

ASSESSMENT OF THE SOCIO-ECONOMIC IMPACTS OF LANDSLIDES ON DONKEY-DEPENDENT COMMUNITIES IN HANANG' DISTRICT, TANZANIA

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ABSTRACT

Climate-related disasters are increasingly threatening rural livestock-dependent communities across sub-Saharan Africa. This study assessed the socio-economic impacts of the December 2023 landslides on donkey owners and users in Hanang' District, Manyara Region, Tanzania. A mixed-methods cross-sectional design was employed, incorporating household surveys, Focus Group Discussions, Key Informant Interviews, and field observations. Data were collected from 223 respondents across three wards and eight villages. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data were subjected to thematic content analysis. The findings demonstrate that donkeys play a vital role in agricultural production, transportation, water collection, and income generation. Prior to the landslides, 61% of households owned or used donkeys, while 9% reported direct donkey losses caused by the disaster. Mean donkey ownership declined significantly from 2.45 to 2.07 donkeys per household ($t = 2.661$, $p = 0.0086$). The leading causes of donkey loss were burial under landslide debris (36.5%), separation from owners (23.8%), and physical injuries (9.5%). Binary logistic regression revealed that household size significantly influenced post-disaster income recovery ($OR = 0.815$, $p = 0.028$), whereas households in Gendabi Ward were significantly less likely to recover than those in the reference ward ($OR = 0.089$, $p = 0.029$). Household type and pre-disaster donkey ownership were not significant predictors of income recovery. Qualitative findings further identified poor harnessing practices, inadequate nutrition, and limited access to veterinary services as major constraints to donkey welfare and resilience. The study concludes that the December 2023 landslides significantly reduced donkey assets and disrupted rural livelihoods. Integrating donkey welfare into disaster risk reduction strategies, strengthening veterinary and extension services, and

promoting livelihood diversification are essential for improving resilience in disaster-prone communities.

Keywords: Donkey welfare; landslides; socio-economic impacts; disaster resilience; rural livelihoods; climate change; working equids; Tanzania.

1. INTRODUCTION

Natural disasters associated with climate change and environmental degradation are increasing in both frequency and intensity, posing growing risks to livelihoods, ecosystems, and rural economies worldwide. The Intergovernmental Panel on Climate Change (IPCC) reports that climate-related hazards, including floods, droughts, and extreme rainfall events, are becoming more severe, particularly in regions already exposed to environmental stress (IPCC, 2014, IPCC, 2014, pp. 69-194 & pp. 1133-1197). Developing countries are disproportionately affected due to their high dependence on climate-sensitive sectors, especially rain-fed agriculture and livestock-based livelihoods, which often have limited adaptive capacity and resilience (IPCC, 2014, pp. 488-568 & pp. 709-754). These vulnerabilities are further exacerbated by poverty, weak infrastructure, and limited access to climate adaptation resources, making rural populations particularly susceptible to disaster impacts and long-term livelihood disruptions. Climate-related hazards, including floods, droughts, landslides, storms, and prolonged dry spells, disrupt agricultural production, destroy infrastructure, reduce household incomes, increase food insecurity, and exacerbate poverty (UNDRR, 2022 pp. 11-4). In sub-Saharan Africa, where adaptive capacity is often constrained by limited resources, weak infrastructure, and dependence on natural resources, these disasters have profound socio-economic consequences for rural communities.

Tanzania has experienced an increasing frequency of climate-induced disasters over recent decades, particularly in ecologically fragile areas characterized by mountainous terrain and highly variable rainfall patterns (Kangalawe & Lyimo, 2017 pp. 38-41). Landslides have become one of the most destructive hazards in northern Tanzania, causing extensive loss of life, displacement of households, destruction of infrastructure, and damage to agricultural land and livestock assets (Ogola E, Omemo P, Opere S, Okoko G, et al 2023, pp 15-28). Such disasters not only result in immediate humanitarian crises but also undermine long-term livelihood recovery by reducing productive assets and limiting income-generating opportunities.

Rural livelihoods in Tanzania are predominantly based on mixed crop-livestock production systems. Livestock contribute significantly to household income, food security, agricultural productivity, and resilience during economic shocks. While considerable attention has been given to cattle, sheep, and goats in disaster preparedness and recovery programmes, working equids, particularly donkeys have received comparatively little attention, despite their important economic

and social roles and the welfare challenges reported in similar low-resource settings (Ahmed ZA, Mohamed MOS, Mohamed AA, Mio JB2023, pp. 45-58).

Working donkeys are indispensable to millions of rural households across Africa, Asia, and Latin America. They provide affordable and reliable transport for agricultural produce, water, firewood, construction materials, and household goods, while also supporting cultivation and access to markets, schools, and health services (Valette, 2015 pp. 6-9). For resource-poor households, donkeys reduce labour demands, lower transport costs, improve market participation, and strengthen household resilience to environmental and economic shocks (Maggs, Ainslie, & Bennett, 2021 pp. 3-5). Their contribution extends beyond direct income generation by enabling access to essential services and supporting diversified livelihood strategies.

Growing evidence indicates that healthy working equids make significant contributions to sustainable rural development, poverty reduction, and achievement of several Sustainable Development Goals. Nevertheless, donkeys remain largely invisible within livestock policies, agricultural development programmes, and disaster risk reduction frameworks. Consequently, emergency response interventions frequently prioritize major livestock species while overlooking working equids, despite their importance to vulnerable households (The Brooke, 2019 pp. 1–15 & FAO, 2014, pp 3-7).

The welfare of working donkeys is closely linked to the well-being and resilience of the communities that depend on them. Previous studies have documented widespread welfare challenges, including inadequate nutrition, excessive workloads, poor harnessing, limited veterinary services, infectious diseases, and insufficient access to water and shelter (Biffa & Woldemeskel, 2006 pp. 115-118; Stringer, Bell, & Christley, 2017 pp. 5-7). During disasters, these challenges are often intensified by feed shortages, injuries, disease outbreaks, displacement, and disruption of veterinary services. Poor donkey welfare reduces work efficiency and productivity, thereby diminishing household income and slowing post-disaster recovery.

Recent studies on disaster resilience emphasize that recovery depends not only on rebuilding physical infrastructure but also on restoring livelihood assets, strengthening social support systems, improving institutional preparedness, and protecting productive livestock resources (Wu H, Heyland LK, Yung et al., 2023 pp369-381). Climate change adaptation strategies increasingly advocate for integrated approaches that combine disaster risk reduction, sustainable livestock management, early warning systems, community participation, and ecosystem conservation to enhance resilience among vulnerable rural populations (Tekua & Tarikub, 2026 pp 101-122; Macherera & Chimbari, 2016 pp 206). However, despite growing research on livestock-based resilience, empirical evidence specifically examining the impacts of disasters on working equids

and donkey-dependent households remains limited (Ravichandran et al., 2023 pp 1927; Pritchard et al., 2022 pp 342-353).

On 2 December 2023, Hanang' District in Manyara Region experienced devastating landslides following prolonged heavy rainfall. The disaster caused extensive loss of life, widespread destruction of infrastructure, displacement of communities, and substantial livestock losses (Kiremeji et al., 2025, pp. 2-4). Although emergency response efforts focused primarily on human rescue and support for major livestock species, relatively little attention was given to working donkeys, despite their critical contribution to transportation, agriculture, and household livelihoods.

Hanang' District hosts one of the largest donkey populations in Manyara Region, with approximately 32,013 donkeys recorded in the 2023 District Livestock Census (Manyara Regional Agricultural Sample Census Report, 2023, p. 47). Given the dependence of many households on donkeys for income generation and daily livelihood activities, losses associated with the landslides are likely to have had significant socio-economic consequences. However, limited empirical evidence exists regarding how natural disasters affect donkey ownership, donkey welfare, household livelihoods, and post-disaster recovery in Tanzania.

This study addresses this knowledge gap by assessing the socio-economic impacts of the December 2023 Hanang' landslides on donkey-dependent households, evaluating the welfare status of surviving donkeys, and identifying community priorities for recovery and resilience. The findings contribute to the growing evidence on disaster resilience and working equids and provide practical recommendations for integrating donkey welfare into disaster preparedness, response, recovery planning, and climate adaptation policies.

1.1 Objectives of the Study

1.1.1 General Objective

To assess the socio-economic impacts of the December 2023 landslides on donkey-dependent communities in Hanang' District, Manyara Region, Tanzania.

1.1.2 Specific Objectives

The study sought to:

1. Examine the socio-economic characteristics of communities affected by the landslides in Hanang' District.
2. Assess the status, utilization, and welfare of donkeys within the affected communities.
3. Determine the contribution of donkeys to household livelihoods and community resilience.

4. Identify immediate, short-, and long-term strategies for supporting donkey-dependent communities following landslides.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Hanang' District, Manyara Region, northern Tanzania (34°45'E-35°48'E; 4°25'S–5°00'S). The district covers 3,639 km² and is characterized by rugged terrain, including Mount Hanang' (3,418 m). It experiences a bimodal rainfall pattern with annual rainfall of 700-900 mm. The economy is primarily based on agriculture and livestock production, increasing vulnerability to climate-related hazards. Three wards (Gendabi, Jorodom, and Ganana) and eight villages were purposively selected based on landslide severity and reliance on donkeys for livelihoods.

2.2 Study Design

A cross-sectional mixed-methods research design was employed to collect both quantitative and qualitative data on the socio-economic impacts of the December 2023 landslides on donkey owners and users in Hanang' District. The mixed-methods approach enabled a comprehensive assessment of livelihood impacts, donkey welfare, and community resilience by integrating numerical data with participants' experiences and perspectives.

2.3 Sampling Procedures and Sample Size

Purposive sampling was employed to recruit donkey owners, donkey users, and key stakeholders directly affected by the December 2023 landslides. This approach ensured the inclusion of households dependent on donkeys for their livelihoods and with firsthand experience of the disaster. A total of 223 respondents participated in the household survey. Qualitative data were collected through 10 Key Informant Interviews (KIIs) and 3 Focus Group Discussions (FGDs) involving District Livestock Officers, Ward Executive Officers, Livestock Extension Officers, and Community Development Officers, who provided expert insights into the socio-economic impacts of the landslides and the role of donkeys in local livelihoods.

2.4 Data Collection Methods

Data were collected using a mixed-methods approach. Household surveys administered via Kobo Collect captured quantitative data on socio-demographic characteristics, donkey ownership, livelihood activities, donkey welfare, and landslide impacts. Key Informant Interviews and Focus Group Discussions provided in-depth qualitative insights into community vulnerability, coping strategies, donkey welfare, and disaster response mechanisms, while field observations were used to validate and complement the findings. Quantitative data were analyzed using descriptive and

inferential statistics in Microsoft Excel, including frequencies, percentages, means, ranges, Pearson's Chi-square test, paired-sample t-test, and binary logistic regression. Qualitative data were analyzed thematically to identify key patterns related to livelihoods, donkey welfare, and disaster impacts.

2.5 Ethical Considerations

Participation in the study was voluntary, and informed consent was obtained from all respondents prior to data collection. Ethical clearance and the necessary research permissions were secured from district authorities and relevant institutions, including the Ministry of Livestock and Fisheries and the Tanzania Livestock Research Institute (TALIRI). Confidentiality and anonymity of participants were maintained throughout the study, and all information collected was used solely for research purposes.

3. RESULTS

3.1 Descriptive Statistical Analysis Results

To enhance clarity and interpretation, the findings are presented using tables and graphical illustrations of key socio-economic and donkey welfare indicators, summarizing respondents' demographics, donkey ownership patterns, welfare conditions, livelihood contributions, and the impacts of the December 2023 landslides.

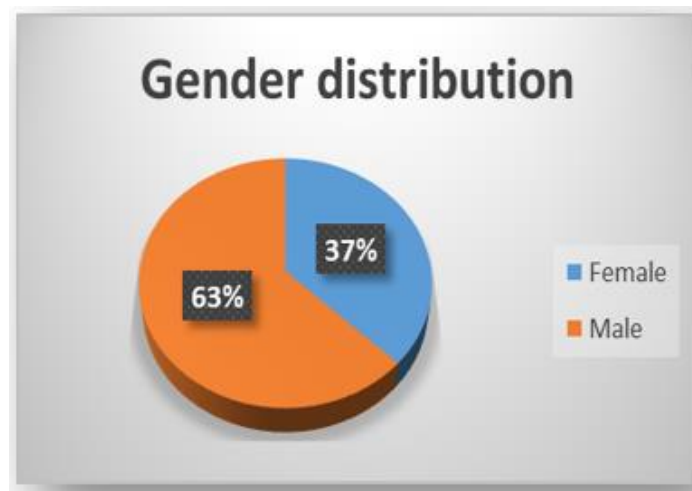


Figure 1: Gender Distribution of Respondents

Figure 1 presents the proportion of male and female respondents who participated in the study.

As shown in Figure 1, male respondents constituted the majority of the study participants, accounting for 62.8% of the total sample, while female respondents represented 37.2%. This

gender distribution suggests that men play a more prominent role in livestock ownership and decision-making related to household livelihood activities within the study area. However, the substantial participation of women indicates their important involvement in donkey-related activities and household livelihood management.

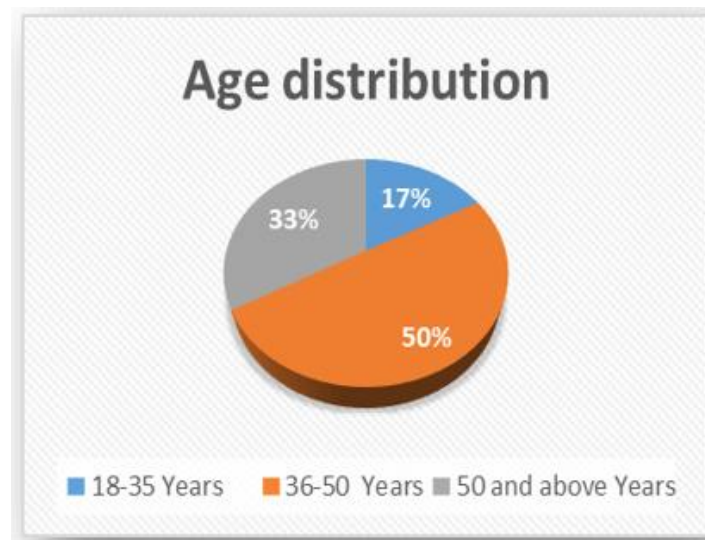


Figure 2: Age Distribution of Respondents

Figure 2 presents the distribution of respondents across three age categories: 18–35 years, 36–50 years, and above 50 years.

As shown in Figure 2, the majority of respondents belonged to the 36–50 years age group, representing the economically active segment of the population. This finding suggests that middle-aged individuals are the primary participants in donkey-dependent livelihood activities within the study area. Their active involvement highlights the important role of donkeys in supporting household production, income generation, and other livelihood-related activities among working-age community members.

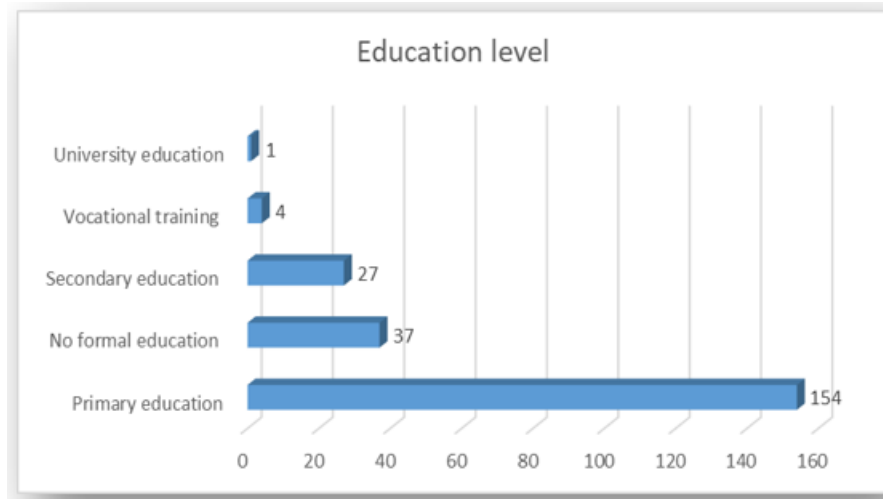


Figure 3: Educational Attainment of Respondents

Figure 3 illustrates the educational levels attained by respondents participating in the study.

As shown in Figure 3, most respondents had attained primary education (69.1%), while 16.6% had no formal education, 12.1% had secondary education, 1.8% had vocational training, and 0.4% had university education. These findings indicate generally low levels of educational attainment, reflecting the predominantly rural context of the study area and households' reliance on agriculture and livestock keeping. Limited access to secondary and tertiary education may also constrain knowledge of improved livestock management, donkey welfare, and disaster preparedness. This underscores the need for targeted community education and capacity-building initiatives to strengthen resilience.

Occupation	Frequency	Percent
Agriculture	312	34.78%
Small business/trade	241	26.87%
Animal husbandry	230	25.64%
Employment	50	5.57%
Transportation activities	38	4.24%
Beekeeping activities	15	1.67%
Artisans and handcrafts	10	1.11%
Other	1	0.11%

Figure 4: Household Livelihood Activities

Figure 4 presents the distribution of major household livelihood activities, including agriculture, livestock keeping, transportation services, trade, and other income-generating activities.

As shown in Figure 4, agriculture was the predominant livelihood activity (34.8%), followed by small business and trade (26.9%) and livestock keeping (25.6%), highlighting households' strong dependence on climate-sensitive livelihoods. Although some households engaged in supplementary activities, such as formal employment, transportation services, beekeeping, and handicrafts, these were relatively uncommon. These findings underscore the need to strengthen disaster preparedness, climate adaptation, and livelihood diversification to enhance the resilience of rural households.

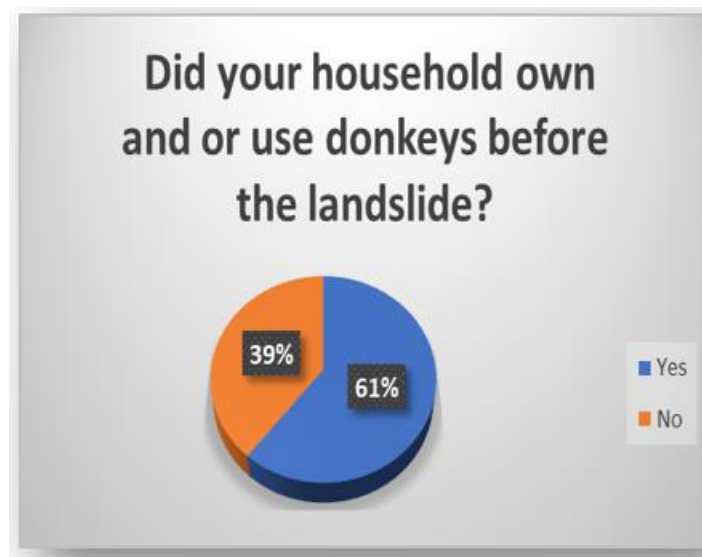


Figure 5: Household Ownership or Use of Donkeys Before the Landslides

Figure 5 presents the proportion of households that owned or used donkeys prior to the December 2023 landslides.

As shown in Figure 5, 61.4% of respondents owned or used donkeys before the landslides, while 38.6% had never owned or used them. The high level of donkey ownership highlights their importance in supporting rural livelihoods through transportation, agricultural activities, water collection, and income generation. Consequently, the loss or reduced availability of donkeys due to the landslides likely disrupted livelihood activities, reduced household income, and weakened community resilience. These findings underscore the need to integrate donkey welfare into disaster preparedness, response, and recovery interventions.

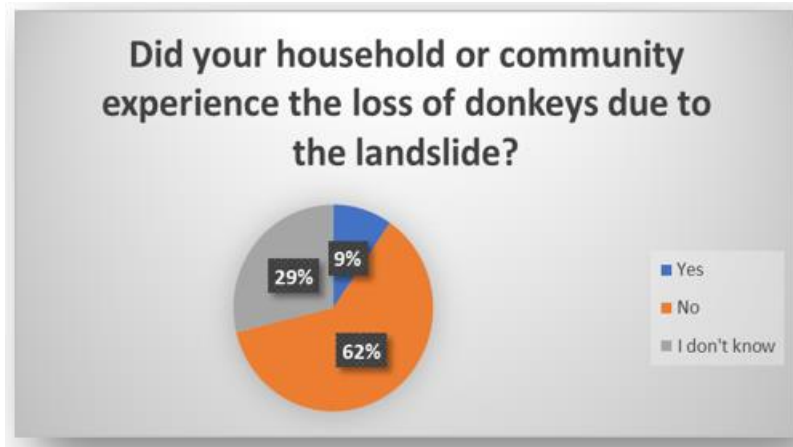


Figure 6: Household Experience of Donkey Losses Due to the Landslides

Figure 6 presents the proportion of households that experienced donkey losses as a result of the December 2023 landslides.

As shown in Figure 6, 62% of respondents reported no donkey losses following the landslides, while 9% experienced direct losses due to death, injury, or separation of donkeys from their owners. A further 29% were uncertain whether losses had occurred. Although most households retained their donkeys, the reported losses highlight the negative impact of the landslides on donkey-dependent livelihoods and emphasize the need for improved livestock monitoring and disaster preparedness.

	<i>The household that owns before the landslide.</i>	<i>The household that owns after the recent landslide.</i>
Mean	3	2
Range	19	12
Minimum	1	0
Maximum	20	12

Figure 7: Household Donkey Ownership Before and After the Landslides

Figure 7 presents the distribution of the number of donkeys owned per household before and after the December 2023 landslides.

As shown in Figure 7, the average number of donkeys owned per household declined from 3 before the landslides (range: 1-20) to 2 after the landslides (range: 0-12). The reduction in both the average and maximum number of donkeys, together with households reporting no remaining donkeys after the disaster, demonstrates the significant impact of the landslides on donkey

ownership. This decline likely affected household livelihoods by reducing access to transportation, agricultural support, and income-generating opportunities.

Reasons for the loss	Frequency	Percent
Buried in Landslide Debris	23	36.51%
Separation from Owners	15	23.81%
Physical Injury	6	9.52%
Drowning	5	7.94%
Infrastructure Damage	2	3.17%
Lack of Emergency Shelter	4	6.35%
Lack of Resources for Rescue Operations	5	7.94%
Outbreak of diseases	2	3.17%
Business for livelihoods	1	1.59%

Figure 8: Reasons for Donkey Loss During and After the Landslides

Figure 8 presents the main causes of donkey losses during and after the December 2023 landslides, along with their corresponding frequencies and percentages.

As shown in Figure 8, the leading cause of donkey loss was burial under landslide debris (36.5%), followed by separation from owners (23.8%) and physical injuries (9.5%). Other causes included drowning, infrastructure damage, limited emergency shelters and rescue resources, disease outbreaks, and continued use of donkeys during the disaster. These findings highlight the vulnerability of working donkeys to natural disasters and underscore the need for improved disaster preparedness, including livestock evacuation plans, emergency shelters, and community-based response mechanisms.

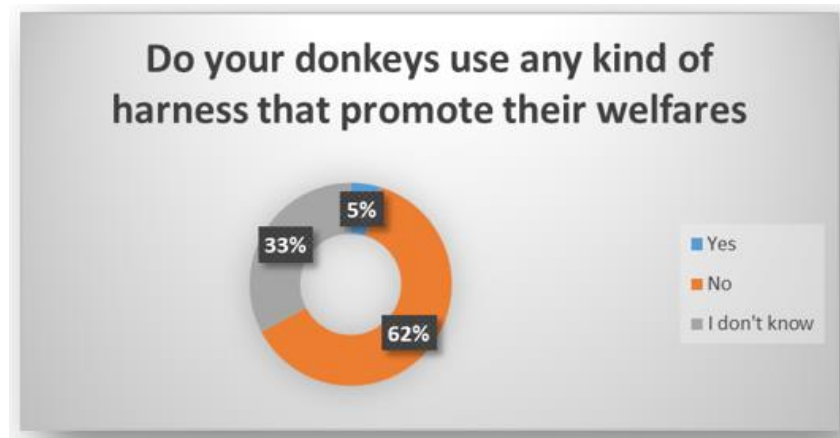


Figure 9: Use of Welfare-Friendly Harnesses Among Respondents

Figure 9 presents the proportion of respondents using welfare-friendly harnesses for their donkeys.

As shown in Figure 9, the majority of respondents (62%) reported not using welfare-friendly harnesses, while 33% had limited or no knowledge of appropriate harnessing practices. Only 10.7% reported using improved harnesses. These findings indicate that traditional harnessing methods remain widespread, potentially compromising donkey health, welfare, and work performance. They also highlight the need for increased awareness, training, and improved access to welfare-friendly harnesses to enhance donkey welfare and support sustainable rural livelihoods.

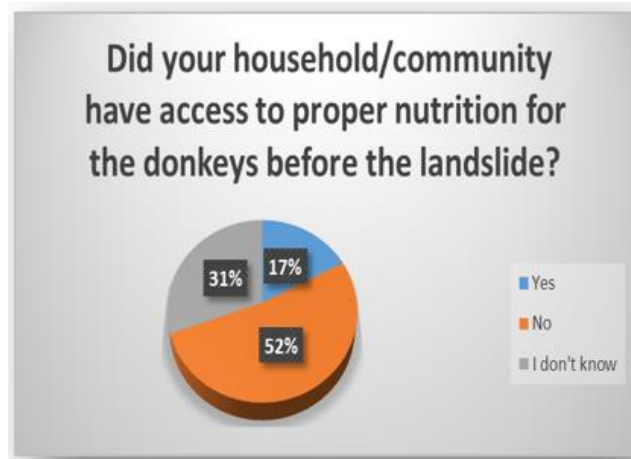


Figure 10: Household Access to Proper Donkey Nutrition

Figure 10 presents the proportion of households with access to adequate and nutritious feed for donkeys prior to the December 2023 landslides.

As shown in Figure 10, inadequate nutrition was a major challenge affecting donkey welfare before the landslides. More than half of the respondents (52%) reported that their donkeys lacked access to adequate

nutrition, while 31% were uncertain about feed availability. Only 17% indicated that their donkeys had access to sufficient and nutritious feed, which was primarily obtained from natural grazing areas and tree fodder. These findings highlight significant gaps in donkey feeding practices and underscore the need for improved awareness, training, and support to enhance donkey nutrition, welfare, and productivity.

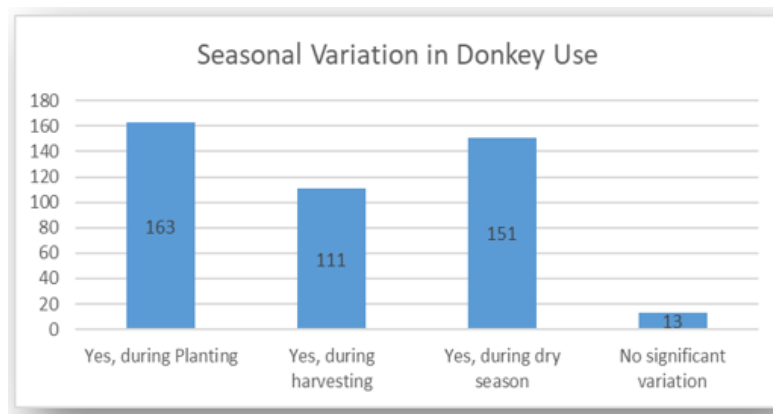


Figure 11: Seasonal Variation in Donkey Use During Agricultural Activities

Figure 11 presents the variation in donkey use during planting, harvesting, and dry seasons.

As shown in Figure 11, donkey use varied across agricultural seasons, with the highest use reported during the planting season (163 responses), followed by the dry season (151 responses) and the harvesting season (111 responses). These findings demonstrate the critical role of donkeys in supporting agricultural production, transportation, and other livelihood activities, particularly during periods of high labour demand. Only 13 respondents reported no seasonal variation in donkey use, highlighting the close link between donkey utilization and agricultural cycles.

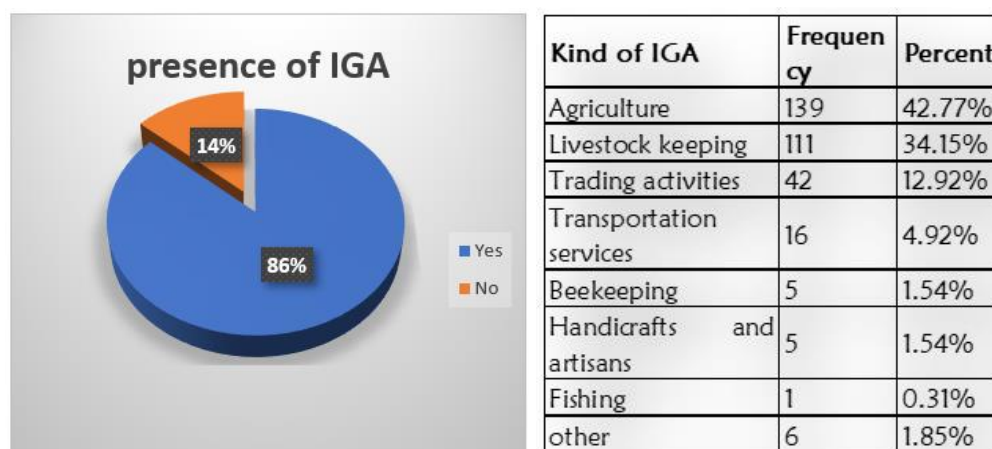


Figure 12: Livelihood Areas Supported by Donkey-Related Income

Figure 12 presents the main livelihood areas supported by income generated from donkey-related activities.

As shown in Figure 12, donkeys made a substantial contribution to household livelihoods, with 86% of respondents using them for income-generating activities that supported food security, education, healthcare, and housing, while 14% did not. Donkey-related income was primarily derived from agriculture (42.8%) and livestock keeping (34.2%), followed by trading (12.9%), transportation (4.9%), and smaller contributions from beekeeping and handicrafts and artisans (1.5% each). These findings highlight the diverse economic role of donkeys in supporting household income, livelihood diversification, and rural resilience.

<i>On average, how much would you earn per day from each donkey you had/have?</i>	<i>Tshs</i>
Mean	16000
Range	70000
Minimum	0
Maximum	70000

Figure 13: Donkey Contribution to Daily Household Income

Figure 13 presents the contribution of donkeys to daily household income in the study area.

As shown in Figure 13, each donkey generated an average daily income of Tshs 16,000, with earnings ranging from Tshs 0 to Tshs 70,000. The variation reflects differences in the type and intensity of donkey use, as well as access to markets and livelihood opportunities.

Overall, the findings show that donkeys are important income-generating assets that contribute to household livelihoods and support the economic resilience of rural communities.

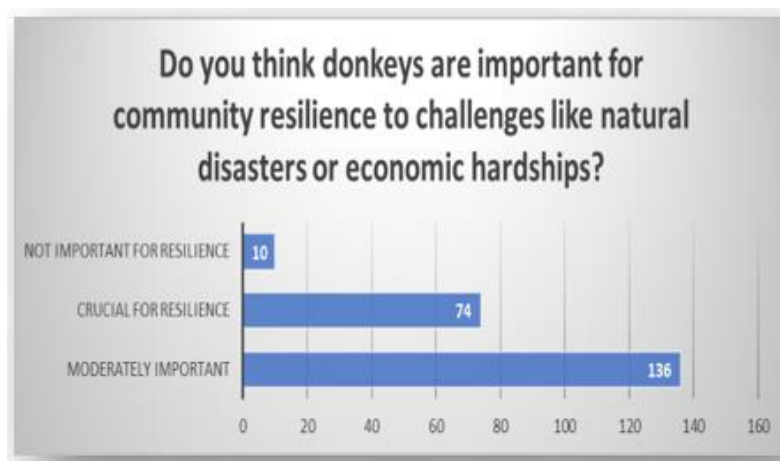


Figure 14: Perceptions of the Importance of Donkeys During Disasters and Economic Hardship

Figure 14 presents respondents' perceptions of the importance of donkeys in enhancing community resilience during disasters and periods of economic hardship.

As shown in Figure 14, most respondents recognized donkeys as important for strengthening household and community resilience. Donkeys were considered highly important by 74 respondents and moderately important by 136 respondents, while only 10 respondents considered them unimportant. These findings highlight the vital role of donkeys in supporting livelihoods, income generation, and households' ability to cope with and recover from socio-economic and environmental shocks.

3.2 Inferential Statistical Analysis Results

Inferential statistical analysis was conducted to assess the relationships between socio-economic characteristics and donkey ownership, examine changes in donkey ownership before and after the landslide event, and identify factors influencing household income recovery. The analysis employed descriptive statistics, Pearson's Chi-square test, paired-sample t-test, and binary logistic regression.

3.2.1 Socio-Demographic Characteristics of Respondents

Table 3.2.1.1: Distribution of Respondents by Gender

Gender of respondent	Freq.	Percent	Cum.
Female	83	37.22	37.22
Male	140	62.78	100.00
Total	223	100.00	

Table 3.2.1.1 shows that most respondents were male (62.78%), while females accounted for 37.22%. This indicates a higher representation of men among surveyed households. The pattern may reflect gendered roles in livestock ownership and household decision-making in the study area, where men are more often the primary owners and managers of productive assets.

Table 3.2.1.2 Distribution of Respondents by Household Type by Household Type

Type of household	Freq.	Percent	Cum.
FHH	55	24.66	24.66
MHH	168	75.34	100.00
Total	223	100.00	

The results presented in Table 3.2.1.2 indicate that 75.34% of the surveyed households were male-headed, whereas 24.66% were female-headed. This distribution shows that male-headed

households constituted the majority of households in the study area.

3.2.2 Descriptive Statistics of Continuous Variables

Table 3.2.2.1 Summary Statistics of Continuous Variables

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
hh size	223	6.987	2.964	1	23	2	16	1.094	6.528
donkeys owned pre	164	2.445	2.553	0	20	0	12	2.732	16.539
donkeys owned post	164	2.073	2.1	0	12	0	10	1.589	6.624

Table 3.2.2.1 shows that the average household size was 6.99 members. Households owned a mean of 2.45 donkeys before the landslide, compared with 2.07 donkeys after the event. These findings indicate a decline in donkey ownership following the landslides.

3.2.3 Association Between Household Type and Donkey Ownership

Table 3.2.3.1 Relationship Between Household Type and Donkey Ownership.

Type of household (Numeric)	Has Donkeys (Binary)		
	0	1	Total
FHH	10	31	41
MHH	27	96	123
Total	37	127	164

Pearson Chi2 = 0.10 Prob = 0.7463

A Pearson Chi-square test was conducted to examine the association between household type and donkey ownership (Table 3.2.3.1). The results indicated that there was no statistically significant relationship between household type and donkey ownership ($\chi^2 = 0.10$, $p = 0.7463$). Since the p-value exceeded the conventional significance level of 0.05, the null hypothesis was not rejected. This finding suggests that donkey ownership did not differ significantly between male-headed and female-headed households within the study area.

3.2.4 Effect of Landslides on Donkey Ownership

Table 3.2.4.1: Paired Sample t-Test for Donkey Ownership Before and After Landslides

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf. interval]	
donkey~e	164	2.445122	.1993655	2.553124	2.05145	2.838794
donkey~t	164	2.073171	.1640157	2.100426	1.749301	2.39704
diff	164	.3719512	.1397812	1.790073	.0959358	.6479667

mean(diff) = mean (donkeys_owned_~e - donkeys_owned_~t) t = 2.6610

H0: mean(diff) = 0 Degrees of freedom = 163

Ha: mean(diff) < 0 Ha: mean(diff) ≠ 0 Ha: mean(diff) > 0

Pr (T < t) = 0.9957 Pr (T > t) = 0.0086 Pr (T > t) = 0.0043

A paired-samples t-test was conducted to determine whether the number of donkeys owned by households changed significantly following the landslide event (Table 3.2.4.1). The results revealed a statistically significant decline in donkey ownership after the landslide ($t = 2.661$, $p = 0.0086$). Since the p-value was less than the 0.05 significance level, the null hypothesis was rejected. This finding indicates that the landslides had a significant negative effect on household donkey ownership, resulting in a reduction in the number of donkeys owned by affected households.

3.2.5 Factors Influencing Household Income Recovery

Table 3.2.5.1 Binary Logistic Regression Results

Logistic regression

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
income_post_num							
Gender of resp~i	1	.	.	.	.	.	
Male	1.254	.893	0.32	.751	.311	5.061	
Type of househ~	1	.	.	.	.	.	
MHH	2.218	1.707	1.04	.301	.491	10.022	
hh_size	.815	.076	-2.20	.028	.679	.978	**
Ward names	1	.	.	.	.	.	
Gendabi	.089	.099	-2.18	.029	.01	.785	**
Jorodom	.314	.367	-0.99	.321	.032	3.097	
donkey_pre_bin	1.396	1.017	0.46	.647	.335	5.821	
Constant	75.976	101.841	3.23	.001	5.492	1051.115	***

Mean dependent var	0.884	SD dependent var	0.321
Pseudo r-squared	0.129	Number of obs	164
Chi-square	15.189	Prob > chi2	0.019
Akaike crit. (AIC)	116.426	Bayesian crit. (BIC)	138.125
*** $p < .01$, ** $p < .05$, * $p < .1$			

Binary logistic regression results showed that the overall model was statistically significant ($\chi^2 = 15.189$, $p = 0.019$), explaining 12.9% of the variation in household income recovery.

Household size was a significant predictor (OR = 0.815, $p = 0.028$), indicating that larger households were less likely to recover their income after the landslide. Residence in Gendabi Ward was also significantly associated with lower odds of income recovery (OR = 0.089, $p = 0.029$), compared to the reference category.

In contrast, gender, household type, pre-landslide donkey ownership, and residence in Jorodom Ward were not statistically significant predictors ($p > 0.05$). Overall, income recovery was mainly influenced by household size and geographic location. Additionally, the landslides significantly reduced donkey ownership across households.

4. COMMUNITY RESPONSE AND RECOVERY STRATEGIES

Respondents proposed several immediate and long-term interventions to support recovery which included Immediate Interventions, Veterinary treatment services, Emergency animal feeds and supplements, Temporary shelters for animals and Access to clean water.

4.1. Short-Term Strategies

This includes livelihood support programs, sustainable grazing management, donkey welfare awareness campaigns, replacement of lost donkeys.

4.2. Long-Term Strategies

This includes community-led donkey welfare programs, alternative income-generating projects, environmental conservation initiatives, Education and literacy programs.

5. DISCUSSION

This study provides empirical evidence on the socio-economic and economic impacts of the December 2023 landslides on donkey-dependent livelihoods in Hanang District, Tanzania. Findings drawn from Figures 1–14 and Tables 3.2.1.1-3.2.1.2, 3.2.2.1, 3.2.3.1, 3.2.4.1 and 3.2.5.1 demonstrate that donkeys are essential livelihood assets supporting transportation, agricultural production, income generation, and household resilience. However, the results also reveal significant vulnerability of both donkeys and their owners to climate-related disasters and pre-existing welfare constraints.

5.1 Socio-Demographic Context and Livelihood Dependence

The socio-demographic characteristics of respondents (Table 3.2.1.1; Figures 1–3) indicate that 62.8% were male and 37.2% were female (Figure 1), reflecting gendered patterns in livestock ownership and household decision-making. Household headship was predominantly male (75.34%), while female-headed households accounted for 24.66% (Table 4.2).

The age distribution (Figure 2) shows that half of the respondents (50%) were aged 36-50 years, while 33% were above 50 years, indicating that donkey-dependent livelihoods are mainly managed by economically active adults. Educational attainment was generally low (Figure 3), with 68% having primary education, 16.4% no formal education, and only 12% secondary education. This limited education may constrain the adoption of improved livestock management practices, animal welfare innovations, and disaster preparedness strategies.

Livelihood analysis (Figure 4) further shows that agriculture (34.78%), small-scale trade (26.87%), and livestock keeping (25.64%) dominate household income sources. These activities are highly dependent on natural resources and therefore highly vulnerable to climate-related shocks.

5.2 Donkey Ownership and Economic Functions in Livelihood Systems

Donkey ownership was widespread prior to the disaster, with 61% of households reporting ownership or use (Figure 5). Descriptive statistics (Table 3.2.2.1) indicate that mean donkey ownership declined from 2.45 to 2.07 per household after the landslides, confirming asset loss at the household level.

Donkeys performed multiple economic roles, including transportation of agricultural inputs and outputs, water collection, and market access facilitation. Figure 12 shows that 86% of households used donkeys for income-generating activities, particularly in agriculture (42.77%), livestock keeping (34.15%), and trade (12.92%). Figure 13 further reveals that each donkey generated an average daily income of approximately TZS 16,000, highlighting their substantial contribution to household economies. These findings confirm that donkeys are productive economic assets rather than passive livestock, contributing directly to income generation and household welfare.

5.3 Impacts of Landslides on Donkey Populations and Economic Assets

Although Figure 6 shows that only 9% of households reported direct donkey losses, Table 3.2.4.1 confirms a statistically significant decline in donkey ownership after the landslides ($t = 2.661$, $p = 0.0086$). This suggests broader population-level impacts beyond reported losses. Figure 8 identifies burial under landslide debris (36.51%), separation from owners (23.81%), and physical injuries (9.52%) as the main causes of donkey loss. Additional causes included drowning and lack of rescue resources. These findings demonstrate that donkeys were directly exposed to disaster

risks and largely excluded from formal emergency response systems. From an economic perspective, these losses represent a reduction in productive capital stock. Given the income-generating role of donkeys (Figure 13), even small reductions in herd size translate into cumulative income losses, reduced transport capacity, and lower agricultural productivity.

5.4 Donkey Welfare Conditions and Productivity Constraints

Pre-disaster welfare conditions were generally poor. Figure 9 shows that 62% of respondents did not use welfare-friendly harnesses, while only 10.67% used improved equipment. Similarly, Figure 10 indicates that 52% of households lacked adequate access to proper donkey nutrition.

These welfare deficits likely reduced donkey productivity and resilience even before the disaster. Poor nutrition and improper harnessing reduce working capacity, increase fatigue, and shorten productive lifespan, thereby lowering household economic returns. This highlights that animal welfare is closely linked to both productivity and livelihood outcomes.

5.5 Seasonal Utilization and Economic Functionality

Seasonal utilization patterns (Figure 11) show that donkey use was highest during the planting season (163 respondents) and dry season (151 respondents), followed by the harvesting season (111 respondents). This reflects their critical role in agricultural production cycles, particularly in transporting inputs, water, and goods during peak labor-demand periods.

This seasonal dependency highlights donkeys as essential labor-support assets that enhance agricultural efficiency and household productivity throughout the year.

5.6 Donkeys and Household Resilience

Figure 14 shows that 74 respondents considered donkeys highly important for resilience, 136 moderately important, and 10 not important, indicating strong community recognition of their role in coping with environmental and economic shocks. From a resilience perspective, donkeys function as income-smoothing assets, transport enablers, and productive buffers that households rely on during crises. Their contribution therefore extends beyond income generation to broader livelihood stability and adaptive capacity.

5.7 Determinants of Post-Disaster Recovery

Inferential analysis (Table 3.2.5.1) shows that the logistic regression model was statistically significant ($\chi^2 = 15.189$, $p = 0.019$). Household size ($OR = 0.815$, $p = 0.028$) and residence in Gendabi Ward ($OR = 0.089$, $p = 0.029$) significantly influenced income recovery.

Larger households were less likely to recover income due to higher dependency burdens, while households in Gendabi experienced lower recovery outcomes due to spatial disparities in disaster

severity and access to resources. In contrast, pre-disaster donkey ownership was not statistically significant, suggesting that recovery depends on multiple socio-economic and contextual factors rather than a single asset base.

5.8 Integrated Economic Impact Interpretation

Overall, the evidence presented in Figures 1-14 and Tables 3.2.1.1-3.2.1.2, 3.2.2.1, 3.2.3.1, 3.2.4.1, and 3.2.5.1 demonstrates that the December 2023 landslides caused a multidimensional economic shock, reflected in reduced livestock assets (Tables 3.2.1.1-3.2.5.1), disruption of income-generating activities (Figures 12 and 13), direct donkey losses through burial, injury, and separation (Figure 8), reduced agricultural and transport productivity (Figures 11 and 12), and unequal household income recovery (Table 3.2.5.1). Although pre-disaster donkey ownership was not a significant predictor of income recovery, the loss of donkeys as productive assets increased household vulnerability and weakened livelihood resilience.

5.9 Policy Implications

This study highlights donkeys as essential economic assets in Hanang' District, contributing to household income, agricultural productivity, and overall resilience. The December 2023 landslides reduced donkey ownership and exposed underlying welfare and structural vulnerabilities. These findings underscore the need to integrate working equids into disaster risk reduction and rural development frameworks to strengthen rural resilience.

6. CONCLUSION

This study demonstrates that donkeys are indispensable economic assets in Hanang' District, contributing significantly to household income, agricultural productivity, and resilience. The December 2023 landslides resulted in measurable reductions in donkey ownership and exposed underlying welfare and structural vulnerabilities. Strengthening the integration of working equids into disaster risk reduction and rural development frameworks is essential for enhancing rural economic resilience.

7. RECOMMENDATIONS

7.1 Policy Recommendations, this includes integrating donkey welfare into national and district disaster management frameworks, strengthening veterinary service delivery in rural and disaster-prone communities, developing policies supporting working equids during emergencies and promoting climate-resilient agricultural and livestock systems.

7.2 Community-Level Recommendations, this includes to conduct training on donkey welfare and disaster preparedness, Promoting improved harnessing systems and feeding practices,

establishing community-based livestock emergency response groups and Encourage savings groups and alternative livelihood programs.

7.3 Research Recommendations, we recommend future longitudinal studies to assess the long-term impacts of climate-related disasters on working equids and to evaluate the effectiveness of community-based resilience and recovery interventions.

7.4 Funding Statement and Declaration of Conflict of Interest.

This study was supported by Brooke East Africa in collaboration with INADES-Formation Tanzania, both of which work to promote donkey welfare, improve livestock-based livelihoods, and strengthen community resilience to socio-economic and environmental challenges. The authors declare that there are no conflicts of interest associated with this study.

7.5 Acknowledgements and Study Limitations.

The authors gratefully acknowledge the invaluable support and cooperation of local authorities, livestock officers, enumerators, and community members in Hanang' District, whose participation was essential to the successful completion of this study. This study has several limitations. First, its cross-sectional design captured conditions at a single point in time and therefore could not assess long-term socio-economic impacts or recovery trajectories following the landslides. Future longitudinal studies are recommended to better understand recovery dynamics and the sustained impacts on donkey-dependent livelihoods. Second, the use of purposive sampling may limit the generalizability of the findings. However, this approach was appropriate for identifying households directly affected by the landslides and dependent on donkeys for their livelihoods, ensuring the collection of relevant, context-specific data.

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