water sectors.
<b>Datasets</b> (if applicable)	Dataset for observed rainfall and temperature was obtained from the Ghana Meteorological Agency
<b>Additional assumptions</b> (if applicable and not covered by common ratings approach)	N/A
<b>Additional limitations</b> (if applicable and not covered by common ratings approach)	<ol style="list-style-type: none"> <li>1. Limitation due to climate uncertainty</li> <li>2. Limitation related to growth uncertainty</li> <li>3. No environmental services calculated in the study</li> <li>4. Limited range of adaptation options used in the study</li> </ol>

Metadata	
<b>Metadata identifier</b>	1.1.1 & 1.1.1A
<b>Explanation for <i>Impact</i> rating</b> (Explanation of the impact rating given and how it relates to the specific information in question)	Almost all parts of the country experience some form of drought. However, the northern part of the country is more vulnerable to drought conditions compared to the south. The northern part of the country generally records only one rainy season compared to the south which is mainly bimodal.
<b>Explanation for <i>Confidence</i> rating</b> (Explanation of the confidence rating given and how it relates to the specific information in question)	Various ensembles on rainfall patterns in Ghana are in agreement on the vulnerability of the northern sector to drought. This lends to the high confidence in the rating.
<b>Climate projections, emissions scenarios, or models used</b> (if relevant)	Not relevant in this assignment
<b>Source(s)</b> (e.g., document, study, report, etc.)	<p>1.1.1 Information reported in this project is mainly from the National Climate Change vulnerability assessment report published in 2008. The information is also reported in various forms in Ghana's first, second and third national communication documents published by the United Nation Framework Convention on Climate Change (UNFCCC).</p> <p>1.1.1A Historical data on observed incidence of agricultural pests and diseases is not available. The crop research institute (CRI) of the CSRI –Ghana researches on agricultural pests and diseases as part of its mandate. Reliable data will be needed in this area for proper future projections.</p>
<b>Datasets</b> (if applicable)	Dataset for observed rainfall and temperature was obtained from the Ghana Meteorological Agency
<b>Additional assumptions</b> (if applicable and not covered by common ratings approach)	N/A
<b>Additional limitations</b> (if applicable and	Limitation is not on the rating used in the report but rather on the

Metadata	
<b>Metadata identifier</b>	1.1.1 & 1.1.1A
not covered by common ratings approach)	fact that current comprehensive impact assessment has not been conducted to update the information and data provided. The following other general limitations are plausible; <ol style="list-style-type: none"> <li>1. Limitation due to climate uncertainty</li> <li>2. Limitation related to growth uncertainty</li> <li>3. No environmental services calculated in the study</li> <li>4. Limited range of adaptation options used in the study</li> </ol>

Metadata	
<b>Metadata identifier</b>	2.1
<b>Explanation for <i>Impact</i> rating</b> (Explanation of the impact rating given and how it relates to the specific information in question)	<p>The exposure level of individuals and the national economy on water resources for domestic, industrial and agricultural services or activities is very high making the impact rating very high. Again, the exposure level of people and property to flooding which occurs very frequently with heavy rainfall across different parts of the country is very high.</p> <p>Additionally, the northern part of the country has very high exposure to drought with very limit capacity to address the problem. These conditions may result to higher vulnerabilities to the impacts of climate change.</p> <p>Quantitatively, Ghana’s water and energy sectors have already shown signs of vulnerability to climate change, particularly the effect of highly variable precipitation patterns on hydropower production. The 1980–83 drought not only affected export earnings through crop losses, but also caused large-scale human suffering and called into question the nation’s continued dependence on hydroelectric power. By 2050, the annual average output of the water and energy sector is expected to decline to within a range of \$2.19 billion to \$2.26 billion from a 2050 baseline output of \$2.33 billion. This represents a decline of between 3 and 6%. <b>Source: World Bank 2010 in the EACC report of Ghana.</b></p>
<b>Explanation for <i>Confidence</i> rating</b> (Explanation of the confidence rating given and how it relates to the specific information in question)	<p>Water Research Institute (WRI) of the Center for Scientific and Industrial Research (CSIR) researches into water resources issues in Ghana.</p> <p>Confidence is based on WRI’s scientific credibility in doing scientific research in water as a natural resource in the country. Over three (Amisigo et al, 2015; Kankam-Yeboah et al, 2010; EPA 2008, etc.) credible researches on Hydrological modeling in Ghana have given similar results. Again, these studies are peer reviewed making it more reliable and credible.</p>
<b>Climate projections, emissions scenarios, or models used</b> (if relevant)	Not relevant in this assignment.
<b>Source(s)</b> (e.g., document, study, report, etc.) World Bank 2010 in the EACC report of Ghana. National vulnerability study on climate change 2008.	Amisigo et al, 2015; Kankam-Yeboah et al, 2010; EPA 2008
<b>Datasets</b> (if applicable)	Dataset for observed rainfall and temperature was obtained from the Ghana Meteorological Agency.
<b>Additional assumptions</b> (if applicable)	N/A

Metadata	
<b>Metadata identifier</b>	2.1
and not covered by common ratings approach)	
<b>Additional limitations</b> (if applicable and not covered by common ratings approach)	Limitation is not on the rating used in the report but rather on the fact that current comprehensive impact assessment has not been conducted to update the information and data provided.

Metadata	
<b>Metadata identifier</b>	3.1
<b>Explanation for <i>Impact</i> rating</b> (Explanation of the impact rating given and how it relates to the specific information in question)	The impact of climate on health is rated medium here based on the information and data provided by studies cited in this reporting frame. The data covers only few pilot studies in the northern sector of the country which makes generalization highly difficult. Again, the relationship between climate change and health is not direct and so will be difficult to assess the actual contribution of climate in terms of impacts if the other intermediate and confounding variables are not known.
<b>Explanation for <i>Confidence</i> rating</b> (Explanation of the confidence rating given and how it relates to the specific information in question)	The studies that were used for this assessment are based only in the northern part of the country. Again, not enough studies have been conducted in this area and so we are very moderate in our rating with respect to confidence.
<b>Climate projections, emissions scenarios, or models used</b> (if relevant)	Not relevant in this assignment.
<b>Source(s)</b> (e.g., document, study, report, etc.)	Information reported in this project is mainly from the National Climate Change vulnerability assessment report published in 2008. The information is also reported in various forms in Ghana's first, second and third national communication documents published by the United Nation Framework Convention on Climate Change (UNFCCC).
<b>Datasets</b> (if applicable)	Data is from a cross-sectional studies conducted in the Upper West region of Ghana
<b>Additional assumptions</b> (if applicable and not covered by common ratings approach)	N/A
<b>Additional limitations</b> (if applicable and not covered by common ratings approach)	Limited studies in climate change and health impacts in Ghana affect rating.

## Data Quality Table: Agriculture and Food Security

Data quality assessment		
<b>Dataset:</b> <i>(List the dataset assessed)</i>	This table assesses data quality for the Agriculture and Food Security sector of the study. Dataset include; Rainfall and temperature data from the Ghana meteorological agency- <a href="http://www.ghana.meteo.gov.gh">www.ghana.meteo.gov.gh</a> , root and tuber crop production data from the ministry of food and agriculture (MOFA), Cocoa research institute data on cocoa yields.	
Data Quality Criteria	Levels	Score
<b>1. Transparency and auditability</b>	1. Data unavailable to public	
	2. Limited summary data available	1
	3. Full raw/primary data set and metadata available	
<b>2. Verification</b>	1. Unverified data	
	2. Limited verification checks in place	
	3. Detailed verification in place and documented	3
<b>3. Frequency of updates</b>	1. Sporadic	
	2. Every 3-5 years	2
	3. Annual or biennial	2
<b>4. Security</b>	1. Future data collection discontinued	
	2. Future data collection uncertain	3
	3. Future data collection secure	
<b>5. Spatial coverage</b>	1. Partial national coverage	3
	2. National coverage, some bias	
	3. Full national coverage, including adjacent marine areas, if and where appropriate	
<b>TOTAL</b>		14
Total scores should be rated as follows: 5 to 8 (Low); 9 to 12 (Medium); 13 to 15 (High)		<b>RATING</b> High

## Data Quality Table: Water Resources Sector

Data quality assessment		
<b>Dataset:</b> <i>(List the dataset assessed)</i>	This table assesses data quality for the Water Resources sector of the study. Dataset include; Rainfall and temperature data from the Ghana meteorological agency- <a href="http://www.ghana.meteo.gov.gh">www.ghana.meteo.gov.gh</a> , Ghana water research institute- <a href="http://www.csir-water.com">www.csir-water.com</a> , Ghana climate vulnerability assessment document	
Data Quality Criteria	Levels	Score
<b>1. Transparency and auditability</b>	1. Data unavailable to public	
	2. Limited summary data available	1
	3. Full raw/primary data set and metadata available	
<b>2. Verification</b>	1. Unverified data	
	2. Limited verification checks in place	
	3. Detailed verification in place and documented	3
<b>3. Frequency of updates</b>	1. Sporadic	
	2. Every 3-5 years	2
	3. Annual or biennial	
<b>4. Security</b>	1. Future data collection discontinued	
	2. Future data collection uncertain	3
	3. Future data collection secure	
<b>5. Spatial coverage</b>	1. Partial national coverage	3
	2. National coverage, some bias	
	3. Full national coverage, including adjacent marine areas, if and where appropriate	
<b>TOTAL</b>		12
Total scores should be rated as follows: 5 to 8 (Low); 9 to 12 (Medium); 13 to 15 (High)		<b>RATING</b> Medium

## Data Quality Table: Health Sector

Data quality assessment		
Data Quality Criteria	Levels	Score
<b>Dataset:</b> <i>(List the dataset assessed)</i>	This table assesses data quality for the Health sector of the study. Dataset include; Rainfall and temperature data from the Ghana meteorological agency- <a href="http://www.ghana.meteo.gov.gh">www.ghana.meteo.gov.gh</a> and a limited sampled cross-sectional survey data captured in the 2008 vulnerability study	
<b>1. Transparency and auditability</b>	1. Data unavailable to public	
	2. Limited summary data available	1
	3. Full raw/primary data set and metadata available	
<b>2. Verification</b>	1. Unverified data	
	2. Limited verification checks in place	
	3. Detailed verification in place and documented	3
<b>3. Frequency of updates</b>	1. Sporadic	1
	2. Every 3-5 years	
	3. Annual or biennial	
<b>4. Security</b>	1. Future data collection discontinued	
	2. Future data collection uncertain	2
	3. Future data collection secure	
<b>5. Spatial coverage</b>	1. Partial national coverage	2
	2. National coverage, some bias	
	3. Full national coverage, including adjacent marine areas, if and where appropriate	
	<b>TOTAL</b>	9
Total scores should be rated as follows: 5 to 8 (Low); 9 to 12 (Medium); 13 to 15 (High)		<b>RATING</b> Medium