Impacts of Climate Induced Water Scarcity on Rice Production among Smallholder Farmers in the Northern Region, Ghana

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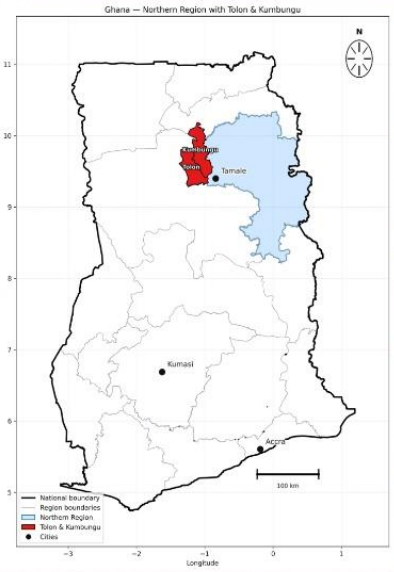
INTRODUCTION

- Climate change has intensified water scarcity threatening food security in Northern Ghana
- Climate-Agricultural Paradox

- R/F with Short Rainy Seasons
- Drought
- Vulnerability

- Recurrent droughts & reduction in water bodies suggests climate-induced hydrological imbalance

METHODOLOGY



Climate Data (1990–2022)	Obj. 1- Trends Analysis	MK test, Sen's Slope, Pettitt t.
Satellite Imag (2014–2024)	Obj. 2- LULCC Analysis	Spatial analysis RS/ GIS
Yields / CL.D (1990–2022)	Obj. 3- Yields + CL.D R/ship	GLS Reg. Time series CL.D
420 Cross-sectiona Hhd	Obj. 4-Demog., Adapt. /Yields	Des. Stat + OLS Reg.
420 Cross-sectiona Hhd	Obj. 1- Farmers Challenges	Factor Anaysis

RESULTS & DISCUSSION

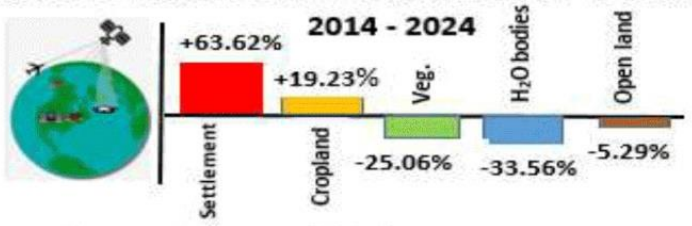
Objective 1 & 2

CLIMATE TRENDS (1990 – 2022)

Deceasing Max RH, Increasing Temp & Rainfall Trends

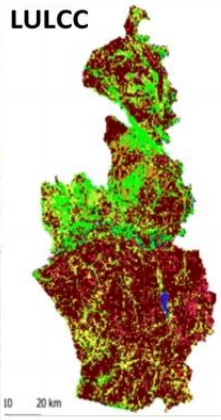
Trends suggests disconnect btw rainfall patterns & effective water availability

SPATIO-TEMPORAL DYNAMICS OF LULCC



Demonstrating rapid landscape

LULCC



Objective 3 & 4

CLIMATE – YIELDS RELATIONSHIP

(Time series 1990-2022)

GLS reg. showed that RF, Min & Max Temp significantly influenced Rice over the period 1990-2022

Highlighting the role of climatic factors in rice prod.

ADAPTATION PRACTICES– YIELDS R/SHIP

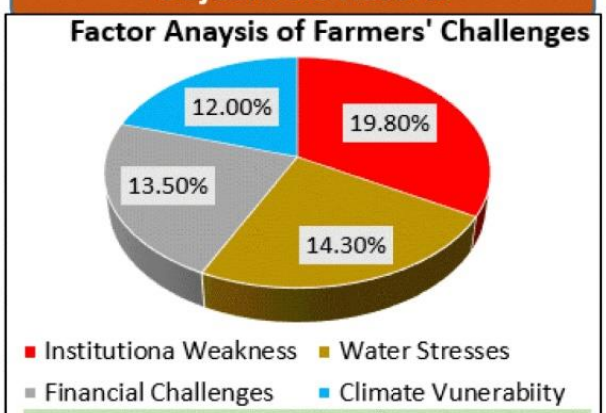
(Cross-sectional Data)

Adaptation practices such as improved seeds, irrigation practices, and soil moisture conservation significantly influenced rice yields

Confirming that effective adaptation can increase yields

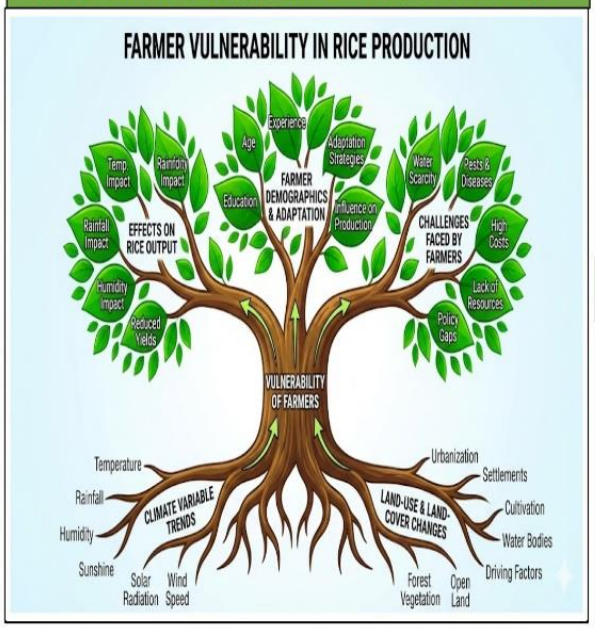
Objective 5 Results

Factor Anaysis of Farmers' Challenges



Categories together account for 60% of the total variance

MODEL DEVELOPED – 1. FVT MODEL



MODEL DEVELOPED – 2. IFV MODEL

Integrated Farmer Vulnerability (IFV) Index

$$V_f = (E \times S)(1 - A)(1 + L)(1 + C)$$

Where:
- V_f = Integrated Farmer Vulnerability Index
- E = Climate exposure index
- S = Sensitivity of rice productivity
- A = Adaptive capacity index
- L = (LULCC) impacts
- C = Socio-economic & institutional challenges

Conclusion & Recommendations

In conclusion the study revealed climate-agricultural paradox, where increasing RF does not translate to adequate water availability leading to water scarcity. Climatic factors have significant influence on rice yields, underscoring the need for effective adaptation

Recommendations

- Use of FVT and IFV models
- Strengthening regional interventions and capacity building in WEF nexus.
- Strengthening agric. institution and irrigation system for sustainable farming.

APPRECIATION

- SustainFood, Penn State University, Michigan State University, Stockholm Environment Institute
- Principle Investigators:
  - Prof. Michael Jacobsen
  - Prof. Christopher Scott
  - Prof. Laura Schmitt Olabisi
  - Prof. Annette Huber-Lee
  - Prof. Vicki Morrone
- F & F Dr. Kenneth Uchua, Dr. Celestine Gever
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