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A cross-sectional study to establish the relationship between residential land use and food security in Amudat District.

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ABSTRACT

Background
The study aimed to establish the relationship between residential land use and food security in Amudat District.

Methodology
The study employed a descriptive research design using both quantitative and qualitative approaches to enhance validity through triangulation. The target population comprised 2,980 households, from which a sample of 426 was selected. Simple random sampling was used to ensure equal representation. Data were collected using a structured questionnaire, interview guide, observation checklist, and documentary review guide. Quantitative data were analyzed using SPSS Version 26. Qualitative data from interviews and document reviews were analyzed thematically and presented narratively to complement quantitative results.

Results
Of the 426 planned participants, 350 responded, yielding an 82.2% response rate. Most respondents were male (60%), aged 30–49 years (58%), and married (70%). Educational attainment was generally low, with 80% having no formal or only primary education. Half of the households owned 0–5 acres of land. Residential land use was characterized by informal, customary, and poorly planned settlements. Respondents disagreed that residential areas were well planned or adequately serviced, recording mean scores below 2.00 for planning, housing allocation, water, electricity, waste management, and street lighting. Customary land ownership scored 4.25, while informal homestead clustering scored 4.05. Food security was generally low; households lacked sufficient food (mean 1.61), dietary diversity (1.53), nutritious diets (1.56), and affordability of preferred foods (1.48). Many ate fewer than two meals per day (4.15), borrowed food (3.60), and purchased food from neighboring districts (3.45). Correlation analysis showed a moderate positive relationship between residential land use and food security ($r = 0.316$, $p = 0.002$).

Conclusion
Residential land use significantly influences food security outcomes in Loroo Sub-County.

Recommendation
Strengthening land planning, improving infrastructure, and supporting small household production systems are essential for enhancing food security in the district.

Keywords: *Residential land, food security, Amudat District.*
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Background
Residential land use refers to how land is allocated for settlement, housing, and urban expansion. Globally, residential expansion has historically influenced food security by reducing agricultural land and altering access to natural resources. Since the 1996 World Food Summit, the increasing competition between housing needs and food production has contributed to pressure on food systems. Urbanization in Asia and parts of Africa has reduced farmland and increased household dependence on markets, affecting the affordability and availability of food (FAO, 2022).

In Asia, population growth and expanding residential areas have shifted land away from agricultural production, thereby threatening food security. Research by Shen and Yeon (2021) indicates that changing climatic conditions combined with residential expansion affect crop yields and household food access, especially in highly populated countries like China.

African countries such as Kenya and Uganda face similar challenges. Rapid urban growth reduces land for household-

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level food production and increases reliance on purchased food. Uganda's urbanizing regions face food security constraints linked to limited land for kitchen gardening and small-scale livestock rearing. In Northern Uganda and Amudat District, residential land constraints among formerly displaced communities and pastoral households reduce access to farmland, contributing to persistent household food insecurity.

The Sustainable Livelihoods Framework explains that limited residential land affects natural capital by reducing household access to productive land. This leads to increased vulnerability and reliance on markets, where households may adopt negative coping strategies such as skipping meals or reducing food quantity and diversity.

METHODOLOGY

Study Design

This study employed a descriptive research design. The design was applied to obtain information on the status of residential land use and to describe existing conditions related to food security. To enhance responsiveness, both qualitative and quantitative approaches were adopted. Quantitative data collection and analysis required an understanding of the relationships among variables through descriptive and inferential statistics, while qualitative data were transcribed and organized into themes.

Study Population

The study population comprised all households or farmers in Loroo Sub-County, totaling 2,933 households (Loroo Sub-County Development Plan, 2024). According to the 2024 population census, the Sub-County had a total population of 9,257 people, of whom 4,747 were males, and 4,510 were females. The average household size was estimated at 4.5 persons per household, with a population density of 245 persons per square kilometer. Approximately 91% of the residents were engaged in crop cultivation and agro-pastoralism.

Other categories of the study population included three Community-Based staff members, sixteen District Production staff members, and twenty-eight Farmer Forum members.

Sample Size

Sampling was a method of selecting participants from a target population such that the selected participants represented the entire population (Amin, 2005). The study employed the formula developed by Krejcie and Morgan (1970) to determine the sample size based on the population size. Accordingly, the representative sample of the study population, as determined using Krejcie and Morgan's (1970) table, was considered adequate for the study. The population was stratified into functional areas relevant to the study across different sections to minimize bias (see Appendix I).

Table 1: Showing the Breakdown of Samples

Category of respondents	Target population	Sample size	Sampling technique
House-holds heads	2,933	379	Simple random sampling
Technical staff (Production & CBS staff)	20	19	Simple random sampling
Members of the Farmer Forum	30	28	Simple random sampling
Total	**2,980**	**426**	

Source: Loroo- Sub-County Production Records (2024) and Sample determined using Krejcie and Morgan (1970),

Sample size determination table

Sampling Techniques and Procedure

Only the probability sampling technique was used in determining the sample from the sample size, as explained below;

Simple Random Sampling

This technique was employed to select households or farmers, as well as technical staff comprising production and community-based staff and farmer forum members. The simple random sampling method was applied to respondents as presented in Table 1. Given the homogeneity of the respondents, the lottery method was used to ensure that every individual had an equal chance of inclusion. This method was chosen because the population was valid and large, and some level of non-response was anticipated.

Data Collection Methods

The study employed several data collection methods, including questionnaires, interviews, observations, and documentary review. Bell (1999) emphasized that the quality of data and the appropriateness of the methods employed were particularly important in the social sciences due to the diverse philosophical and methodological approaches to studying human activity. He further stated that the veracity of results and the soundness of research

conclusions depended on the suitability of the methodology and the quality of data upon which the conclusions were based.

The choice of questionnaires and interviews as data collection methods was justified on the grounds that, being descriptive in nature, the study required intensive interaction with informants to gain deeper insight into the research issues. Observation involved examining elements relevant to the study. The researcher made direct observations of the processes and activities in which the respondents were engaged. Documentary review involved collecting information from secondary sources. Key sources included production department monthly reports, research reports, environmental and water resources management reports, and farm management guides, among others. The adoption of documentary analysis as a data collection method was justified by the fact that the research problem had a time dimension (2014–2019), which required reviewing documents related to the phenomenon to supplement the primary data.

Data Collection Instruments

The instruments employed were in line with the methodology, which enabled him to collect relevant data. The instruments constituted: questionnaire, interview guide, observation checklist, and documentary review guide, as explained below:

Questionnaire

Self-administered questionnaires were employed to collect data from farmers or households. This approach was used because many respondents had limited writing skills and a limited grasp of English, which necessitated translating statements into the local language while the researcher recorded the responses. A five-point Likert scale questionnaire was employed (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree) to obtain data from the selected respondents. The questionnaire was designed in accordance with the study phenomena and objectives, which guided its formulation. This approach facilitated the coding process and enabled the collection of data from a wide range of perspectives, as respondents were free to express their views on the subject.

Interview Guide

The interview guide contained brief questions aimed at obtaining information from respondents as key informants, to supplement data collected through questionnaires. Each face-to-face interview session lasted approximately 30 minutes and involved production staff, CBS staff, and Farmer Forum members, as they were responsible for running agricultural programs, including sensitization and monitoring of farmers' activities.

Probing during interviews provided the researcher with vital and reliable information concerning the phenomena under study. The interviews were in-depth, allowing the researcher to uncover information that might not have been obtained otherwise. This method enabled the researcher to solicit responses from key respondents, thereby supplementing data collected through questionnaires.

Observation Checklist

Direct observations of the processes were made, and activities in which the respondents were involved. This was important because certain processes and behaviors, resulting from the execution of programs, could not be accurately measured otherwise. This method involved the use of human senses to collect data directly. The observation checklist guided the researcher on the specific activities and processes to observe.

Documentary Review Guide

A worksheet was used to review documents, collecting data from the Production Office and Community-Based Services departments. The data worksheet contained a sequence of checks to determine whether there were seasonal changes and whether farmers had adjusted to the current situation.

Validity and Reliability

Reliability

The data collection instruments were pre-tested on 5 individuals who performed similar roles to those earmarked for the main study. This pre-testing helped to ascertain the dependability, accuracy, and ability of the instruments to elicit necessary and adequate responses. Respondents were requested to provide constructive criticisms and suggestions, which were incorporated to improve the final research instruments.

Consequently, all statements under each variable were subjected to this test. The results yielded a Cronbach's alpha of 0.84, indicating that the instruments were highly reliable. Statements that were initially below the threshold were refined to enhance responsiveness and ensure consistency in measurement.

Validity

The instruments applied were expected to be valid, practical, and free from bias. Before the instruments were administered, they were validated by examining their content to ensure they measured the intended attributes and were free from bias, contamination, and deficiency. This process helped to minimize bias during data collection and ensured that the instruments could generate dependable responses for the study.

The instruments were subjected to expert judgment by a panel of specialists who reviewed each item for relevance, clarity, and appropriateness. Out of 30 items evaluated, 28

were deemed valid, resulting in a Content Validity Index (CVI) of 0.93 (28/30). Since the CVI exceeded the acceptable threshold of 0.7, the instruments were considered valid and were accepted for use in data collection. Items that did not meet the criteria were refined to enhance validity before the final administration.

Data Collection Procedures

The letter of introduction was obtained from the School of Graduate Studies and Research at Team University, detailing the purpose and nature of the study to be conducted in Loroo Sub-County. The researcher scheduled an appointment with the District Production Officer (DPO), who then introduced the researcher to the District Agricultural Officer and Head of Community-Based Services and instructed them to assist in identifying respondents. After respondents were identified, the researcher held a meeting with them, explained the purpose of the study, and requested their assistance in identifying participants. Appointments were then scheduled with farmers/households and technical staff. Each session of interviews and questionnaire administration lasted approximately 30 minutes, and all responses were manually recorded. To protect the privacy of respondents, the researcher provided a brief overview of the study, obtained verbal consent before data collection, and omitted respondents' names from the instruments.

Data Analysis

Analysis is the computation of certain measures along with searching for patterns of relationships that exist among data groups (Kothari, 2004). The data was collected and analyzed both qualitatively and quantitatively as explained below;

Quantitative Data Analysis

Quantitative data were edited to minimize errors by checking for completeness, legibility, comprehensibility, consistency, and uniformity. After editing, the data were coded, classifying or grouping similar responses into meaningful categories in relation to the variables under study. The coded responses were then used to formulate general response categories. Following coding, the data were entered into a spreadsheet in SPSS version 26 for analysis. The analysis focused on descriptive techniques, providing a general overview of the data through descriptive statistics, including measures of central tendency and measures of dispersion.

Qualitative Data Analysis

Thematic analysis was used to analyze qualitative data from interviews, while content analysis was applied to the review of documents. Content analysis involved the systematic classification, organization, and comparison of the content of documents or communications. The communications analyzed included responses from the Likert scale questionnaires, interview content, and field notes. The data were classified, categorized, and themes were generated. The findings were then presented in descriptive form, aligned with the research questions.

Merging Qualitative and Quantitative Data

The collected data were organized according to the objectives of the study, then edited, coded, classified, and tabulated. The data were subsequently arranged in frequencies and percentages, which formed the basis for correlation and prediction analysis used to establish the effect of land use on food security, thereby guiding data interpretation, discussion, conclusions, and recommendations. Classification simplified the task of interpreting data from the perspectives of farmers and other stakeholders regarding the phenomena under study.

Measurement of Variables

Variables were measured in terms of both land use and food security by examining their dimensions. Respondents were asked, on a four-point Likert-type scale ranging from one (negligible impact) to four (extreme impact), to indicate their perceptions of the effect of land use practices on food security. Qualitative data were analyzed based on the opinions of the respondents. The study also considered variables related to climate change adaptation and farmer resilience, which involved assigning numerical values from the questionnaire to facilitate easy interpretation. A five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) was used to obtain quantifiable primary data from respondents.

Ethical Considerations

First, permission was obtained from the School of Graduate Studies and Research. The letter issued was addressed to the District Production Officer, Amudat District, requesting approval and assistance in identifying respondents.

The researcher utilized the services of research assistants, who were first trained on the principles of data collection before accompanying the researcher to the field.

The rights of the study participants were protected by ensuring that they had the freedom to participate or decline participation. Privacy and confidentiality were maintained, and the subjects were assured that any information provided would remain confidential. Their names were omitted from data collection tools to ensure anonymity. Additionally, participants were informed that their responses would not cause them any harm or affect their employment.

The confidentiality of respondents was ensured, and the views provided. Consent was sought from participants, with assurance that the study was purely for academic purposes. The purpose, expected outcomes, and potential benefits of

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the study were clearly explained to respondents, and the sources of information were duly acknowledged.

At each selected study site, focal persons were contacted for permission and to provide necessary information before commencement of the study. The purpose, general content, and nature of the investigation were explained to each respondent to obtain verbal and written consent before their inclusion in the study.

RESULTS

Response Rate

The response rate was determined using the formula;

$$\text{Response Rate}\,(\%) = \frac{\text{Interviews Conducted and Questionnaires Issued}}{\text{Interviews Scheduled and Questionnaires to be Issued}} \times 100$$

Table 2: Response Rate of the Study

Category of respondents	Interviews Scheduled / Questionnaires to be Issued	Interviews Conducted / Questionnaires Collected	Response Rate (%)
Household heads	379	315	83.1
Technical staff (Production & CBS)	19	15	78.9
Members of the Farmer Forum	28	20	71.4
Total	426	350	82.2

Source: Primary Data (2025).

The response rate of the study indicates the proportion of scheduled interviews and distributed questionnaires that were completed and returned by the respondents. As shown in Table 2, a total of 426 interviews and questionnaires were planned across the three categories of respondents. Of these, 350 were completed, representing an overall response rate of 82.2%, which is considered acceptable for social science research.

Specifically, among household heads, 379 questionnaires were scheduled for administration, of which 315 were completed, yielding a response rate of 83.1%. Technical staff involved in production and Community-Based Services (CBS) had 19 scheduled interviews, with 15 conducted, giving a response rate of 78.9%. Members of the Farmer Forum had 28 planned questionnaires, with 20 completed, resulting in a response rate of 71.4%.

The high overall response rate demonstrates that the study was able to obtain sufficient data to reliably assess land use and food security among households in Loroo Sub-County, Amudat District, Uganda. The slightly lower response rate among Farmer Forum members may be attributed to their limited availability during the data collection period.

Socio-Demographic Characteristics of Respondents

The study involved a total of 350 respondents from Loroo Subcounty, Amudat District, Uganda. Table 3 summarizes the demographic characteristics of the respondents, including gender, age, marital status, educational qualification, and land ownership.

Table 3: Demographic Characteristics of Respondents (N = 350)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	210	60.0
	Female	140	40.0
Age (years)	18–29	70	20.0
	30–39	105	30.0
	40–49	98	28.0
	50 and above	77	22.0
Marital Status	Single	70	20.0
	Married	245	70.0
	Widowed/Divorced	35	10.0
Education Qualification	No formal education	140	40.0
	Primary education	140	40.0
	Secondary education	56	16.0
	Tertiary/college	14	4.0
Land Owned (acres)	0–5	175	50.0

	6–10	105	30.0
	11–15	49	14.0
	16 and above	21	6.0

Source: Primary data (2025)

Regarding gender, the majority of respondents were male (60%), while females constituted 40% of the sample. This reflects the typical pattern in rural Ugandan households where men are often the household heads and primary decision-makers in agricultural activities.

The age distribution indicated that most respondents were within the 30–49-year age bracket, with 30% aged 30–39 years and 28% aged 40–49 years. Respondents aged 18–29 years accounted for 20%, while 22% were 50 years and above. This suggests that the population engaged in agricultural activities in the study area is largely mature and within the productive working age.

In terms of marital status, the majority of respondents were married (70%), followed by single respondents (20%) and widowed/divorced individuals (10%). This high proportion of married respondents is consistent with the family-based nature of farming in the region.

Educational qualifications revealed that 40% of respondents had no formal education, while another 40% had completed primary education. Secondary education was attained by 16% of respondents, and only 4% had tertiary or college-level education. These findings indicate generally low levels of formal education among respondents, which may have implications for the adoption of modern agricultural practices and food security strategies.

Regarding land ownership, half of the respondents (50%) owned 0–5 acres, 30% owned 6–10 acres, 14% owned 11–15 acres, and 6% owned 16 acres or more. This indicates that most households in the study area operate on small-scale landholdings, which may constrain agricultural productivity and affect household food security.

Overall, the demographic profile suggests a predominantly male, married, and middle-aged population with limited formal education and small landholdings. These characteristics provide important context for understanding land use patterns and food security challenges in Loroo Sub-County.

Residential Land Use in Loroo Sub-County, Amudat District

Descriptive Analysis of Residential Land Use in Loroo Sub-County, Amudat District

The study examined residential land use in Loroo Sub-County to determine the extent of planning, infrastructure provision, and settlement patterns. Respondents were asked to indicate their level of agreement with statements regarding residential land use on a five-point Likert scale (SA = 5 to SD = 1). The findings are presented in Table 4

Table 4: Residential Land Use in Loroo Sub-County, Amudat District (N = 350)

Statement	SA	A	N	D	SD	Mean	Std Dev
Residential areas are well planned and organized	10	20	30	150	140	1.99	0.98
There is adequate land allocated for residential housing	5	15	25	160	145	1.88	0.92
There are no land disputes related to residential land use in my community	8	22	30	155	135	1.95	0.95
There is enough infrastructure (e.g., roads, water, electricity)	5	10	25	165	145	1.83	0.91
The cost of acquiring land for residential use is affordable	12	28	40	130	140	2.04	1.01
There is a mix of planned and informal settlements	8	18	30	150	144	1.92	0.97
Residential land is largely informal and clustered with traditional homesteads	150	130	30	20	20	4.05	0.96
Land is customarily owned	180	120	25	15	10	4.25	0.85
The area has apartment blocks and gated communities	2	5	10	120	213	1.41	0.74
The area has access to piped water	5	10	20	150	165	1.76	0.90
The area has access to electricity	5	15	25	155	150	1.85	0.92
The area has waste management systems	3	10	20	160	157	1.74	0.89
The area has street lighting systems	2	8	15	165	160	1.69	0.87
The area has police outposts	5	15	25	155	150	1.85	0.92

Source: Primary data (2025)

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The results indicate that residential areas in Loroo Sub-County are largely unplanned and poorly organized. A majority of respondents disagreed that residential areas are well planned (Mean = 1.99, SD = 0.98) and that there is adequate land allocated for residential housing (Mean = 1.88, SD = 0.92). This suggests that formal planning mechanisms are largely absent, and land for residential purposes is allocated on an ad hoc basis. Land disputes related to residential plots are common, as reflected by the low agreement on the absence of such disputes (Mean = 1.95, SD = 0.95).

The availability of basic infrastructure in residential areas was found to be inadequate. Respondents reported limited access to piped water (Mean = 1.76, SD = 0.90) and electricity (Mean = 1.85, SD = 0.92), poor waste management systems (Mean = 1.74, SD = 0.89), insufficient street lighting (Mean = 1.69, SD = 0.87), and limited presence of police outposts (Mean = 1.85, SD = 0.92). These findings indicate that residential areas in the subcounty face significant challenges in access to essential services, which may affect health, security, and overall quality of life.

The study revealed that residential land in Loroo Sub-County is predominantly customary owned (Mean = 4.25, SD = 0.85) and informally settled (Mean = 4.05, SD = 0.96), with households clustered around traditional family homesteads. Planned settlements, including apartment blocks and gated communities, are very rare (Mean = 1.41, SD = 0.74), and there is a notable mix of informal and scattered settlements across the sub-county. This indicates a reliance on customary land tenure systems, which shape settlement patterns and constrain formal residential development.

The cost of acquiring land for residential purposes was generally considered high and unaffordable by respondents (Mean = 2.04, SD = 1.01). This may further limit opportunities for structured residential development and contribute to the prevalence of informal homesteads.

Overall, the findings indicate that residential land use in Loroo Sub-County is largely informal, unplanned, and constrained by inadequate infrastructure and services. The dominance of customary land tenure and traditional homestead clustering reflects the historical and cultural context of land ownership in the area. These conditions highlight the need for strategic planning interventions, infrastructure development, and the formalization of residential areas to improve living conditions and promote sustainable settlement patterns in the sub-county.

Qualitative Analysis of Residential Land Use in Loroo Sub-County

To complement the survey findings, key informant interviews were conducted with two household heads and three members of the Farmers' Forum in Loroo Sub-County. The interviews provided in-depth perspectives on residential land use, planning, and access to infrastructure in the study area.

Respondents consistently emphasized that residential areas in the sub-county are largely informal and unplanned. Household heads reported that families typically settle on customary land inherited from ancestors, often constructing houses close to farmland and in proximity to other family homesteads. One household head explained, *"Most people here live on land inherited from our ancestors. There is no formal planning, and houses are built close to each other. Roads are poor, and we rely on rainwater for domestic use because piped water is unavailable."*

Another head of household highlighted the small size of residential plots and high land costs, noting that electricity and waste management services are scarce. *"Residential plots are small, and it is hard to buy land because the price is high. Electricity is rare, and we do not have proper waste disposal systems. Families build houses near their farmland, so settlements are scattered and informal."*

Members of the Farmers' Forum corroborated these observations. They indicated that customary land tenure dominates, and formal residential planning or development is minimal. One member stated, *"Land here is mostly customary, and there is little regulation for housing. Some families have tried to organize their compounds, but most people just build where they can. Infrastructure like roads and water pipes is almost nonexistent."*

Another member added that planned residential structures, such as apartment blocks or gated communities, are virtually absent, and land acquisition remains informal and costly. *"We see traditional homesteads everywhere. There are no apartment blocks or planned neighborhoods. If you want to buy land, it is expensive, and the process is informal. The government has not intervened much in planning."*

Finally, respondents noted that settlements are clustered but lack proper organization, and disputes occasionally arise due to the informal inheritance of land. *"Settlements are clustered but unplanned. There are land disputes occasionally because people inherit land differently. Services like electricity, street lighting, and waste management are very limited. Most land is under customary ownership."*

Overall, the qualitative findings reinforce the survey results, highlighting a pattern of informal settlement, customary land tenure, scattered homesteads, and inadequate residential infrastructure in Loroo Sub-County. These conditions reflect the historical and cultural context of land use in the area and underscore the need for strategic planning

interventions and infrastructure development to improve living conditions and promote sustainable residential development.

Food Security in Amudat District

Descriptive Analysis of Food Security in Amudat District

The study assessed food security among households in Loroo Subcounty, Amudat District, focusing on availability, access, utilization, and coping strategies. Data collected from 350 respondents indicate a high prevalence of food insecurity in the study area.

Table 5: Food Security in Loroo Sub-County, Amudat District (N = 350)

Statement	SA	A	N	D	SD	Mean	Std Dev
Most households have enough food	15	20	25	150	140	1.61	0.84
Most households have access to all kinds of food	10	15	30	140	155	1.53	0.80
Households feed on nutritious food	12	18	25	145	150	1.56	0.81
We can afford to buy the types of food we prefer	8	10	20	145	167	1.48	0.78
We have fewer than two meals daily	200	100	25	15	10	4.15	0.92
We consume a variety of foods from different food groups	20	25	30	140	135	1.62	0.83
We sometimes borrow food from neighbors or relatives	150	100	25	50	25	3.60	1.05
We store enough food for the scarce period	18	20	30	145	137	1.58	0.82
Most of the food is bought and brought from neighbouring districts	140	90	30	60	30	3.45	1.10

Source: Primary Data (2025)

The findings reveal that most households do not have enough food to meet their daily dietary needs. Only a small proportion of respondents agreed or strongly agreed that households have sufficient food (SA=15, A=20; Mean = 1.61, SD = 0.84). Similarly, access to a variety of foods was reported to be limited (Mean = 1.53, SD = 0.80), and the consumption of nutritious foods was minimal (Mean = 1.56, SD = 0.81). Most households are unable to afford the types of food they prefer, reflecting economic constraints on food access (Mean = 1.48, SD = 0.78).

A significant number of households reported having less than two meals daily (Mean = 4.15, SD = 0.92), indicating severe food insufficiency and inadequate caloric intake. The consumption of diverse food groups is also limited, as most respondents disagreed that they regularly consume a variety of foods (Mean = 1.62, SD = 0.83).

Households employ coping strategies such as borrowing food from neighbors or relatives during periods of scarcity, with a considerable proportion of respondents agreeing to this practice (Mean = 3.60, SD = 1.05). Furthermore, many households rely on food purchased from neighboring districts due to insufficient local production (Mean = 3.45, SD = 1.10), reflecting dependence on external sources for food security. Storage of food for lean periods is minimal, as most households reported inadequate storage facilities or practices (Mean = 1.58, SD = 0.82).

In summary, the descriptive analysis highlights that food insecurity is widespread in Loroo Subcounty, characterized by insufficient food availability, poor access to diverse and nutritious foods, reliance on external sources, and inadequate coping mechanisms. These findings underscore the urgent need for interventions to improve agricultural productivity, local food supply, economic access, and food storage infrastructure to enhance household food security in the sub-county.

Qualitative Insights on Food Security

To complement the survey findings, key informant interviews were conducted with two household heads and three members of the Farmers' Forum. The interviews provided in-depth perspectives on household food security and coping strategies.

One household head highlighted the scarcity of food and limited meal frequency, stating:

"Most days we eat only once or twice. There is never enough food for everyone in the household, and sometimes children go to bed hungry."

The second household head emphasized limited access to preferred and nutritious foods:

"Even when we have food, it is mostly staple grains. We rarely afford vegetables, fruits, or protein-rich foods. Buying what we want is often impossible because of low income and high prices."

Members of the Farmers' Forum provided further insight into household coping mechanisms and reliance on external sources. One member noted:

"During lean periods, many families borrow food from neighbors or relatives. Sometimes we have to buy maize or

beans from neighboring districts because local production is not enough to meet our needs."

Another member discussed the challenges related to food storage and preservation:

"Very few households can store enough food for the dry season. Most food is consumed immediately after harvest, and losses are high due to lack of granaries or other storage facilities."

The third member reflected on household vulnerability and dietary diversity:

"Most families eat the same food every day, mainly maize and beans. There is very little variety, and children often do not get enough nutrients. This affects their health and growth."

These qualitative insights corroborate the survey findings, showing that food insecurity in Loroo Subcounty is severe. Households face challenges in food availability, access, and utilization, with limited dietary diversity, insufficient storage, and reliance on external sources or borrowing during periods of scarcity.

In conclusion, both quantitative and qualitative data indicate that urgent interventions are needed to improve food production, access to markets, dietary diversity, and storage facilities to enhance food security in Loroo Sub-County.

Documentary Review Findings on Food Insecurity in Loroo Sub-County

A documentary review was conducted to complement primary data, drawing on reports from government agencies, non-governmental organizations (NGOs), and academic sources relating to food security in Amudat District and the Karamoja region. The review provides a contextual understanding of the structural and systemic factors contributing to food insecurity in Loroo Sub-County.

Documented evidence indicates that Loroo Sub-County, like much of Amudat District, experiences chronic food deficits due to low agricultural productivity and limited irrigation infrastructure. A 2023 report by the Uganda National Planning Authority (UNPA) on Karamoja noted that agricultural activities in the region are predominantly rain-fed and subsistence-oriented, making households vulnerable to seasonal droughts and erratic rainfall patterns. Similarly, district-level agricultural reports highlight that production of staple crops such as maize, sorghum, and beans is insufficient to meet local demand, necessitating reliance on food imports from neighboring districts.

The review revealed that household access to food is constrained by low income and high food prices. According to a 2022 World Food Programme (WFP) assessment, many households in Amudat spend a significant proportion of their income on basic food items, leaving little room for dietary diversity. In Loroo Subcounty, poor infrastructure, such as inadequate roads and market facilities, further limits access to food markets, particularly during the rainy season when some areas become inaccessible.

Existing documents emphasize that dietary diversity in Loroo Subcounty is low, with most households relying on starchy staples and limited protein sources. A report by the Uganda Bureau of Statistics (UBOS, 2021) found high rates of malnutrition among children under five in the Karamoja region, attributed to inadequate intake of essential nutrients. Household surveys cited in NGO reports reveal that meals often consist of one or two food groups per day, reflecting both economic constraints and limited food knowledge.

Documentary evidence suggests that households in Loroo Sub-County adopt coping mechanisms during periods of food shortage, including borrowing from neighbors, purchasing food on credit, and reducing meal frequency. Reports from local NGOs indicate that some community-based initiatives, such as small-scale irrigation schemes, farmer cooperatives, and food relief programs, have been implemented; however, these interventions remain insufficient to meet the high demand for food security support.

Loroo Sub-County is multifaceted, influenced by climatic variability, limited agricultural infrastructure, low household income, inadequate market access, and poor dietary diversity. The review aligns with primary data collected in this study, indicating that households frequently experience insufficient food availability, low nutritional quality, and reliance on external sources or coping mechanisms during lean periods.

The documentary review thus provides a systemic perspective on the structural challenges of food insecurity in the sub-county, highlighting the need for integrated interventions that address agricultural productivity, market access, income generation, nutrition education, and resilience to climatic shocks.

Correlation Analysis

The study examined the relationship between residential land use and food security among households in Loroo Subcounty, Amudat District. Pearson's correlation analysis was conducted to determine the strength and direction of the association between these variables, as presented in Table 6.

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Table 6: Correlation between residential land use, commercial land use, farming land use, and food security in Amudat District.

Variable	Pearson Correlation with food security	Sig. (2-tailed)	N
Residential land use	0.316	0.002	350

**Correlation is significant at the 0.01 level (2-tailed).*
Source: Primary Data (2025).

Residential land use shows a moderate positive correlation with food security ($r = 0.316$, $p = 0.002$). This implies that improvements in residential planning, such as organized settlements, access to utilities, and secure land tenure, are associated with better food access and household stability. Households located in more organized and serviced residential areas are more likely to have reliable access to food and engage in supplementary livelihood activities, such as backyard gardening and small-scale livestock rearing.

In summary, the correlation analysis demonstrates that farming land use has a moderate influence on residential land use.

Regression Analysis of the Relationship between Land Use and Food Security

To determine the extent to which land use dimensions (residential, commercial, and farming land use) influence food security in Loroo Subcounty, Amudat District, a multiple linear regression analysis was conducted. Food security was treated as the dependent variable, while residential land use, commercial land use, and farming land use were the independent variables. The results are summarized in Table 7.

Table 7: Regression Coefficients

Independent Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	0.842	0.144	—	5.847	0.000
Residential Land Use	0.182	0.052	0.178	3.500	0.001**

***Significant at the 0.01 level (2-tailed)*
Source: Primary Data (2025)

The regression analysis reveals that residential land use is a significant predictor of food security in Loroo Sub-County. Residential land use has a positive but relatively weaker effect on food security ($\beta = 0.178$, $p < 0.01$). Well-planned residential areas with access to land for home gardens, secure tenure, and infrastructure such as roads and water supply contribute to better household nutrition and food stability.

DISCUSSION

Residential Land Use and Food Security in Loroo Subcounty

The study established a moderate positive and statistically significant relationship between residential land use and food security ($r = 0.316$, $p = 0.002$). This finding suggests that improvements in residential land planning and organization, such as access to basic infrastructure, secure land tenure, and proximity to services, enhance household food security. Well-planned residential areas provide households with access to utilities such as water, roads, and electricity, which are essential for supporting livelihood diversification and reducing vulnerability to food insecurity. These results are consistent with the findings of Munyati(2021) and Henderson, Miller, and Green (2020), who observed that unplanned residential expansion in rural areas leads to the fragmentation of agricultural land and reduced food production. In Loroo Subcounty, most residential land is informally organized and characterized by scattered homesteads and limited access to infrastructure, which constrains both home-based food production and market access. As Nguyen (2024) emphasized, such unregulated rural urbanization can undermine local food systems by reducing arable land and increasing dependence on purchased food.

Moreover, Zhang and Li (2019) found that rural housing expansion disrupts smallholder farming systems, making it difficult for households to sustain agricultural production. This observation resonates with conditions in Loroo, where the proliferation of unplanned settlements has encroached upon fertile land, thereby reducing space available for cultivation. Kassie et al. (2020) further noted that this process can heighten food insecurity by raising food prices and straining local supply chains, an effect observed in Loroo, where most food commodities are sourced from neighboring districts.

At the policy level, weak enforcement of zoning and land-use regulations in Uganda parallels findings by Olatunji et al. (2023) in Nigeria, where uncontrolled residential expansion aggravated rural food insecurity. Conversely,

studies such as Sharma and Patel (2022) in India demonstrate that land-use policies protecting agricultural land from residential encroachment can sustain local food production. Hence, the moderate relationship observed in this study suggests that, while residential planning improvements can enhance food access and stability, poorly managed expansion may threaten agricultural productivity and long-term food security in rural Amudat.

Conclusion

The study found a moderate positive relationship between residential land use and food security ($r = 0.316$, $p = 0.002$). This indicates that well-planned residential development, supported by adequate infrastructure and access to basic services, contributes to household food stability and nutrition. Organized settlements with access to water, roads, and electricity create a conducive environment for home-based food production, such as backyard gardens and small livestock keeping. However, unplanned and expansive residential development, often on arable land, continues to threaten food security in Loroo Sub-County.

Recommendation

1. The Amudat District Local Government should develop and implement an integrated land-use plan that designates clear zones for residential, agricultural, and commercial purposes to minimize the conversion of arable land into housing areas.
2. The local government should improve rural infrastructure, such as roads, water supply, and electricity, to support livelihood diversification and small-scale food production within residential areas.
3. The local government should encourage land registration and documentation under customary tenure systems to ensure secure ownership.
4. Extension workers and local NGOs should train households on sustainable backyard gardening techniques, organic composting, and water-efficient irrigation systems to enhance food availability within residential spaces.
5. The District Land Board should enforce zoning regulations and control unregulated housing developments that encroach on productive farmland, ensuring residential growth does not compromise food production potential.

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List of abbreviations

CVI Core Vulnerability Index
FAO Food and Agriculture Organization
NGOs Non-Governmental Organizations
SPSS Statistical Package for the Social Sciences
UBOS Uganda Bureau of Statistics
USAID United States Agency for International Development
WFP World Food Programme

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The authors declare no conflict of interest.

Data availability

Data is available upon request from the author.

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