



The role of climate information in enhancing household food security in rural northern Ghana

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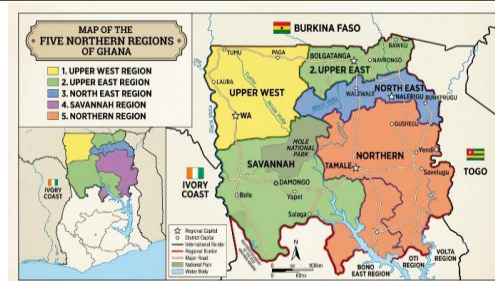
Introduction

- ❖ In Africa, where agriculture is predominantly rain fed and adaptive capacity is low, climate variability reduces farm productivity and makes food access more uncertain (Gebre, 2021; Randell et al., 2022).
- ❖ Access to climate forecast information services (CIS), especially weather and seasonal forecasts has been increasingly promoted as a key tool to support climate smart decisions, stabilise production and improve diets (Ngigi & Muange, 2022).
- ❖ Yet, existing literature typically treats CIS and food security separately (Alidu et al., 2025; Baffour-Ata et al., 2022).
- ❖ This study examines the determinants of household access to climate information and how climate information influences household food security directly and indirectly through agricultural yield.

Materials and Methods

Study area: Rural Northern Ghana

- ❖ Climate change is a threat to rural northern Ghana's agricultural development.
- ❖ Smallholder farmers face severe risks of crop failure, storage losses, and economic volatility.



Sample design

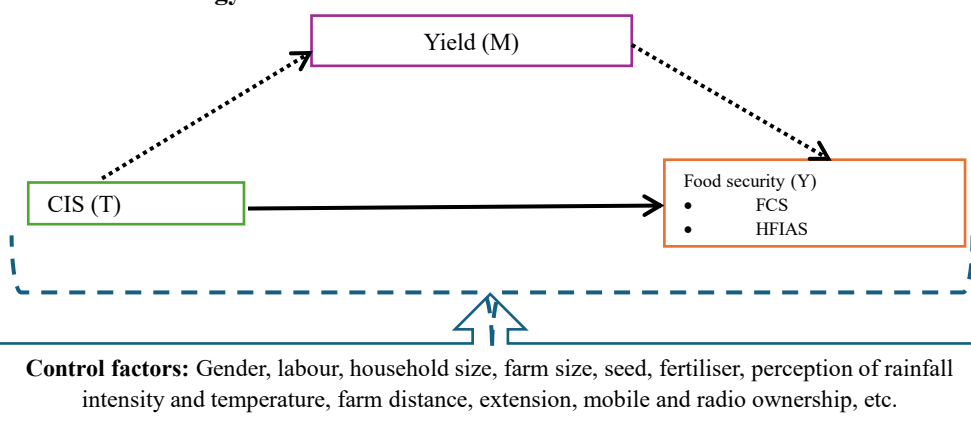
- ❖ Two-stage stratified design:
 - First stage: rural primary sampling units (PSUs) were drawn in each of the five regions with probability proportional to size-198
 - Second stage: 15 households were randomly selected in each selected PSU
- ❖ **Sample size:** 2970 farm households

Data and descriptive statistics

Table 1. Mean differences in access to climate information

Variable	Measurement	weather information access in the past 12 months			
		No	Yes	Total	p. value
CIS		78.3%	21.7%		
Yield	Kg/ha	2.583	3.064	2.689	<0.001
HFIAS	Household food insecurity experience in the past 4 weeks	4.940	4.435	4.830	<0.001
FCS	Household food consumption score in a week	33.747	37.595	34.582	<0.001

❖ **Estimation Strategy:** The causal mediation estimation



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Factors influencing household access to CIS

Table 2. Probit marginal effect estimates for factors influencing CIS

Variable	Marginal effect (dy/dx)	Std. Err.
Gender	0.043***	0.012
Extension	0.430***	0.027
Age	-0.000	0.000
Household size	0.004*	0.002
Literacy	0.136***	0.018
farm distance	0.016***	0.005
Farm size	-0.001	0.001
Phone	0.046***	0.011
Asset	0.011***	0.001
Radio	0.086***	0.013
Increased temperature	0.077***	0.011
Decreased rainfall intensity	0.095***	0.010
Credit	-0.028**	0.014
Fixed effects	Yes	Yes
Constant		
LR chi2(17) =		
Observations		

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

From climate information to yield to food security in Ghana

Table 3. How CIS influences food security through yield and directly

Parameter	FCS		HFIAS	
	Coeff.	Std. err	Coeff.	Std. err
Total effect	0.210***	(0.031)	-0.103**	(0.054)
Direct effect	0.194***	(0.027)	-0.088*	(0.048)
Indirect effect (A*B)				
Sobel effect	0.016***	(0.004)	-0.015***	(0.006)
Delta effect	0.016***	(0.004)	-0.015***	(0.006)
Monte Carlo effect	0.016***	(0.004)	-0.015***	(0.006)
Mediation size effect				
RIT	0.078		0.146	
RID	0.085		0.171	
Control factors	Yes	Yes	Yes	Yes
Location fixed effect	Yes	Yes	Yes	Yes
Type of mediation test				
Baron and Kenny approach	Partial		Partial	
Zhao, Lynch & Chen's approach	Partial		Partial	

Note: *** p<0.01, ** p<0.05, * p<0.1

Discussions

- ❖ **The Catalysts of Adoption (Who uses CIS?)**
 - Extension & Infrastructure Matter Most: Access to extension services is the ultimate driver, increasing the probability of accessing CIS by 43.0%. Information assets like radios (8.6%) and mobile phones (4.6%) act as essential transmission channels for accessing CIS.
 - Perception Triggers Action: Households who perceived that rainfall intensity is falling and temperatures are rising are likely to increase access to CIS by 9.5% and 7.7%, respectively.
- ❖ **Food Security Pathway:** The production gains from CIS-driven yields translate directly into measurable household nutrition and psychological relief:
 - Dietary Quality (FCS Pathway): CIS access expands total household dietary diversity by 7.8%, which is directly channelled through resulting yield improvements.
 - Food Anxiety (HFIAS Pathway): CIS significantly reduces food deprivation and access anxiety by 14.6%, which is directly transmitted through yields.

Conclusions and policy implications

1. Information is Nutrition: access to CIS cannot be viewed simply as an agricultural tool but as a direct determinant of household nutritional status (FCS) and mental well-being (HFIAS).
2. The Mediation Lesson: While yield is a powerful transmitting channel (accounting for up to 14.6% of food anxiety relief), the remaining majority effect of CIS is direct. This proves that climate alerts protect food security through smarter market timing, minimised post-harvest handling losses, and better household food budgeting.
3. Policy Action: To eradicate food insecurity among smallholder farmers, policy needs to build a hybrid delivery system: deploy face-to-face extension agents to train farmers on CIS, broadcast alerts via local radio, and bundle credit options directly with climate-smart technologies.



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