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The role of multiple household income source in enhancing livelihood in western zone Tanzania[1]

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Abstract: Rural households in developing countries face significant challenges in achieving sustainable livelihoods, with dependence on a single income source often leaving them vulnerable to poverty and food insecurity. This study examines the role of income diversification in promoting livelihood sustainability in Tanzania's western zone, specifically Kigoma and Katavi regions, which are characterized by high poverty levels and a large refugee population. Income diversification is highlighted as a vital coping strategy for addressing climate variability, low agricultural productivity, and inadequate infrastructure. Using a cross-sectional research design, data were collected from 510 respondents through structured questionnaires, and a multinomial logit model was used for analysis. The findings show that households engaging in diverse income-generating activities—such as agriculture, livestock rearing, small businesses, and fishing—achieve greater food security and income stability. Key determinants of income diversification include education, gender, land access, and infrastructure. The study recommends policies to enhance equitable access to agricultural inputs, financial services, and gender-inclusive opportunities, while promoting non-farm income activities, improving market access, and investing in critical infrastructure. These findings underscore the importance of diversified income strategies in reducing vulnerability and building resilience among rural households.

Keywords*: income diversification, household livelihood, Kigoma, Katavi, Tanzania, rural households.*

O papel das múltiplas fontes de rendimento familiar na melhoria dos meios de subsistência na zona ocidental da Tanzânia

Resumo: As famílias rurais em países em desenvolvimento enfrentam desafios significativos para alcançar meios de subsistência sustentáveis, com a dependência de uma única fonte de renda, muitas vezes, deixando-as vulneráveis à pobreza e à insegurança alimentar. Este estudo examina o papel da diversificação de renda na promoção da sustentabilidade dos meios de subsistência na zona ocidental da Tanzânia, especificamente nas regiões de Kigoma e Katavi, que são caracterizadas por altos níveis de pobreza e uma grande população de refugiados. A diversificação de renda é destacada como uma estratégia de enfrentamento vital para lidar com a variabilidade climática, baixa produtividade agrícola e infraestrutura inadequada. Usando um desenho de pesquisa transversal, os dados foram coletados de 510 entrevistados por meio de questionários estruturados, e um modelo logit multinomial foi usado para análise. As descobertas mostram que as famílias envolvidas em diversas atividades geradoras de renda — como agricultura, criação de gado, pequenos negócios e pesca — alcançam maior segurança alimentar e estabilidade de renda. Os principais determinantes da diversificação de renda incluem educação, gênero, acesso à terra e infraestrutura. O estudo recomenda políticas para melhorar o acesso equitativo a insumos agrícolas, serviços financeiros e oportunidades inclusivas de gênero, ao mesmo tempo em que promove atividades de renda não agrícola, melhora o acesso ao mercado e investe em infraestrutura crítica. Essas descobertas ressaltam a importância de estratégias de renda diversificada na redução da vulnerabilidade e na construção de resiliência entre famílias rurais.

Palavras-chave: diversificação de renda, subsistência familiar, Kigoma, Katavi, Tanzânia, famílias rurais.

El papel de las fuentes de ingresos múltiples en el hogar para mejorar los medios de vida en la zona occidental de Tanzania

Resumen: Los hogares rurales de los países en desarrollo enfrentan desafíos significativos para lograr medios de vida sostenibles, ya que la dependencia de una sola fuente de ingresos a menudo los deja vulnerables a la pobreza y la inseguridad alimentaria. Este estudio examina el papel de la diversificación de ingresos en la promoción de la sostenibilidad de los medios de vida en la zona occidental de Tanzania, específicamente las regiones de Kigoma y Katavi, que se caracterizan por altos niveles de pobreza y una gran población de refugiados. La diversificación de ingresos se destaca como una estrategia de afrontamiento vital para abordar la variabilidad climática, la baja productividad agrícola y la infraestructura inadecuada. Utilizando un diseño de investigación transversal, se recopilaron datos de 510 encuestados a través de cuestionarios estructurados, y se utilizó un modelo logit multinomial para el análisis. Los hallazgos muestran que los hogares que participan en diversas actividades generadoras de ingresos, como la agricultura, la cría de ganado, las pequeñas empresas y la pesca, logran una mayor seguridad alimentaria y estabilidad de ingresos. Los determinantes clave de la diversificación de ingresos incluyen la educación, el género, el acceso a la tierra y la infraestructura. El estudio recomienda políticas para mejorar el acceso equitativo a los insumos agrícolas, los servicios financieros y las oportunidades que incluyan la perspectiva de género, al tiempo que se promueven las actividades generadoras de ingresos no agrícolas, se mejora el acceso a los mercados y se invierte en infraestructuras esenciales. Estos hallazgos subrayan la importancia de las estrategias de ingresos diversificados para reducir la vulnerabilidad y generar resiliencia en los hogares rurales.

Palabras clave: diversificación de ingresos, medios de vida de los hogares, Kigoma, Katavi, Tanzania, hogares rurales.

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Introduction

Income diversification is increasingly recognized as a vital strategy for ensuring household survival and stability worldwide (Kitole et al., 2023). Single sources of income often prove insufficient, particularly in regions susceptible to environmental and economic risks (Dimova et al., 2010; Dimoso & Andrew, 2021). Globally, approximately 25% of rural households rely on multiple income sources to mitigate vulnerabilities. In developed countries, where strong structural and financial systems exist, about 60% of households engage in secondary income activities, such as small businesses, real estate, or agricultural ventures (OECD, 2021; Utouh & Kitole, 2024; Ramtin et al., 2024). Such diversification significantly reduces unemployment, enhances household asset bases, and provides protection against market uncertainties and environmental adversities (World Bank, 2022; Mpfubhusa, 2024). In these settings, institutional trust and access to formal financial systems further bolster economic security and diversification efforts.

In Africa, where agriculture employs 65% of the population and contributes 32% to GDP, income diversification serves as a fundamental survival mechanism (FAO, 2023; Fasha & Minde, 2020). However, agricultural productivity is highly vulnerable to climatic changes, with droughts alone reducing yields by an estimated 30% annually (IFPRI, 2022). As a result, rural households increasingly turn to non-farm income-generating activities such as trade, casual labor, and remittances (Mohamed et al., 2024; Kitole, 2023; Kitole et al., 2024). For example, in Ethiopia, 40% of rural households earn supplementary income from small enterprises (Beyene et al., 2022; Minot et al., 2023). Evidence from Sub-Saharan Africa indicates that income diversification significantly enhances food security and poverty reduction. In Tanzania, Kenya, and Uganda, around 50% of rural households rely on multiple income streams, improving resilience against economic and climatic shocks (World Bank, 2023). For instance, Kenyan smallholder farmers who combine livestock keeping and trade report 20% greater resilience during droughts compared to those relying solely on crops (FAO, 2022; Kitole et al., 2023).

Income diversification is especially important in Tanzania's Western Zone, where agriculture and livestock production dominate economic activities. Despite agriculture employing 65% of the rural workforce, it contributes only 28% to household incomes due to declining productivity, market barriers, and climate variability (Mpfubhusa & Mushi, 2024). Diversified sources, including fishing, livestock, petty trading, and wild edible plants, contribute approximately 42% of household incomes in this region (Kitole et al., 2023). Households that combine farming with off-farm activities achieve higher food security and income stability (Sesabo & Tol, 2005; Kassie & Fellizar, 2017). For example, 60% of rural households engaged in mixed livelihoods report improved food security, while livestock breeding adds 30% to rural incomes by mitigating the effects of crop failures (Kitole et al, 2024). However, the region faces challenges such as limited credit access, inadequate infrastructure, and systemic barriers like gender discrimination, which restrict opportunities for expanding income sources (Lemessa & Gemechu, 2016; Tesfa, 2014).

The Western Zone regions of Kigoma and Katavi remain among the least developed areas in Tanzania, with poverty rates of 39% and 41%, respectively, compared to the national average of 26.4% (URT, 2022). Agriculture, the primary livelihood source for over 75% of the population, is highly vulnerable to prolonged droughts, which reduce yields by up to 30% (FAO, 2023). Limited market access reduced grazing land, and insufficient veterinary services further constrain agricultural and livestock productivity. The reliance on rain-fed agriculture exacerbates these vulnerabilities, making single-source livelihoods unsustainable in the face of climatic unpredictability and economic instability (Kitole et al., 2024). These challenges highlight the urgent need for diversified income strategies to improve household resilience and livelihood sustainability. Addressing these constraints is critical to achieving sustainable livelihoods in Kigoma and Katavi. This study aims to explore the role of multiple household income sources in enhancing livelihoods in these regions. By identifying the barriers and opportunities associated with diversification, the

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research seeks to provide evidence-based recommendations for improving household resilience, reducing poverty, and fostering sustainable development in the Western Zone of Tanzania.

Theoretical Literature Review

The Sustainable Livelihoods Framework (SLF), developed by the Department for International Development (DFID), provides a valuable theoretical foundation for understanding how households in Kigoma and Katavi utilize resources to achieve sustainable livelihoods. The framework identifies five key assets—human, natural, financial, physical, and social capital—that households leverage to manage risks and create opportunities (DFID, 1999). For example, natural resources like fertile land or fishing waters (natural capital) and community participation (social capital) directly impact households' ability to diversify income sources. In this study, the SLF offers insights into how these assets are utilized to navigate socio-economic and environmental challenges, fostering livelihood diversification and resilience in the region.

Complementing the SLF, the Resource-Based Theory (RBT) emphasizes the importance of unique and diverse resources in achieving economic sustainability. Households with access to livestock, entrepreneurial skills, or microcredit, for instance, are better equipped to supplement agricultural income and withstand risks associated with climatic variability. Additionally, the Push-Pull Framework enriches this analysis by examining the drivers of income diversification. Push factors like poverty and declining agricultural productivity compel households to seek alternative livelihoods, while pull factors such as market opportunities and improved infrastructure encourage diverse economic participation (Barney, 1991). By integrating these frameworks, the study provides a comprehensive understanding of the constraints and opportunities influencing livelihood diversification in Kigoma and Katavi, highlighting pathways for sustainable development.

Empirical Literature review

Income diversification is a critical strategy for improving rural livelihoods and reducing poverty, particularly in sub-Saharan Africa. Studies such as Abate et al. (2023) demonstrate that Ethiopian households with multiple income sources experience better welfare outcomes, highlighting how diversification shields rural families from economic shocks. Similarly, Dimova and Sen (2010) emphasize the dual role of income diversification in Tanzania as both a survival mechanism and a strategy for wealth accumulation, enabling households to escape poverty and build resilience. Aikaeli (2021) reinforces these findings by identifying diversification into off-farm activities as a key determinant of rural income in Tanzania.

Environmental challenges also play a significant role in shaping rural livelihood diversification. Abdi et al. (2024) highlight how environmental degradation and rising food prices affect food security in sub-Saharan Africa, underscoring the importance of institutional quality in mitigating these impacts. Likewise, Gallehdarvand et al. (2024) show that income diversification in rural Iran helps reduce the adverse effects of environmental inequality on food security, offering valuable insights for Tanzania. Kitole et al. (2024) further argue that integrating environmental sustainability with economic growth policies is essential for effective rural livelihood diversification.

Access to credit is another crucial enabler of diversification. Ayele and Kayamo (2023) find that Ethiopian smallholder farmers with better access to formal credit are more likely to engage in off-farm income-generating activities. Lemessa and Gemechu (2016) similarly show that access to credit empowers rural households to diversify beyond agriculture. In Tanzania, Yirdaw (2021), Dimoso and Andrew (2021) and Kitole and Sesabo (2024) notes significant barriers to credit access, but addressing these challenges could open new opportunities for diversification. These findings suggest that improved financial inclusion is key to unlocking the potential of rural households to adapt and thrive economically. Moreover, institutional frameworks and support systems are equally

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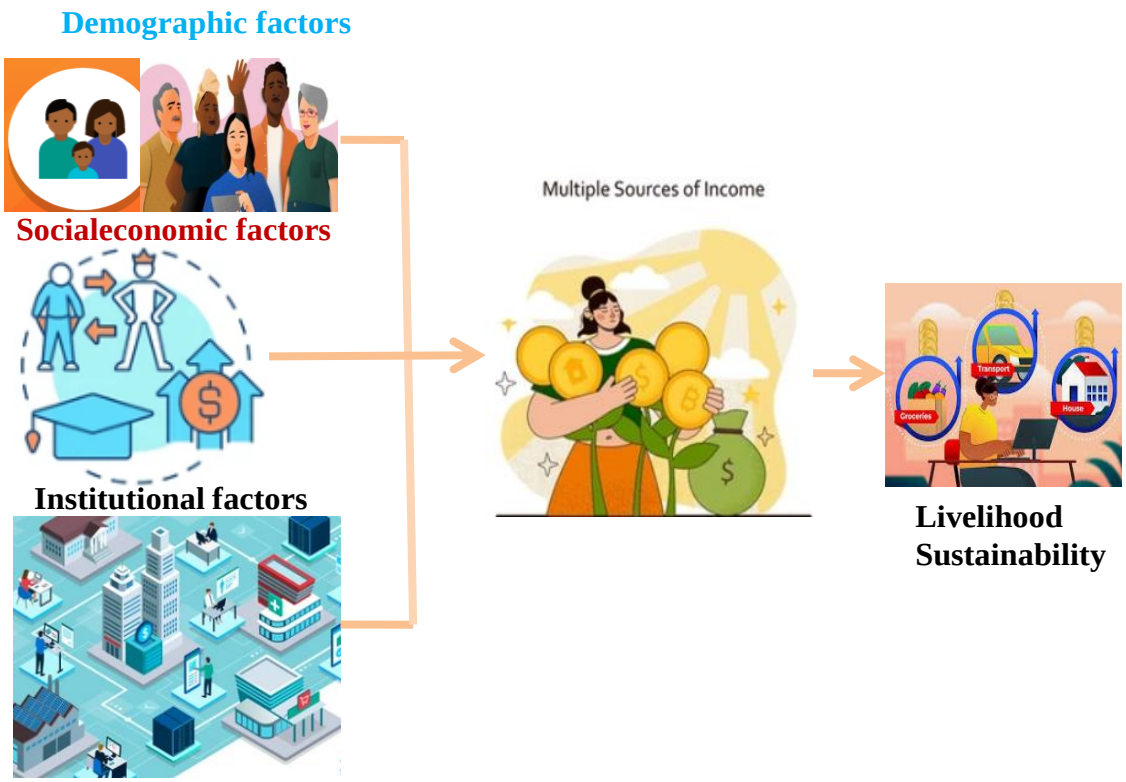
critical for sustainable livelihoods. The study by Kitole and Genda (2024), and Kitole et al. (2023) emphasizes the importance of institutional support, resource access, and market linkages. Roothaert et al. (2021) provide an example from northern Tanzania, where school feeding initiatives drove agricultural diversification and improved household incomes. In the Western Zone, similar multi-stakeholder programs could catalyze economic transformation by addressing structural barriers and enhancing market connectivity for rural communities.

Finally, empirical studies in Tanzania underscore the broader benefits of income diversification. Fasha and Minde (2020) observe improved food security and livelihoods among smallholder farmers in the Southern Agricultural Growth Corridor of Tanzania. Jamaldin (2024) highlights the positive impact of banana production in Missenyi District, while Mapunda (2024) demonstrates how off-farm employment enhances food and nutrition security in the Southern Highlands. Mwajombe and Liwenga (2022) emphasize the contribution of wild edible plants to household incomes in Kondoa District, illustrating the potential of leveraging local resources for economic resilience. These examples align with global perspectives, such as the World Bank (2022, 2023) and FAO (2023), which stress the importance of diversified livelihoods for achieving sustainable development goals and enhancing food security.

Figure 1: Conceptual framework



Source: authors' design 2025

Methodology

This study employed a cross-sectional research design, which was chosen for its ability to capture data at a single point in time, enabling a comprehensive understanding of the relationship between multiple income sources and livelihood sustainability in the Kigoma and Katavi regions. The cross-sectional design is particularly suitable for this research as it allows for the collection of diverse data from a large sample size within a limited timeframe, making it an efficient and

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practical approach for examining the complex factors influencing income diversification.

The study was grounded in the positivism theory, which guided the research approach. Positivism emphasizes objectivity, measurement, and empirical evidence, making it an appropriate theoretical foundation for this study. By focusing on observable phenomena and measurable variables, the study aimed to establish reliable and generalizable findings about the role of income diversification in enhancing livelihood sustainability. The positivist perspective ensured that the research maintained a structured and scientific approach, allowing for the identification of causal relationships between variables.

A quantitative approach was adopted to facilitate the systematic collection and analysis of numerical data. This approach was chosen because it allows for the statistical analysis of relationships between variables, providing objective evidence to support the study's findings. The use of quantitative methods ensured that the research was data-driven, enabling robust conclusions about the impact of multiple income sources on food security and income stability.

Data were collected using a structured questionnaire, which was designed to capture relevant information on income sources, livelihood activities, and factors influencing diversification. The questionnaire included both closed-ended and scaled questions to ensure the collection of precise and comparable data. It was administered to a sample of 510 respondents selected from the Kigoma and Katavi regions. The administration process involved trained enumerators who conducted face-to-face interviews with participants to ensure clarity and accuracy in responses. The sample was carefully chosen to ensure representation across different demographic groups and income-generating activities.

Ethical considerations were carefully addressed throughout the study. Approval was obtained from the regional authorities in Katavi and Kigoma, ensuring compliance with local regulations and cultural sensitivities. Written consent was obtained from all participants after explaining the study's purpose, procedures, and confidentiality measures. Respondents were assured that their participation was voluntary and that their responses would be used solely for research purposes. These measures ensured that the study upheld ethical standards and respected the rights and dignity of all participants.

Analytical model

The study employed a multinomial logistic regression model to analyze the effects of independent variables on the dependent variable, which in this case are the multiple sources of household income. This statistical model is particularly useful when dealing with multiple discrete alternatives. It facilitated the identification and quantification of the factors influencing households' decisions regarding different types of household income sources. This approach is similar to studies conducted by Mangula et al. (2019), Kitole et al. (2023; 2024), and Dimoso & Andrew (2021).

The multinomial logit model was chosen due to its capability to utilize the cumulative distribution function of the logistic distribution, making it well-suited for analyzing categorical dependent variables with more than two possible outcomes. It is a robust and effective tool frequently used in studies involving multiple-choice scenarios (Kitole & Sesabo, 2022). The model allows for a clear understanding of the relationship between independent variables (such as education, household member age) and the likelihood of household income sources. The multinomial logit equation applied to explain the determinants of cooking energy choices among households is expressed as:

$$log\left[\frac{\pi_j(x_i)}{\pi_k(x_i)}\right] = \alpha_{0i} + \beta_{ij}x_{1i} + \beta_{2j}x_{2i} + \cdots \ldots \ldots \ldots + \beta_{pj}x_{pi}$$

Whereas $j = 1,2, \ldots . . k$

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Additionally, the reduced form of the equation is expressed as:

$$\log\left(\pi_j(x_i)\right) = \frac{\exp\left(\alpha_{0i} + \beta_{ij}x_{1i} + \beta_{2j}x_{2i} + \cdots \ldots\ldots + \beta_{pj}x_{pi}\right)}{1 + \sum_{j=1}^{k-1} \exp\left(\alpha_{0i} + \beta_{ij} \text{ĉ}_{1i} + \beta_{2j}x_{2i} + \cdots \ldots\ldots + \hat{a}_{pj}x_{pi}\right)}$$

For $j = 1,2,\ldots,(k-1)$, and the parameters á and â will be estimated by the use of maximum likelihood. This Model was Chosen because the dependent variable has more than two unordered categories: sale of food crop, sale of cash crop, business income, selling of livestock and other household income sources and was preferred due to its straightforward computational process and its enhanced predictive capability in contrast to the Multinomial probit Model (Mhagama, and Heriel, 2023). On the other hand, variables that have been used in this study have been presented at Table 1.

Table 1. Description of variables used in the study

Variable	Measurement of variables
Household member's highest level of education	Categorical variable
Household member age	Categorical variable
Gender	Categorical variable
District	Categorical variable
Household main source of lighting	Categorical variable
Household main source for cooking	Categorical variable
Total area (land access/ownership)	Continuous variable
House roof	Continuous variable
House floor	Continuous variable

Source: authors' design (2025)

Findings

The graph illustrates the primary sources of household cash income in enhancing livelihood in western zone of Tanzania (Kigoma and Katavi). Figure 2 shows the majority of households, 314; rely on the sale of food crops as their main income source. Other significant sources include other source of household income with 121 households and business income with 42 households. A smaller number of households depend on wages or salaries in cash (15), the sale of cash crops (9), and the sale of livestock (8). This data highlights that agricultural activities, particularly food crop sales, play a dominant role in household income generation, with other income sources being relatively less prominent.

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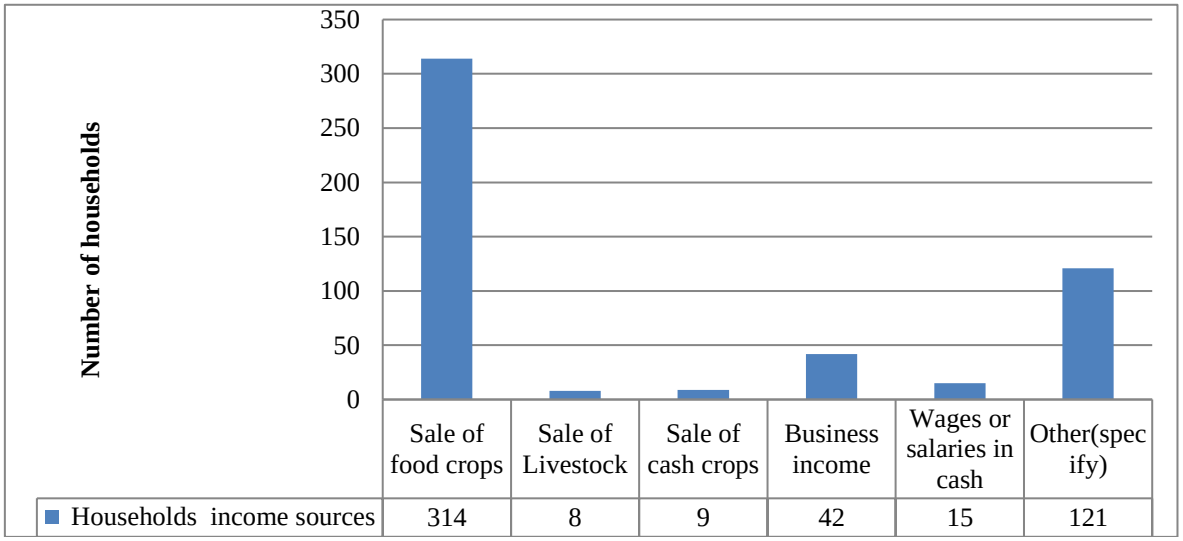
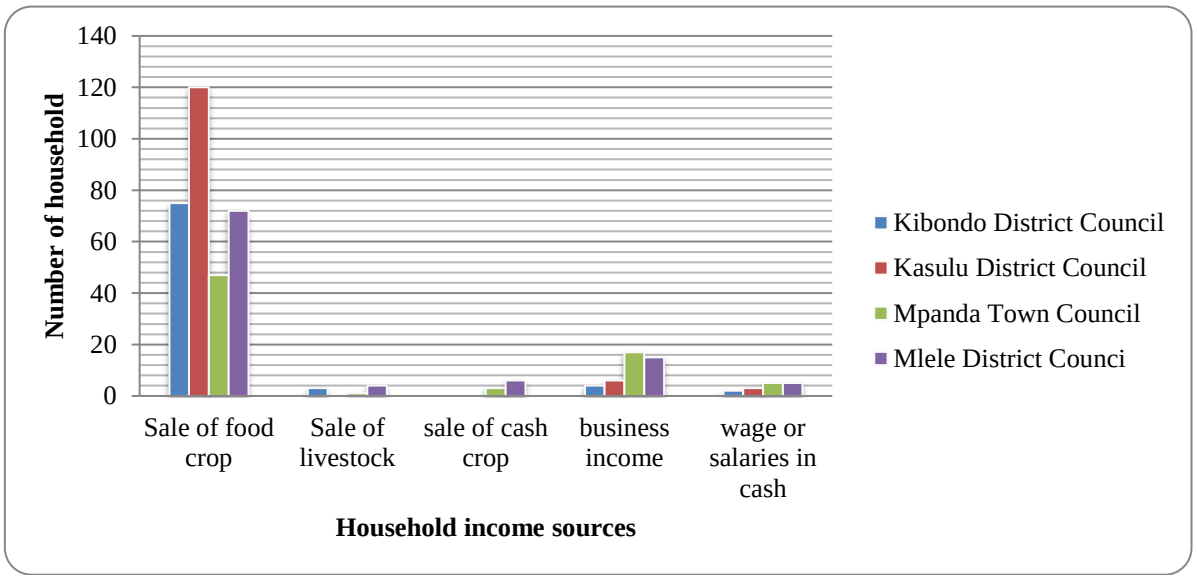
Figure 2 Household main source of cash income



Source: Authors' computations

Figure 3 compares the main sources of household cash income across four districts including Kibondo, Kasulu, Mpanda, and Mlele. The sale of food crops is the dominant income source in all districts, with Kasulu District leading at over 120 households, followed by Mlele and Kibondo, while Mpanda records fewer households in this category.

Figure 3 Household main source of cash income across districts



Other income sources such as business income, wages, and salaries in cash are relatively less significant but show variation across districts, with Mpanda having a notable contribution from business income. The sale of livestock and cash crops is minimal across all districts, indicating their limited role in household cash income generation. Overall, the data highlight the reliance on food crop sales as the primary income source, with other sources playing a supplementary role.

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Table 2 Multinomial logit results for multiple sources of income in western zone Tanzania

Variable	Sale of Livestock	Sale of cash crops	Business income	Wages or salaries in cash	Other income sources
Household member's highest level of education					
primary education	0.3414	0.8426	-0.8057	-0.7373	0.2664
	(0.1342)	(0.6134)	(0.7224)	(0.3252)	(0.6086)
secondary education	0.6605	-0.5648	-0.4696	-0.5841	0.8038
	(0.3132)	(0.3284)	(0.8092)	(0.2998)	(0.6663)
vocational education	0.7284	0.7019	-0.5615	-0.8274	0.0349
	(0.667)	(0.8131)	(0.9140)	(0.7667)	(0.7845)
college education	0.7504	0.6763	-0.5472	0.4635	0.6436
	(0.2685)	(0.3431)	(0.0293)	(0.3290)	(0.7460)
University	0.9980	-0.6895	-0.3945	-0.3474	0.5046
	(0.8761)	(0.2136)	(0.9778)	(0.6358)	(0.7167)
Household member age					
35-54	-0.0492	-0.0468	-0.9872	0.7582	0.1342
	(0.6467)	(0.1001)	(0.6989)	(0.9139)	(0.3700)
55-64	0.3480	0.5751	0.1515	0.7313	0.9032*
	(0.4932)	(0.3844)	(0.8936)	(0.3762)	(0.5403)
64+	0.4535	-0.6342	-0.6522	-0.8059	-0.4906
	(0.6098)	(0.4817)	(0.0169)	(0.3358)	(0.1720)
Gender					
Male	-0.5132	0.3443	0.6229	-0.3149	0.2035
	(0.1479)	(0.2122)	(0.3998)	(0.6975)	(0.2540)
District					
Kasulu District Council	-0.2522	-0.0307	0.5912	-0.2511	0.1515
	(0.7456)	(0.7654)	(0.7749)	(0.0489)	(0.3436)
Mpanda Town Council	-0.0153	0.4455	1.1058	-0.5245	0.1345***
	(0.0675)	(0.3491)	(0.7641)	(0.2052)	(0.4209)
Mlele District Council	-0.224	0.11382	0.4091*	-0.2678	0.5138
	(0.7070)	(0.1491)	(0.7813)	(0.3187)	(0.4511)
Household main source of lighting					
Solar	-0.4216	0.7656	-0.6161	0.1834	-0.8572*
	(0.0858)	(0.7423)	(0.5321)	(0.9720)	(0.4913)
Biogas	0.6298	0.4816	-0.7156	0.2254	-0.9706
	(0.6345)	(0.8919)	(0.4115)	(0.5976)	(0.5079)
Hurricane Lamp	0.0945	0.3923	-0.3955	0.1849	0.4261
	(0.6623)	(0.7152)	(0.3952)	(0.8766)	(0.8967)
Firewood	0.2708	0.6495	0.5459	0.7752	0.3902
	(0.1756)	(0.4025)	(0.2379)	(0.4129)	(0.3510)
Torch/ Rechargeable Lamp	-0.7343	-0.0003	-0.7264	0.5243	-0.2066
	(0.8380)	(0.2780)	(0.7407)	(0.5814)	(0.5596)
Other (specify	-0.6830	3.0687	-0.1558	-0.8009	0.4524*
	(0.4621)	(0.1389)	(0.1003)	(0.3322)	(0.8091)
Household main source for cooking					
Solar	0.9488	-0.6714	-0.4893	-0.2945	0.7299
	(0.3453)	(0.0914)	(0.5867)	(0.0122)	(0.4220)
Gas (hh biogas)	0.7865	0.0432	-0.7191	0.4957	0.2913
	(0.4746)	(0.0255)	(0.2316)	(0.2399)	(0.6110)
Gas (Industrial)	0.8523	0.2119	-0.8649	0.0392	0.5270
	(0.3354)	(0.2352)	(0.6137)	(0.4375)	(0.5052)
Paraffin/kerosene	0.0260	0.8812	-0.6232	0.2351	0.9019
	(0.0154)	(0.4532)	(0.4907)	(0.3869)	(0.6267)
Charcoal	0.9266	0.6862	0.4684	0.0573	0.4273
	(0.5443)	(0.4212)	(0.2818)	(0.3484)	(0.2505)
Firewood	0.1800	0.8475	0.0210	0.5263	0.4265
	(0.0133)	(0.5112)	(0.0208)	(0.3484)	(0.3150)

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Crop Residues	-0.9372	0.4953	-0.8094	0.7085	-0.1360
	(0.0124)	(0.3634)	(0.1127)	(0.7156)	(0.0789)
Livestock dung	0.5348	0.9517	-0.2808	-0.1485	-0.2177
	(0.3549)	(0.5312)	(0.1126)	(0.1023)	(0.1243)
Generator/Private source	0.6651	0.2291	0.0260	0.6276	0.0257
	(0.3356)	(0.1347)	(0.0226)	(0.4584)	(0.0218)
Other (specify	0.8536	-0.5738	-0.2247	-0.1149	0.2662
	(0.4406)	(0.0291)	(0.7672)	(0728.36)	(0.1451)
Total area (land access/ownership)	0.1544	-0.0682	-0.0434*	-0.0104	-0.0660**
	(0.0966)	(0.0794)	(0.0236)	(0.0248)	(0.0271)
Number of rooms	0.2070	-0.1161	-0.0014	-0.1411	-0.1159
	(0.8948)	(0.5713)	(0.1236)	(0.2289)	(0.1153)
household number of meals per day	8.2317	0.4728	0.4239	0.5606	-0.5428*
	(5.2006)	(0.2971)	(0.4851)	(0.2620)	(0.3290)
number of days household consumed meat	-0.2139	-0.5556*	0.1668	0.6009*	-0.2252
	(0.9840)	(0.9093)	(0.1893)	(0.3212)	(0.1869)
number of days household consumed fish in last seven days	0.6824	0.7465*	-0.0698	-0.1388	-0.0875
	(0.3253)	(0.4477)	(0.1228)	(0.2302)	(0.0908)
House roof					
Tiles	0.8116	0.9038	0.9577**	-0.9833	0.3405
	(0.4445)	(0.5243)	(0.5600)	(0.0554)	(0.6754)
Grass/leaves	-0.6065	-0.0217	-0.5738	0..6465	-0.0312
	(0.0234)	(0.7728)	(0.8832)	(0.3446)	(0.3433)
Grass & mud	-0.3043	-0.8647	-0.1088	-0.0477	0.3872*
	(0.1284)	(0.4517)	(0.2318)	(0.0214)	(0.8406)
House floor					
Wood Planks, Bamboo, Palm	0.0119	0.6511	-0.4144	0.8910	-0.4752
	(0.0126)	(0.5517)	(0.0276)	(0.6902)	(0.0279)
Ceramic Tiles, Terrazzo	0.7619	0.3056	0.20196	0.3054	0.56015
	(0.4534)	(0.1557)	(0.106)	(0.1957)	(0.2506)
Cement	-0.7452	0.6943	0.5279	1.5115*	0.7295*
	(0.3676)	(0.6640)	(0.5402)	(0.1413)	(0.4102)
Other (specify)	-0.0505	0.4895**	-0.26716	-18.788	-0.7845
		(0.4497)	(0.3315)	(22288.1)	(0.4307)

Standard errors in parentheses.

****p < 0.01, **p < 0.05, *p < 0.1.*

The age of household heads significantly influences their reliance on various income sources. Households with heads aged 55–64 are more likely to depend on "Other income sources," as indicated by a positive coefficient of 0.903 and significant at ($p < 0.05$). This suggests that individuals in this age group may transition from labor-intensive activities, such as farming, to less physically demanding economic pursuits, such as small-scale businesses or rent collection. Conversely, older households (64+) show a negative association with business income, reflected by a coefficient of -0.652 ($p < 0.1$) indicating reduced participation in entrepreneurial ventures at advanced ages.

The choice of income sources varies significantly by district. Households in Mpanda Town Council are more likely to rely on "Other income sources," with a coefficient of 0.135 and significant at ($p< 0.01$). This highlights Mpanda's diverse economic opportunities and better infrastructure, which promote alternative livelihoods. In contrast, households in Mlele District Council are associated with higher cash crop income, as reflected by a positive coefficient of 18.014 and significant at ($p < 0.1$) likely due to favorable agricultural conditions in the area.

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The type of lighting a household uses also significantly impacts income diversification. Households relying on alternative lighting sources, such as solar or firewood, are more inclined toward "Other income sources," with a coefficient of 0.452 and significant at ($p < 0.10$). This suggests that infrastructure limitations, particularly lack of electricity, may drive households to engage in non-agricultural income-generating activities. Additionally, households using solar power show a negative association with cash crop income, indicated by a coefficient of -0.422 and significant at ($p < 0.05$) implying that energy access constraints might limit agricultural productivity.

Land size plays a critical role in determining income sources. Households with larger land areas are positively associated with income from Sale of cash crops, with a coefficient of 0.154 and significant at ($p < 0.05$), highlighting the importance of land for agricultural productivity. On the other hand, smaller landholdings are significantly linked to reliance on "Other income sources," as shown by a negative coefficient of -0.066 ($p < 0.01$). This suggests that households with limited land are more likely to explore non-agricultural ventures.

Nutritional status represented by number of meals consumed daily is an indicator of household food security and its economic flexibility. Households consuming fewer meals are less likely to diversify into "Other income sources," as indicated by a negative coefficient of -0.543 and significant at ($p < 0.1$). This finding underscores the relationship between nutritional status and the ability to engage in diverse income-generating activities.

Dietary diversity also correlates with income sources. A decrease in meat consumption days is negatively associated with cash crop income, with a coefficient of -0.556 and significant at 1%, suggesting that households prioritize reinvesting earnings from cash crops into other needs. However, wages or salaries show a positive relationship with meat consumption, reflected by a coefficient of 0.601 and significant at ($p < 0.05$) indicating that salaried households can afford better diets. Similarly, frequent fish consumption is positively linked to cash crop income, as shown by a coefficient of 0.747 and statistically significant at 5% highlighting how agricultural earnings support dietary diversity. Housing characteristics, such as roof type, are significant indicators of economic stability. Households with tiled roofs are more likely to earn income from business activities, with a ($p < 0.05$). This association underscores the role of better housing as both a reflection of and a contributor to entrepreneurial ventures.

The type of flooring also significantly influences income diversification. Households with cement floors are positively associated with wages or salaries, as indicated by a coefficient of 0.512 and significant at ($p < 0.1$). They are also more likely to depend on "Other income sources," with a coefficient of 0.730 and ($p < 0.1$). These findings suggest that better housing conditions correlate with greater financial stability, enabling households to diversify their income sources effectively.

Discussion

The findings presented in Table 2 provide critical insights into the role of multiple income sources in enhancing livelihoods in the Western Zone of Tanzania. The observed relationship between older age groups and reliance on alternative income sources aligns with Jamaldin's (2024) findings, which highlighted that older individuals often leverage their experience to diversify income, particularly in banana farming. This study also underscores the importance of infrastructure development, capital investment support, and gender equity in promoting diversified income sources, resonating with Aikaeli (2021), who emphasized structural factors like education, age, and market proximity as pivotal to shaping income diversification strategies.

Households in Mpanda Town Council demonstrated a strong reliance on diverse economic opportunities, whereas those in Mlele District focused more on cash crop incomes. These findings align with Jamaldin's (2024) observations that market access and agricultural conditions

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significantly influence income sources. Similarly, Kitole and Genda (2024) emphasized the necessity of diverse income strategies in regions constrained by climate and limited resources. Improved infrastructure and favorable agricultural conditions are critical for promoting diversified livelihoods in Kigoma and Katavi. Infrastructure limitations, such as inadequate electricity, were found to drive households toward non-agricultural income sources. These findings parallel those of Kitole and Utouh (2023) and Omary et al. (2020), who highlighted water and energy accessibility as crucial for enhancing household food security and income generation. The reduced cash crop incomes among solar-powered households further underscore the impact of energy constraints on agricultural productivity.

The positive correlation between larger landholdings and cash crop income supports the findings of Kitole et al. (2023) and Ojo et al. (2024), who identified land rights and irrigation as significant factors affecting agricultural productivity and food security. Similarly, Jamaldin (2024) highlighted that larger planting areas increase the likelihood of adopting improved seeds, which in turn boosts incomes. These results suggest that policies promoting equitable land access and agricultural technology adoption could enhance both productivity and diversification, especially in rural areas.

Household dietary trends observed among those earning from cash crops and business activities align with Beyene et al. (2022), who linked income diversification to household resilience. Increased income from diverse sources was found to improve dietary quality, reinforcing the critical role of diversification in enhancing overall well-being. This highlights the broader socio-economic benefits of income diversification, including improved nutrition and health outcomes.

Additionally, the association between better housing quality and diversified income sources parallels Roothaert et al. (2021), who found that market linkages, such as those created through school feeding programs, improve rural livelihoods. Investments in infrastructure, including housing, could act as catalysts for economic resilience and livelihood diversification. Improved housing not only enhances living conditions but also reflects economic stability and progress, suggesting a strong link between infrastructure development and income diversification.

The findings reaffirm the importance of targeted interventions in infrastructure, education, and resource access, as emphasized by Mwajombe and Liwenga (2022) and Kitole and Sesabo (2024). Integrated approaches that combine natural resource management with off-farm income activities could address livelihood challenges specific to the Western Zone of Tanzania. Such approaches can also promote resilience by enabling households to diversify their income sources while adapting to environmental and market constraints.

Therefore, the study underscores the interconnectedness of infrastructure, resource access, and diversification strategies in enhancing livelihoods. By addressing systemic challenges and creating enabling environments, policymakers can facilitate sustainable economic growth and resilience in rural communities. The integration of tailored interventions that consider local dynamics will be essential in realizing long-term improvements in household incomes and overall well-being.

Conclusion

This study highlights the critical importance of income diversification in improving livelihoods and enhancing food security in the Western Zone of Tanzania, particularly in Kigoma and Katavi regions. While agriculture remains the dominant economic activity, its productivity is constrained by challenges such as limited market access, declining yields, and the impacts of climate change. Consequently, households engaging in diversified income streams, such as livestock rearing, fishing, petty trading, and utilizing wild edible plants, exhibit greater food

security and economic stability. However, these strategies face significant barriers, including limited credit access, inadequate infrastructure, and insufficient education. Addressing these constraints is essential for promoting sustainable livelihoods and reducing poverty.

The recommendations in this study are particularly relevant to Kigoma and Katavi, regions characterized by a heavy reliance on rain-fed agriculture, underdeveloped infrastructure, and high vulnerability to climate shocks. For instance, infrastructure development—such as improved roads and storage facilities tailored to the remote nature of these regions—can help farmers reduce post-harvest losses and access markets more efficiently. Similarly, promoting the use of locally available wild edible plants and indigenous knowledge systems aligns with the cultural and ecological characteristics of the area, ensuring that proposed solutions are feasible and contextually appropriate.

To achieve rapid and impactful results, several key interventions should be prioritized. First, improving access to agricultural inputs, such as seeds, fertilizers, and irrigation technologies, is urgent to enhance productivity and mitigate climate variability. Second, infrastructure development, particularly the construction of rural roads and storage facilities, should be expedited to facilitate market access. Third, empowering women through access to credit and entrepreneurship training holds immense potential for immediate socio-economic gains. Prioritizing these actions will ensure that the foundation for sustainable development is laid, addressing the most pressing needs of vulnerable households.

Implementing these recommendations is expected to yield significant improvements in food security, economic resilience, and poverty reduction. Enhanced access to agricultural inputs and markets will boost productivity and profitability, ensuring a more reliable food supply. Empowering women and fostering gender inclusivity will unlock untapped economic potential, increasing household income and promoting equitable development. Additionally, diversifying income sources through small-scale businesses, livestock rearing, and value-added agricultural enterprises will reduce dependency on rain-fed farming, mitigate risks associated with climate shocks, and foster economic resilience. Over time, these measures will reduce environmental vulnerability, create sustainable livelihoods, and contribute to long-term regional stability.

An integrated approach combining infrastructure development, financial inclusion, education, and resource access is crucial for addressing the challenges faced by households in Kigoma and Katavi. Developing microfinance schemes and savings cooperatives can empower households to invest in diversified income streams, while vocational and formal education programs tailored to local conditions will equip individuals with the skills needed to adapt to evolving economic and environmental demands. These targeted actions, rooted in the specific needs and characteristics of the regions, will ensure sustainable livelihoods, resilience to climate variability, and improved well-being for the communities in Kigoma and Katavi.

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