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THE ROLE OF AGRIPRENEURSHIP ON FOOD SECURITY: MEDIATING ROLE OF INNOVATION

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The study is motivated by persistent challenges in food security in Tanzania, despite the increasing adoption of innovative practices within agricultural activities. The primary objective is to examine the contribution of agripreneurship to household food security in Tanzania, with innovation acting as a mediating factor. Specifically, the study: (i) assesses the level of agripreneurship among farming households; (ii) evaluates the extent to which agripreneurs employ innovative practices; and (iii) determines the status of household food security using multidimensional indicators. Based on a sample of 384 agripreneurs selected through Probability Proportion Sampling (PPS), the study undertakes key analytical tasks, including bivariate correlation analysis and confirmatory factor analysis, to explore the relationships among the study variables. The findings indicate a high prevalence of food insecurity in the study areas and reveal limited engagement in innovation among agripreneurs. Importantly, the results confirm that innovation mediates the relationship between agripreneurship and food security, challenging the assumption of a direct linear association. The study recommends that policymakers develop strategic initiatives to support agripreneurs in adopting innovation and establish a network of food innovation hubs to enhance collaboration and address regional agricultural needs effectively.

Keywords: *agripreneurship, innovation, food security, Tanzania*

INTRODUCTION

Africa possesses abundant resources that can enhance agricultural sustainability and bolster food security (Nakashima et al.,2022). However, addressing the challenge of food shortage in Africa necessitates increased financing in agricultural equipments, technological support, empoweremnt for farmers, and consistent public policies conducive to economic upsurge and transfiguration (Lazaro and Alexis, 2021). Despite initiatives such as the African Union (AU) 2014 Malabo Declaration, inclusive, Africa Agriculture Development Programme (CAADP), and Science, Technology, and Innovations Strategy for Africa 2024, the region faces a critical obstacle in the form of inadequate investments in the agricultural sector (Mkomwa et al., 2022; Etuk and Ayuk, 2021; Warinda et al., 2020). With the fastest population growth rate globally, Africa is projected to reach 2.5 billion people by 2050, posing significant implications for food security (Nieves et al., 2017). Governments, in partnership with donors and donors organization, have inaugurate various programs to transform the agricultural sector and enhance food security, such as the continental policy initiatives (AU Agenda 2063 and AfDB's Feed Africa Strategy 2025) (Mkomwa et al., 2022; Etuk and Ayuk, 2021; Warinda et al., 2020).

In East Africa, inadequate investments persist, only few countries are on track of meeting the CAADP goal of utilizing 10% in the farming sector (African Union Commission, 2024). Tanzania, alike East African nations, grapples with food insecurity due to challenges like deficient agricultural infrastructure, unreliable markets, limited access to credit, low agro-dealer presence in rural areas, fluctuating cost of food, turbulent, and insufficient outflow and irrigation (Lazaro and Alexis, 2021; Rutsaert et al., 2021; Ismail and Changalima, 2019). As a potential solution, promoting agripreneurship and innovation among local farmers can facilitate a change from Peasant cultivation to advanced agribusiness venture. Agripreneurship has proved effective in improving food availability, alleviating poverty, and fostering socio-economic progress, dissimilar to traditional farming, agripreneurship is adjustable, multifunctional, and can absorb trained and jobless population, contributing to increased productivity and, subsequently, food security in Africa (Akrong and Kotu, 2022).

The agricultural landscape is evolving from conventional tilling to the agro mechanics, where agripreneurship and innovation play a crucial role in transforming traditional agriculture into a modern-agricultural sector (Singh and Misra, 2021). Agripreneurs employing innovation act as catalysts for sectoral development, addressing challenges like youth unemployment in rural areas by motivating youths to engage in agri-activities and fostering economic self-sufficiency (Choudhury and Easwaran, 2019; Uche and Familusi, 2018). The necessity for innovation in agripreneurship stems from aspects such as growing demand for quality and organic food, affordable agricultural production equipments, private

sector willingness to enter agribusiness, efforts to reduce malnutrition, and global attention to safeguarding food security (Uneze, 2013). "Agripreneur" is a person engaged primarily in farming or agricultural activities, representing a shift from traditional income-generating farming activities to more entrepreneurial endeavors (Basir and Musa, 2022). The term "agripreneur" is coined to combine the term agriculture and entrepreneur. Though it is generally accepted that innovation is heart of entrepreneurship, studies on the link between entrepreneurship and innovation presented both concepts as separate from each other. Innovation is the fuzzy concept in which its application varies according to context or conditions.

Agripreneurship involves a profitable fusion of agricultural and entrepreneurial activities, transforming farms into agribusiness enterprises, encompassing both traditional and modern business endeavors (Rajesha et al., 2016; Singh and Misra, 2021). Though it is generally accepted that innovation is heart of entrepreneurship, studies on the relationship between entrepreneurship and innovation presented both concepts as separate from each other (Chung *et al.,* 2022; Berger *at al.,*2021). Innovation is the fuzzy concept in which its application varies according to context or conditions. Agripreneurship innovation entails applying fresh insights and existing expertise to enhance food production (Mutenje et al., 2016). Agripreneurship is complemented by three forms of innovation: hardware, software, and org-ware. Hardware innovations involve physical tools such as gadgets and irrigation systems, enhancing productivity and cost-effectiveness (Vik & McElwee, 2011). Software innovations focus on processes and knowledge, including advancements like GPS systems and weather modification (Rajesha et al., 2016; Singh & Misra, 2021). Org-ware emphasizes institutional arrangements and farmer organizations for coordination and input access (Choudhury & Easwaran, 2019; Basso et al., 2009). Agripreneurs, motivated by profit and strategic thinking, aim to diversify farming, leveraging market potentials, innovative technologies, and resources (Choudhury and Easwaran, 2019; Basso et al., 2009). This significantly contributes to African economies, fostering higher productivity, rise food security, removing poverty, rural employment, livelihoods, tax revenues, income to farmers, improved welfare, economic growth, and non-farm investments in rural areas (Ouko et al., 2022; Ramushu, 2021; Uneze, 2013; Kazungu and Magigi, 2012).

Despite consistent GDP growth in Tanzania, substantial poverty reduction remains challenging, especially in rural areas where 66.3% rely on agriculture (Government of the United Republic of Tanzania, 2015). Agripreneurship and innovation could uplift the impoverished population, but challenges like low food production, capital scarcity, and limited entrepreneurial mindset hinder progress (Kinyondo and Magashi, 2017). Barriers include capital shortage, lack of technical support, market access, financial information, and environmental factors. Tanzanian government measures, like reduced interest rates and liberalized labor laws, aim to encourage agripreneurs. Initiatives, including the Agricultural Development Bank, seek to boost production, yet food security remains unsatisfactory, evident in the Global Food Security Index (2022) ranking Tanzania 90th with an overall score of 49.1%, highlighting affordability (45.8%), availability (58.7%), quality and safety (50.2%), and sustainable adoption (41.7%) (Lazaro and Alexis, 2021; Rutsaert et al., 2021). The UN's Food Systems Summit emphasizes innovation's role, with collaborative efforts like the World Economic Forum and FAO's roadmap aiming to accelerate digital food systems innovation globally. Food security initiatives, though, require further enhancement in Tanzania.

Although agripreneurship extends entrepreneurial principles into the agricultural sector (Fitz-Koch, 2018), its interdisciplinary exploration in Africa and particularly in Tanzania remains underdeveloped. Existing empirical studies demonstrate considerable variation in objectives, indicators, and methodological approaches, resulting in a fragmented understanding of how agripreneurship contributes to household food security. In Tanzania, research linking agripreneurship to food security is notably scarce (Kazungu & Kumburu, 2023), and most available studies employ narrow or single-dimensional food security indicators. This limits their ability to offer comprehensive and actionable insights.

Furthermore, previous studies provide conflicting perspectives regarding agripreneurship's potential to enhance food security. While some scholars recognise its positive role in stimulating innovation and productivity (Boney et al., 2013), others question its actual contribution, citing contextual and structural barriers (Liang, 2018). Zwane (2020) highlights the importance of strong agricultural innovation systems for sustainable food security, yet such system-level analyses have rarely been integrated with household-level agripreneurship dynamics in Tanzania. Similarly, Boratyńska and Huseynov (2017) demonstrate that food security outcomes are influenced by both direct and indirect policy interventions, including technological support and improvements in the agricultural environment factors closely tied to agripreneurial innovation. This knowledge can guide interventions in key areas, such as food availability, access, and affordability, aligning with Sustainable Development Goals 1, 2, and 8, combating poverty, eradicating hunger, and promoting decent employment, and economic growth (Akrong and Kotu, 2022). Against this background, the present study aims to examine the contribution of agripreneurship to household food security in Tanzania, with innovation acting as a mediating factor.

This study is guided by the following specific objectives: (i) to assess the level of agripreneurship among farming households; (ii) to determine the extent to which agripreneurs employ innovative agricultural practices; (iii) to assess the status of household food security using multidimensional indicators; and (iv) to analyse the mediating effect of innovation on the relationship between agripreneurship and household food security. To achieve these objectives, the study undertakes several key research tasks such as collecting and analysing data on the education levels of agripreneurs; the prevalence of stunting, wasting, and underweight among children under five years; the average number of months households experience food shortages; the proportion of households facing moderate or severe food insecurity; and the proportion of agripreneurs applying innovative agricultural practices. These tasks form the basis for a comprehensive empirical assessment of agripreneurship, innovation, and food-security outcomes in the study areas.

THEORETICAL AND EMPIRICAL DEBATES

Entrepreneurship theory traces its origins to early thinkers such as Jean-Baptiste and Richard Cantillon, whose work linked entrepreneurial behaviour to agricultural systems (Vik & McElwee, 2011). Subsequent intellectual traditions expanded these foundations: the German school, including Baumol, Schumpeter, and von Thünen, emphasised creative destruction, while neo-classical theorists like Knight, Marshall, and Schultz viewed entrepreneurs as market coordinators. The Austrian school, represented by Kirzner, Menger, and von Mises, underscored opportunity recognition as central to entrepreneurship (Wennekers *et al.,* 1999). Despite this rich history, early entrepreneurship scholarship largely overlooked agriculture due to its regulatory complexity and sectoral uniqueness (Fitz-Koch et al., 2018).

Agripreneurship, situated within dynamic agricultural environments, highlights innovation as a crucial driver of food security. Precision farming practices, rooted in earlier theoretical traditions, boost yields and strengthen food availability (Vik & McElwee, 2011). Mobile-based agri-tech platforms enhance farmers' access to markets, weather forecasts, and agronomic advice, improving income and market participation (Pindado and Sánchez, 2017). Agripreneurial diversification such as integrating aquaculture with crop farming reduces exposure to climate and price shocks (Fitz-Koch et al., 2018). Innovations in post-harvest technologies, including solar-powered cold storage, decrease spoilage and improve food utilisation (Vik & McElwee, 2011). These developments underscore the growing scholarly interest in the intersection between agripreneurship, innovation, and food security (Pindado and Sánchez, 2017).

Tanzania, however, faces a deepening food security crisis. Between 2019 and 2020, over 20% of households in Arusha, Tanga, and Manyara experienced acute food insecurity (URT, 2020). Regions such as Dodoma, Singida, and Tabora reported even higher levels, affecting 45–55% of households. By 2022, an estimated 5.3 million Tanzanians 9.4% of the population were food insecure (Rashid et al,, 2024), with rural households disproportionately affected. Although agribusiness and innovation are recognised as key pathways to improving food security, empirical research on agripreneurship, innovation, and food security remains scarce in Tanzania and Africa (Dias et al., 2019; Fitz-Koch *et al.,* 2018). This gap limits both theoretical advancement and practical interventions, despite agripreneurship's potential to enhance agricultural commercialisation, raise incomes, and reduce poverty (FAO, 2020; Alao *et al.,* 2018; Zhou *et al.,* 2013).

RESEARCH METHODS

Cross-sectional research design was utilized since facts to be obtained at a single specific moment and is useful for description uses and setting up connection amongs parameters (Wang and Cheng, 2020). The invrestigation took place in Tanzania's Arusha, Tanga, and Manyara regions Tanzania because they are among regions confronted acute food insecurity, with 16% experiencing a catastrophic situation and an additional 5% facing an urgent situation (URT, 2020).

Sample Size, Techniques, and Data Collection Methods

Sample size determination was done basing on the Cochran's formula which states that:

$$n = \frac{z^2 pq}{e^2}$$

Where,

$n =$ Estimated sample size

$z =$ Confidence level at 95% (standard value of 1.96)

$p =$ Estimated target population (Using standard value of 0.5% since it is unknown)

$q = 1 - p$ (1-0.5)

$e =$ Margin of error at 5% (standard value of 0.05)

Estimated sample size will be calculated as follows:

$$n = \frac{1.96^2 x 0.5 x 0.5}{0.05^2}$$

$$= \frac{3.8416 x 0.25}{0.0025}$$

$$= 384.16$$

The study involved 384 respondents, constituting the sample size based on Cochran's formula, and focused on three administrative regions in Tanzania. The Probability Proportion Sampling to Size (PPS) technique was utilized to select agripreneurs (household heads) proportionally to their numbers in each region. Agripreneurs served as the primary data source, complemented by secondary data from regional profiles and government reports. Structured questionnaires facilitated data collection from the target population, encompassing household heads engaged in agripreneurship within the specified geographical boundaries.

Analytical Model

The study utilized descriptive statistics and standardised anthropometric indices (HAZ, WHZ, and WAZ) were calculated using the 2006 WHO growth reference to evaluate the prevalence of stunting, wasting, and underweight among children. According to WHO the child is considered stunted, underweight or wasted if the HAZ, WHZ and WAZ are below -2 standard deviations from the median of the WHO growth standards (WHO, n.d). Furthermore, WHO provides cut-off value for public health significance (Table 1).

Table 1: Cut-off values for public health significance

S/N	Indicator	Prevalence cut-off values for public health significance
1.	Stunting	<2.5%: very low
		2.5 to <10%: low
		10 to <20%: medium
		20 to <30%: high
		≥30%: very high
2.	Wasting	2.5%: very low
		2.5 to <5%: low
		5 to <10%: medium
		10 to <15%: high
		≥15%: very high
3.	Overweight	2.5%: very low
		2.5 to <5%: low
		5 to <10%: medium
		10 to <15%: high
		≥15%: very high

Source: WHO (n.d)

All variables, measured on a Likert-type scale (1-5), determined respondents' agreement levels. Ordinal scale analysis was preferred due to the ranking nature of responses. Agripreneurship, innovation, and food security were measured using scales with Cronbach's Alpha values of 0.80, 0.87, and 0.96, respectively, ensuring internal stability.

Bivariate correlations and confirmatory factor analysis tested the association of study variables. First Pearson's correlation coefficient (r) was computed:

$$r_{xy} = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2}}$$

Where:
X_i and Y_i=individual scores of variables X and Y
$\bar{X}$ and $\bar{Y}$=mean scores of X and Y
r_{xy} ranges from –1 (perfect negative correlation) to +1 (perfect positive correlation)

This analysis assessed associations among agripreneurship, innovation, and food security.

Confirmatory Factor Analysis (CFA) was used to validate the measurement model and test whether the observed variables load appropriately onto latent constructs. The basic CFA measurement model is represented as:

$$X = \Lambda + \xi\delta$$

Where:
X=vector of observed variables (e.g., questionnaire items)
Λ=matrix of factor loadings
ξ=vector of latent factors (Agripreneurship, Innovation, Food Security)
δ=vector of measurement errors

The overall model fit was assessed using standard goodness-of-fit indices. The Chi-square statistic (χ^2) was $\chi^2 = 142.36$, $p < 0.001$, indicating a statistically significant difference between the observed and estimated covariance matrices. However, because Chi-square is sensitive to sample size, additional fit indices were considered. The Comparative Fit Index (CFI) was 0.93 and the Tucker–Lewis Index (TLI) was 0.91, both exceeding the recommended threshold of 0.90, suggesting that the model fits the data well. The Root Mean Square Error of Approximation (RMSEA) was 0.06, which falls below the acceptable cut-off point of 0.08, further confirming that the model demonstrates an acceptable level of fit.

The hypothesized three-factor model (Agripreneurship, Innovation, and Food Security) was compared with alternative models in the analysis. Table 2 outlines variable measurement and operationalization.

Table 2: Operationalization of Variables

Variable	Definition	Measurement
DV Y= Food security	Food security entails consistent availability and affordability of safe, nutritious food, promoting health and well-being. (Availability, accessibility, and affordability)	Index
IV Agripreneurship	Agripreneurship blends farming and entrepreneurship, transforming farms into lucrative agribusinesses.	Index
MV Innovation	Innovation introduces new concepts, enhancing the value of products or services (hardware, software, org-ware).	Index

RESEARCH RESULTS AND DISCUSSION

Educational level of agripreneurs

Two in three respondents had completed primary education (66.8%), with higher proportions in Arusha (71.8%). Just over one in ten respondents (15%) had attained ordinary level secondary education. Arusha and Manyara had the highest proportion of respondents with ordinary level of secondary education (16.3%) and (16.0%) while Tanga had the

lowest proportion (11.3%). Nearly 12 % of respondents had never attended school, with a comparatively higher proportion in Tanga (19%) and lowest in Arusha (6.3%) (Table 3). This implies that the majority had lower level of education just completed primary education a situation that denies that to engage in innovation in the spectrum of enhancing food security.

Table 3: Educational level of agripreneurs

Level of Education	**Arusha**	**Tanga**	**Manyara**	**Overall**
College & University	1.0	0.8	0.5	0.7
Vocational Training	0.1	0.4	0.2	0.2
Advanced secondary school form 5-6	0.1	0.1	0.2	0.1
O-Level-Secondary school form 1-4	16.3	11.3	16.0	15
Never Attended	6.3	19.0	10.3	12
Primary school 1-4	4.4	6.3	6.4	5.7
Primary school 5-7	71.8	62.2	66.4	66.8

Prevalence of stunting, wasting, and underweight in children under five years of age

Stunting, wasting and underweight are among indicators that can show status of food security. The study therefore assessed prevalence of stunting, wasting and underweight for under five children. The findings in Table 4 show that the prevalence of stunting among under-five children was 38.7.% (95% CI 38.5%-44.5%). Arusha had the highest prevalence of stunting (40%), followed by Tanga (39%) and the lowest was in Manyara (36%). Boys had a comparatively higher prevalence of stunting (42.7%, 95% CI 38.5%-44.5%) than girls (34.8%, 95% CI 34.1%-36.5%). The prevalence of stunting observed is higher than the national average of 30% reported in the 2022 Demographic and Health Survey and Malaria Indicator Survey. This implies that food insecurity continues to be a problem in Tanzania due to problems associated with availability, accessibility and affordability. Similar assertation was put forward by Khamis et al. (2017) who noted that prevalent stunting, wasting, and underweight in children under five years of age was mostly associated with availability, accessibility and affordability.

Table 4: Prevalence of stunting, wasting, and underweight (n= 1152), age 6-59 month

Indicator	Gender	Arusha	Tanga	Manyara	Overall, 95%CI
Stunting	Boys (n=341)	44.4	44.2	39.7	42.7% (38.5-44.5)
	Girls (n=276)	35.9	35.5	33.0	34.8% (34.1-36.5)
	All (n=617)	40.4	39.6	36.2	38.7% (37.9-40.5)
Wasting	Boys (n=475)	7.2	3.3	12.5	7.6 % (3.1-8.0)
	Girls (n=310)	3.3	3.2	8.2	4.9% (1.7-5.9)
	All (n=785)	5.4	3.2	10.3	6.3 (4.5-10.5)
Underweight	Boys (n=470)	13.9	10.4	16.4	13.5% (12.6-16.6)
	Girls (n=330)	8.5	10.5	11.1	10.0% (8.0-13.6)
	All (n=800)	11.3	10.5	13.6	11.8 % (10.8-14.6)

The prevalence of wasting among under-five children was 6.3% (95% CI 4.5.% -10.5%). The highest prevalence of wasting was observed in Manyara (10.3%) and the lowest in Tanga (3.2%). Boys had a comparatively higher prevalence of wasting (7.6%) than girls (4.9%). Nationally, the existence of wasting in 2022 was 3%. The prevalence of underweight was highest in Manyara (13.6%), lowest in Tanga (10.4%), and the overall was 11.8% (95% CI 8.0%-13.6%). This value is also higher than the national average of 12% reported in 2022.

Average number of months of food shortage in the previous 12 months

Sixty three percent of households did not have enough food to meet family needs in the previous farming season. This situation was more severe in Manyara (71%) and Tanga (76%), but less so in Arusha (56%). On average, households experienced food shortage for three months in the previous 12, with those in the Manyara reporting an average of 3.5 months, followed by Tanga (3.1 months, while the lowest was in Arusha which reported an average of 2.5 months. This implies that the situation of food security in the study area is not good hence require innovative approaches to resolve the matter.

Table 5: Proportion (%) of households that did not have enough food to meet family needs in the previous farming season (n=13420)

Response	Arusha	Tanga	Manyara	Total
Yes	56	62	71	63
No	28	34	14	25
Don't know	16	4	15	12
Average months of food shortage	2.5	3.1	3.5	3.0

This assertion is corroborated by the findings of IPC (2023), indicating that food insecurity in Tanzania is principally influenced by the absence of innovative methods to harness water for irrigation during extended dry periods and unpredictable rainfall. This situation results in suboptimal crop and livestock production, consequently adversely impacting both pasture and water availability.

Proportion of households facing moderate or severe food insecurity

Food insecurity was measured according to the Food Insecurity Experience Scale Global Standard Scale (FIES-GSS). This indicator uses eight elements to assess the level of food insecurity. Households responding yes to any of the elements 4-7 (skipped a meal because there was not enough money or other resources; ate less than required; ran out of food or hungry but did not eat) experience moderate food insecurity. Households responding yes to element 8 experience severe food insecurity. Results show that 28% (95%CI, 27.5-29.5%) were moderately food insecure while 33% (95%CI, 32.5-34.5%) experienced severe food insecurity (Figure 1). This implies that over 50% of the households are food insecure and required agripreneurship innovative approaches in order to redress situation. This variation might be attributed by changes in climate parameters which are known to affect climate-sensitive sectors, agriculture inclusive here require some sort of innovation.

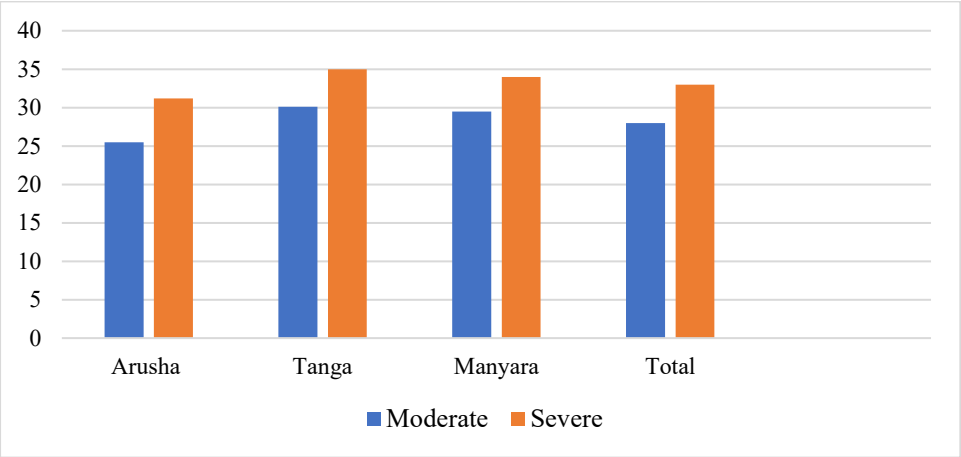

Figure 1: HHs with moderate or severe food insecurity (n=384)

Proportion of Agripreneurs employing Innovations practices

Innovations are necessary for agripreneurs in order to resolve food security. Findings for this show that 46% (95% C.I, 45.5%- 46.5%) employed innovative practices such as hardware, software and org-ware. Hardware innovations involve the use of physical tools to maximize agricultural productivity Software innovations encompass processes, skills, knowledge, and information required for the effective utilization of technological advancements in agriculture and finally Org-ware innovation focusing on institutional arrangements related to innovation accessibility and utilization, involves farmer organizations. This implies that few agripreneurs in the study areas do apply innovation in their farming. Arusha had the highest (52%) and lowest in Tanga (43%) proportions of Agripreneurs employing innovation in their farming business (Figure 2).

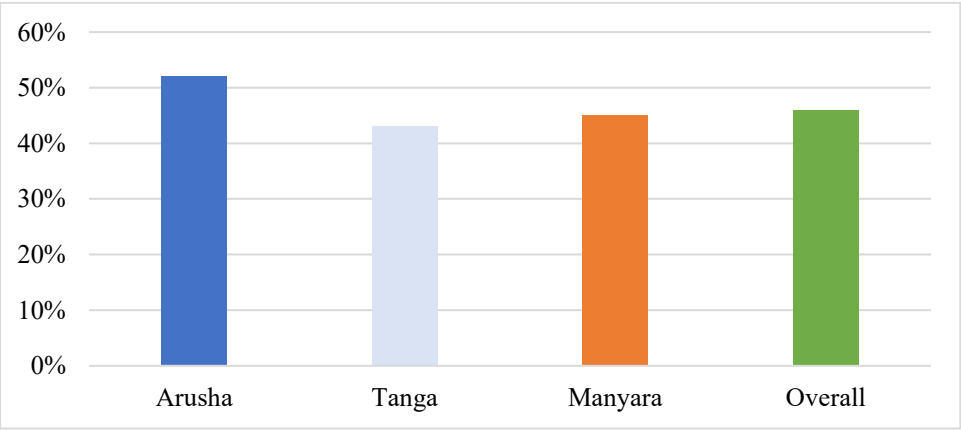

Figure 2. Proportion (%) of Agripreneurs employing innovation(n=384)

Agripreneurship Innovation and Food Security

The correlation coefficients indicate a statistically significant and positive association between agripreneurship and food security ($r = 0.21$, $p < 0.01$). Similarly, there exists a positive correlation between agripreneurship and innovation ($r = 0.31$, $p < 0.01$). Furthermore, the research reveals a significant and positive relationship between innovation and food security ($r = 0.17$, $p < 0.01$).

Table 6: Bivariate correlations

Variable	Correlation					
	1	2	3	4	5	6
Agripreneurship	0.08	− 0.03	0.09	(0.80)		
Innovation	0.07	− 0.01	0.12*	0.31**	(0.86)	
Food security	0.01	0.01	0.13*	0.21**	0.17**	(0.96}

n = 384. Cronbach's α in parenthesis
*p < 0.05 (two-tailed)
**p < 0.01 (two-tailed)

The method of maximum likelihood estimation was employed through confirmatory factor analysis (CFA). The model under consideration comprised three factors: agripreneurship, innovation, and food security, which were compared against alternative two-factor and one-factor models. Results indicated that the three-factor model demonstrated satisfactory fit indices ($\chi 2/df = 1.44$, TLI = 0.98, CFI = 0.98, RMR = 0.06), as detailed in Table 7. This three-factor model exhibited superior appropriateness compared to the other two models. Consequently, the distinctiveness of the three constructs utilized in this study was reinforced, and, in recognition of this, all three constructs were retained for further analysis.

Table 7: Confirmatory factor analysis

Model	X2	df	TLI	CFI	IFI	RMR
Hypothesized three factor model	217.44	150	0.98	0.98	0.99	0.06
Two factor model a	1585.65	169	0.64	0.64	0.68	0.23
One factor model b	2399.4	170	0.44	0.50	0.50	0.26

n = 384, All models are compared with the full measurement model
$\chi 2$ Chi square, df degrees of freedom, TLI Tucker–Lewis Index, CFI Comparative Fit Index, IFI Incremental Fit Index, RMR root mean square residual
a Combine grit and food security into one latent factor
b Combine items of all variables into one latent factor

Furthermore, findings indicated that agripreneurship is positively associated with food security (availability, accessibility and affordability) ($\beta = 0.27$, $p < 0.01$) and innovation ($\beta = 0.44$, $p < 0.01$). It was also noted that innovation is positively allied with food security ($\beta = 0.13$, $p < 0.05$). The finding aligned with El Bilali (2018) who highlighted that innovation is fundamental to attaining food security. Innovation enable agripreneurs to apply innovative farming and business practices consequently ensures food security as presented in Figure 3.

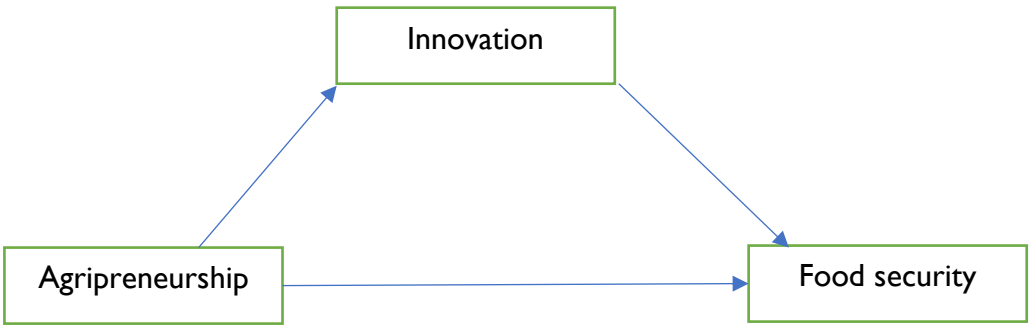

Figure 3: Direct and indirect effects of the construct

Additionally, mediation framework (Table 6) demonstrated agriprenurship exerts a positive indirect influence on food security ($\beta = 0.06$). The earlier two-tailed test indicated that the indirect effect was significant (Sobel $z = 1.82$, $p < 0.10$). Furthermore, bootstrap analysis with a 90% confidence interval confirmed the Sobel test result, as the interval for the indirect effect did not include zero (0.00, 0.15). These results imply that innovation intercede the association amid agripreneurship and food security and thus the connection among the two is not linear. The findings provide a solid backing for the theoretical assumptions that agriprenurship and innovation is strong predictor for food security. agripeneurship leads to food security due to the fact that input supply, production, processing, and the delivery of farm produce essential to ensure food security. This is supported by the study conducted by Kazungu and Kumburu (2023) who found that agripreneurship significantly positive affect food security. The findings further reveal that agripreneurship is positively related to food security. When entrepreneurs use innovative techniques all three forms of innovation (i.e. hardware, software, and org-ware) facilitate food availability due to presence of food in the desired quantity, contingent on production, circulation, and trade arrangements; accessibility due to obtainaibilty food without hindrances related to travel time, geographical features, safety, and shipping costs and affordability due to the fact obtain sufficient, safe, and nutritious food while considering household income demands beyond food expenses. In conclusion, the findings revealed a posivite connection between innovation and food security.

Table 8: Mediating effect

Variables				*β*	*SE*	*t*-value	*p*-value
Direct and total effects							
Food security regressed on agripreneurship				0.32	0.09	3.64	0.00
Innovation regressed on agripreneurship				0.44	0.08	5.52	0.00
Food security regressed on innovation, controlling for agripreneurship				0.13	0.07	1.96	0.05
Food security regressed on agripreneurship controlling for innovation				0.27	0.09	3.01	0.00
	Value		SE	LL 90% CI	UL 90% CI	z	p
Indirect effect and significance using the normal distribution							
Sobel	0.06		0.03	0.00	0.15	1.82	0.06
		M	SE	LL 90% CI		UL 90% CI	
Bootstrap results for indirect effect							
Effect		0.06	0.04	0		0.15	

Innovation acts as a mediator between agripreneurship and food security, the findings indicates that food security may happen using different innovative techniques. Innovation is pivotal catalyst for availability, accessibility as well as affordability. This implies that a combination of different types of innovations is needed to ensure food security. This is due to the fact that food insecurity arises not solely from the the lack of hardware innovation (the use of machine and equipment) and software innovation (utilization of skills and knowledge) but also from their socio-cultural conditions, absence of collective action, and limited social capital (org-ware innovation) for devising strategies to ensure food security. This is affirmed by Boratyńska and Huseynov (2017), who assert that it is crucial for food security, particularly when integrating various forms of innovation, including hard, soft, and organizational innovations. It is essential not to overlook traditional (indigenous) technologies such as fermentation, extraction, encapsulation, fat replacement, and enzyme technology. These traditional methods play a vital role in producing new health food ingredients, eliminating or reducing undesirable components in food, adding specific nutrients or functional ingredients, adjusting food compositions, masking unwanted flavours, and stabilizing ingredients that are cost-effective and align with the requirements of the local context. On the contrary, the results of this study challenge the assumptions made by several theories, including those of Jean-Baptiste and Richard Cantillon from the 18th and 19th centuries, as well as the 20th-century theories by Baumol, Schumpeter, and von Thünen. These theories depicted entrepreneurs as the creators of creative destruction and instability. Primarily, these theorists discussed the characteristics of entrepreneurs, suggesting that through these attributes, entrepreneurs could align markets via entrepreneurial activities, bringing them to equilibrium and ultimately generating profits.

However, these theories are inadequately applicable in today's agricultural sector, which confronts numerous challenges such as globalization, market liberalization, food price crises, natural resource depletion, climate change, natural disasters, rapid urbanization, changing production and consumption patterns, demographic shifts, and more. Many of these challenges, either directly or indirectly, contribute to evolving markets, creating both opportunities and risks for farmers, particularly smallholders, youth, and women. The demand for innovation in addressing these challenges receives limited attention from the theorists.

CONCLUSIONS

Food insecurity continues to be a formidable challenge in Tanzania, with a significant number of agripreneurs failing to integrate innovation into their agricultural practices. This study concludes that, within the confines of other factors being constant, introducing innovation into agripreneurship is indispensable for ensuring food security. The research highlights that innovation, acting as a mediator between agripreneurship and food security, can serve as a viable solution by guaranteeing food availability, accessibility, and affordability. Therefore, study asserts that there is a linear relationship between agripreneurship and food security does not exist. However, it is crucial to recognize that previous theories on agripreneurship fall short in providing insights into the role of innovation, necessitating a more comprehensive approach.

Considering the myriad challenges faced by contemporary agriculture, such as globalization, market liberalization, food price crises, natural resource depletion, climate change, rapid urbanization, and shifts in production and consumption patterns, it is imperative to foster innovative practices in agripreneurship. This underscores the need for policymakers to develop a strategic roadmap to support agripreneurs in accelerating innovation. This roadmap should propose the establishment of a global coalition dedicated to digital food systems innovation, uniting public, private, and non-profit entities to cultivate digital data ecosystems within the agricultural sector. Additionally, there is a recommendation to create a network of food innovation hubs connecting stakeholders to harness knowledge, technology, data, and institutional capacity, tailored to specific regional needs. This approach is essential, given that previous theories on agripreneurship do not offer adequate insights into the realm of innovation, emphasizing the necessity for more comprehensive research endeavours.

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