

# Intra-household factors under different irrigation arrangements affecting irrigation-nutrition pathways in smallholder farm households in Kenya

Nixon Murathi Kiratu<sup>1</sup>, Eefje Aarnoudse<sup>2</sup>, Martin Petrick<sup>1</sup>

<sup>1</sup>Justus Liebig University of Giessen, Institute of Agricultural Policy and Market Research, Germany

<sup>2</sup>Bonn-Rhein-Sieg University of Applied Sciences, International Centre for Sustainable Development

## Introduction

- ❑ **Irrigation** can increase Africa's agricultural production by 50%.
- ❑ E.g. utilizing marginal lands, shift from season-constrained rain-fed agriculture especially in the face of climate change.
- ❑ Need to ensure that irrigation agriculture does not only **increase caloric supply** but also bolsters the regions **nutritional security**.
- ❑ **Women empowerment, production diversity and farm income** are three vital **irrigation-nutrition pathways**.
- ❑ Interlinkages of these 3 pathways with household factors makes them a **key entry point** for nutrition-sensitive food system initiatives.

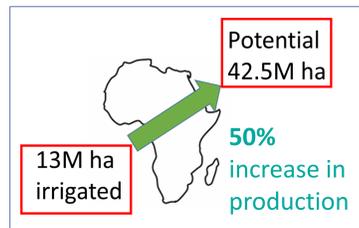


Figure 1: Africa irrigation potential (You et al., 2011)

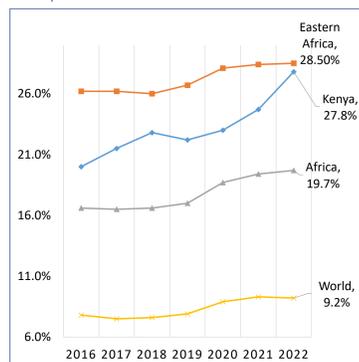
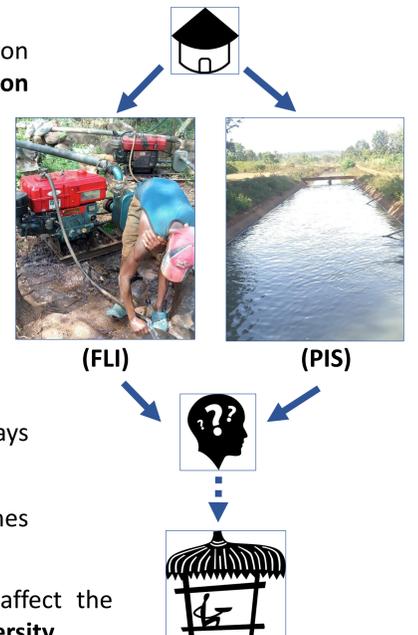


Figure 2: Prevalence of undernourishment (%) (annual value) (FAO, IFAD, UNICEF, WFP and WHO. 2023)

## Problem & objectives

- ❖ **Socio-technical set-up** in which household irrigation takes place has given rise to **different irrigation arrangements**:
  - ❖ Public irrigation scheme arrangement (**PIS**).
    - ❖ Publicly funded and managed.
  - ❖ Farmer-led irrigation arrangement (**FLI**).
    - ❖ Farmer or farmer group initiatives.
- ❖ **NB**: Need for disaggregated analysis.
- ❖ Such **analysis is missing** in literature.
  - ❖ **Factors** affecting irrigation-nutrition pathways remain largely **understudied**; and
  - ❖ **Linkage** of irrigation to nutritional outcomes remain vague and largely **uninvestigated**.
- ❖ **Objective**: Analyze **intra-household factors** that affect the three irrigation-nutrition pathways and **dietary diversity**.



## Methods



Figure 3: Map of the study area

- Cross-sectional data
  - 198 - Non-irrigating farm households;
  - 97 - FLI farm households; and
  - 89 - PIS farm households.
- Sample of **387 smallholder** farm households.
- Data collected in 1<sup>st</sup> Quarter of 2021.
- **Heckman two-step regression model**
  - 1<sup>st</sup> stage:  $I = \alpha_1 X_i + u$  :
    - Where  $I$  is the household **irrigation arrangement**;  $\alpha_i$  are the parameters to be determined;  $u$  is the error term; and  $X_i$  represents the household socio-economic factors.
- 2<sup>nd</sup> stage:  $Y = \beta_1 X_i + u$  :
  - Where  $Y$  represents **production diversity, farm income, women empowerment and dietary diversity**;  $\beta_i$  are the parameters to be determined;  $u$  is the error term; and  $X_i$  represents the household socioeconomic factors.

## Descriptive statistics

Variables	Non-irrigators	FLI	PIS
<b>Dependent variables</b>			
	<b>Means</b>		
Women's empowerment	0.73	0.74	0.71
Production diversity	3.88	3.62	2.94
Farm income (USD)	746.60	2,140.97	1,908.31
Minimum dietary diversity for women	4.46	4.93	4.72
<b>Independent variables</b>			
	<b>Means</b>		
Age of the household head (years)	56.22	47.45	49.03
Age of the primary female decision maker (years)	51.88	41.63	44.29
Education level of the household head (years)	7.34	9.09	8.43
Education level of the primary female decision maker (years)	6.32	8.25	8.52
Gender of the household head (Female)	0.28	0.10	0.24
Household size	3.43	3.69	3.58
Single adult household type	0.27	0.13	0.21
Land owned (acres)	1.54	1.75	1.39
Land rental price (per acre)	104.47	162.24	330.69
Primary female decision maker production decision	0.82	0.68	0.61
Tropical livestock units	0.74	0.72	0.55
Assets (USD)	779.97	2,670.62	1,582.15
Household group membership	0.74	0.83	0.84
Knowledge of pumping technology	0.07	0.89	0.09
Access to hybrid seeds	0.37	0.55	0.62
Distance to the market (Kilometers)	3.48	4.51	2.89

## Regression results & discussion

	Farmer-led irrigation arrangement	Coefficient
<b>Women empowerment</b>	Primary female decision maker production decision	0.13***
	Assets (USD)	>0.00*
	Household group membership	>0.00*
	Age of the household head (years)	0.01**
<b>Production diversity</b>	Tropical livestock units	0.74***
<b>Farm income</b>	Land owned (acres)	1018.97***
<b>MDDW</b>	Primary female decision maker production decision	0.43**
	Tropical livestock units	0.20*
	Land owned (acres)	0.11*

Notations: The notations and the meanings are as follows: \*\*\* p<.01, \*\* p<.05, and \* p<.1.

NB: Socio-economic factors only significant for FLI production diversity analysis only.

## Conclusions

- Different household factors affect **women empowerment, production diversity and farm income** differently in households depending on the irrigation arrangement.
- Ability of the **primary female decision maker** making **production decisions** and **assets** are key factors for household **women's empowerment**.
- **Land ownership** and **livestock-keeping** are important factors that influence household **farm income** and **dietary diversity** respectively.

## 3 key points:

1. Ability of the **primary female decision maker** making **production decisions** enhances **women's empowerment** for both irrigation arrangements;
2. Ownership of **livestock** is a key contributor to the household's **nutrition**; and
3. **Land ownership** is a key factor to the improvement of **farm income**.

	Public irrigation scheme arrangement	Coefficient
<b>Women empowerment</b>	Primary female decision maker production decision	0.17***
	Assets (USD)	>0.00*
	Household group membership	0.12**
<b>Farm income</b>	Land owned (acres)	1371.36***
<b>MDDW</b>	Tropical livestock units	0.40***
	Age of the household head (years)	-0.03**

Notations: The notations and the meanings are as follows: \*\*\* p<.01, \*\* p<.05, and \* p<.1.

## Policy recommendations

- ✓ Need to have **policy specific approaches and initiatives** that are geared towards **specific irrigation arrangements**.
- ✓ **Household socio-economic factors** are **viable irrigation-nutrition pathways policy entry points**.



**Contact information**  
Justus Liebig University of Giessen  
Institute of Agricultural Policy and Market Research  
[nixon.kiratu@agrar.uni-giessen.de](mailto:nixon.kiratu@agrar.uni-giessen.de)  
[nixonstudy@gmail.com](mailto:nixonstudy@gmail.com)

JUSTUS-LIEBIG-  
UNIVERSITÄT  
GIESSEN

IPPAE  
INTERNATIONAL PHD PROGRAM  
Agricultural Economics,  
Bioeconomy and  
Sustainable Food Systems



Deutscher Akademischer Austauschdienst  
German Academic Exchange Service

