



Research Article

Impacts of Livestock Improvement Projects on the Subjective Well-Being of Agro-Pastoral Households in Kenya's Lower Eastern Arid and Semi-Arid Lands

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Abstract

Livestock production remains the primary source of livelihood in the arid and semi-arid lands (ASALs) of Kenya's lower eastern region. Despite sustained investments by governments and non-governmental organizations, the economic returns from livestock development projects have remained modest, and poverty levels persist. This study evaluated the impact of a Livestock Improvement Project (LIP) on the subjective wellbeing of agro-pastoral households in Mwala Sub-County, Machakos County. Specifically, the study assessed household subjective wellbeing and examined its contributions to livestock performance, access to agricultural credit, capacity building in livestock management, and participation in collective action. A cross-sectional study was conducted to collect household information using a structured questionnaire. A sample of 285 households was selected through stratified random sampling from 1,100 project beneficiaries organized into 45 farmer groups. Data were collected using a structured questionnaire and analyzed using descriptive and inferential statistics at a 95% confidence level ($p \leq 0.05$). Household subjective wellbeing was relatively high ($M = 7.3$, $SD = 1.2$) on a 10-point scale (1=low and 10 high). Regression results indicated that subjective wellbeing was positively and significantly influenced by livestock performance ($\beta = 0.944$, $p < 0.001$), access to agricultural credit ($\beta = 0.748$, $p < 0.001$), capacity building ($\beta = 0.878$, $p < 0.001$), and participation in collective action ($\beta = 0.834$, $p < 0.001$). The study concludes that the LIP had a positive impact on household wellbeing and recommends that future livestock interventions in ASALs integrate capacity building, access to credit, and collective action to enhance sustainable livelihood outcomes. The study contributes to livestock development literature by applying the subjective wellbeing perspective to project impact evaluation.

Keywords

Livestock Performance, Agricultural Credit, Capacity Building, Collective Action, Sustainable Rural Livelihoods, Kenya

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1. Introduction

Arid and semi-arid lands (ASALs) constitute approximately 89% of Kenya's total land area and are characterized by low and highly variable rainfall, high evapotranspiration, and recurrent droughts. Arid zones typically receive 150-550 mm of annual rainfall, while semi-arid zones receive 550-850 mm, with a moisture index below 50% [1]. Rainfall variability in these regions is pronounced and increasingly influenced by climate change, resulting in frequent droughts that undermine natural resource availability and agricultural productivity [2-7]. Kenya recently experienced a prolonged and severe drought between 2014 and 2022, with substantial impacts on livelihoods, food security, and livestock systems [8-10].

Despite these constraints, ASALs support approximately 36% of Kenya's population and host nearly 70% of the national livestock herd [11]. Livestock production remains the dominant livelihood strategy in these regions, particularly within mixed crop-livestock (agro-pastoral) systems practiced by the majority of rural households, including those in Machakos County [9, 12]. Pastoral and agro-pastoral systems are widely recognized as ecologically adaptive and socio-culturally embedded livelihood strategies capable of sustaining wellbeing in dryland environments [13, 14].

However, livestock production in Kenya's ASALs continues to face persistent social, economic, and environmental challenges, including limited access to improved genetics, inadequate feeds and nutrition, high disease burden, weak market linkages, financial exclusion, human-wildlife conflict, and increasing climate variability [11, 15]. In response, government agencies and development partners have implemented livestock improvement projects aimed at enhancing productivity, strengthening resilience, and reducing rural poverty [16, 17]. Despite sustained investments, evidence suggests that improvements in livestock performance and household welfare have remained uneven, raising questions about the effectiveness and sustainability of these interventions.

Existing evaluations of livestock development projects have largely emphasized economic and production-based outcomes, with limited attention to broader social impacts. In particular, subjective wellbeing, an increasingly important indicator within sustainability science, has rarely been applied to assess livestock project outcomes in ASAL contexts [15]. This study addresses this gap by examining the impact of a Livestock Improvement Project on the subjective wellbeing of agro-pastoral households in the semi-arid areas of Mwala Sub-County, Machakos County. Specifically, the study quantifies the contributions of livestock performance, access to agricultural credit, capacity building, and participation in collective action to household subjective wellbeing, thereby offering a more holistic assessment of livestock development interventions in dryland systems.

2. Literature Review

2.1. Subjective Wellbeing of the Households in a Livestock Improvement Project

Wellbeing is widely recognized as a multidimensional concept that can be measured both subjectively and objectively. Subjective wellbeing refers to individuals' self-reported perceptions of their quality of life, encompassing feelings of satisfaction, happiness, and psychological functioning [18]. The OECD's multidimensional framework identifies eleven domains of wellbeing, including income and wealth, housing, health, knowledge and skills, environmental quality, safety, social connections, civic engagement, work-life balance, and subjective wellness. These dimensions provide a comprehensive lens through which household wellbeing can be assessed [19].

Subjective wellbeing is typically measured using self-report instruments, such as satisfaction scales ranging from 0 ("not at all satisfied") to 10 ("completely satisfied"), which capture individuals' evaluations of their lives [20]. While subjective measures lack external reference points, they are valuable for capturing personal experiences and inequalities across groups.

The concept of subjective wellbeing has been applied both as a predictor of outcomes and as an outcome in its own right. Stone and Krueger [21], highlight its use in diverse contexts, including gender differences, the impact of public spaces, effects of industrial closures, natural disasters, and workplace conditions. More recently, subjective wellbeing has been integrated into sustainability and policy evaluations, enabling policymakers to better understand how interventions affect people's lives [22].

In Kenya, subjective wellbeing has been used to evaluate social protection programs. For instance, unconditional cash transfer schemes demonstrated positive impacts on household satisfaction and resilience [23]. Similarly, livestock diversification strategies have been shown to improve resilience and wellbeing outcomes under climate risks, underscoring the importance of integrating subjective wellbeing into agricultural development assessments [24] (Ngigi et al., 2021). Beyond Africa, Gao et al. [25] examined the socio-economic and wellbeing impacts of coal power phaseout in China, illustrating how subjective wellbeing can capture the broader consequences of environmental and economic transitions [26].

Overall, subjective wellbeing provides a critical dimension for evaluating livestock improvement projects. By incorporating self-reported measures of satisfaction and life quality, researchers and policymakers can better assess the holistic impacts of interventions on household welfare, resilience, and sustainability.

2.2. Farmer Participation in Collective Action Initiatives Related to Livestock Improvement

Collective action has long been recognized as a critical in-

stitutional mechanism for coordinating individual efforts toward shared goals. Collective Action has been defined as an “action taken by a group (either directly or on its behalf through an organisation) in pursuit of members’ perceived shared interests” [27]. Contemporary definitions emphasize that collective action involves group-based decisions and activities undertaken to advance members’ common interests, often through formal or informal organizations [28]. Within agricultural systems, collective action initiatives (CAIs) are particularly important for smallholder households, as they enable resource pooling, knowledge sharing, and joint problem-solving to enhance social and economic wellbeing [29, 30].

Mainindi et al. [31] while working with households in Muranga county in Kenya identified two typologies of collective action initiatives namely, efficiency and livelihood that were highly distinct in their level of formalization, membership composition, nature and scope of coordination, level of social capital, level of social networking and internal governance mechanisms.

Collective Action Initiatives have been shown to enhance access to communal grazing resources and an improvement to the condition of the land and the grazing resources. Gebremedhin et al. [32] concluded that collective action was found to be effective in managing communal grazing lands in crop-livestock mixed systems in northern Ethiopia. These communal grazing lands are important livestock feed resources, but end up being degraded due to lack of management. CA in the form of restricted grazing of the lands using restrictions and regulations was found to contribute to more sustainable use of the resources and alleviation of feed shortage, when compared to privatisation or government instituted control of the communal grazing area. Call and Jagger [33] working in communal grazing lands in Uganda realized that collective action enhanced strong social bonds among the livestock keepers, success in access to the grazing resources and an improvement in the land condition.

Recent studies highlight the diverse benefits of collective action in livestock systems. Participation in farmer groups and cooperatives has been shown to improve access to markets, credit, and extension services, thereby enhancing productivity and resilience [34] and technical efficiency [35]. In Kenya, collective engagement in livestock-related activities such as milk marketing, breeding, and water resource management has strengthened household economic performance and livelihood security [35]. Beyond economic outcomes, collective action fosters social capital, trust, and community cohesion, which are strongly associated with higher subjective wellbeing [36].

Farmer participation levels significantly influence the magnitude of benefits derived from collective action. Higher engagement is linked to improved group performance, greater individual returns, and enhanced adaptive capacity to climate variability [37]. Self-help groups and cooperatives also serve as platforms for empowerment, particularly among women and marginalized households, by expanding opportunities for

entrepreneurship and social inclusion [38].

Collective action further contributes to sustainable resource management. Evidence from pastoral communities in Ethiopia demonstrates that collective governance of grazing lands improves livestock productivity, reduces degradation, and enhances household wellbeing [39]. Similarly, farmer organizations across sub-Saharan Africa have been instrumental in promoting climate adaptation strategies and improving marketing performance through collective bulking and stronger external linkages [40].

Overall, the literature underscores that collective action initiatives are vital for livestock improvement projects. By integrating economic, social, and environmental dimensions, CAIs enhance household resilience, productivity, and subjective wellbeing, making them indispensable for sustainable livestock development in agro-pastoral systems.

2.3. Agency Contribution to the Performance of Livestock Projects in Machakos County Kenya

Livestock development in Machakos County has benefited from the strategic involvement of both governmental and non-governmental agencies, whose contributions span financial investment, technical assistance, capacity building, and policy support. These agencies have played a pivotal role in enhancing livestock productivity, market access, and household resilience in semi-arid regions.

International organizations such as the International Livestock Research Institute (ILRI), the Food and Agriculture Organization (FAO), the United States Agency for International Development (USAID), and the International Fund for Agricultural Development (IFAD) have supported livestock initiatives in Kenya through research, innovation platforms, and farmer training programs [41, 42]. ILRI’s work in Kenya includes projects such as MoreMilk and MaziwaPlus, which aim to improve dairy productivity and antibiotic stewardship among smallholder farmers [43]. FAO has promoted Farmer Field Schools (FFS) as a participatory training approach to build farmer capacity in livestock management, with recent guidelines tailored for East Africa [44].

In Machakos County, USAID’s Kenya Semi-Arid Livestock Enhancement Support (K-SALES) project, implemented by Land O’Lakes, focused on improving livestock competitiveness, productivity, and market integration. The project supported farmer training, input access, and value chain development, with documented improvements in livestock health and household income [45, 46].

The Swedish International Development Cooperation Agency (SIDA) has contributed through its support of the Agricultural Sector Development Support Programme (ASDSP II), which aims to commercialize agriculture and strengthen value chains at the county level. ASDSP II has been implemented in collaboration with Kenya’s Ministry of Agriculture and all 47 county governments, including Machakos, with a

focus on livestock, dairy, and poultry value chains [47, 48].

Governmental agencies, particularly the State Department for Livestock Development, have provided strategic direction through national policies and research agendas. The Kenya National Livestock Research Agenda (2025-2035) outlines priorities for improving animal health, genetics, and market systems, emphasizing the role of livestock in food security and economic growth [49].

Despite these contributions, challenges remain. Coordination gaps, limited access to finance, and weak monitoring systems continue to hinder project performance. Strengthening multi-agency collaboration, enhancing participatory planning, and investing in localized capacity building are essential for improving the effectiveness and sustainability of livestock development interventions in Machakos County.

2.4. Conceptual Framework

Conceptual framework is a graphical representation of the direct contribution of the independent variable to the dependent variable. The dependent variable for this study was subjective wellbeing of the households participating in livestock improvement project. Four independent variables related to livestock improvement were used, they included: (i) performance of livestock production, (ii) access to agricultural credit, (iii) farmers' capacity building, (iv) farmers participation in collective action. The direct relationship between the independent variables and dependent variable can be affected by moderating variables, these are factors not included in this relationship but can influence the relationship, these include government policies, climatic factors among others. The variables and their hypothesized relationships are described in Figure 1.

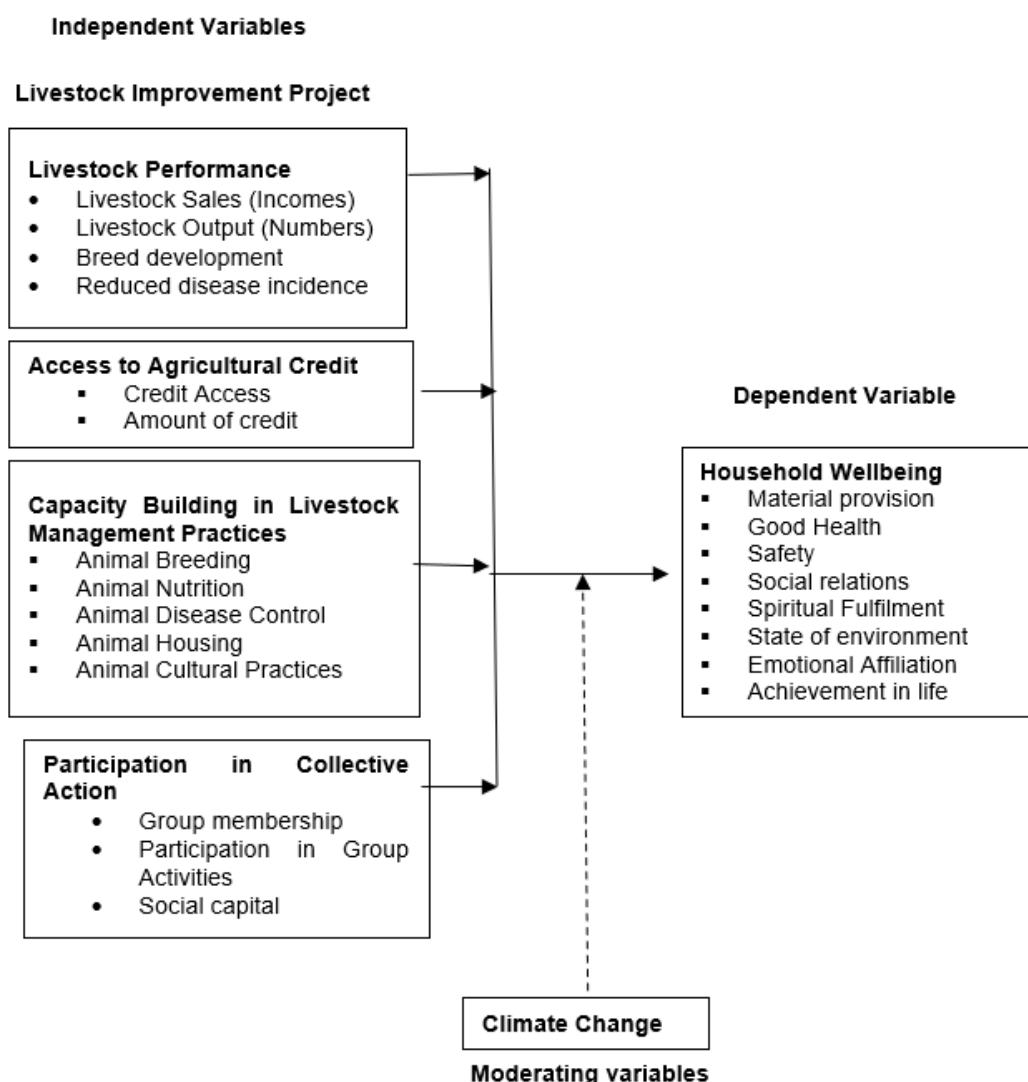


Figure 1. Conceptual framework for analysing the contribution of livestock improvement project on the wellbeing of the households in Machakos County.

3. Materials and Methods

3.1. Research Design

This study employed a descriptive research design, which is appropriate for systematically describing population characteristics and examining relationships among variables without experimental manipulation [50]. The design facilitated the assessment of livestock-related interventions within agro-pastoral

households participating in a livestock improvement project.

3.2. Study Area

The study was conducted in Mwala Sub-county (Figure 2), one of the eight sub-counties of Machakos County in Kenya's lower eastern region [52]. The area has experienced rapid population growth, resulting in declining average farm sizes. Small-scale farms average approximately 0.756 ha, while large-scale farms average about 10 ha [16].

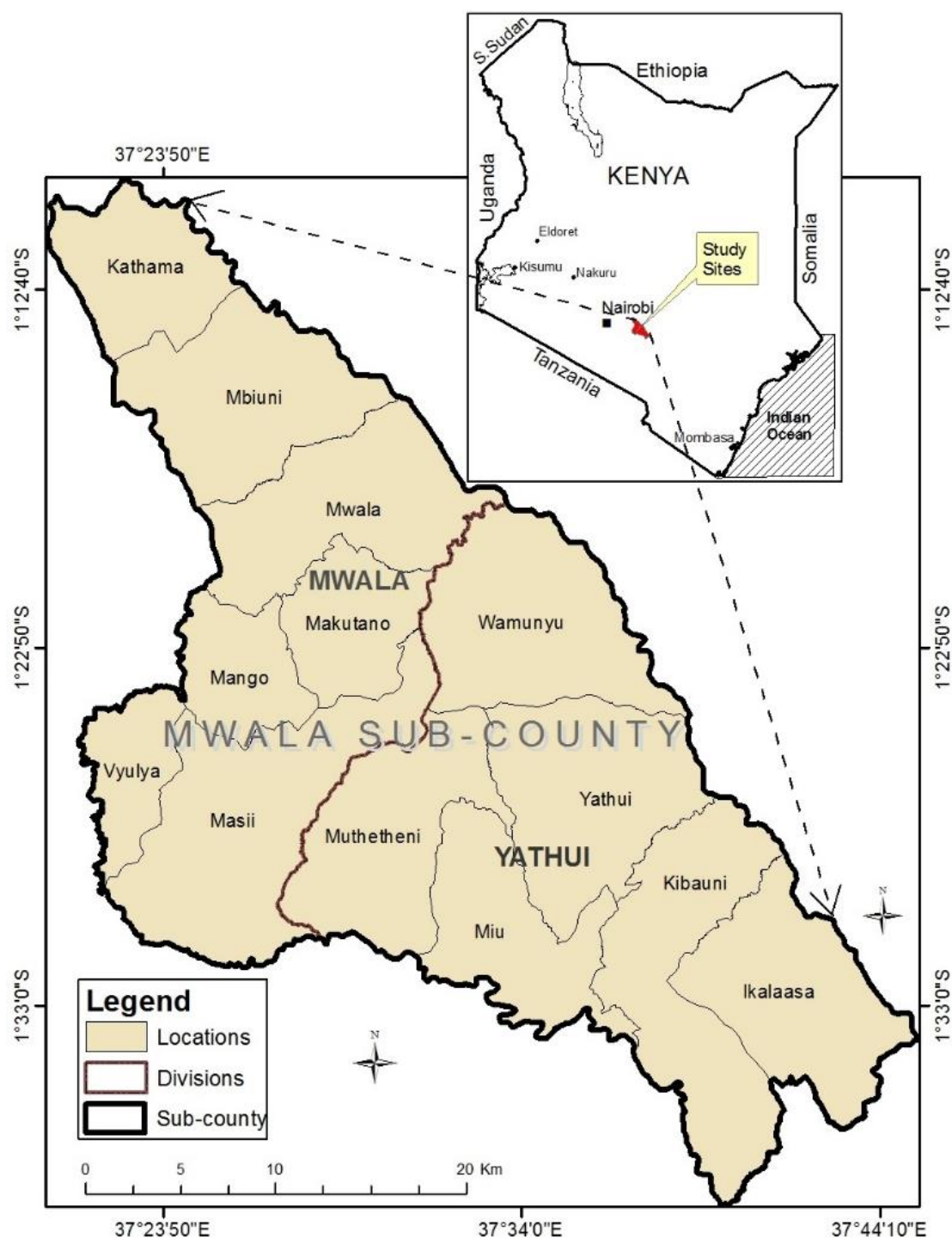


Figure 2. Map of Mwala Sub-County Showing the Study Area and Sub-divisions.

Mwala Sub-county is characterized by a semi-arid climate, with temperatures ranging from 18 °C to 29 °C and a bimodal rainfall regime. Annual rainfall varies between 500 mm and 1,250 mm, with long rains occurring from March to May and short rains from October to December [52]. The dry season extends from June to September, with June being the driest month. Approximately 84% of Machakos County falls within arid and semi-arid agro-ecological zones, making agricultural production highly vulnerable to climate variability [52-54, 63].

3.3. Agricultural Context

Agriculture is the primary economic activity in Machakos County, with livestock production constituting the dominant subsector [52]. The prevailing farming system is agro-pastoralism, which integrates crop cultivation with livestock rearing [12]. Crop and livestock production play a central role in household food security, employment creation, and socio-economic wellbeing in the region [55].

3.4. Target Population and Sampling Frame

The target population comprised agro-pastoral households located in the arid and semi-arid areas of Mwala Sub-County that engage in small-scale livestock farming alongside crop production. According to the 2019 national census, the sub-county had approximately 163,000 residents living in 35,503 households [54].

The sampling frame consisted of 1,100 households that had benefited from a livestock improvement project and were registered members of 45 livestock farmer groups. Each group comprised approximately 24 farmers, all of whom identified livestock production as their primary enterprise.

3.5. Sample Size and Sampling Procedure

The required sample size was determined using the formula proposed by Krejcie and Morgan [56] (1970) and cited by Gichohi and Kathuri [50] (2023). Based on the sampling frame of 1,100 households, a sample size of 285 respondents was obtained. The sample was proportionally allocated across the 45 farmer groups (strata), and respondents were selected using simple random sampling to ensure representativeness.

3.6. Data Collection and Analysis

Data were collected using a structured questionnaire administered to sampled households. The instrument captured quantitative information on household characteristics, livestock practices, and participation in the livestock improvement project.

3.6.1. Variable Development and Description

The variables were operationalized as multi-indicator indices. The indicators are shown in the conceptual framework

(Figure 2). The household heads rated the indicators on a 10-point scale, where 1 corresponded to the lowest rating and 10 to the highest rating. The scores for each indicator were summed up to create an index [57]. The constructed indices (interval data) were evaluated for their reliability and validity using the Cronbach's alpha [51]. The indices met their minimum threshold for reliability and validity as they exceeded the recommended threshold of ($\alpha = 0.7$), indicating a high level of internal consistency.

3.6.2. Descriptive and Inferential Analysis

Data analysis was conducted using descriptive and inferential statistical techniques in IBM SPSS (Version 26). The index descriptive analysis included: means, standard error of the mean, mode, median, standard deviation, mode, *t*-test, and chi-square. The inferential statistics used included: ANOVA, simple or bivariate linear regression was used to determine the existing relationships between the independent and dependent variables using the Beta statistics.

4. Results

4.1. Demographic Characteristics of the Households Participating in the Livestock Improvement Project

The demographic characteristics of the households participating in the Livestock Improvement Project in Mwala Sub-County are presented (Table 1).

The majority of household heads were male (89.1%) and married (84.9%), while 10.9% were widowed and 4.2% were single ($n = 285$). The mean age of participants was 45.2 years ($SD = 12.0$; range: 26-67), with most respondents aged 41-50 years (28.1%). Educational attainment was predominantly secondary (41.1%) or college level (29.1%), with fewer respondents reporting primary or university education. Household size ranged from two to nine members, with four-member households being most common (24.6%).

Table 1. Descriptive Statistics for the Demographic Characteristics of the Project Participants.

Demographic Characteristics	Frequency	Percent
Gender		
Male	254	89.1
Female	31	10.9
Marital Status		
Married	242	84.9
Widow	31	10.9

Demographic Characteristics	Frequency	Percent
Single	12	4.2
<i>Age Categories (yrs.)</i>		
20-30	43	15.1
31-40	66	23.2
41-50	80	28.1
51-60	55	19.3
Above 61	41	14.4
<i>Level of Formal Education</i>		
Primary 'Lower'	6	2.1
Primary 'Upper'	62	21.8
Secondary	117	41.1
College	83	29.1
University Degree	17	6.0
<i>Household Number</i>		
2.00	22	7.7
3.00	56	19.6
4.00	70	24.6
5.00	48	16.8
6.00	28	9.8
7.00	29	10.2
8.00	26	9.1
9.00	6	2.1

n=285

4.2. Size of Land Owned by Households

Land ownership among project households is summarized (Table 2).

Table 2. Size of Land Owned by the Households.

Size in Ha. (Acres)	Frequency	Percent
.404 (1.00)	68	23.9
.809 (2.00)	55	19.3
1.21 (3.00)	57	20.0
1.618 (4.00)	29	10.2
2.02 (5.00)	22	7.7
2.42 (6.00)	25	8.8
2.83 (7.00)	19	6.7

Size in Ha. (Acres)	Frequency	Percent
3.23 (8.00)	10	3.5
Total	285	100.0

Mean 1.33±04, Median 1.21, Mode .404, Std. Dev .829, Min .404, Max 3.23

Most households (63.2%) owned land below the mean, indicating generally small landholdings. The most common land size was 0.404 ha (23.9%), while only 3.5% owned 3.23 ha. These findings are consistent with county-level averages [62] (Machakos County Government, 2018).

4.3. Livestock Ownership Characteristics of Study Participants

Table 3 summarizes Livestock ownership patterns among households participating in the Livestock Improvement. Data on animal ownership were obtained through participant self-reports and cross-validated with project records.

Table 3. Descriptive Statistics for the Number of Animals Owned by Households Participating in the Livestock Improvement Project.

Numbers (Categories)	Frequency	Percent
<i>Poultry</i>		
1-10	27	9.5
11-20	73	25.6
21-30	69	24.2
31-40	45	15.8
41-50	30	10.5
51-60	26	9.1
Above 61	15	5.3
<i>Sheep</i>		
0	85	29.8
1-10	116	40.7
11-20	56	19.6
21-30	28	9.8
<i>Goats</i>		
1-10	85	29.8
11-20	101	35.4
21-30	68	23.9
41-50	31	10.9
<i>Cattle</i>		

Numbers (Categories)	Frequency	Percent
1-10	231	81.1
11-20	28	9.8
21-30	26	9.1

n=285

Poultry and small ruminants constituted the dominant livestock assets among participating households, while cattle ownership was comparatively limited in both prevalence and herd size, underscoring the importance of small livestock in household livelihood strategies.

Poultry ownership was widespread, with most households keeping 11-30 birds (49.8%). Mean flock size was 33 birds (SE = 1.2; SD = 20), with sizes ranging from 10 to 100. Sheep ownership was limited, with 29.8% of the households owning none and most owners keeping 1-10 sheep. The mean sheep flock size was 6.9 (SE = 0.42; SD = 7). Goat ownership was more common, with most households owning 11-30 goats; the

mean herd size was 18.3 (SE = 0.66; SD = 11). Cattle ownership was generally low, with 81.1% of the households owning between 1-10 animals and a mean herd size of 8.3 (SE = 0.43; SD = 7.4).

4.4. Subjective Wellbeing of the Households Participating in the Livestock Improvement Project

Subjective wellbeing was the primary outcome variable and was assessed among households participating in the Livestock Improvement Project (LIP) in Mwala Sub-County, Machakos County. Wellbeing was measured using a composite index constructed from self-reported assessments of perceived project-related benefits.

Household heads rated each of the 30 indicators on an 11-point scale (0-10), where higher scores indicated greater perceived assistance attributable to the LIP. Indicator scores were summed to generate a household-level subjective wellbeing index. Descriptive statistics for the domains are reported (Table 4).

Table 4. Descriptive Statistics for the Domains of the Subjective Wellbeing Index of the Households Participating in Livestock Improvement Project.

Domains	Mean	SD	Minimum	Maximum
Standard of Living	7.62	.118	1.0	10
Access to Good Health	7.07	.186	1.50	10
Safety of the Households	7.34	.209	1.00	10
Social relations	7.98	.217	1.00	10
Spiritual Affiliations	6.15	.830	1.00	10
Environment	6.88	.371	4.75	10
Emotions and affiliations	7.93	.581	5.80	10
Life Achievements	6.25	.988	4.18	10
Subjective Wellbeing	7.28	.120	3.78	9.69

Cronbach's alpha was ($\alpha=.899$).

The scores for the subjective wellbeing index ranged from 3.78 to 9.69, with a mean of 7.28 (SD = 1.20), a median of 7.25, and a mode of 9.06. Most households (84.9%) reported scores above 6.01, indicating generally high wellbeing. The

index was classified into five categories: *Very Low* (1-2), *Low* (2.01-4), *Medium* (4.01-6), *High* (6.01-8), and *Very High* (8.01-10) and a chi-square test for equality of categories was undertaken (Table 5).

Table 5. Chi-square Test for the Equality of the Categories for the Subjective Wellbeing Scale of the Households.

Categories	Levels	Observed N	Expected N	Residual
1-2	Very Low	-	-	-

$\chi^2=168.29$

Categories	Levels	Observed N	Expected N	Residual	
2.01-4	Low	1	71.3	-70.2	df=3
4.01-6	Medium	42	71.3	-29.2	p=.001
6.01-8	High	146	71.3	74.8	
8.01-10	Very High	96	71.3	24.8	
Total		285			

Mean 7.28 ± 0.07 , Median 7.25, Mode 9.06, Std. Dev 1.20, Min 3.78, Max 9.69

Chi-square analysis revealed significant differences among categories ($\chi^2 = 168.29$, $df = 3$, $p < 0.001$), with the High category (6.01-8) observed significantly more frequently than expected. These results suggest that the majority of participants perceived their household wellbeing to be predominantly within the high range.

Gender Differences in Subjective Wellbeing of the Participating Households

Subjective wellbeing scores were compared between male ($n = 254$) and female ($n = 31$) respondents. Mean wellbeing was 7.28 for males and 7.29 for females, with a mean difference of -0.007. An independent-samples t-test indicated that this difference was not statistically significant ($t = -0.029$, $df = 283$, $p = 0.977$), demonstrating that gender was not associated with variation in perceived household wellbeing among the project participants (Table 6).

Table 6. Mean Subjective Wellbeing for Male and Female Respondents.

Gender	n	Mean	Mean difference	t	df	p
Male	254	7.2866	-.00659	-.029	283	.977
Female	31	7.2932				

4.5. Contribution of Livestock Performance to the Subjective Wellbeing of Agro-pastoral Households

4.5.1. Livestock Performance Within the Livestock Improvement Project

Livestock performance, defined as project-related improvements in livestock value and productivity, was assessed using an eight-indicator composite index rated by household heads on a five-point scale (1 = very low, 5 = very high). Indicators included animal sales, herd size, herd loss reduction, breed improvement, milk production, multiple births, and herd quality (Table 7).

Table 7. Mean Scores for the Indicators of the Livestock Performance Index.

Livestock Performance Measure		Level of Measure	
		Mean	SD
1	level of increase in animal sales	2.29	1.00
2	level of increase in herd numbers	2.73	1.01
3	level of decrease in herd loss reduction	2.92	1.24
4	level of breed improvement (grade animal)	3.48	1.27
5	level of increase in milk production	3.51	1.07
6	level of increase in animal numbers	3.49	1.22

Livestock Performance Measure		Level of Measure	
		Mean	SD
7	level of increase in multiple births	2.46	1.06
8	Level of increase in herd quality	2.63	1.29
	Index of livestock performance measures	2.94	.822

Mean 2.94±06, Median 3, Mode 2, Std. Dev .822, Minimum 1 Maximum 5

The overall livestock performance index mean of 2.94 (SD = 0.82; Cronbach's α = 0.789).

4.5.2. Contribution of Livestock Performance to Household Subjective Wellbeing

The effect of livestock performance on household subjective wellbeing was examined using simple linear regression. Livestock performance was the independent variable, and subjective wellbeing was the dependent variable.

The results (Table 8) showed a significant positive relationship (β = 0.944, t = 48.03, p < 0.001), with the model explaining 89% of the variance in wellbeing (R^2 = 0.89; $F(1, 284)$ = 2306.8, p < 0.001). These findings indicate that higher livestock performance was strongly associated with increased subjective wellbeing among households participating in the Livestock Improvement Project, underscoring the contribution of livestock productivity improvements to household socioeconomic outcomes.

Table 8. Regression Coefficients for Livestock Performance and the Subjective Wellbeing of the Households.

	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
	<i>B</i>	Std. Error	Beta		
(Constant)	4.353	.066		66.437	.001
Performance measure	1.030	.021	.944	48.030	.001

($F(1, 284) = 2306.8$, $p < .001$).

R square 89%

4.6. Contribution of Access to Agricultural Credit to the Subjective Wellbeing of Agro-Pastoral Households

4.6.1. Access to Agricultural Credit by Households Participating in the Livestock Improvement Project

Access to agricultural credit, the independent variable in this study, was defined as the positive contribution of credit access to livestock production among households participating in the Livestock Improvement Project (LIP). The variable was operationalized as a composite index comprising six indicators (Table 9).

Table 9. Mean Scores for the Indicators of the Access to Agricultural Credit Index.

No	Access to Agricultural Credit	Assessed Level	
		Mean	SD
1	Amount of credit acquired from LIP (category)	3.31	.789
2	Enhanced purchase of breeding animals	2.63	1.30

No	Access to Agricultural Credit	Assessed Level	
		Mean	SD
3	Enhanced water development and access for animals	2.77	.666
4	Enhanced acquisition of animal inputs (feed, pasture)	2.54	.987
5	Enhanced disease control (vaccines, drugs)	3.12	1.22
6	Building for animal and hay barn	2.11	.890
	Index of Access to Agricultural Credit contribution	2.70	1.09

Mean 2.70 ± 0.06 , Median 3, Mode 2, Std. Dev. 1.09, Minimum 1, Maximum 5

4.6.2. Contribution of Access to Agricultural Credit to Household Subjective Wellbeing

The effect of access to agricultural credit on household subjective wellbeing was assessed using simple linear regression. Access to credit served as the independent variable, and subjective wellbeing as the dependent variable.

The results (Table 10) indicated a significant positive relationship ($\beta = 0.748$, $t = 18.94$, $p < 0.001$), with the model explaining 55.7% of the variance in wellbeing ($R^2 = 0.557$; $F(1, 284) = 358.5$, $p < 0.001$). These findings demonstrate that higher access to agricultural credit is positively associated with improved subjective wellbeing among agro-pastoral households participating in the Livestock Improvement Project.

Table 10. Regression Coefficients for Access to Agricultural Credit and the Subjective Wellbeing of the Households.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	5.059	.127		39.861	.001
Credit	.823	.043	.748	18.935	.001

($F(1, 284) = 358.5$, $p < .001$).

R^2 value of .557

4.7. Contribution of Capacity Building to the Subjective Wellbeing of Agro-pastoral Households

The fourth objective of this study looked at the relationship between capacity building (independent variable) and subjective wellbeing (dependent variable) of the agro-pastoralists involved in the livestock improvement project.

4.7.1. Capacity Building Among Project Households

Capacity building was assessed as a composite index reflecting project-related improvements in livestock management knowledge and skills across nine indicators (Table 11). Household heads rated each indicator on a five-point scale (1 = very low, 5 = very high).

Table 11. Mean Scores for the Indicators of Capacity Building Index.

Level of Capacity Building		Mean	SD
1	Feeds and Feeding (types, supplements, minerals, mixing)	3.11	.765
2	Pasture Management (rotation, fodder conservation)	2.01	.664

	Level of Capacity Building	Mean	SD
3	Animal Breeding (selection, mating system,	3.80	.764
4	Disease Control (vaccines, deworm, tick control)	2.21	.741
5	Marketing of Animals	2.85	.804
6	Animal Housing and Facilities (types, safety)	2.08	.769
7	Dairy Management (milking, feeding, selection)	2.70	.695
8	Husbandry Practices (raring young, foot care,	2.38	.201
9	Records and Planning	3.22.	.
	Index of Capacity Building	2.76	1.16

Mean 2.76 ± 0.06 , Median 3, Mode 2, Std. Dev 1.16, Minimum 1, Maximum 5

The overall capacity-building index had a mean of 2.76 (SD = 1.16). Internal consistency was acceptable (Cronbach's $\alpha = 0.755$).

4.7.2. Contribution of Capacity Building to Subjective Wellbeing of the Households

The relationship between capacity building and household subjective wellbeing was assessed using simple linear regression (Table 12).

Capacity building was a significant positive predictor of wellbeing ($\beta = 0.878$, $t = 30.82$, $p < 0.001$), explaining 77.0% of the variance in subjective wellbeing ($R^2 = 0.770$; $F(1, 284) = 949.79$, $p < 0.001$). These results indicate that enhanced capacity building was strongly associated with improved subjective wellbeing among agro-pastoral households participating in the Livestock Improvement Project.

Table 12. Regression Coefficients for Capacity Building and the Subjective Wellbeing of the Households.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	4.770	.089		53.863	.001
Capacity Building	.909	.029	.878	30.819	.001

($F(1, 284) = 949.79$, $p < .001$).

R^2 value of .770;

4.8. Contribution of Famer Collective Action on the Subjective Wellbeing of the Households

4.8.1. Collective Action Among Project Households

Collective action was assessed as a composite index capturing household participation in eleven group-based activities related to the Livestock Improvement Project (Table 13). Household heads rated the contribution of each activity to household wellbeing on a five-point scale (1 = very low; 5 = very high). Descriptive statistics for the composite index are presented (Table 13).

Table 13. Mean Scores for the Indicators of Collective Action Index.

	Collective action activities involved in	Level of Participation	
		Mean	SD
1	Conservation of fodder	3.61	.800

Collective action activities involved in		Level of Participation	
		Mean	SD
2	Disease control	2.97	.674
3	Marketing of animals	2.01	.777
4	Animal feeding	2.88	.333
5	Water development	2.14	.281
6	Breeding Management	2.66	.896
7	Exchange of breeding animals	3.01	.934
8	Meetings /Training	2.55	.567
9	Buildings/housing of animals	2.79	.373
10	Payment of group dues	2.79	.489
11	Marketing of Milk	2.01	.381
	Collective Action Index	2.95	1.01

Mean 2.95 ± 0.06 , Median 3, Mode 2, Std. Dev. 1.01, Minimum 1, Maximum 5

The overall collective action index had a mean of 2.95 (SD = 1.01), indicating moderate engagement. Internal consistency of the index was acceptable, as indicated by Cronbach's alpha (.887).

4.8.2. Contribution of Collective Action to the Subjective Wellbeing of the Households Involved in Livestock Improvement Project

The relationship between collective action and household subjective wellbeing was assessed using bivariate linear regression (Table 14).

Table 14. Regression Coefficients for Collective Action and the Subjective Wellbeing of the Households.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	4.359	.122		35.837	.001
Collective action	.991	.039	.834	25.444	.001

($F(1, 284) = 647.37, p < .001$).

R^2 value of .695;

Collective action was a significant positive predictor of wellbeing ($\beta = 0.834, t = 25.44, p < 0.001$), explaining 69.5% of the variance in subjective wellbeing ($R^2 = 0.695; F(1, 284) = 647.37, p < 0.001$). These results demonstrate that increased

participation in collective action activities was strongly associated with improved subjective wellbeing among households involved in the Livestock Improvement Project.

5. Discussion

5.1. Subjective Wellbeing of Agro-pastoral Households Participating in Livestock Improvement Project

This study found that agro-pastoral households participating in the Livestock Improvement Project (LIP) in Mwala Sub-County reported relatively high levels of subjective wellbeing across multiple dimensions. This aligns with multidimensional frameworks of wellbeing, which conceptualize wellbeing as encompassing material living standards, health, safety, social relations, psychological functioning, and environmental control rather than income alone [58, 59]. High wellbeing among participants suggests that the project generated benefits extending beyond livestock productivity to broader livelihood and psychosocial outcomes.

Disease control interventions implemented under the LIP likely contributed substantially to improved wellbeing. Reduced livestock mortality and morbidity enhance income stability and food availability while lowering uncertainty and stress associated with production risks. Similar evidence from Ghana demonstrates that disease-induced livestock losses negatively affect farmers' physical and psychological wellbeing, with improved veterinary services identified as a critical pathway for enhancing wellbeing and food security among livestock-dependent households [60]. These findings reinforce the role of animal health interventions as both economic and wellbeing-enhancing mechanisms.

The institutional and policy context within which livestock improvement initiatives operate also influences farmer wellbeing. Supportive agricultural policies can strengthen resilience and productivity, while poorly aligned regulations may impose administrative and psychological burdens. Evidence from Kenya's agricultural policy reforms highlights that subsidy management and financing frameworks must balance productivity goals with farmer welfare to avoid unintended stress and exclusion [61-63].

Technology adoption promoted through livestock development projects further contributes to enhanced wellbeing by increasing productivity, income, and food security. Empirical research in Kenya shows that farmers who adopt agricultural innovations, including ICT-based tools, report higher subjective wellbeing, largely mediated by improvements in income and reduced production risks [64-66]. These findings are consistent with the observed wellbeing outcomes among LIP participants, suggesting that technology-enabled productivity gains translate into improved life satisfaction.

Farm-level conditions, including access to advisory services, community engagement, and working environments, play a critical role in shaping farmers' wellbeing. Supportive extension services, social capital, and favorable working conditions have been shown to enhance job satisfaction and emotional wellbeing among farming households [67]. Collectively, the findings indicate that livestock improvement projects are most

effective in enhancing subjective wellbeing when they integrate technical, institutional, and social support components.

5.2. Contribution of Livestock Performance to Subjective Wellbeing of Agro-Pastoral Households

This study found a statistically significant and positive relationship between livestock performance and the subjective wellbeing of agro-pastoral households participating in the Livestock Improvement Project in Mwala Sub-County. Improved livestock performance, reflected in higher productivity, improved herd quality, and reduced losses, appears to enhance wellbeing by strengthening household income, food security, and psychosocial stability.

Livestock constitute a central livelihood asset for agro-pastoral households, providing income, food, and a buffer against economic shocks. Improved performance increases marketable surplus and asset values, which contributes to greater financial security and reduced vulnerability [68]. In sub-Saharan Africa, livestock production remains a major contributor to agricultural value added and rural livelihoods [69]. Recent analyses of Kenya's livestock sector highlight its contribution of approximately 42% to agricultural GDP and 12% to national GDP, underscoring its importance for household welfare and national development [70]. Similarly, value chain studies emphasize that livestock production remains a cornerstone of rural livelihoods, particularly in pastoral and agro-pastoral systems [71, 72].

Income derived from livestock sales is commonly allocated to essential needs such as food, education, and healthcare, which are closely linked to subjective wellbeing. Beyond economic effects, livestock ownership and improved performance also enhance social status and perceived security, contributing positively to psychological wellbeing and life satisfaction [73, 74]. Evidence from sub-Saharan Africa suggests that livestock production contributes significantly to household resilience and multidimensional wellbeing, with benefits extending beyond productivity gains alone [75].

Collectively, these findings suggest that livestock improvement interventions generate multidimensional wellbeing benefits that encompass economic, social, and psychological domains. By enhancing livestock performance, projects such as the LIP not only improve household income and food security but also strengthen psychosocial stability and social capital, thereby contributing to sustainable wellbeing outcomes in agro-pastoral communities.

5.3. Contribution of Access to Agricultural Credit to Subjective Wellbeing of the Households

This study demonstrates that access to agricultural credit contributes positively and significantly to the subjective wellbeing of agro-pastoral households participating in the Livestock Improvement Project in Mwala Sub-County. Enhanced

access to credit strengthens households' ability to invest in livestock production, thereby improving livelihood security and perceived quality of life.

Livestock improvement initiatives typically require both technical and non-technical investments, including improved breeds, animal health services, feed, housing, and water infrastructure. Financial constraints often limit smallholder participation in such interventions, particularly in agro-pastoral systems [76]. Access to agricultural credit reduces these constraints by enabling households to adopt productivity-enhancing practices and manage production risks more effectively.

Empirical evidence supports the role of credit in facilitating the adoption of improved livestock management practices. Ogali et al. [77] found that access to credit significantly increased adoption of improved indigenous poultry management in Kenya, resulting in higher productivity and income. These outcomes are closely associated with improved subjective wellbeing through enhanced food security, income stability, and reduced financial stress.

More broadly, livestock development in sub-Saharan Africa remains constrained by underinvestment despite its central role in rural livelihoods. Institutional arrangements such as agricultural cooperatives and credit associations improve household wellbeing by expanding access to finance, supporting entrepreneurship, and strengthening social and economic resilience [36]. Collectively, these mechanisms underscore the importance of inclusive financial services in enhancing both material and psychosocial dimensions of wellbeing among agro-pastoral households.

5.4. Contribution of Capacity Building to Subjective Wellbeing of the Households

This study demonstrates that capacity building has a significant and positive influence on the subjective wellbeing of agro-pastoral households participating in the Livestock Improvement Project in Mwala Sub-County. Capacity-building interventions facilitated the transfer of livestock management knowledge, skills, and technologies, enabling households to improve animal performance and productivity. These gains are closely associated with enhanced household income, food security, and reduced production-related risks, all of which contribute to higher levels of subjective wellbeing.

Capacity building strengthens human capital, a critical factor in sustainable livestock development and rural livelihoods. Training in animal health, feeding, breeding, and farm management improves farmers' technical competence and decision-making capacity, thereby increasing productivity and fostering psychological wellbeing through greater confidence and reduced stress. Such outcomes extend beyond economic benefits to include improved life satisfaction and social stability among participating households.

Evidence from sub-Saharan Africa supports these findings. Ogali et al. [77] reported that training in improved indigenous poultry management significantly increased productivity and

livelihood outcomes among Kenyan smallholder farmers. Similarly, Coppock et al. [78] found that participatory capacity-building approaches among pastoral communities in Ethiopia improved livestock productivity and household wellbeing. More recently, Sow et al. [79] demonstrated that training livestock champions in animal health, nutrition, and genetics in Mali enhanced small ruminant productivity and strengthened community resilience. Similarly, participatory training approaches have been shown to improve both technical outcomes and psychosocial wellbeing by empowering farmers with knowledge and collective problem-solving skills [80].

Overall, the results highlight the importance of integrating capacity-building components into livestock improvement programs to achieve sustained productivity gains and improvements in both the economic and psychosocial dimensions of household wellbeing.

5.5. Contribution of Collective Action to Subjective Wellbeing of the Households

This study found that collective action significantly and positively influenced the subjective wellbeing of the households participating in the livestock improvement project in Mwala Sub-County. Participation in group-based livestock management activities enhanced both economic outcomes and social cohesion, thereby improving household wellbeing. These findings align with evidence that collective action initiatives among smallholders improve income stability, social capital, and overall wellbeing [76].

In Kenya, collective engagement in livestock-related activities—such as milk marketing, breeding, access to agricultural information, and water development—has been shown to improve household economic performance and livelihood security [81]. Cooperative participation further strengthens entrepreneurship, access to financial services, and social standing, which are key contributors to wellbeing [82]. Beyond economic gains, collective action enhances social relationships and community participation, which are strongly associated with higher subjective wellbeing [36, 83, 84].

The extent of farmer participation in collective action influences the magnitude of benefits realized. Higher engagement levels are associated with improved group performance, greater individual returns, and better living conditions [85, 86]. Participatory self-help groups, particularly among resource-poor households and women, have emerged as effective mechanisms for empowerment and human development [87].

Collective action also plays a critical role in improving livestock management and resource sustainability. Empirical evidence from pastoral groups in Ethiopia and northern Kenya shows that collective governance of grazing resources improved livestock productivity, risk management, and household wellbeing [88-89]. Furthermore, participation in farmer groups enhances access to markets, credit, training, and improved technologies, strengthening household resilience and wellbeing [30, 84].

Overall, these findings underscore the importance of integrating collective action mechanisms into livestock improvement programs to achieve sustained productivity gains and improvements in both the economic and psychosocial dimensions of household wellbeing.

6. Conclusion

This study demonstrates the usefulness of subjective wellbeing (SWB) as an indicator for assessing the social and sustainability impacts of livestock improvement projects in arid and semi-arid lands (ASALs). Evidence from agro-pastoral households in Mwala Sub-County indicates that the Livestock Improvement Project (LIP) significantly enhanced household wellbeing. Livestock performance, access to agricultural

credit, capacity building, and participation in collective action all exerted positive and statistically significant effects on subjective wellbeing.

The results highlight the importance of integrated livestock development approaches that extend beyond productivity gains. Access to credit enables investment in livestock inputs, capacity building strengthens technical and managerial skills, and collective action improves market access, reduces transaction costs, and enhances social capital. Together, these elements contribute to more sustainable livelihood outcomes.

From a sustainability perspective, livestock interventions in ASALs should prioritize financial inclusion, farmer training, and group-based participation to enhance resilience and long-term wellbeing. Methodologically, the study contributes to the literature by validating subjective wellbeing as a complementary metric for evaluating livestock development interventions.

Abbreviations

ASALs	Arid and Semi-Arid Lands
ASDSP	Agricultural Sector Development Support Programme
CA	Collective Action
CAI	Collective Action Initiatives
FAO	Food and Agriculture Organization
FFS	Farmer Field Schools
IBM	International Business Machines
ILRI	International Livestock Research Institute
IFAD	International Fund for Agricultural Development
K-SALES	Kenya Semi-Arid Livestock Enhancement Support project
LIP	Livestock Improvement Project
OECD	Organization for Economic Co-operation and Development,
SIDA	Swedish International Development Cooperation Agency
SPSS	Statistical Package for the Social Sciences
SWB	Subjective Well-being
USAID	United States Agency for International Development

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Conflicts of Interest

The authors declare no conflicts of interest.

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