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Correlates of Livelihood Pathway Choices among Smallholder Farmers in Rice Commercialization in Kilombero, Tanzania

John Jeckoniah

Department of Development and Strategic Studies, Sokoine University of Agriculture, Morogoro, Tanzania. Email: jjeckoniah@sua.ac.tz

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Abstract: *Improving livelihoods in agrarian economies remains a central development challenge, particularly within the context of agricultural commercialization. This study investigates the correlates influencing smallholder farmers' choices of livelihood pathways; stepping up, stepping out, hanging in, or dropping out; within the rice commercialization processes in Kilombero District, Tanzania. Guided by the APRA (Agricultural Policy Research in Africa) framework, a repeated cross-sectional design and mixed-methods approach were employed, drawing data from 10 purposively selected villages. Inferential analysis using multinomial logistic regression revealed statistically significant associations between farmers' socio-economic profiles and livelihood trajectories. Female farmers ($p < 0.01$), households with low empowerment scores ($p < 0.05$), and multidimensionally poor (MPI) farmers ($p < 0.01$) were significantly more likely to hang in or step out rather than step up in commercialization. Additionally, limited access to extension services ($p < 0.05$), weak market linkages ($p < 0.05$), and lack of credit access ($p < 0.01$) were negatively associated with upward livelihood mobility. Qualitative findings reinforced the role of institutional and structural barriers, particularly gender norms and asset inequality, in constraining farmers' commercialization outcomes. The study recommends targeted policy interventions that enhance women's and youth empowerment, promote equitable access to technologies such as the System of Rice Intensification (SRI), and strengthen institutional support systems and market integration for smallholder farmers.*

Keywords: *Livelihood Trajectories, Rice Commercialization, Gender Disparities, Multinomial Logistic Regression, Smallholder Empowerment*

1. Background Information

Agricultural commercialization is increasingly recognized as a critical pathway for enhancing rural livelihoods, increasing agricultural productivity, and driving inclusive economic growth in sub-Saharan Africa (Pingali *et al.,* 2019; Bryan & Garner, 2022). In Tanzania, rice commercialization, particularly among smallholder farmers, has gained traction as a poverty alleviation strategy aligned with national and regional development policies (URT, 2021). However, the commercialization of agriculture is not a uniform process. It is deeply embedded in socio-economic structures that shape access to resources, markets, and decision-making power, especially for marginalized groups such as women, youth, and the elderly (Doss & Meinzen-Dick, 2020; Proscovia *et al.,* 2022). Therefore, understanding the correlates of farmers' livelihood pathway choices in the context of rice commercialization is essential for designing targeted interventions to reduce poverty and inequality.

Several studies affirm that agricultural commercialization can contribute to increased income, asset accumulation, and overall livelihood improvement (Gebreslassie *et al.,* 2015; Poulton & Chinsinga, 2018). Yet, the benefits of commercialization are not equitably distributed. Empirical evidence shows that factors such as gender, land tenure, market access, and education levels significantly influence who benefits and who is left behind (Etuk & Ayuk, 2021; Kipkorir *et al.,* 2023). Specifically, women often face systemic barriers in land ownership, access to inputs, and decision-making, which limits their participation and gains in commercial agricultural systems (Ajani & Egbokwe, 2013; Kabeer, 2005).

From a Sustainable Livelihoods Framework (Chambers & Conway, 1992), livelihood outcomes are shaped by the dynamic interaction of assets, structures, and processes; including gendered access to resources. Complementing this, Empowerment Theory (Kabeer, 2005) emphasizes the importance of individuals' agency in making strategic life choices. These frameworks highlight a key theoretical gap: while commercialization is promoted as a growth strategy, there is insufficient understanding of how empowerment; especially women's empowerment; mediates livelihood trajectory choices in the commercialization continuum. Furthermore, previous studies have largely treated

commercialization outcomes as binary (success/failure) rather than exploring nuanced livelihood pathways such as stepping up, stepping out, hanging in, or dropping out (Dorward, 2009; APRA, 2016; Schultea *et al.*, 2023). Additionally, few studies utilize strong inferential analysis to examine the drivers of these livelihood pathways. There is a need for more granular, gender-disaggregated analyses that interrogate how socio-economic and institutional factors shape smallholders' navigation within commercialization processes over time.

This study addresses these gaps by examining the correlates of livelihood pathway choices among smallholder rice farmers in Kilombero District, Tanzania. Guided by the Agricultural Policy Research in Africa (APRA) framework, the study employs a repeated cross-sectional design and mixed-methods approach to explore how farmers' engagement in rice commercialization intersects with socio-economic characteristics, empowerment levels, and institutional support systems to shape their livelihood trajectories.

The study seeks to answer the following main research question: *What are the key socio-economic and institutional factors influencing smallholder farmers' choice of livelihood pathways (stepping up, stepping out, hanging in, or dropping out) in rice commercialization processes, and how do these choices vary by gender and empowerment status?* Therefore, by generating gender-sensitive empirical evidence, the study aims to inform policy and programmatic interventions that strengthen inclusive commercialization, particularly for marginalized groups, and support sustainable livelihood transitions.

2.0 Theoretical Framework

This study draws upon the Sustainable Livelihoods Framework (SLF) (Chambers & Conway, 1992) and Empowerment Theory (Kabeer, 2005) to explain smallholder farmers' livelihood pathway choices within the context of rice commercialization in Kilombero District, Tanzania. The Sustainable Livelihoods Framework (SLF) conceptualizes livelihoods as the capabilities, assets (both tangible and intangible), and activities required for a means of living. It posits that people's ability to sustain livelihoods is influenced by the availability and interaction of five forms of capital: human, social, natural, physical, and financial (Scoones, 1998; Ellis, 2000). These capitals are mediated by vulnerability contexts (e.g., shocks, seasonality), institutional processes, and policies that influence access and livelihood strategies. Livelihood outcomes, such as income levels, food security, or well-being; result from these dynamic interactions. The SLF highlights the diversity of strategies that individuals and households adopt, such as intensifying production, diversifying income sources, or exiting agriculture altogether (Chambers & Conway, 1992).

Complementing this, Empowerment Theory, as articulated by Kabeer (2005), defines empowerment as the process through which individuals acquire the ability to make strategic life choices in a context where this ability was previously denied to them. Empowerment involves three interrelated dimensions: *resources* (material, human, and social), *agency* (the ability to define one's goals and act upon them), and *achievements* (the outcomes of exercising agency). Empowerment is both a process and an outcome and is shaped by structural inequalities—especially those rooted in gender norms, asset control, and institutional exclusion (Cornwall & Edwards, 2010; Ibrahim & Alkire, 2007).

Together, these frameworks provide a nuanced understanding of how livelihood pathways are not only constrained or enabled by material assets and institutions, but also mediated by individual and collective agency. They highlight how gendered access to resources, decision-making power, and institutional support play critical roles in shaping whether farmers can "step up," "step out," "hang in," or "drop out" of commercialization processes (Dorward, 2009; Schultea *et al.*, 2023).

Despite their relevance, both frameworks face critiques. The SLF has been criticized for its underemphasis on power relations and political economy, often treating institutions and structures as neutral rather than contested (De Haan & Zoomers, 2005). It tends to present livelihoods in a linear fashion, overlooking the non-linear and conflict-laden nature of transitions, particularly in agrarian commercialization where market integration can lead to both prosperity and dispossession (Scoones, 2009; Oya, 2013).

Similarly, Empowerment Theory has been critiqued for its conceptual ambiguity and challenges in operationalization. Critics argue that empowerment is often measured simplistically (e.g., via proxy indicators such as participation in groups or access to credit), neglecting the deeper, subjective dimensions of agency and transformation (Cornwall, 2016; Kabeer, 2012). Moreover, in contexts where structural inequalities are deeply entrenched, empowerment cannot be reduced to individual efforts alone; it must be seen as both an outcome and a struggle shaped by wider socio-political forces (Mahmud, Shah, & Becker, 2012).

Despite these critiques, the SLF and Empowerment Theory remain analytically valuable for examining the correlates of livelihood trajectory choices among smallholder farmers in Kilombero. The SLF provides a holistic framework for identifying the key assets (e.g., access to land, extension services, credit) and institutional environments (e.g., market linkages, land tenure systems) that shape farmers' capacity to

engage in commercialization. It also allows for disaggregating livelihood responses into the four pathways; *stepping up*, *stepping out*, *hanging in*, or *dropping out;* which move beyond binary categorizations of success or failure (APRA, 2016; Dorward, 2009).

Empowerment Theory adds critical depth by enabling an analysis of how gender and agency influence farmers' ability to convert assets and opportunities into livelihood outcomes. For instance, the study's finding that female-headed households and low-empowerment farmers are more likely to "hang in" or "step out" suggests that access alone is insufficient without the agency to leverage it. This intersectional lens is essential for understanding how structural barriers, such as patriarchal norms or exclusionary institutions, undermine commercialization benefits for women and other marginalized groups (Doss & Meinzen-Dick, 2020; Kabeer, 2005).

Henceforth, by integrating these frameworks, this study offers a comprehensive theoretical lens that connects material assets, structural factors, and agency to livelihood outcomes. This dual-theoretical approach is especially relevant to policy-making, as it underscores the need for not only resource provision but also institutional reform and empowerment strategies to foster inclusive agricultural transformation.

3.0 Methodology

3.1 Study Area

This study was conducted in Mngeta Division, located in Kilombero District of Morogoro Region, Tanzania. The area was purposively selected due to its strategic relevance to the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) initiative, which aims to integrate small-scale farmers (SSFs) with large-scale commercial farming to accelerate agricultural transformation. Mngeta hosts the Kilombero Plantation Limited (KPL), a prominent large-scale rice farm, surrounded by numerous SSFs and medium-scale farmers (MSFs) in adjacent villages.

Proximity to KPL offers access to agricultural innovations and support services including training on System of Rice Intensification (SRI) techniques, input use, and production technologies. These services are hypothesized to enhance farmers' commercialization capacities, foster economic growth, and generate empowerment and livelihood outcomes. Consequently, Mngeta presents a suitable case for examining how empowerment levels and livelihood improvements influence farmers' choices among the four livelihood pathways: stepping up, stepping out, hanging in, and dropping out, within the rice commercialization context.

3.2 Sampling Procedure and Sample Size

The study employed a two-stage stratified random sampling design, following the methodological guidelines of APRA (2016), and previous applications in Jeckoniah *et al.* (2020) and Isinika *et al.* (2021, 2022). The first stage involved purposive selection of ten villages within Mngeta Division, based on their proximity to KPL and their involvement in rice production. Stratification criteria included farm size, electricity access, and adoption of SRI, all considered key drivers of commercialization.

In the second stage, simple random sampling was used to select respondents. From each village, 50 SSFs were sampled, with 10 additional farmers held in reserve to replace non-respondents or unavailable farmers. In addition, 100 SRI farmers were selected from KPL's official farmer registry.

Data collection was conducted in two waves, in 2017 and 2019. The 2017 survey yielded data from 537 households (drawn from a population of 7,156 rice-farming households). The 2019 survey expanded the sample to 807 households, following a 31% attrition rate in the initial cohort, attributable largely to seasonal migration, a common phenomenon in Kilombero Valley.

Three farmer categories were maintained across both survey rounds: SSFs, MSFs, and SRI farmers. Table 1 summarizes the sample composition by key characteristics after post-stratification.

Table 1. Sample Composition after Post-Stratification

Household Characteristic	2017 (n = 537)	%	2019 (n = 807)	%
Electricity Access				
With Electricity	223	41.5	667	82.7
Without Electricity	314	58.5	140	17.3
Sex of Household Head				
Female	66	12.3	129	16.0
Male	471	87.7	678	84.0
Farmer Category				
SSFs	357	66.5	622	77.1
MSFs	74	13.8	94	11.6
SRI	106	19.7	91	11.3

3.3 Measurement of Variables and Data Analysis

3.3.1 Measurement of Women's Empowerment

Women's empowerment was assessed using a Composite Empowerment Index (CEI), drawing from the Women's Empowerment in Agriculture Index (WEAI) framework developed by Hazarika et al. (2014) and Malapit et al. (2017). The CEI incorporated six key dimensions:

- Care work responsibilities
- Control over income
- Decision-making on agricultural plots
- Dietary diversity

- Food security
- Participation in collective action

Each dimension was scored between 0 and 1. The final CEI score represented the average across these dimensions and was categorized as follows:

- Low empowerment: 0.0 – 0.5
- Medium empowerment: 0.6 – 0.7
- High empowerment: 0.8 – 1.0

These thresholds mirror the classification used in the Human Development Index (UNDP, 2022). The CEI scores were further analyzed in relation to livelihood pathway choices (stepping up, stepping out, hanging in, or dropping out) to examine associations between empowerment and livelihood transitions.

3.3.2 Measurement of Rice Commercialization

The study computed a Rice Commercialization Index (RCI) to quantify the extent of commercialization, defined as:

$$\text{RCI} = \frac{\text{Quantity of rice sold}}{\text{Total rice produced}}$$

This index, ranging from 0 (no rice sold) to 1 (entire rice output sold), was preferred over general household commercialization indices due to rice's dominance in household cash income, accounting for approximately 96% of farming income. The RCI was compared across farmer categories (SSF, MSF, SRI) and empowerment levels, enabling analysis of commercialization patterns and associated livelihood outcomes.

3.3.3 Measurement of Livelihood Outcomes

To assess livelihood outcomes, the Multidimensional Poverty Index (MPI) was employed, as recommended by Alkire and Santos (2014) and Alkire et al. (2016). The MPI captures multiple deprivations across three dimensions: education, health, and standard of living. It was selected due to its robustness in reflecting quality-of-life indicators relevant to smallholder contexts.

In this study, households were classified as multidimensionally poor if their deprivation score exceeded 33.3%, following global standards. Higher MPI scores indicated greater deprivation and, thus, deeper poverty.

To triangulate these findings, MPI scores were compared with subjective poverty assessments, derived from a self-anchoring ladder (Alkire et al., 2020), allowing insight into perceived versus measured poverty.

3.4 Data Analysis Techniques

Data were analyzed using descriptive and inferential statistics. Descriptive analysis profiled the sample across socio-economic and empowerment variables. To assess correlates of livelihood pathways, a Multinomial Logistic Regression (MLR) model was used. This method enabled identification of statistically significant predictors of pathway choices (e.g., stepping up vs. hanging in). Independent variables included sex of household head, CEI, MPI, access to electricity, SRI adoption, and market access.

The integration of quantitative survey data with qualitative narratives (collected through key informant interviews and focus group discussions) enriched the interpretation of regression findings and validated conclusions related to gender dynamics, market linkages, and institutional support systems.

3.6 Ethical Considerations

Prior to data collection, informed consent was obtained from all participants. The study maintained strict confidentiality and anonymity, and participation was voluntary. Ethical clearance was granted by the appropriate institutional review board at Sokoine University of Agriculture (SUA) and President's Office - Regional Administration and Local Government in Tanzania (TAMISEMI).

4.0 RESULTS AND DISCUSSION

4.1 Gender and Livelihood Pathways in Rice Commercialization

This study revealed that a significant majority of respondents (85.4%) experienced livelihood improvement, categorized as *stepping up*, through participation in rice commercialization. However, 7.4% of respondents exited commercialization (*stepping out*), 1.3% regressed to less productive engagements (*stepping down*), and 5.8% stagnated (*hanging in*) within subsistence-level rice farming. These dynamics suggest that while rice commercialization offers substantial potential for upward mobility, a notable minority of farmers remain marginalized or disempowered within this process.

Gender and age disparities were observed across the livelihood pathways. Women were less likely than men to step up and more likely to either hang in or step out. This finding aligns with Jeckoniah (2020), who reports that female farmers, multidimensionally poor individuals, and those with low empowerment scores are statistically more likely to stagnate or exit commercialization processes. These disparities reflect underlying structural inequalities, particularly in access to and control over productive resources such as land, labor, credit, and agricultural technologies.

Moreover, younger farmers were more likely to step up compared to their older counterparts, suggesting that age may positively influence adaptive capacity, innovation uptake, and market responsiveness. This demographic insight supports Loison's (2019) argument that livelihood diversification and upward mobility often hinge on demographic and socio-economic variables such as age, education, and household labor availability.

The relatively low proportion of farmers in the "stepping out," "stepping down," and "hanging in" categories can be partly attributed to institutional and infrastructural barriers such as poor extension service delivery, weak market linkages, and limited access to financial services. As Jeckoniah (2020) argues, lack of access to technologies like the System of Rice Intensification (SRI), combined with entrenched gender norms and asset inequality, constrains inclusive participation and outcomes in rice commercialization.

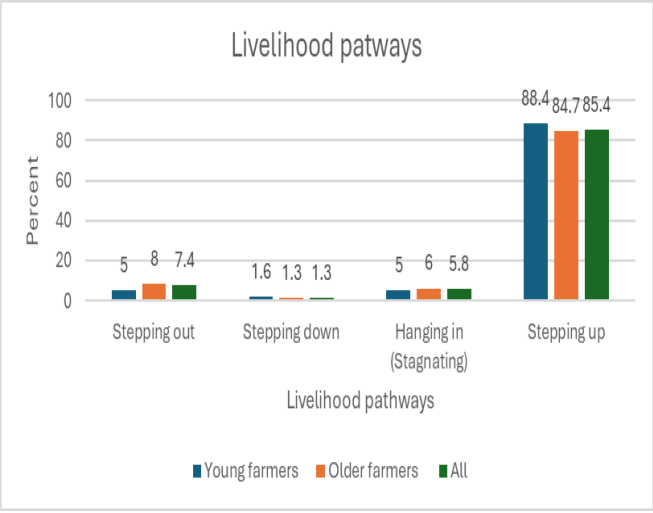
In light of these findings, policy and programmatic responses should:

- Enhance women's empowerment and access to productive assets, especially land and finance;
- Strengthen youth-targeted support mechanisms, including entrepreneurship training and digital agriculture platforms;
- Expand access to extension services, technologies, and markets, ensuring equitable benefit distribution across gender and age groups.

Table 2. Livelihood Outcomes and Choice of Pathways

Livelihood Pathway	Young Farmers	Older Farmers	All
Stepping Out	13 (5.0%)	82 (8.0%)	95 (7.4%)
Stepping Down	4 (1.6%)	13 (1.3%)	17 (1.3%)
Hanging In (Stagnating)	13 (5.0%)	61 (6.0%)	74 (5.8%)
Stepping Up	228(88.4%)	863(84.7%)	1091(85.4%)

Figure1: Livelihood improvement among young and older farmers



The findings from Figure 1 underscore the complex and differentiated nature of livelihood outcomes within rice commercialization pathways in Kilombero District. While the majority of both young and older farmers reported improvements in their livelihoods, falling within the "stepping up" category—the data reveal important socio-demographic distinctions, particularly regarding age and gender.

Age-related differences are particularly pronounced, with young farmers exhibiting a greater propensity to step up compared to their older counterparts. This trend suggests that younger farmers may possess greater adaptive capacity, higher openness to innovation, and stronger engagement with emerging agricultural technologies and market opportunities. These observations echo the findings from Jeckoniah (2020), where age emerged as a significant correlate of upward livelihood mobility, reinforcing the view that youth represent a critical entry point for targeted commercialization support.

Gender disparities also remain salient. Women were consistently underrepresented among those stepping up and more likely to hang in or step out. This pattern aligns with the broader structural realities highlighted in the study's abstract, wherein female farmers ($p < 0.01$) were statistically more likely to remain in low-return pathways due to constraints such as limited access to credit, extension services, and control over key productive resources. The persistence of patriarchal land tenure systems and gendered institutional arrangements in the study area further exacerbates women's marginalization in commercialization outcomes.

Moreover, the intersection of age, gender, and educational background plays a significant role in shaping livelihood trajectories. Livelihood diversification is not a uniform process; rather, it reflects the accumulation strategies available to different demographic groups, influenced by their socio-economic position and agency. The findings confirm that resource access and accumulation are not only economic processes but also deeply embedded in local power relations, particularly those defined by gender.

These findings resonate with earlier research by Andersson *et al.* (2013), Manjur *et al.* (2014), and Zakaria *et al.* (2015), which emphasized that increased income alone does not guarantee equitable livelihood transformation, especially for women and other marginalized groups. Instead, effective commercialization requires deliberate efforts to dismantle institutional and cultural barriers that limit participation and returns.

In light of this, policy interventions must go beyond productivity enhancement to address social and structural inequities. This includes:

- Empowering women and youth through access to land, finance, and training;
- Promoting inclusive technologies such as the System of Rice Intensification (SRI);

- Expanding access to tailored extension services;
- Strengthening market integration and reducing gendered bottlenecks along the value chain.

Together, these interventions can foster a more inclusive and equitable rice commercialization model that maximizes livelihood improvements across all demographic groups.

4.2 Livelihood Pathway Differentials by Gender

The analysis of livelihood pathway choices by sex reveals important gendered dynamics in smallholder farmers' participation in rice commercialization in Kilombero District. As shown in Table 3, there is a statistically observable gender gap across the four identified livelihood trajectories, stepping up**,** stepping out**,** hanging in**,** and stepping down**.**

A significantly higher proportion of male farmers (86.1%) were categorized as stepping up, actively increasing their investment and engagement in rice commercialization, compared to female farmers (81.0%)**.** This suggests that male farmers are more likely to consolidate gains from commercialization due to their relatively higher access to productive assets, decision-making authority, and control over revenues generated from rice production (Jeckoniah et al., 2020).

In contrast, female farmers were more likely to be stepping out (9.8%) or stepping down (2.9%)**,** compared to 7.1% and 1.1% of male farmers, respectively. These findings indicate that women are more prone to disengaging partially or fully from rice production as a primary livelihood source. Qualitative insights attribute this pattern to a strategic reorientation towards alternative livelihood activities enabled by the commercialization process, such as food vending, rice retailing, and informal labor in rice milling centers, activities often concentrated in lower-value nodes of the value chain (Isinika *et al.*, 2020).

Moreover, a slightly higher percentage of women (6.3%) than men (5.7%) were found in the **"***hanging in***"** category, representing farmers who remain in rice farming without progressing or regressing. This stagnation reflects structural constraints such as limited access to credit, weak market integration, and unequal access to extension services, all of which disproportionately affect female farmers and impede their capacity to enhance productivity or scale operations.

These patterns reinforce the quantitative findings from the multinomial logistic regression model, which showed that being female ($p < 0.01$)**,** experiencing multidimensional poverty ($p < 0.01$)**,** and having a low empowerment score ($p < 0.05$) were all negatively associated with upward mobility (stepping up) in commercialization. Together, the findings underscore the urgent need for targeted and gender-responsive interventions to mitigate structural barriers and promote equitable access to commercialization opportunities.

Table 3: Distribution of Livelihood Pathways by Sex (Percent within Sex)

Livelihood Pathway	Male Farmers (%)	Female Farmers (%)	All Farmers (%)
Stepping Out	78 (7.1%)	17 (9.8%)	95 (7.4%)
Stepping Down	12 (1.1%)	5 (2.9%)	17 (1.3%)
Hanging In (Stagnating)	63 (5.7%)	11 (6.3%)	74 (5.8%)
Stepping Up	990(86.1%)	141(81.0%)	1091(85.4%)
Total (N)	**1143(100%)**	**174 (100%)**	**1317 (100%)**

4.3 Livelihood Pathways by Farmer Characteristics

The analysis revealed notable differences in livelihood pathway choices across various categories of farmers involved in rice commercialization. As presented in Table 4, medium-scale farmers were disproportionately more likely to pursue the *stepping up* pathway (93.9%), reflecting higher levels of investment in the rice commercialization process. This trend is largely attributable to their comparatively better access to productive assets, especially land, and use of draught power for land preparation. Their livelihood improvements were primarily driven by expansion in cultivated area and higher yields per unit area.

Small-scale farmers, on the other hand, demonstrated lower levels of progression within the rice commercialization continuum. While a considerable proportion (83.0%) were still stepping up, they also showed the highest proportion of farmers stepping out (8.6%) or hanging in (6.9%). These findings suggest that limited resource endowments, including land and capital, constrain their ability to scale up production, resulting in stagnation or partial withdrawal. Many smallholders redirected rice incomes into other income-generating activities such as mobile money services, food vending, and informal trade, indicative of livelihood diversification rather than consolidation within the rice value chain.

Farmers practicing the System of Rice Intensification (SRI) displayed relatively high levels of livelihood improvement, with 89.6% stepping up. However, a notable portion also opted to step out (5.7%), indicating that despite higher productivity from SRI practices, these farmers also viewed rice as a stepping stone toward other, possibly less labor-intensive or more profitable, economic activities. This suggests a dual motivation: enhancing rice-based livelihoods while seeking upward mobility through diversified income streams.

These findings underscore the complex and dynamic nature of livelihood trajectories in agrarian settings, where farmer characteristics such as scale of operation and adoption of productivity-enhancing technologies significantly shape their commercialization outcomes.

Table 4: Livelihood Pathways by Farmer Characteristics

Livelihood Pathway	Small-Scale Farmer	Medium-Scale Farmer	SRI Farmer	All Farmers
Stepping Out	79(8.6%)	5 (3.0%)	11 (5.7%)	95 (7.4%)
Stepping Down	14(1.5%)	0 (0.0%)	3 (1.6%)	17(1.3%)
Hanging In (Stagnating)	63(6.9%)	5 (3.0%)	6 (3.1%)	74(5.8%)
Stepping Up	763(83.0%)	155(93.9%)	173(89.6%)	1091(85.4%)
Total (N)	919	165	193	1277

4.4 Level of Women's Empowerment and Livelihood Pathways

The study found a statistically significant association between the level of women's empowerment and their respective livelihood trajectories in rice commercialization ($p < 0.05$). This relationship underscores the central role of empowerment in shaping the ability of women farmers to engage effectively and productively in commercial agriculture. As Table 5 illustrates, women with higher levels of empowerment were significantly more likely to step up within the rice commercialization process (34.6%) compared to their less empowered counterparts.

Conversely, women with low empowerment were more likely to step out (41.5%), stagnate (39.7%), or even step down (50.0%), reflecting both direct and indirect constraints imposed by structural gender inequalities. These limitations include restricted access to productive resources (land, credit, inputs), limited decision-making authority, and insufficient representation in farmer organizations or market networks.

The gradient trend suggests that increased empowerment positively correlates with livelihood advancement. Medium-empowered women also showed considerable engagement in stepping up (36.0%), but a notable proportion still faced challenges that caused them to remain stagnant or exit commercialization efforts. These findings are aligned with previous research (Jeckoniah *et al.*, 2020), which emphasizes that determinants of women's empowerment, such as control over income, workload balance, and participation in productive decision-making, serve as critical correlates for meaningful participation in and benefit from rice commercialization processes.

The results strongly advocate for gender-responsive policy interventions that integrate empowerment dimensions, particularly access to productive resources, leadership opportunities, and technology adoption support, as a pathway to inclusive agricultural transformation.

Table 5: Level of Women's Empowerment and Livelihood Pathways

Livelihood Pathway	Low Empowerment	Medium Empowerment	High Empowerment	Trend (Chi-square)
Stepping Out	34 (41.5%)	37 (45.1%)	11 (13.4%)	χ^2 = 0.002
Stepping Down	7 (50.0%)	4 (28.6%)	3 (21.4%)	
Hanging In (Stagnating)	23 (39.7%)	20 (34.5%)	15 (25.9%)	
Stepping Up	264 (29.4%)	324 (36.0%)	311 (34.6%)	
Total	328	385	340	

4.5 Multidimensional Poverty and Livelihood Pathways

The relationship between multidimensional poverty and livelihood trajectories in the rice commercialization process was found to be statistically significant (χ^2, $p < 0.05$)**,** as shown in Table 6. Using the Multidimensional Poverty Index (MPI) as a proxy for poverty status, the findings reveal a clear divergence in livelihood outcomes between MPI-poor and MPI-non-poor smallholder farmers.

Farmers categorized as MPI non-poor were more likely to "step up" **(57.0%)** in the rice commercialization process compared to their MPI-poor counterparts (43.0%). In contrast, MPI-poor farmers were disproportionately represented among those "stepping out" (61.0%) and "stepping down" (64.3%)**,** indicating that poverty significantly undermines the ability to sustain or expand commercial farming activities.

This outcome suggests that poverty acts as both a constraint and a push factor, with poorer households either stagnating in subsistence-level production ("hanging in") or exiting commercialization altogether in pursuit of alternative livelihoods. The absence of sufficient productive assets, lack of liquidity, and vulnerability to shocks further exacerbate their inability to invest or scale up.

These findings align with broader development literature asserting that commercialization tends to disproportionately benefit resource-endowed households unless deliberate equity-enhancing policy interventions are implemented

(Isinika *et al.*, 2021; 2022). Programs aimed at reducing multidimensional poverty, particularly through asset-building, financial inclusion, and safety nets, would therefore contribute significantly to inclusive rice-sector transformation.

Table 6: Livelihood Pathways by Multidimensional Poverty Status

Livelihood Pathway	MPI Non-Poor	MPI Poor	Total (%)	Trend (Chi-square)
Stepping Out	32 (39.0%)	50 (61.0%)	82 (100%)	χ^2 = 0.002
Stepping Down	5 (35.7%)	9 (64.3%)	14 (100%)	
Hanging In (Stagnating)	26 (44.8%)	32 (55.2%)	58 (100%)	
Stepping Up	514 (57.0%)	387 (43.0%)	901 (100%)	
Total	577	478	1,055 (100%)	

4.6 Temporal Dynamics of Livelihood Pathways (2017–2020)

Although an upward trend in livelihood improvement was observed between 2017 and 2020, particularly in the proportion of households stepping up (from 39.5% to 60.5%), the overall change in livelihood pathways across the two time points was not statistically significant ($p > 0.05$), as presented in Table 7.

Notably, increases were observed in all categories, including stepping out, suggesting the dynamic nature of rural livelihoods and the influence of structural factors such as climate variability, market volatility, and evolving household priorities. Some farmers used commercialization gains to transition into non-farm economic activities, while others exited due to inability to cope with commercialization risks and input costs.

These mixed trends underscore the importance of adopting a longitudinal and context-specific approach to livelihood analysis, recognizing that participation in commercialization is not linear but often cyclical, fluid, and responsive to opportunity structures and shocks.

Table 7: Changes in Livelihood Pathways between 2017 and 2020

Livelihood Pathway	2017	2020	Total (%)	Trend (Chi-square)
Stepping Out	41 (43.2%)	54 (56.8%)	95 (100%)	χ^2 (p-value) = 0.844
Stepping Down	7 (41.2%)	10 (58.8%)	17 (100%)	
Hanging In (Stagnating)	27 (36.5%)	47 (63.5%)	74 (100%)	
Stepping Up	431 (39.5%)	660 (60.5%)	1,091 (100%)	
Total	506	771	1,277 (100%)	

4.7 Factors Influencing Farmers' Livelihood Trajectories in the Context of Rice Commercialization

To further analyze the factors influencing farmers' livelihood trajectories in the context of rice commercialization, a Multinomial Logistic Regression (MLR) was employed. The outcome variable was the livelihood pathway choice, categorized into four groups: stepping up (reference category), stepping out, stepping down, and hanging in. The model incorporated predictor variables such as gender, age, education, scale of farming, use of SRI technology, access to credit, and empowerment score.

Table 7: Key Multinomial Logistic Regression (MLR) Results for Predictors of Stepping Out, Stepping Down, and Hanging in Strategies

Predictor Variable	Stepping Out (RRR)	Stepping Down (RRR)	Hanging In (RRR)	Significance
Female (1=yes)	2.34***	2.72**	1.68**	p<0.01/0.05
Age (years)	0.97***	1.01	0.98**	p<0.01/0.05
Education (years)	0.93**	1.00	0.95*	p<0.05/0.1
Small-scale farmer	1.76***	1.89**	1.62**	p<0.01/0.05
SRI adopter	0.74**	0.79	0.68***	p<0.05
Access to credit (1=yes)	0.59***	0.84	0.66***	p<0.01
Empowerment score	0.81***	0.88	0.85***	p<0.01

*(**Note**: Relative Risk Ratios (RRRs) >1 indicate a higher likelihood of being in the given category compared to the reference group "stepping up"; *p<0.1, **p<0.05, ***p<0.01)*

The MLR results confirm that being female significantly increases the likelihood of a farmer stepping out, stepping down, or stagnating in commercialization, compared to stepping up. This reinforces descriptive findings in Section 4.2 and aligns with Jeckoniah *et al.* (2020), who assert that women often face systemic barriers such as unequal land rights, limited decision-making autonomy, and underrepresentation in extension services. The gender gap is further compounded by socio-cultural norms that position women in low-return value chain segments (Isinika *et al.*, 2020).

The inverse relationship between age and upward movement (stepping up) indicates that younger farmers are more likely to succeed in commercialization pathways. This corroborates earlier findings in Section 4.1 and aligns with Loison (2019), who highlights youth as more adaptive, innovative, and responsive to modern farming technologies. Older farmers, by contrast, may be less inclined or able to intensify production or adopt new practices, leading to stagnation or exit.

Education reduces the likelihood of stepping out or stagnating, suggesting that better-educated farmers are more capable of navigating market systems, interpreting extension advice, and managing risk. Similarly, higher empowerment

scores, which capture autonomy in decision-making and control over resources, reduce the probability of adverse pathways. These findings echo those of Manjur et al. (2014) and Zakaria *et al*. (2015), who argue that empowerment and knowledge are critical for equitable gains from commercialization.

Small-scale farmers were significantly more likely to exit or stagnate in commercialization compared to medium-scale farmers, largely due to constraints in land, capital, and labor. Adoption of the System of Rice Intensification (SRI) significantly reduced the likelihood of stagnation and exit, underscoring the value of innovative, resource-efficient technologies in promoting resilience and upward mobility (Jeckoniah, 2020).

Access to credit emerged as a strong enabler of stepping up, reducing the likelihood of all adverse livelihood pathways. This finding reflects the importance of liquidity in adopting inputs, managing shocks, and scaling production. It supports recommendations in Section 4.2 for financial inclusion strategies to promote commercialization.

The MLR results reinforce the need for targeted, evidence-based interventions to ensure equitable commercialization. Suggested actions include:

- Gender-responsive policy frameworks that dismantle structural barriers to women's participation in high-value nodes of the value chain.
- Youth-targeted programs to scale innovations and leverage their adaptive potential.
- Investment in education and empowerment programs to strengthen farmer agency.
- Support for smallholders via land access schemes, inclusive technologies like SRI, and tailored financial products.

5.0 Conclusions and Recommendations

The study demonstrates that participation in rice commercialization significantly enhances livelihoods for the majority of farmers in Kilombero District, with 85.4% experiencing upward mobility ("stepping up"). However, a notable minority either stagnate, regress, or exit commercialization, highlighting persistent inequalities and barriers within the agricultural system. Gender and age emerge as critical determinants of livelihood pathways, with women and older farmers less likely to advance, reflecting entrenched structural inequalities such as limited access to land, credit, extension services, and decision-making power. Younger farmers tend to exhibit greater adaptive capacity and market engagement, underscoring the importance of targeting youth in agricultural development initiatives.

Medium-scale farmers, endowed with more resources and access to technologies like draught power and SRI, are more likely to progress within commercialization, whereas small-scale farmers face greater constraints that push some to diversify away from rice farming. Women's empowerment is a pivotal factor influencing livelihood outcomes; those with higher empowerment levels are more likely to improve their livelihoods through commercialization, whereas disempowered women face higher risks of stagnation or exiting. Multidimensional poverty further compounds these challenges, indicating that socio-economic disadvantage intersects with gender and resource access to shape farmers' trajectories.

These findings suggest that rice commercialization, while offering pathways out of poverty, is unevenly beneficial and deeply influenced by socio-demographic and structural factors. To promote inclusive and equitable agricultural development, policy and programmatic interventions must go beyond enhancing productivity and market access. It is essential to dismantle systemic barriers by empowering women through improved access to land, credit, technology, and leadership opportunities; supporting youth engagement with tailored entrepreneurship and digital platforms; and strengthening extension services to be gender-sensitive and accessible. Furthermore, fostering stronger market linkages that mitigate gendered bottlenecks and supporting livelihood diversification strategies can create more resilient farming communities.

Ultimately, a holistic approach that integrates social equity with economic growth will maximize the benefits of rice commercialization, enabling all farmers, regardless of gender, age, or scale, to sustainably improve their livelihoods and contribute to broader rural development goals.

Declaration of Conflict of Interest

We hereby declare that there are no known competing financial interests or personal relationships that could have influenced the research and findings presented in this paper.

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