

Water-Dependent Adaptive Decisions in Farming Systems

Emmanuel Frimpong Boamah, PhD* and Andy Bonaventure Nyamekye®

*Department of Urban and Regional Planning, Community of Global Health Equity, University at Buffalo

®Water Systems and Global Change Group, Wageningen University and Research

Introduction

Water variability poses challenges to smallholder farmers in sub-Saharan Africa. Farmers must constantly adapt their decisions and practices in response to water uncertainty and variability.

This study probes the question, “How do peri-urban farmers adapt their farming decisions to variability and uncertainties in water availability, and how are these decisions embedded within the broader logics of appropriateness and consequentiality? We address this question by focusing on farmers within the Ashaiman delta, Ghana. In this empirical case, we develop indices to quantify the adaptive nature of decisions made by farmers to manage water variability and uncertainty.

Methods

The study employed a mixed-methods approach in gathering and analyzing data

Data Collection Strategy:

Focus Group sessions with farmers, semi-structured interviews with key stakeholders, and survey of farmers (structured survey instrument), and focus group with farmers and stakeholders to triangulate results from analysis.

Analysis:

1. Water-dependent adaptive decision-making index (WDAI)

$$WDAI_i = \frac{\sum(WDS_{i1} + WDS_{i2} + WDS_{i3} + \dots + WDS_{in})}{A(WDS_T)} \quad \text{eqn 1}$$

Where:

- X_i = the number of all possible decisions or practices available to farmer “i”
- S_i = the number of standard or business-as-usual decisions or practices farmer “i” pursues
- $A_i = X_i - S_i$ = the number of non-standard decisions or practices farmer “i” pursues under different water-dependent scenarios
- WDS_{in} = the number of decisions farmer “i” pursues under the different water-dependent scenarios “n = 1, 2, 3...n.” Example, WDS_{i1} = decisions farmer “i” pursue under the first water-dependent scenario (e.g., the first water-dependent scenario could be about anticipating low rainfall or low water supply from the irrigation dam)
- WDS_T = the total number of water-dependent scenarios

2. Appropriateness of WDAI (Eqn. 2) & Consequentiality of WDAI (Eqn. 3)

$$\frac{AA_i}{AT_i} \text{ Eqn 2} \quad \& \quad \frac{CA_i}{AT_i} \text{ Eqn 3}$$

Where;

- AA_i = the number of appropriateness factors considered by farmer “i” in making A_i decisions
- CA_i = the number of consequentiality factors considered by farmer “i” in making A_i decisions
- AT_i = the total number of appropriateness and consequentiality factors considered by farmer “i” in making A_i decisions

Results

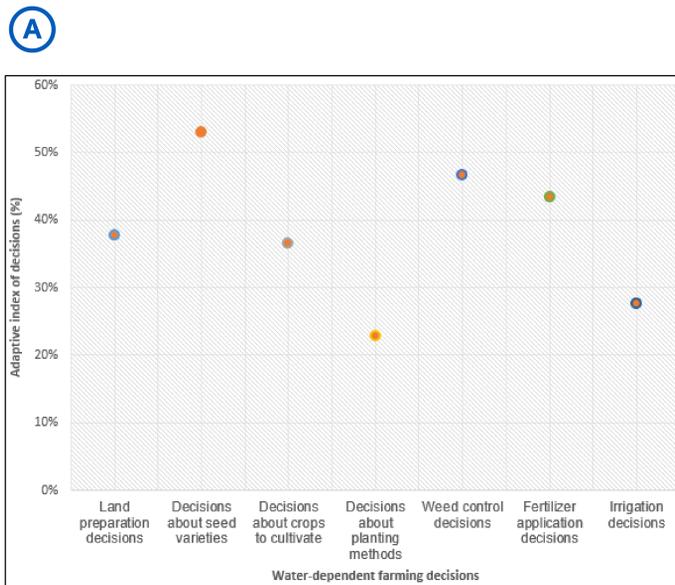


Figure 1: Water-dependent adaptive decisions by different farming decisions/practices

Farmers are able to adapt, to some extent, their decisions and practices on choosing seed varieties and weed control, but are less able to adapt their decisions on land preparation, types of crops cultivated, fertilizer application, planting method, and irrigation method.

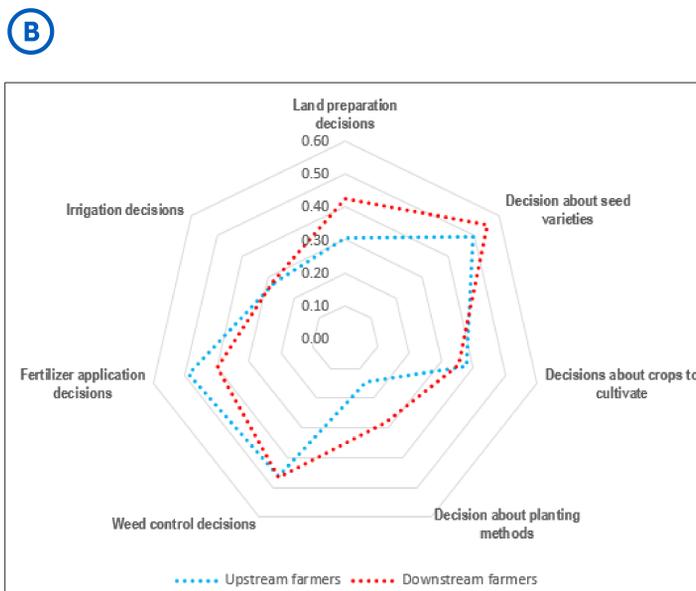


Figure 2: Water-dependent adaptive decisions among upstream and downstream farmers

- ❖ To manage their water challenges, upstream water users adapt their decisions regarding fertilizer application and types of crops cultivated more than downstream farmers.
- ❖ Downstream farmers adapt their decisions on land preparation, choice of seed varieties, and planting method more than upstream farmers.

Results (cont'd)

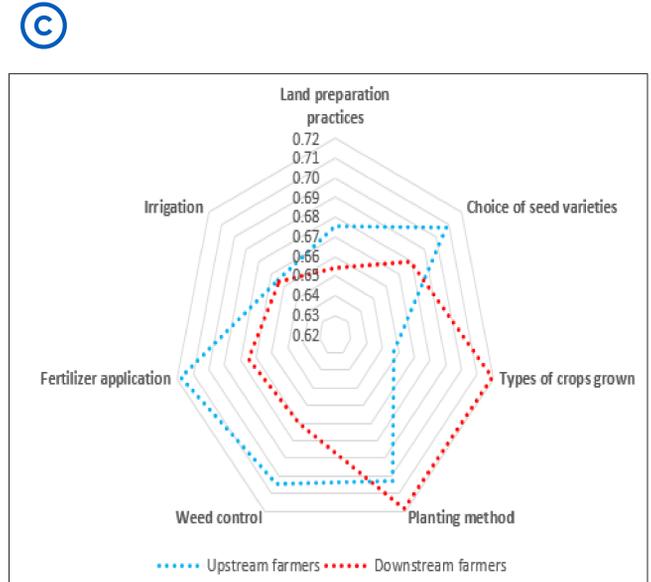


Figure 3: Appropriateness of Adaptive Decisions: Upstream farmers consider the appropriateness of their adaptive decisions more than downstream farmers

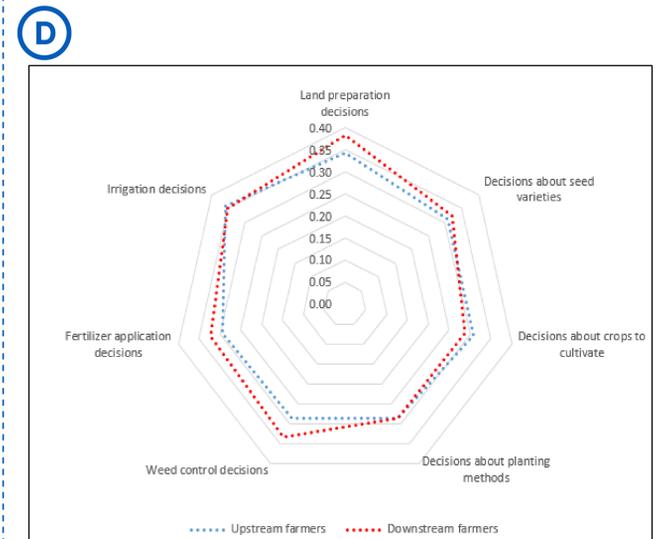


Figure 4: Consequentiality of Adaptive Decisions: Downstream farmers consider the consequences of their adaptive decisions more than upstream farmers

Conclusion

- ❖ Upstream farmers consider the appropriateness of the adaptive decisions in issues such as fertilizer application, weed control, planting method, and choice of seed varieties.
- ❖ Downstream farmers consider the appropriateness of the adaptive decisions in only two issues: types of crops grown and the planting method to use.
- ❖ To these farmers, adaptive decisions is the norm; water-dependent adaptive decision is a survival strategy against local and global geo-political and climate threats such as land eviction, flooding, draught

References

1. Haasnoot, M., Kwakkel, J. H., Walker, W. E., & ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global environmental change*, 23(2), 485-498.
2. Kwakkel, J. H., Haasnoot, M., & Walker, W. E. (2016). Comparing Robust Decision-Making and Dynamic Adaptive Policy Pathways for model-based decision support under deep uncertainty. *Environmental Modelling & Software*, 86, 168-183.
3. Nyamekye, A. B., Dewulf, A., Van Slobbe, E., Termeer, K., & Pinto, C. (2018). Governance arrangements and adaptive decision-making in rice farming systems in Northern Ghana. *NJAS-Wageningen Journal of Life Sciences*, 86, 39-50.