A Cause-Effect Study of Trypanosomosis Dynamics in Cows under Agro-Pastoral Systems in The Gambia

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Theme: "Harnessing One Health Technologies & Innovations towards Eliminating Trypanosomiasis in Africa"

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Introduction

- African Animal Trypanosomosis (AAT) is one of the most serious constraints to cattle health and productivity in sub-Saharan Africa.
- The tropical environment of The Gambia, with its diverse climatic and soil conditions, creates a complex setting for AAT.
- In cows, its impacts are shaped by multiple interlinked factors, including host susceptibility and management practices.
- Understanding the cause-effect dynamics of AAT within agro-pastoral systems is critical.
- This study examines how various factors interact to influence AAT in cows, providing insights for more effective control strategies.

Olaniyan et al. (2022); Hernández-Castellano et al. (2020); De Almeida et al. (2018)

Objective

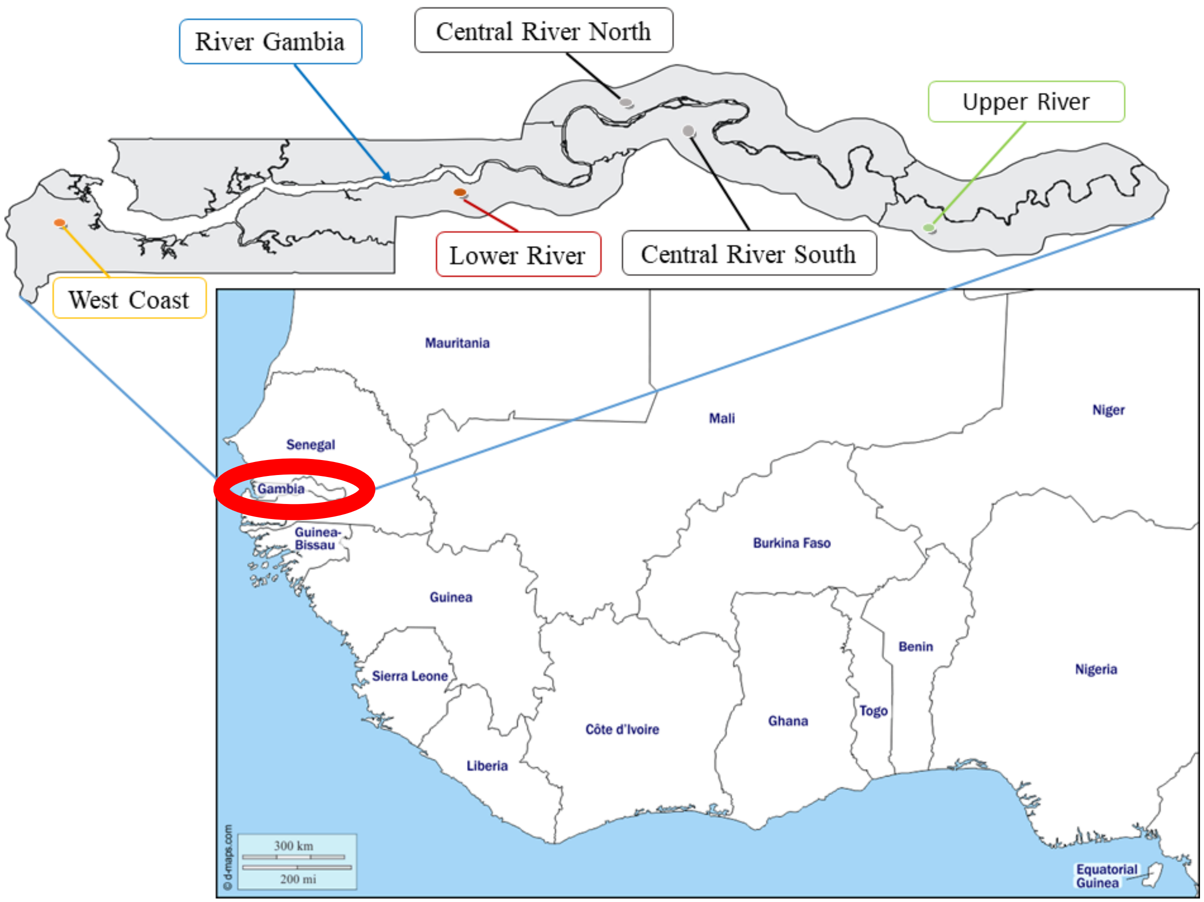
This study in relation to naturally grazed within agro-pastoral farming systems of The Gambia aimed to:

1. Examine the underlying cause-effect dynamics of AAT in cows with emphasis on technical, biophysical, physiological, and institutional factors;
2. Identify and proffer solutions concerning key challenges facing smallholder cattle farmers with regard to control and eradication of AAT disease;
3. Contribute to scientific evidence that can guide decisions, technical interventions and policy on control and eradication of AAT disease, especially in sub-Saharan Africa.

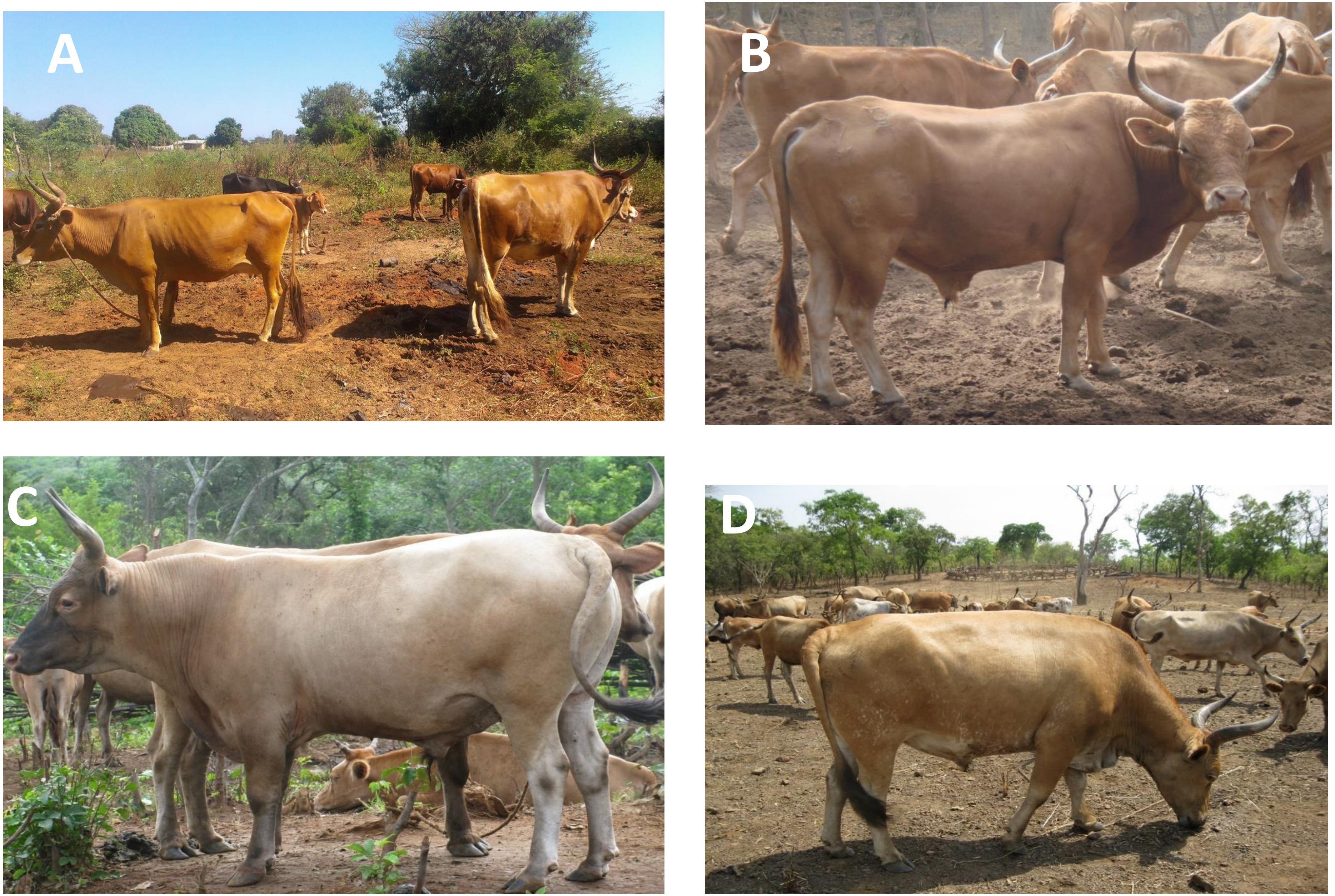
Study context

Gambia

- Latitude 13°05' to 13°57'N and longitude 13°47' to 16°74'W)
- Agriculture makes up 23.2% of the gross domestic product (GBoS, 2023)
- Sudanese-Guinean climate with a short rainy season (June-October).
- N'Dama cattle – approximately 97% of the cattle in the country (MoA, 2016).
- Meta-analysis of studies from 1980 to 2018 showed 5.2% (95% CI: 4.0–6.4) national prevalence (Olaniyan et al, 2021)



N’Dama cattle in the Gambia

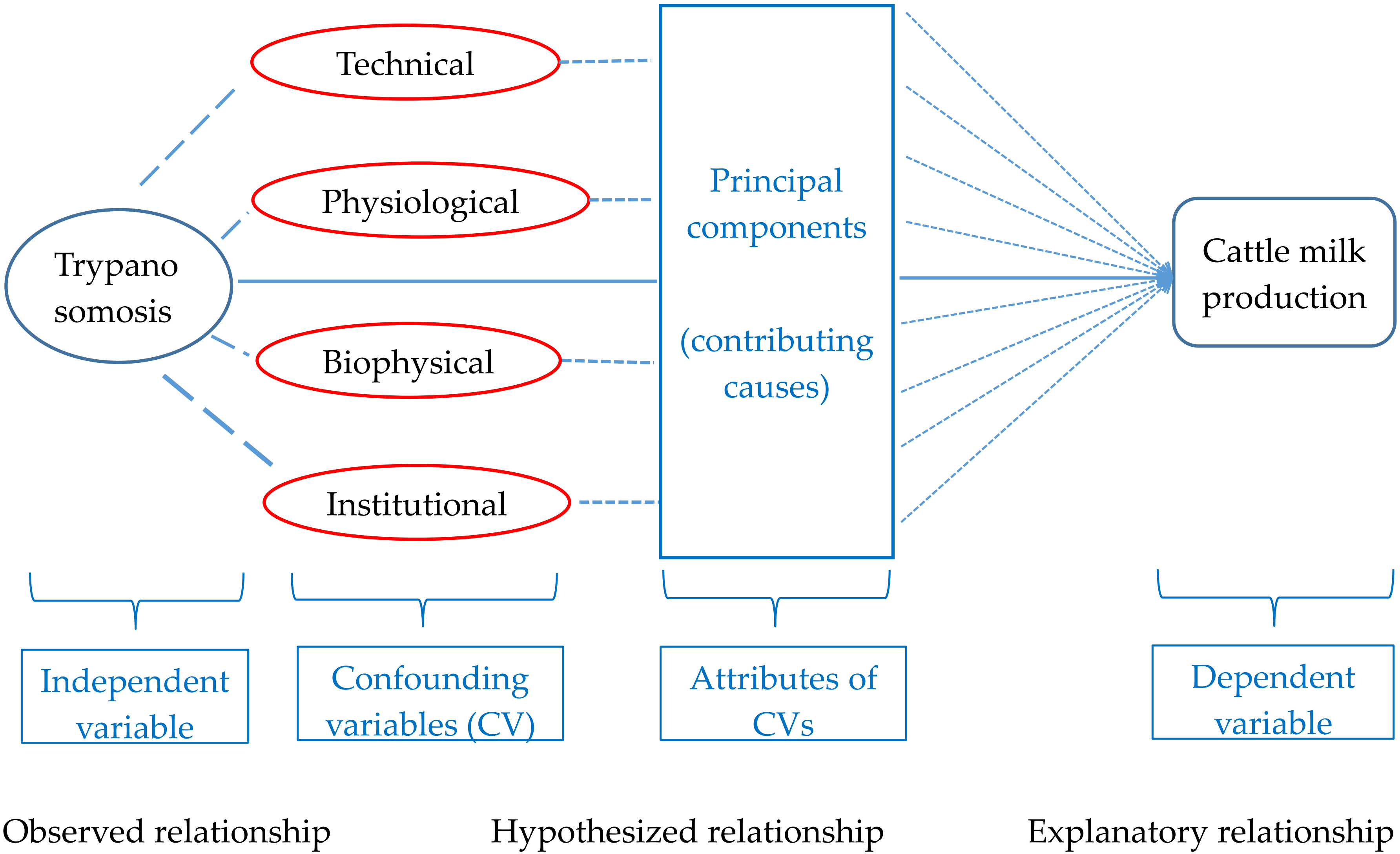


Methodology (1)

- Survey Design
  - Literature review
  - Conceptual framework
  - Questionnaire design
    - Likert scale (5-point, bipolar agreement)
    - Four constructs, each with ≥ 6 questions [Constructs = hypothesized variables linking trypanosomosis to milk production]
  - Pretesting: 10 participants → 147 to 150 respondents

- Statistical Analysis – Principal Component Analysis (PCA)
  - Internal consistency: Cronbach's Alpha
  - PCA suitability checks:
    - Sample size ratio ≥ 6:1
    - ≥ 2 correlations > 0.3
    - KMO > 0.70 (min. 0.50)
    - Bartlett's test ($p < 0.05$)

Conceptual Framework



Summary of the variables examined

Table 1: Summary of the confounding variables examined

Construct	Tag	Description
Technical	A	Farm management practices influencing trypanosomosis impacts on milk production. Examples: draught use, feed supplementation, village herding, herd size, inbreeding, pasture clearing, crossbreeding, etc.
Physiological	B	Functional conditions of cows predisposing them to infection risks. Examples: pregnancy, daily milk yield, lactation length, body condition, feed stress, and co-infections, etc.
Biophysical	C	Environmental and ecological factors affecting trypanosomosis. Examples: land size, temperature, rainfall, soil fertility, feed resources, wildlife presence, proximity to rivers, forest cover, etc.
Institutional	D	Policy and organizational factors influencing trypanosomosis prevalence Examples: farmer partnerships, pastoral resource management, eradication policies, animal health regulation support, farmer–extension–research linkages.

Methodology (2)

- Component loadings - PCA with Varimax rotational option
- Retention criteria:
  - Eigenvalues > 1
  - Scree test (Cattell)
  - Variance explained
  - Interpretability criterion
- Outputs: Scree plots
- Representation & Tools
  - Cause-and-Effect (Fishbone) Diagram

Results (1)

Table 2: Overview of the examined constructs

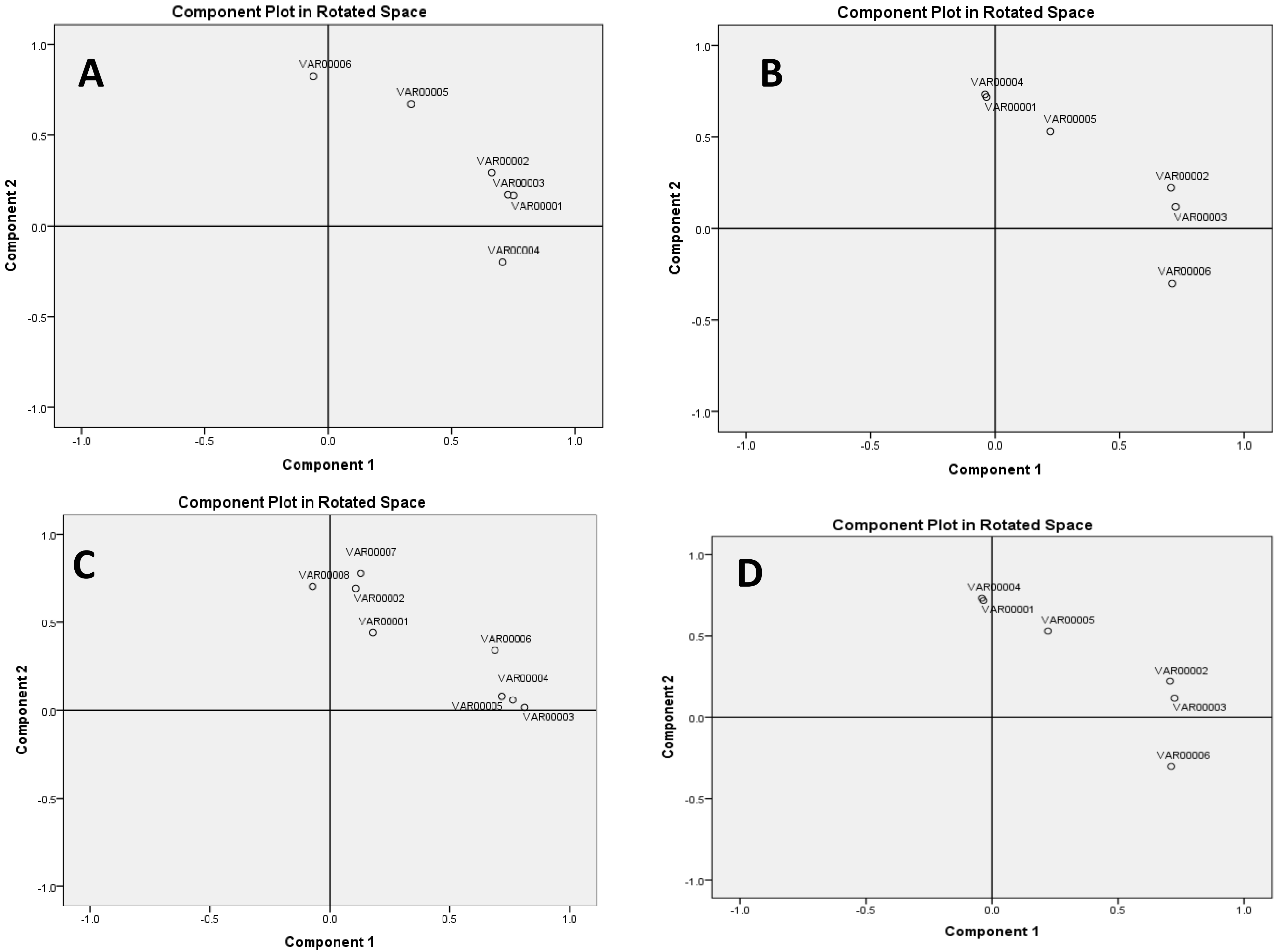
Constructs	No. of items	N	Cronbach's Alpha	KMO[a]	Bartlett's statistic[b]			No. of extracted components
					$\chi 2$	df	p-value	
Technical	8	147	0.31	0.55	110.69	28	0.000	2
Physiological	6	149	0.40	0.54	70.42	15	0.000	2
Biophysical	8	150	0.70	0.74	224.12	28	0.000	2
Institutional	6	150	0.68	0.74	135.56	15	0.000	2

N = valid number of respondents;

a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy

b Bartlett's test of sphericity at 5% significance level with the null hypothesis that the correlation matrix of a construct is an identity matrix i.e. not correlated

$\chi 2$ = chi-square value; df = degree of freedom;



Component Plot in Rotated Space
A
VAR00006
VAR00005
VAR00002
VAR00003
VAR00001
VAR00004
Component 1
Component 2
1.0
0.5
0.0
-0.5
-1.0
Component Plot in Rotated Space
B
VAR00004
VAR00001
VAR00005
VAR00002
VAR00003
VAR00006
Component 1
Component 2
Component Plot in Rotated Space
C
VAR00007
VAR00008
VAR00002
VAR00001
VAR00006
VAR00004
VAR00005
VAR00003
Component 1
Component 2
Component Plot in Rotated Space
D
VAR00004
VAR00001
VAR00005
VAR00002
VAR00003
VAR00006
Component 1
Component 2

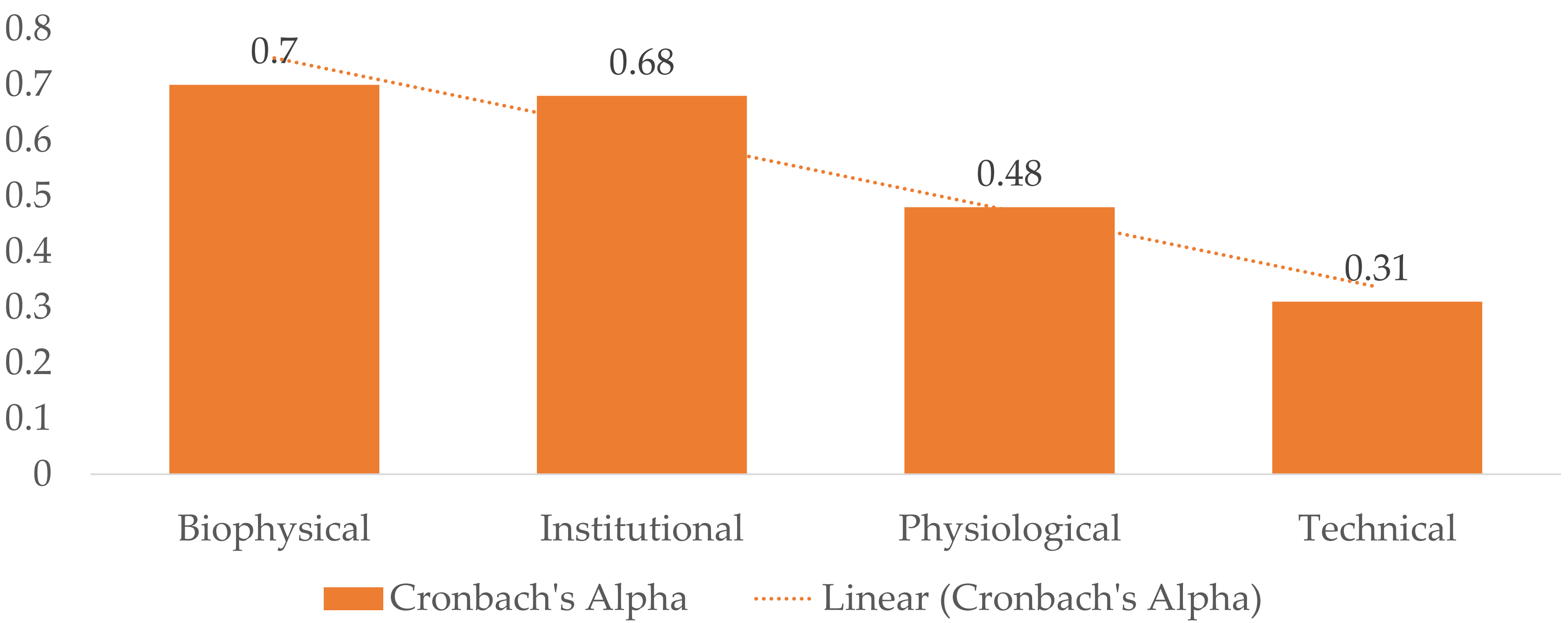
Results (2)

- **PCA Appropriateness**
  - KMO > 0.5 for all constructs → PCA qualified
  - ≥ 2 correlations > 0.3 in correlation matrix
  - Bartlett's test significant ($p < 0.05$)
  - Sample size ratio ≥ 6:1 across constructs
- **Reliability (Cronbach's Alpha)**
  - Biophysical construct: 0.70 (most consistent)
  - Institutional construct: 0.68 (high consistency)
  - Physiological construct: 0.48 (moderate)
  - Technical construct: 0.31 (low consistency)

Results (1)

Key Insights

- Biophysical and institutional factors = strongest, most reliable influence
- Physiological = moderate influence
- Technical = least consistent



Implications of the findings

- Demonstrates that technical, physiological, biophysical, and institutional factors interact to shape trypanosomosis risks.
- Reveals farmer vulnerabilities and adaptive responses, guiding context-specific livestock health policies.
- Links disease dynamics to broader land-use and ecological changes, reinforcing the need for integrated approaches.
- Provides further evidence for systems-based research and policy on AAT.

Conclusion and recommendation

- AAT remains a critical barrier to cow health and productivity in The Gambia.
- Its dynamics are shaped by ecological, biological, and management factors within agro-pastoral systems.
- Understanding these cause-effect relationships contributes to targeted interventions.
- Partnerships are essential to improve cow productivity and secure livelihoods of vulnerable farming communities.

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Asante
Gracias
Merci
Thank You
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Teşekkür
ederim