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Economic and Food Security Impacts of Livestock on Rural Households in Ummsimaima Administration, North Kordofan State, Sudan

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ABSTRACT

This study examined the contribution of livestock to rural household income and food security in Ummsimaima Administrative Unit, Sheikan Locality, North Kordofan State, Sudan. The study was motivated by the high incidence of poverty and food insecurity in rural Sudan, where livelihoods depend mainly on rain-fed agriculture and livestock production. Primary data were collected from 138 randomly selected households using structured questionnaires, while secondary data were obtained from reports and previous studies. Descriptive statistics, Food Energy Intake (FEI) approach, and correlation analysis were used for data analysis. The results revealed that livestock is the most important source of household income, contributing about 54.45% of total annual income, followed by non-farm labor income (26.05%) and seasonal migration income (9.45%). Goats, cattle, sheep, and poultry were the most common livestock species, while camel rearing was absent among sedentary farmers. All households depended entirely on local indigenous breeds, with no use of improved breeds. Average annual household income from livestock products was SDG 299,917, with cattle products representing the main source of cash revenue. However, livestock production also required substantial annual expenditure, averaging SDG 2,588,650, mainly on feed concentrates, water, and veterinary services. Food security analysis showed that the average daily per capita calorie intake was 2,092 kcal, placing households in the moderately food insecure category. The average daily food expenditure per person was SDG 2,422 (about 0.931 USD), indicating weak purchasing power and economic vulnerability. Correlation analysis indicated weak relationships between livestock income and socio-economic factors such as education, occupation, age, and livestock expenditure. The study concluded that livestock remains a vital but underdeveloped sector in the study area. Improving breeds, veterinary services, water access, and institutional support could significantly enhance rural household income and food security.

Keywords: Food security, Livestock, Rural households and North Kordofan State

INTRODUCTION

At present, nearly half of the world's population, estimated at about three billion people, lives in poverty, surviving on less than two US dollars per day. Among them, approximately 1.2 billion people live in extreme poverty on less than one US dollar per day. More than three-quarters of this group, around 900 million people, reside in rural areas where livelihoods depend mainly on agriculture and related activities. These alarming figures have drawn the attention of the international community to prioritize poverty reduction within development agendas (IFAD, 2003). In Sudan, poverty remains widespread and is predominantly concentrated in rural areas. It particularly affects farmers who depend on rain-fed agriculture. Although sustained economic growth contributed to

reducing extreme poverty from 85% during the 1990s to around 60% in recent years, considerable regional disparities still persist. Sudan continues to be classified as a low-income and food-deficit country. According to the United Nations Human Development Index (2007/2008), Sudan ranked 147th out of 177 countries (IFAD, 2010). Generally, small-scale farmers and pastoralists operating within traditional rain-fed farming and livestock systems experience higher poverty levels compared with those engaged in irrigated agriculture. North Kordofan State is one of the largest states in Sudan and has been significantly affected by economic and environmental challenges. The state lies within a semi-arid zone and is highly vulnerable to drought and desertification. Water scarcity has remained a major concern for decades. As a result, North Kordofan frequently experiences both chronic and seasonal food shortages (WFP, 2010). Food security in Sub-Saharan Africa remains a major concern. Despite sufficient global food production to meet human needs, more than 800 million people still lack adequate access to food (Sida, 2018). The Food and Agriculture Organization (FAO) classifies food insecurity into varying levels of severity (FAO, 2017b). Severe food insecurity refers to situations where households run out of food and are unable to eat for an entire day, often leading to undernourishment. Moderate food insecurity includes uncertainty about obtaining food, skipping meals, and occasionally running out of food due to limited financial resources (FAO, 2018). In Sub-Saharan Africa, more than one-third of the population suffers from severe food insecurity (FAO, 2018). Livestock ownership plays an important role in enhancing household food security. Income generated from the sale of livestock and livestock products can be used to purchase food and meet other household needs. Increased livestock production may also reduce prices and improve poor households' access to animal-source foods. Furthermore, livestock contributes to agricultural productivity through animal traction and manure use. In addition, livestock provides direct household access to nutritious animal-source foods (Kariuki et al., 2013). A study by Dumas et al. (2018) also found that livestock improves household welfare through food security, financial security, labor support, and social benefits such as hosting guests and celebrating community events.

LITERATURE REVIEW

Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). This concept is based on four interrelated dimensions. The first is food availability, which refers to the supply side of food security and depends on the level of food production, stock levels, and net trade. The second dimension is economic and physical access to food, as the presence of adequate food supplies at national or international levels does not necessarily guarantee household food security, since access is influenced by income levels, purchasing power, market conditions, and food prices. The third dimension is food utilization, which refers to the body's effective use of nutrients and depends on proper feeding practices, food preparation, dietary diversity, health conditions, and equitable food distribution within households. The fourth dimension is stability, which means maintaining the other three dimensions over time, since households may still face food insecurity if access to food is disrupted periodically due to drought, political instability, unemployment, or rising food prices. Therefore, achieving food security requires the simultaneous fulfillment of all four dimensions. Food security analysts generally classify food insecurity into two main types according to its duration: chronic food insecurity and transitory food insecurity. Chronic food insecurity refers to a long-term or persistent condition in which people are unable to meet their minimum food requirements over an extended period. It usually results from prolonged poverty, lack of productive assets, and limited access to financial or productive resources. Addressing chronic food insecurity often requires long-term development interventions such as education, improved access to credit, and enhanced productive capacity. In contrast, transitory food insecurity is short-term and temporary, occurring when there is a sudden decline in the ability to produce or access sufficient food to maintain good nutritional status. It is commonly caused by short-term shocks and fluctuations such as drought, conflict, changes in food prices, reduced household income, or year-to-year variations in food production. Because transitory food insecurity can arise suddenly and unpredictably, it requires rapid responses, including early warning systems and social safety net programs. Between these two forms lies seasonal food insecurity, which combines characteristics of both chronic and transitory food insecurity. It is usually predictable, recurring in cyclical patterns due to seasonal changes in

climate, cropping cycles, labor demand, and disease outbreaks, leading to temporary but repeated shortages in food availability and access.

STUDY AREA AND RESEARCH METHODOLOGY

Study Area:

North Kordofan State is located in the central part of the gum belt of Sudan, between latitudes 12°15'–16°32' North and longitudes 27°–32° East (Figure 3.1). Umsimaima Administrative Unit lies in the western part of Sheikan Locality, covering an area of about 280 km². It is divided by the national Western Sudan highway and bordered by Bara Locality to the north, Abu Haraz Locality to the south, El Obeid town to the east, and Al Khoway Locality to the west. The area consists of three main administrative units representing the major tribes, including Bedairia, Shiwehat, Abousonoon, Darhamid, Bergow, and others, who live in about 58 villages and 14 camps. The main livelihoods are agriculture, livestock rearing, and trade. *Acacia senegal* is the dominant tree species and is well known for producing high-quality gum arabic, and the area has been included in the national gum arabic belt project (2016–2020) aimed at combating desertification and poverty, where 380,812 seedlings were planted and 65,000 feddans were seeded in the first phase. The area also produces crops such as sesame, groundnuts, and millet, and contains 23 basic schools and two secondary schools, although it suffers from chronic water shortages despite having a major livestock rural market and an important crop market. The climate is generally arid to semi-arid, with temperatures ranging from about 6°C in winter to over 45°C in summer, and rainfall varying from less than 50 mm in the north to more than 400 mm in the south, making agriculture highly dependent on rainfall distribution. The population of the locality is estimated at 35,299 people (2016). Water resources are mainly dependent on rainfall, supported by water yards and boreholes, but water scarcity remains a major development constraint, causing seasonal migration in some areas. Soils vary and include sandy (goz), gardud, clay, and alluvial soils, with goz soils being particularly suitable for *Acacia senegal*, while other soil types support dryland farming in different parts of the area. Land tenure in Sudan is governed by historical legislation, including the Land Settlement Act of 1925 and the Unregistered Land Act of 1970, which placed most land under government ownership; however, weak enforcement and lack of clear national land-use policy have led to uncontrolled land use and environmental degradation, especially with the expansion of mechanized farming (Rahall and Salam, 2006).

RESEARCH METHODOLOGY

This study relied on both primary and secondary data sources. Primary data were collected through a field survey using a cluster random sampling technique, where structured household questionnaires were administered. Secondary data were obtained from relevant previous studies, research reports, and published literature. The total sample size of the study was 138 randomly selected households from the study area. For data analysis, descriptive statistics were used to summarize and organize the data by describing relationships between variables in a clear and systematic manner. These statistics included measures of frequency, central tendency, dispersion, and variable classification (nominal, ordinal, interval, and ratio). Descriptive analysis was applied as an initial step to simplify the data and support interpretation, particularly for decision-making purposes in relation to population characteristics (Kaur *et al.*, 2018). In addition, the Food Energy Intake (FEI) approach was used to assess household food security status. This method involves two main procedures: the first is a simple approach based on selecting a sub-sample of households whose income or expenditure is close to the recommended calorie level and calculating their average intake to estimate food insecurity levels; the second is a regression-based approach that relates household food expenditure (cost of food basket) to its calorie equivalent, thereby allowing estimation of food consumption adequacy. Although the FEI method incorporates non-food basic needs implicitly, it has some limitations (Ravallion, 1995). According to Stephen (2006), food security levels can be classified based on daily per capita calorie intake, where households consuming 2400 calories and above are considered food secure, 2100–2399 marginally insecure, 1800–2099 moderately food insecure, 1500–1799 severely food insecure, and less than 1500 very severely food insecure.

RESULTS AND DISCUSSION

1. Respondents' Age, Family Size by Gender, and Standard Deviation:

Table (1) showed that the average age of the respondents was 45 years with a standard deviation of 11.45, indicating a moderate variation in age among the sampled households. The results also reveal that the average number of male household members is 3 with a standard deviation of 1.58, while the average number of female members is 4 with a standard deviation of 1.71, indicating that female members slightly exceed male members in the surveyed households. In addition, the average family size was 6 persons with a standard deviation of 2.42, which reflects some variation in household size across the study area.

Table (1) Respondent's age family size by gender, and stander deviation

Items	Mean	Std. Deviation
Age	45	11.45
male	3	1.58
female	4	1.71
Size of family	6	2.42

2. Educational Level:

Figure (1) presents the educational level of respondents, including frequency and percentage distribution. The results indicated that the majority of respondents were educated, with only 16% being illiterate. Specifically, 45% of the respondents have basic education, 13% have intermediate education, 23% have secondary education, and 3% have university-level education. Overall, the findings show that about 84% of the respondents have some level of formal education, which reflects a relatively educated sample population in the study area.

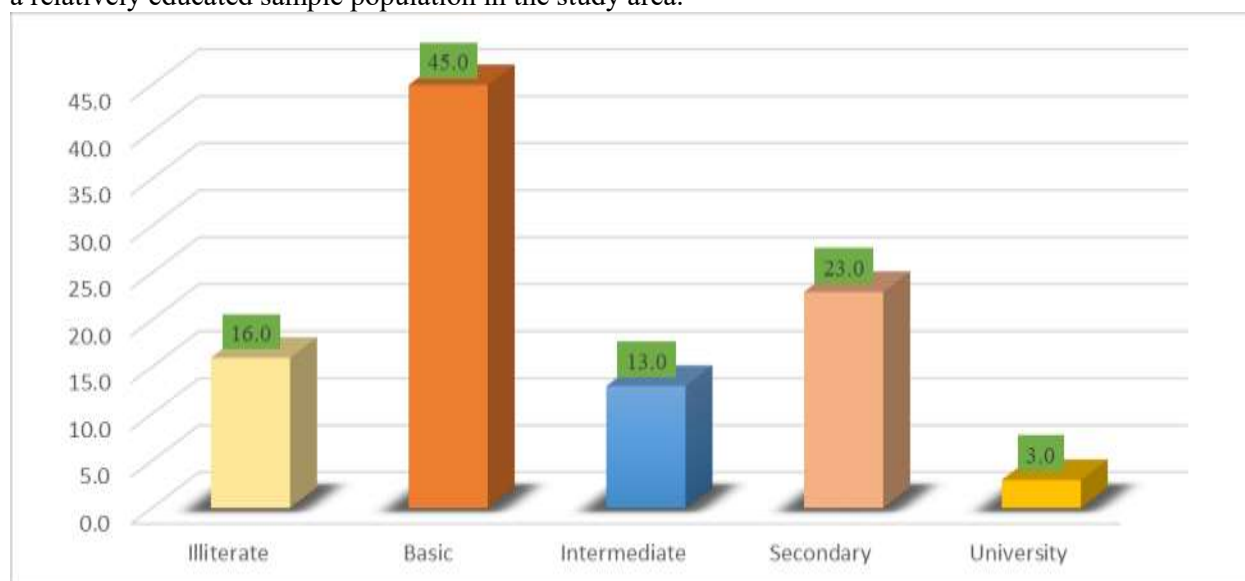


Figure (1) Respondent's education level

3. Average Household Livestock Ownership:

Table (2) presented the average household livestock ownership in the study area, including numbers of mature animals, births, deaths, slaughtered, and sold livestock. The results indicated that sedentary farmers do not rear camels in the study area. Goats appeared to be the most commonly owned livestock, followed by cattle and sheep, while poultry and pigeons are also widely kept. The findings showed that the average household livestock holdings was dominated by small ruminants and poultry, with an average of about 22 poultry and pigeons per household. In terms of reproduction and management dynamics, cattle recorded 5 mature females and 3 males with some recorded births and limited sales, while goats showed higher distribution with 7 females and 2 males, reflecting their importance in household livelihoods. Sheep, chickens, pigeons, and donkeys also contribute to household livestock assets, though at relatively lower production and marketing levels. Overall, the

table reflects the dominance of small livestock in the study area and the absence of camel production among sedentary farmers.

Table (2) reveals average household livestock ownership

Kind	Number		No of mature	Births n.	Deaths n.	Slaughter n.	Sold n
	Male	Female					
Camels	0	0	0	0	0	0	0
Cows	2	5	3	3	0	1	2
Goats	1	7	2	2	4	0	2
Sheep's	6	0	0	0	0	1	6
Pigeons	1	1	1	1	0	1	0
Chickens	2	9	6	6	2	4	0
Donkeys	1	0	0	0	0	0	1
Total	13	22	13	12	6	7	11

4. Annual Household Livestock Products Average Revenues:

Table (3) presents the average annual revenues generated from livestock products at household level, expressed in Sudanese Pounds (SDG). The results show that the total average household income from livestock products is approximately SDG 299,917. The main source of direct income is derived from cattle products, while other types of livestock products contribute little or no recorded income. Specifically, cattle products generate income from milk (SDG 74,000), yogurt (SDG 46,667), sour milk (SDG 75,250), and margarine (SDG 104,000), which together constitute the main share of livestock-derived revenues. In contrast, products from camels, goats, sheep, pigeons, and chickens show no significant recorded sales in monetary terms, which may be attributed to household consumption patterns, cultural practices, or limited market participation. Overall, the findings indicate that cattle play the dominant role in generating cash income from livestock products in the study area.

Table (3) Annual household livestock products average revenues in SDG

kind	Milk	yogurt	Sour milk	margarine	cheese	eggs	Chickens	total
Cows	74,000	46,667	75,250	104,000	0	0	0	299,917

5. Annual Household Average Livestock Expenditure (SDG):

Table (4) presents the average annual expenditure on livestock production per household, which amounts to SDG 2,588,650.25. The results indicated that livestock rearing costs vary across animal types and production inputs. In general, fodder costs were recorded as zero for all livestock categories, which reflects the reliance on open-range grazing systems in the study area. Expenditure is mainly concentrated on concentrates, veterinary services (vaccination and drugs), water, fostering, and labour. Among livestock types, sheep recorded the highest total annual cost (SDG 1,090,546), followed by goats (SDG 656,971), pigeons (SDG 312,788), chickens (SDG 142,716), cows (SDG 114,929.25), and donkeys (SDG 270,700). Costs for concentrates represent a major share of expenditure, particularly for sheep and goats, while water costs also constitute a significant component due to the scarcity of water resources in the area. Veterinary costs are mainly associated with cattle, goats, and sheep, reflecting the need for disease control and animal health management.

Table (4) the annual household livestock average cost SDG

kind	Camel	Cows	Goats	Sheep	Pigeons	Chicken	Donkey
concentrates							
quantities	0	98.08	2260	74,568	9,118	165	383
Cost	0	5,358.25	289,332	448,634	208,800	65,916	260,504
Vaccination and drugs							
quantities	0	300	28	117.1	0	0	0
Cost	0	36,714	38,016	48,806	0	0	0
water							
quantities	0	0	1,525.71	2,519	613	374	46
Cost	0	0	305,143	468,456	103,988	76,800	9,118
fostering							
quantities	0	1	1	1	0	0	0
Cost	0	72,857	20,992	75,844	0	0	0
Labor							
quantities	0	0	1	1	0	0	1
Cost	0	0	3,488	4863	0	0	1078
Total	0	114,929.25	656,971	1,090,546	312,788	142,716	270,700

6. Household Sources of Income

Figure (2) presents the annual household income sources in the study area. The results showed that livestock represents the largest share of total household income, contributing 54.45% of overall income, which makes it the dominant livelihood activity in the study area. Non-farm labor income followed with 26.05%, while seasonal migration income accounts for 9.45%. Farm labor income contributes 4.01%, farm product revenue contributes 5.8%, and crop residues represent the smallest share at 0.24% of total income. Overall, the findings indicate that livestock is the main economic activity and primary source of income for households in the study area. In addition, the contribution of livestock is likely underestimated in monetary terms, as several benefits such as home consumption, gifts, manure production, transportation, and draught power are not fully captured in financial records.

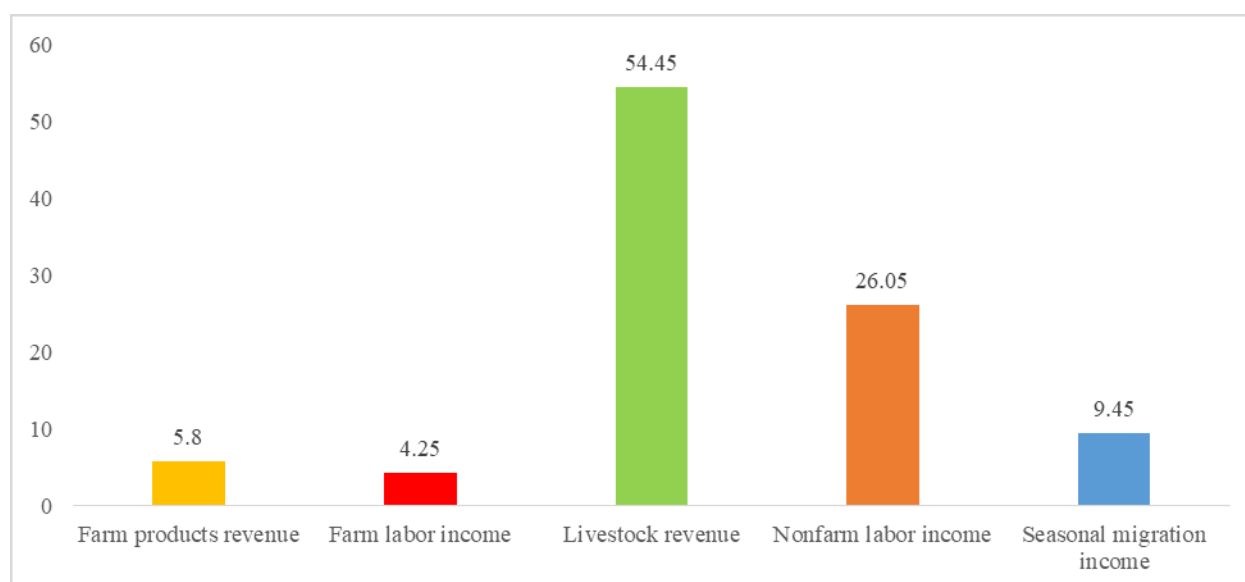


Figure (2) Annual household income SDG

7. Livestock Breed Types

Table (5) shows the distribution of livestock breed types in the study area. The results indicated that all respondents (100%) rely exclusively on local indigenous breeds, while improved breeds were completely absent (0%). This reflects that livestock production in the area was mainly based on traditional and locally adapted breeds, which are generally characterized by low productivity compared to improved genetic breeds. Overall, the findings suggest limited adoption of improved livestock breeds, which may contribute to lower livestock productivity in the study area.

Table (5) Livestock breed kinds

Breed kind	Frequency	Percent
Local breeds	138	100.0
Improved breeds	0	0
Total	138	100.0

8. Daily Per Capita Calorie Intake and Food Expenditure:

Table (6) presents household food consumption items, quantities consumed in kilograms; unit price, and calorie values, total calories consumed, and total food expenditure. The results showed that food security threshold for household was found to be 2,092 kilocalories per person per day, so the person was moderately food insecure. The table also reveals that the average daily food expenditure per person is SDG 2,422, equivalent to approximately 0.931 USD, which is below the international poverty line. Overall, the findings indicate that although households are able to meet minimum caloric requirements at a moderate level, their low income and limited purchasing power reflect economic vulnerability and food insecurity.

Table (6) daily per person k.cal intake

Food Item	Quant. cons.kg	Price/SDG /Kg.	K.cal./kg.	Total k.cal consumed	Total cost SDG
Millet	9.1567	980	3,350	30674.945	8973.566
Sorghum	5.8542	453	3,350	19611.57	2651.9526
Wheat	2.2	171	3,320	7304	3762
meat	1.91	2,225	2,020	3858.2	4249.75
milk	15.75	392	660	10395	6174
sugar	4.3841	1,017	4,000	17536.4	4458.6297
Tea	0.4384	1,443	0	0	632.6112
coffee	0.5906	1,531	0	0	904.2086
onion	5.8043	889	410	2379.763	5160.0227
oil	1147.28	986	8,840	10141955	1131218.08
salt	1.1014	737	0	0	811.7318
okra	0.75	3,746	350	262.5	2809.5
fruits	3.4004	562	2080	7072.832	1911.0248
vegetables	26.3111	454	200	5262.22	11945.2394
macaroni	1.464	600	3,350	4904.4	878.4
Total/H-H/W	1226.3952			10251216.83	1186540.7168
Per/person/Day				2,092	2,422

9. Correlation Analysis:

The correlation analysis results in Tables (7,8,9 and 10) showed very weak or no linear relationships between livestock income and the selected socio-economic variables. The coefficient value of 0.052 indicated a very weak positive relationship between livestock income and education level, explaining only about 0.27% of the variation, while 99.73% was due to other factors. In addition, the coefficient of 0.00 between livestock income and age indicated no linear relationship, meaning age has no effect on livestock income. Furthermore, the coefficient of 0.042 between livestock income and occupation reflects an extremely weak positive relationship, contributing only 0.18% to income variation, while 99.82% is influenced by other factors. Finally, the coefficient of 0.010 between livestock income and livestock expenditure also indicates an extremely weak positive relationship, explaining only 0.01% of the variation, while 99.99% is attributed to other factors. Overall, the findings suggest that livestock income is not significantly influenced by the examined variables and is mainly determined by other unmeasured factors.

Table (7) Education level and livestock income

Correlations			
	Education level	Livestock income	
Livestock income	.166	1	Pearson Correlation
	.052		Sig. (2-tailed)
	138	138	N
Livestock expenditure	1	.166	Pearson Correlation
		.052	Sig. (2-tailed)
	138	138	N

** . Correlation is significant at the 0.01 level (2-tailed).

Table (8) respondents' age and livestock income

Correlations			
	age	Livestock income	
Livestock income	.315**	1	Pearson Correlation
	.000		Sig. (2-tailed)
	138	138	N
Livestock expenditure	1	.315**	Pearson Correlation
		.000	Sig. (2-tailed)
	138	138	N

** . Correlation is significant at the 0.01 level (2-tailed).

Table (9) occupation and Livestock income correlation

Correlations			
	Occupation	Livestock income	
Livestock income	.173*	1	Pearson Correlation
	.042		Sig. (2-tailed)
	138	138	N
Livestock expenditure	1	.173*	Pearson Correlation
		.042	Sig. (2-tailed)
	138	138	N

Table (10) Livestock expenditure and Livestock income correlation

Correlations			
	Livestock expenditure	Livestock income	
Livestock income	.219**	1	Pearson Correlation
	.010		Sig. (2-tailed)
	138	138	N
Livestock expenditure	1	.219**	Pearson Correlation
		.010	Sig. (2-tailed)
	139	138	N

** . Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION AND RECOMMENDATION

This study assessed the contribution of livestock to rural household income and food security in Umsimaima Administrative Unit, Sheikan Locality, North Kordofan State, Sudan. The findings indicate that livestock plays a central role in the livelihoods of rural households and represents the dominant source of income, contributing about 54.45% of total household income. However, this contribution is not fully reflected in monetary terms due to additional non-market benefits such as household consumption, gifts, manure production, transportation, and draught power.

The results also show that households mainly depend on small-scale traditional livestock systems, with goats, cattle, sheep, and poultry being the most common animals, while camels are not reared in the study area. Livestock production is based entirely on local indigenous breeds, with no use of improved breeds, which may contribute to low productivity levels. Despite relatively high livestock ownership, production and marketing of livestock products remain limited, with cattle products being the main source of cash income. In terms of costs, livestock production requires substantial annual expenditure, particularly on feed concentrates, water, and veterinary services, reflecting the challenges of production in a semi-arid environment with limited natural resources and water scarcity.

The study further revealed that the average daily per capita calorie intake is 2,092 kcal, which falls within the moderately food insecure category. Although households are able to meet minimum calorie requirements, their low average food expenditure and income levels indicate economic vulnerability and weak purchasing power. Moreover, correlation analysis shows that livestock income has very weak or no significant relationship with respondents' age, education level, occupation, and livestock expenditure, suggesting that livestock income is influenced more by other unmeasured factors such as environmental conditions, market access, animal health, and production systems. In general, the study concludes that livestock remains a vital but underdeveloped sector in the study area. Improving livestock productivity through better breeds, improved veterinary services, enhanced water access, and stronger institutional support could significantly enhance rural household income and food security.

REFERENCES

- Agresti, A. (2018). *An Introduction to Categorical Data Analysis*. Wiley.
- Dumas, S. E., Maranga, A., Mbullo, P., Collins, S., Wekesa, P., Onono, M., & Young, S. L. (2018). Men are in front at eating time, but not when it comes to rearing the chicken: Unpacking the gendered benefits and costs of livestock ownership in Kenya. *Food and Nutrition Bulletin*, 39(1), 3–27.
- FAO. (2017b). *Regional Overview of Food Security and Nutrition in Africa 2016*. Food and Agriculture Organization of the United Nations.

- FAO. (2018). *The State of Food Security and Nutrition in the World 2018*. Rome: Food and Agriculture Organization of the United Nations.
- Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics*. Sage Publications.
- IFAD. (2003). *Assessment of Rural Poverty*. International Fund for Agricultural Development.
- IFAD. (2010). *Rural Poverty in Sudan*. International Fund for Agricultural Development.
- Kariuki, J., Njuki, J., Mburu, S., & Waihanji, E. (2013). Women, livestock ownership and food security. In J. Njuki & P. C. Sanginga (Eds.), *Women, Livestock Ownership and Markets: Bridging the Gender Gap in Eastern and Southern Africa*.
- Kaur, P., Stoltzfus, J., & Yellapu, V. (2018). Descriptive statistics. *International Journal of Academic Medicine*, 4, 60–63.
- Rahall, S., & Abdel Salam, A. H. (2006). *Land Rights, Natural Resources Tenure and Land Reform in Sudan*.
- Ravallion, M. (1995). *Poverty lines in theory and practice*. LSMS Working Paper. World Bank.
- Sida. (2018). *Agriculture and Food Security*.
- Stephen Devereux. (2006). *Methods Used to Assess Household Food Insecurity*.
- WFP. (2010). *Emergency Food Security Assessment, North Kordofan, Sudan*. World Food Programme.
- World Food Summit. (1996). *Rome Declaration on World Food Security*. Rome.
- World Bank. (2002). *Linking Poverty Reduction and Environmental Management: Policy Challenges and Opportunities*. World Bank.