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Access and Utilisation of Climate Change Information by Small-holder Farmers in Bunkpurugu-Yunyoo Districts, Ghana

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Abstract

The study sought to assess access and utilization of climate change information by small-holder farmers in the Bunkpurugu-Yunyoo Districts of the North-East Region of Ghana. Since the study involved a large farmer population in the area, the survey research design was employed to collect data from 387 household-headed farmers. Generally, farmers in the district had accessed to climate change information via TV, radio and mobile phone. Specifically, farmers received information mainly on temperature, rainfall, windstorm and thunderstorm. However, less than half (49%) of farmers in the study area were able to receive the climate change of information, and the information was not regularly received through the Meteorological Services Department. The study found that farmers in the study area utilized climate information received which aided farmers to prepare their farm lands, plant, harvest, and processed their harvested crops. In contrast, utilization of climate change information was low among farmers. Therefore, access and utilization of climate change information is low farmers in the area; hence the need to be improved.

Key words: **Access, utilisation, small-holder farmers, climate change information, Bunkpurugu-Yunyoo**

1. Introduction

The reality of climate change is undisputed. Droughts, floods, heat waves, and changing rainfall patterns will increase the cost of food, health, basic infrastructure, and humanitarian aid due to climate change as the region's climate changes (Yaro & Hesselberg, 2016, IPCC, 2007). Climate change is predicted to have a wide-ranging, complicated, and temporally and geographically diverse impact on the global scale (Marc, Verjee, & Mogaka, 2015; Wakhungu, 2011; Yaro et al. 2010). Different climate stressors would drastically diminish agricultural production in sub-Sahara Africa and West Africa sub-region, affecting the livelihoods of more than half of the regions rural population who are basically food crop farmers (Hallegatte, Bangalore, Bonzananigo, & Vogt-Schilb, 2016).

Due to its over-reliance on rain-fed agricultural systems and natural resource-based livelihoods, Ghana is one of the countries most vulnerable to the detrimental consequences of climate change (Asante & Amuakwa-Mensah, 2015, Antwi-Agyei, 2021). According to Antwi-Agyei (2021) Ghana experiences increases in temperatures, more acute droughts, and more erratic rainfall patterns, making agricultural output less resilient. But this is spatially and socially differentiated as the impacts of the phenomenon is more pronounced in

Northern Ghana (Bawakyillenuo, Yaro & Teye, 2014; Yaro et al, 2016). This jeopardizes the achievement of the Sustainable Development Goals, notably those linked to food security as significant proportion of the population resides in rural areas and are engaged in food crop production which is mainly rain-fed (Diko, Okyere, Mensah, Ahmed, Owusua Yamoah & Kita, 2021). It is for this reason that the access to climate change information by small-holder farmers remains relevant.

The timely availability and use of climate information services is a key step toward improving farmers' ability to manage climate-related risk and vulnerability (Antwi-Agyei et al. 2021). Climate information services according to the WMO (2018) are the methods for making climate data available to and helpful to decision-makers in a variety of sectors and at various scales. Climate information services deliver timely, contextualized climate information to organizations and individual farmers in order to reduce climate-related risks particularly in relation to food crop farming (Baffour-Ata, Antwi-Agyei, Nkiaka, Andrew, Dougill, Alexander, Anning & Kwakye, 2022). Therefore, climate information is only relevant in combating climate change concerns if it is accessible in a way that smallholder farmers can understand and make use of it (Muema, Mburu, Coulibaly, Mutune, 2018). The provision of climate information is however hampered by technological and socio-economic impediments, restricting the uptake and application of climate data for effective decision-making (Antwi-Agyei et al, 2021).

According to Baffour-Ata et al (2022) access to climate change information by small-holder farmers has seen considerable research in Sub-Saharan Africa citing the cases of Mali, Senegal and Burkina Faso. Similarly, in Northern Ghana such studies have been conducted in Kassena-Nankana Municipality, Talensi District and Bawku Municipality in the Upper East Region by Antwi-Agyei et al (2021) and Baffour-Ata et al (2022) in Tolon and Nanton Districts in the Northern Region. However, it is unclear the extent to which small-holder farmers are able to access and utilize climate change information in the Bunkpurugu and Yunyoo Districts in the North-East Region of Ghana. Though the Bunkpurugu District is now a separate district from Yunyoo, for the purposes of this study, it is considered as one district due to its closeness and climatic similarities. The Bunkpurugu-Yunyoo Districts is located within the same ecological zone, Northern Ghana. It is therefore relevant to understand whether there are differences and variations in terms of the kind of climate information available to farmers in the area and its utilisation in relation to the previous studies.

2. The Study Context and Methodology

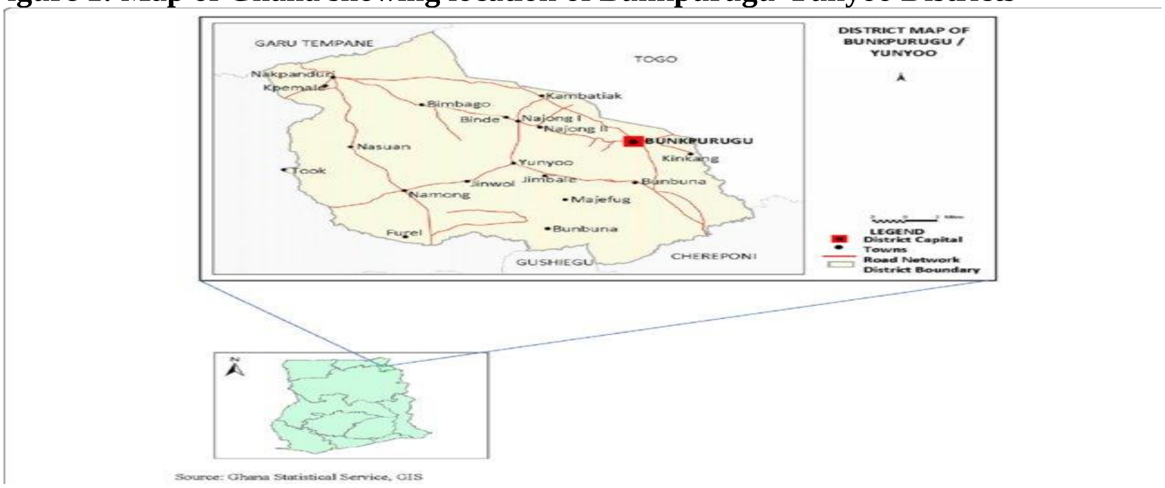
This section of the paper presents the study context and methodology as discussed in detailed in the following.

2.1 The Study Context

Bunkpurugu-Yunyoo district is one of the districts of the North-East Region of Ghana. It was founded in August 2004 as part of the government's efforts to further decentralize governance through Legislative Instrument (C.I) 1748. Bunkpurugu serves as the District's administrative center. Nakpanduri, Nasuan, Kpemale, Najong No. 1, Najong No. 2, Binde, and Bimbagu are some of the other main towns in the district (GSS, 2012). It shares boundaries in the North with the Garu-Tempane, to the East with Togo, West with East Mamprusi and to the South with Gushiegu and Chereponi Districts. The District is located on the western edge of the tropical continental belt, with a single rainfall pattern from April to October, influenced by tropical continental air masses. Annual rainfall ranges around 100 to 115 millimeters. Temperatures rise from 30°C to 40°C on a yearly basis (GSS, 2012).

The population of the district according to 2021 population and housing census stands at 154,768 which accounts for 5 percent of the Region's total population (2,479,461) and with over 85% (85.9%) of the inhabitants residing in rural areas. The population density (rough) in the District is around 98 (97.5) people per square kilometer. The District's rural residents make up the majority of the population (85.9 percent) (GSS, 2012). Being rural districts, the major occupation of the people is farming with about 88% engaged in it (GSS, 2012). The rest of the population is into craft, trade and services.

Figure 1: Map of Ghana showing location of Bunkpurugu-Yunyoo Districts



Source: Ghana Statistical Service (GSS)

2.2 Methodology

The survey research design was employed in collecting data using close-ended questionnaire which targeted household-headed farmers. The Yamane (1967) method of sample size determination was used to determine the sample size for the farmers. Thus, n $= \frac{N}{1+N(\alpha)^2}$, Where **n**=sample size, **N**=sampling frame (321) and **α** represents the margin of error with confidence level of **95%**. Since farmers live in households and given the total households of **17, 621** in the district, with about 88% of the population being farmers, the sampling frame was **15,506**. By substituting 15,506 which represents the sampling frame (**N**) into the formula with a margin of error ***5%***, the sample size (**n**) for the study is **387**.

Since farmers live in households, they were systematically sampled from the households at intervals of 4. By systematic sampling technique, every farmer was given an equal chance of being selected for the study. Data was collected electronically using Phone Tablets which was transmitted to a data base for export to SPSS for analysis and discussion. The analysis was in both descriptive and inferential statistics in relation to the key variables of the study.

3. Results and Discussion

3.1. Socio-Demographic Characteristics of Respondents

As in Table 1, a significant number (87%) of farmers in the district are males whilst their females' counterparts constitute only 9%. This suggests that farming in the area is male dominated. Significant test (Chi-Square (χ^2) further shows that the differences in both sexes are statistically significant. (Pearson Chi-Square = 0.000, Df = 2, Asymp. Sig. (2-sided) = 0.334). In terms of education, more than half (59%) of farmers in the area are illiterates or non-formal. This suggests that utilisation of climate change information may be difficult for farmers since they are more unlikely to interpret or understand climate change data received. Chi-Square Tests also show that the differences of respondents with regard to their educational level are statistically significant. (Pearson Chi-Square = 0.001, Df = 5, Asymp. Sig. (2-sided) = 0.155). Majority (89%) of the farmers are within the age cohorts 31-60 meaning that they have vast experience and better understanding regarding to issues of climate change and food crop farming as majority (66%) of them have been engaged in the farming activities for more than 10 years now. In this case the mean (M) age is of farmers in the area is **37.5** with Std. Deviation **12.1** (M=37.5, SD=12.1).

Table 1: Socio-Demographic Characteristics of Respondents

Variable	**Characteristics**	**N**	**%**
Gender	Male	337	87
	Female	50	9
Education	Non-formal	228	59
	Basic education	93	24
	Secondary education	43	11
	Tertiary	23	6
Age Cohorts	<20	8	2
	21-30	23	6
	31-40	112	29
	41-50	124	32
	51-60	108	28
	>60	12	3
Number of years in Farming	<5	15	4
	5-10	43	11
	11-15	147	38
	16-20	66	17
	>20	116	30

*n=(387)

3.2 Access to Climate Change Information

Access to climate change information by farmers is assessed based on the medium of access, access itself and frequency of access. As in Table 2, farmers had accessed to climate change information through various mediums namely TV, radio and mobile phone. The Mean number of farmers who had medium of accessing climate change information is **50.3** with Std. Deviation **16.9 (M=50.3, SD=16.9)**. Particularly in rural areas, access to TV services is rare due to the inability of farmers to acquire it coupled network challenges. This explaining why greater percentage (75%) of farmers did not have TV. This notwithstanding, a good number of farmers has radios (61%) and mobile phones (50%).

Table 2: Medium to climate change information

Medium	N	%
TV	97	25
Radio	238	61
Mobile phone	195	50

*n= (387)

Table 3 revealed that farmers in the area received various type of climate information namely temperature, rainfall, windstorm and thunderstorm. However, less than half of farmers are able to receive this type of information leaving out the majority who rely on their instincts to cultivate their crops. The Mean number of farmers who received various climate change information is **48.6** with standard Deviation **10.6** (M=48.6, SD=10.6). This means that majority of farmers are unable to take advantage of early rains for example to plant their crops as food crop production in the area is rain-fed and hence can affect crop yield. This is attributable to lack of access to medium (Radio, TV and Mobile Phone) of receiving climate change information on major climate data.

Table 3: Type of climate information received (Multiple Responses)

Variable	N	%
Temperature	116	30
Rainfall	189	49
Windstorm	89	23
Thunderstorm	74	19

*n=387

As observed from Table 4, farmers fairly received climate change information through various means. In this case, the Mean number of farmers who received various climate change information data is **56.8** with Std. Deviation **18.6** (M=56.8, SD=18.6) implying that there is a gap between farmers and climate change information. Notwithstanding, the main sources through which farmers received the information are radio (53%) and community members (51%). This because, radio information has a wide coverage area; even those who do not have radios in their homes can easily listen to and get the information from their neighbours radio as compared to TV and mobile phone. Additionally, obtaining climate change information via community members by farmers is much easier since they interact on daily basis to discuss issues relating to farming activities. Also, Agriculture Extension Agents (AEAs) (45%) and workshops (41%) are the other key means through which farmers access climate change information.

Table 4: Means of Accessing Climate Change Information (Multiple Responses)

Variable	N	%
Television	84	22
Radio	207	53
Text Message via phone	69	18
Voice message	56	14
Community members	198	51
Workshops	157	41
Agric. Extension Agents (AEAs)	176	45
Newspaper	12	3
Social Media (WhatsApp and Facebook)	38	10
None of the above	98	25

*n=387

The study also intended to find out the frequency with which farmers received information as presented on Table 5. The data showed though farmers did receive climate change information, it was not regular. The Mean frequency of receiving climate change information by farmers is **69.3** with Std. Deviation **19.7** (M=69.3, SD=19.7). This deviation shows that farmers hardly received climate change information. Following from this, more than ninety percent (93%) of farmers interviewed indicated that they received climate information 'once a while'. Also, more than half (55%) of farmers indicated that though they did receive climate information it was given them 'any time' but not based on regular specific time periods and intervals. This could gravely affect how farmers plan for their season and in this case could negatively affect crop output.

Table 5: Frequency of Receiving Climate Information (Multiple Responses)

Variable	N	%
Daily	112	29
Weekly	167	43
Monthly	149	39
Annually	103	27
Once a while	359	93
Any time	213	55

*n=387

3.3 Utilisation of Climate Change Information by Farmers

Table 6 shows the extent to which farmers utilize climate information received from various means. The information aided farmers in the area to prepare their farm lands, plant, harvest, and processed their harvested crops. The data however revealed that less than half of farmers found the information useful for their various farming activities. This implies that more than half of farmers did not utilize the information received as they relied on their traditional methods of farming. Hence, this could affect crop yield since good farming practices should rely on climate change information in order to properly plan to avoid drought which is mainly associated with climate change.

Table 6: Utilisation of Climate Change Information (Multiple Responses)

Variable	N	%
Land preparation	115	30
Planting times	163	42
Changing crop patterns/Crop rotation	188	49
Harvesting time decisions	138	36
Processing and storage	108	28

*n=387

3.4 Regression and Correlation Analyses of Access and Utilization of Climate Change Information

This section presents regression and correlation analysis of access and utilization of climate change information by farmers. Therefore, each dependent variable (access and utilisation) is analysed against climate change information which is the independent variable in order to establish significant relationships at $P<0.05$.

3.4.1Climate Change Information and Access

The results in the model summary on Table 7 shows an 'R' value of 0.458, an indication that the correlation between climate change information and access is positively weak. The Table also shows a value of 0.434 recorded for R^2, an indication that 49.3% of access is explained by the climate change information implying limited access.

Table 7: Model Summary

Model	R	R-Square	Adjusted R Square	Std. Error of the Estimate	R-Square Change	F Change	Sig
1	0.458	0.434	0.436	1.102	0.493	51.028	0.156

a. Predictors: (Constant), Climate change information
b. Dependent Variable: Access

The model's significance on Table 8 is measured by the ANOVA. The ANOVA test the hypothesis that the relationship between the variables being tested is statistically significant. On the ANOVA Table however, the value indicating the statistical significance is 0.258, which suggests that the models are statistically insignificant at $p<0.05$. It can therefore be concluded that there is no significant relationship between climate change information and access which means that climate change information is highly independent of its access. This further means that though climate change information is available, its access by farmers is low.

Table 8: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	2542.442	2	1271.221	72.029	10.258
Residual	2135.493	26	17.649		
Total	4677.935	28			

a. Predictors: (Constant), climate change information
b. Dependent Variable: Access

3.4.2 Climate Change Information and Utilisation

Table 9 shows a value of 0.491 recorded for R^2, an indication of about 49% utilization of climate change information by farmers. This implies a weak relationship between availability of climate change information and its utilization. This finding also suggests availability of climate change information does not guarantee its utilization. Other factors such as knowledge and relevance of the information could be limiting factors to utilization.

Table 9: Model Summary

Model R	R-Square	Adjusted R Square	Std. Error of the Estimate	R-Square Change	F Change	Sig
10.461	0.491	0.462	2.102	0.534	51.028	0.036

a. Predictors: (Constant), Climate change information
b. Dependent Variable: utilisation

The model's significance on Table 10 is measured by the ANOVA. The ANOVA established that the relationship between the variables being tested is not statistically significant at 0.031 (i.e., $p<0.05$). This implies that utilization is not dependent on availability of climate change information.

Table 10: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	3185.105	3	3184.332	93.029	0.031
Residual	3631.403	29	20.758		
Total	5855.946	32			

a. Predictors: (Constant), Climate change information
b. Dependent Variable: utilisation

3.4.3 Correlation analysis of Access and Utilisation

This section presents Pearson's correlation analysis on access and utilization of climate change information as presented on Table 11. The correlation coefficient(r) does not equal 0.936 as P-value is 0.251, demonstrating a low or no association between access and utilization. Thus, access is different from utilization. Hence, farmers having access to climate information does not necessarily mean that it will automatically lead to its utilization.

Table 11: Correlation of access and utilization of climate change information

		Access	**Utilisation**
Access	Pearson Correlation	1	0.936**
	Sig.(2-tailed)		.251
	N	387	387
Utilisation	Pearson Correlation	0.936**	1
	Sig. (2-tailed)	.251	
	N	387	

**Correlation is significant at the 0.001 level (2-tailed)

3.5 Discussion

3.5.1 Access to Climate Change Information

Generally, farmers in the study area (Bunkpurugu-Yunyoo Districts) had accessed to climate change information via TV, radio and mobile phone. This is in tandem with the findings of Baffour-Ata et al (2022) in the Tolon and Nanton Districts in the Northern Region. According to them, 70% of farmers in the Districts received climate change information via radio, TV and mobile phones. This reflects the means through which farmers in Northern Ghana received climate change information.

Specifically, farmers received information mainly on temperature, rainfall, windstorm and thunderstorm as confirmed by the findings of Baffour-Ata et al (2022) and Atwi-Agyei et al (2021). However, less than half of farmers in the study area are able to receive this type of information leaving out the majority as confirms the findings of Antwi-Agyei et al (2021) in the Upper East Region. According to them, less than fifty percent of farmers in selected districts in the Upper East Region received information on temperature, rainfall, windstorm and thunderstorm. This paint the general picture of access to climate change information by farmers in Northern Ghana as majority of small-holder farmers do not have access.

Thus, the main sources through which farmers received the information are radio, community members, Agriculture Extension Agents (AEAs) and workshops which are similar to the findings of Baffour-Ata et al (2022) and Atwi-Agyei et al (2021) in Northern Ghana. It is however worth noting that though farmers did receive climate change information; it was not regular, which is a general challenge to farmers in the area.

3.5.2 Utilisation of Climate Change Information

Utilisation of climate change information is essential for boosting food crop productivity by small-holder farmers. The study found that farmers in the study area utilized climate information received. The information aided farmers in the area to prepare their farm lands, plant, harvest, and processed their harvested crops. This supports the findings of Baffour et al and Antwi-Agyei et al who conducted a similar study. They found that though utilization was quite low among farmers, it helped farmers in diverse ways including land preparations, crop variety selection, changing cropping patterns, planting time adjustments, harvesting time and disease/pest management. Hence, climate change information generally is useful to farmers in Northern Ghana including the Bunkpurugu-Yunyoo Districts though, there is a weak relationship.

3.6 Conclusion

Though farmers in the study area had access to various climate change information, there is no significant relationship between climate change information and access which means that climate change information is highly independent of its access. Also, there is no significant relationship between climate change information and its utilization at 0.031 (i.e., $p<0.05$). Hence, there is a weak correlation between access and utilisation as P-value is 0.251, suggesting that access is different from utilization.

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