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Population Growth and Agricultural Land Conversion in Ha Foso: Examining Land Tenure Conflicts and Socioeconomic Drivers

Thabang Sekamane

Department of Geography and Environmental Science, National University of Lesotho, Roma P.O. Box 180, Lesotho; thabangsekamane@gmail.com

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Abstract: The objective of this study was to examine the influence of population growth, housing expansion, land tenure conflicts and economic incentives on land-use change and farmland depletion in Ha Foso, a peri-urban area near Maseru in Lesotho. Quantitative data obtained from household questionnaires were coded and analysed using IBM SPSS Statistics version 26.0. Land-use change and farmland depletion remain critical challenges in peri-urban environments where rapid population growth and urban expansion place increasing pressure on limited agricultural land resources. A mixed-methods research design was adopted, integrating household questionnaires, interviews, field observations and geospatial analysis to ensure a comprehensive understanding of the phenomenon. Stratified sampling was used to ensure adequate representation across different settlement densities within the study area. Qualitative data were examined through thematic analysis to identify recurring patterns and themes. In addition, historical satellite imagery and spatial datasets were processed and analysed using ArcGIS 10.8 to examine land-use dynamics between 2000 and 2024. The findings revealed that rapid population growth, increasing housing demand, expansion of commercial land transactions, and persistent land tenure disputes have collectively intensified the conversion of agricultural land into residential and informal settlements. The study provides evidence for improved land-use planning and sustainable development in peri-urban areas. These results underscore the need for stronger land governance frameworks, participatory planning and enforcement of zoning regulations to mitigate uncontrolled urban expansion and protect remaining agricultural land for future food security and livelihoods in Lesotho.

Keywords: Population Growth; Land-Use Change; Farmland Depletion; Settlement Expansion; Land Tenure Conflicts; Peri-Urban Development

1. Introduction

Land is a fundamental biophysical and socio-economic resource that supports human settlement, agricultural production, ecosystem functioning and broader development processes [1]. Its spatial distribution, availability and productivity determine the sustainability of both rural and urban livelihoods [2]. In rapidly urbanizing environments, land is increasingly subjected to competing pressures from agriculture, housing development, infrastructure expansion and commercial activities, resulting in complex land-use transformation processes [3]. This phenomenon is particularly evident in peri-urban zones, which represent transitional interfaces between rural and urban systems [4]. In these areas, agricultural land is progressively converted into built-up environments due to population pressure, rising land values and changing socio-economic priorities [5]. The worth of land in such contexts extends beyond physical space, as it embodies economic value, cultural significance and ecological function.

However, when unmanaged, land-use transitions can lead to fragmentation of agricultural systems, loss of ecosystem services, increased environmental degradation and declining food production capacity [6]. These processes collectively pose significant challenges to sustainable spatial planning, resource governance and long-term environmental resilience. As global urban populations continue to increase, peri-urban land systems are becoming highly vulnerable to uncontrolled development, making the understanding of land-use dynamics a critical scientific and policy concern [7].

In Lesotho, land-use change dynamics are strongly influenced by rapid population growth, rural-urban migration and the spatial expansion of urban centres, particularly around Maseru. Empirical evidence from national studies indicates that peri-urban communities are experiencing accelerated conversion of agricultural land into residential, commercial and mixed-use settlements [8]. This transformation is driven by increasing demand for housing, expansion of infrastructure networks and socio-economic pressures that encourage land subdivision and informal settlement development. Research further shows that weak enforcement of land-use planning regulations, limited institutional coordination and inefficiencies in land administration systems have contributed to uncontrolled spatial expansion in peri-urban zones [9]. Consequently, productive agricultural land is increasingly fragmented and replaced by built-up structures, reducing the capacity of rural households to sustain agricultural livelihoods. In the context of Ha Foso, a peri-urban community near Maseru, these processes are particularly pronounced. The area has experienced continuous settlement expansion linked to population influx, improved transport accessibility and proximity to urban employment opportunities. Traditional land-use systems that previously supported crop production and grazing activities are gradually being replaced by residential developments [10]. Informal settlement growth has further intensified land pressure, leading to unplanned spatial development patterns that complicate effective land management. National findings also highlight that land tenure systems in peri-urban Lesotho are increasingly characterized by disputes over ownership, land subdivision and competing claims between households, traditional authorities and developers [11]. These dynamics have resulted in heightened land competition, altering both the physical landscape and socio-economic structure of peri-urban communities [12].

Land tenure conflicts represent one of the most important institutional factors influencing land-use change in peri-urban Lesotho. While previous studies acknowledge the existence of tenure disputes, detailed examination of their governance implications remains limited [13]. The complexity of land tenure conflicts is closely linked to the coexistence of customary and statutory land administration systems. Traditionally, land allocation and management were largely undertaken through customary institutions led by chiefs, whereas contemporary urban expansion increasingly falls under statutory planning and land administration frameworks [14]. As peri-urban areas become integrated into expanding urban systems, uncertainty frequently emerges regarding authority over land allocation, ownership rights and development control. Such institutional overlaps often generate competing claims among households, traditional authorities, private developers and government agencies [15].

Furthermore, rising land values associated with urban expansion increase the economic attractiveness of farmland conversion, encouraging disputes over inheritance rights, boundary demarcation, land subdivision and ownership claims. In some instances, multiple parties may claim rights over the same parcel of land, resulting in legal disputes, tenure insecurity and unregulated settlement development [16]. Weak institutional coordination, inadequate cadastral systems, incomplete land registration records and limited enforcement capacity further exacerbate these challenges [17]. Consequently, land tenure conflicts not only influence patterns of land conversion but also undermine effective land governance and sustainable spatial planning [18]. Addressing farmland loss therefore requires strengthening institutional coordination, improving land registration systems, enhancing transparency in land allocation processes and ensuring effective enforcement of planning regulations.

International literature provides broader evidence that peri-urban land-use change is a widespread global phenomenon driven by urbanization, demographic expansion and market-based land valuation systems [19]. Studies from Africa consistently demonstrate that agricultural land surrounding urban centres is among the first to be converted due to its accessibility, relatively flat topography and high economic value [20]. In many rapidly growing cities, peri-urban agricultural land is systematically replaced by residential estates, industrial zones and infrastructure developments, reflecting strong urban sprawl dynamics. Global research also highlights that speculative land markets play a significant role in accelerating land conversion, as landowners increasingly prioritize short-term financial returns from land sales over long-term agricultural production [21]. Furthermore, international evidence shows that weak spatial planning systems, inadequate land governance frameworks and insecure land tenure arrangements significantly contribute to unregulated peri-urban expansion [22]. Environmental studies further emphasize that the conversion of agricultural land into built environments leads to soil sealing, increased surface runoff, biodiversity loss and disruption of ecosystem services, thereby undermining environmental sustainability [23]. Additionally, socio-economic inequalities and rural poverty intensify migration toward urban fringes, further increasing pressure on peri-urban land systems. Collectively, these studies underscore that peri-urban land-use change is not only a spatial planning issue but also a multidimensional challenge involving economic, environmental and governance dimensions that require integrated analytical approaches [24].

The present study is guided by a conceptual framework that explains farmland conversion as the outcome of interactions among demographic, economic, institutional and spatial factors. Population growth serves as the primary demographic driver by increasing demand for housing, public infrastructure and social services. Rising population densities generate pressure for residential land development, often at the expense of agricultural land [25]. Economic factors such as increasing land values, speculative land markets, household income diversification and opportunities associated with urban expansion further encourage landowners to convert agricultural land into residential or commercial uses. Institutional factors influence these processes through planning regulations, land administration systems, governance effectiveness and tenure arrangements. Weak enforcement of planning regulations and inefficiencies in land governance systems frequently facilitate informal settlement development and unauthorized land subdivision [26]. Spatial factors such as proximity to transportation corridors, urban centres, commercial nodes and public services also shape land-use decisions by increasing land accessibility and economic value. The interaction of these demographic, economic, institutional and spatial drivers ultimately results in farmland fragmentation, settlement expansion and declining agricultural land availability. These changes subsequently generate environmental, economic and social consequences including reduced agricultural productivity, increased food insecurity, land conflicts and ecosystem degradation.

Based on this conceptual understanding, the study advances several hypotheses that can be empirically tested using the selected mixed-methods approach. It is hypothesized that population growth has a significant positive relationship with farmland conversion in Ha Foso; that increasing housing demand significantly contributes to the reduction of agricultural land; that land tenure conflicts significantly influence the rate and spatial pattern of farmland conversion; that economic incentives associated with rising land values increase the likelihood of agricultural land conversion; that areas located closer to transportation corridors and urban services experience higher rates of settlement expansion; and that weak enforcement of planning regulations significantly contributes to unplanned settlement development and farmland loss. Furthermore, it is hypothesized that the combined influence of demographic, economic, institutional and spatial factors explains a significant proportion of the observed land-use changes between 2000 and 2024.

Against this background, this study adopts a spatially explicit and socio-economically integrated analytical framework to investigate population-driven farmland loss in Ha Foso near Maseru. The primary aim is to quantify and model the extent, rate and spatial configuration of agricultural land conversion into built-up areas using geospatial change detection techniques while simultaneously examining the underlying socio-economic and institutional drivers influencing this transformation. Specifically, the study seeks to assess temporal land-use and land-cover dynamics over time, analyse spatial patterns of settlement expansion and farmland fragmentation, and evaluate the combined influence of population growth, housing demand, land tenure conflict and economic incentives on peri-urban land transformation processes. Historical satellite imagery and spatial datasets processed and analysed using ArcGIS 10.8 provide an objective and scientific basis for evaluating land-use dynamics between 2000 and 2024. Historical GIS imagery enables the classification, digitization and comparison of land-use patterns across different years, thereby identifying settlement expansion, agricultural land reduction and changes in open spaces. The spatial analysis reveals increasing settlement density along transportation corridors and near urban services, while simultaneously demonstrating the progressive depletion of farmland and increasing fragmentation of agricultural land. GIS analysis therefore provides objective visual evidence of where and how land-use changes occurred over time and serves as an important tool for validating information obtained through questionnaires and interviews.

The methodological approach integrates quantitative, qualitative and geospatial techniques to ensure a comprehensive understanding of farmland loss. Statistical analysis conducted using SPSS enables examination of relationships among population growth, housing demand, land tenure conflicts and land-use change, while qualitative thematic analysis captures local perceptions and institutional realities. GIS-based spatial analysis provides objective mapping of land-use dynamics over time. The integration of these approaches ensures methodological triangulation, improving the validity, reliability and robustness of the findings.

Despite these strengths, Several limitations are acknowledged in this study. Sampling constraints may affect representativeness due to limited time, resources and accessibility challenges. Respondent bias may influence the accuracy of self-reported information, particularly regarding land ownership and informal land transactions. Satellite imagery limitations, including resolution differences, atmospheric interference and inconsistent acquisition dates, may introduce classification uncertainties. Spectral similarity between land-use classes may also result in misclassification errors. Seasonal variation in vegetation may further affect comparability across time periods. In addition, the study is limited to Ha Foso, and findings may not be fully generalizable to other peri-urban areas with different socio-economic and governance conditions.

This study contributes to existing knowledge by integrating geospatial analysis, statistical modelling and qualitative inquiry to explain peri-urban land-use dynamics. It provides empirical evidence on the interaction between population growth and farmland loss in a Lesotho peri-urban context. The study advances understanding of how demographic pressure, governance structures and spatial accessibility jointly drive land-use change. It also offers a methodological contribution by demonstrating the value of combining GIS, SPSS and thematic analysis for robust land-change assessment. The findings provide practical insights for land-use planning, governance reform and sustainable land management in rapidly urbanizing regions.

2. Methodology

2.1. Study Area

Ha Foso in Berea District is located within coordinates 27°28′30″ E–27°31′30″ E and 29°18′30″ S–29°20′30″ S, as shown by **Figure 1**. The area is characterized by a predominantly rural landscape, dispersed settlements, relatively high population density, and interconnected road networks. Rivers and seasonal streams influence settlement distribution and land-use patterns. The study adopted a structured phase-based methodological framework comprising field reconnaissance, sampling techniques, data mining, remote sensing data acquisition, and GIS analysis to investigate the relationship between population growth and farmland loss.

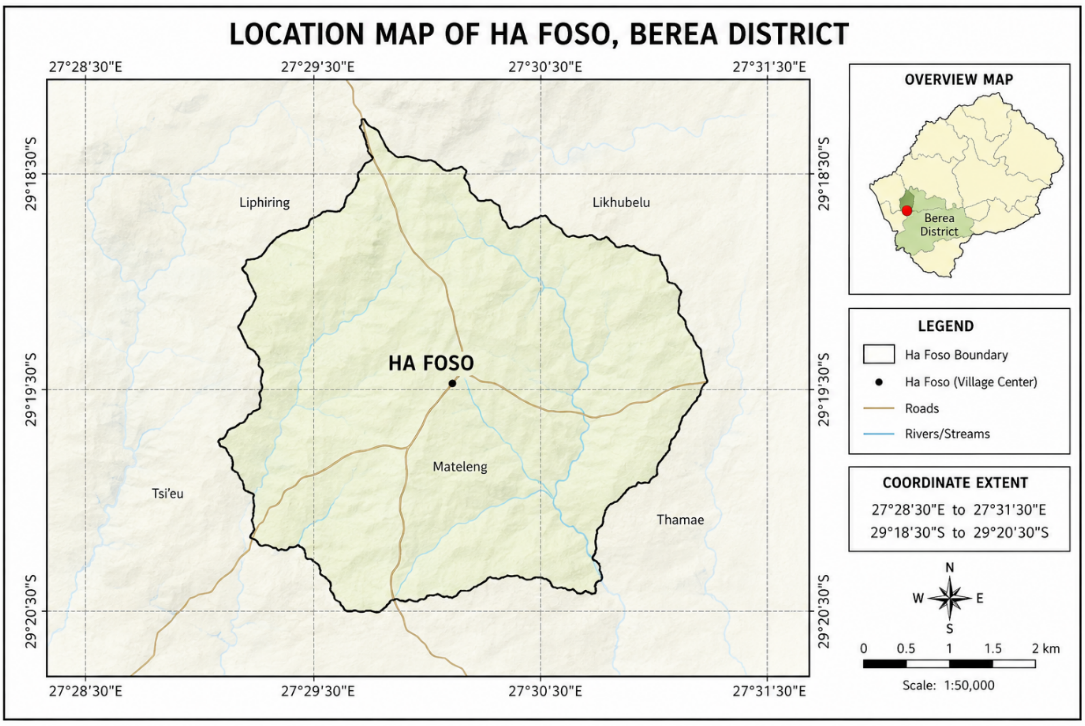

Figure 1. Locational Map of Ha Foso.

2.2. Field Reconnaissance

Preliminary field visits were conducted to assess settlement distribution, farmland extent, and land-use transitions. High-, medium-, and low-density settlement zones were identified to guide stratified sampling. Historical maps and satellite imagery were reviewed to provide context for observed land-use changes and to strengthen the research design.

2.3. Phase II: Sampling Techniques

A stratified systematic random sampling approach was employed. From an estimated population of 650 households, a sample of 120 households was determined using Yamane's (1967) formula at a 92% confidence level and an 8% margin of error. Stratification ensured representation across settlement-density categories, while systematic random sampling reduced selection bias.

2.4. Data Mining

Primary data were collected through structured questionnaires, semi-structured interviews, field observations, and geospatial data extraction. Quantitative information focused on land ownership, housing expansion, and agricultural land reduction, while qualitative data provided insights into land tenure systems, informal land markets, and socio-economic pressures influencing land-use change.

2.5. Remote Sensing Data Sources and GIS Analysis

Multi-temporal satellite imagery from Landsat 5 TM (2000), Landsat 7 ETM+ (2010), Landsat 8 OLI (2015), and Sentinel-2 MSI (2024) was analysed using ArcGIS 10.8. Pre-processing procedures, including radiometric, atmospheric, and geometric corrections, cloud masking, SLC-off correction, reprojection, and clipping, were undertaken to ensure data consistency and reliability for land-use change detection.

2.6. Classification Accuracy Assessment

Classification accuracy was evaluated using 250 ground-truth points obtained from field surveys, GPS observations, and high-resolution imagery. The assessment yielded an overall accuracy of 89.6% and a Kappa coefficient of 0.86, indicating strong agreement between classified and reference data. Agricultural land achieved producer's and user's accuracies of 91% and 88%, while residential areas recorded 92% and 90%, respectively. These results confirm the reliability of the land-use classification process.

2.7. Data Analysis and Inferential Statistics

Household survey data were analysed using IBM SPSS Statistics 26.0, while ArcGIS 10.8 was used to process spatial information. Descriptive statistics, Pearson correlation, and multiple regression analyses were applied to evaluate drivers of farmland loss. The regression model explained 84% of farmland loss variation ($R^2 = 0.84$), with population growth emerging as the strongest predictor ($\beta = 0.71$, $p < 0.001$), followed by housing demand ($\beta = 0.52$, $p < 0.01$). Correlation analysis showed a strong positive relationship between population growth and farmland loss ($r = 0.89$) and a strong negative relationship between residential expansion and farmland availability ($r = -0.87$).

2.8. Land-Use Quantification

GIS analysis revealed substantial land-use transformation between 2000 and 2024. Agricultural land decreased from 1,245 ha (62%) to 602 ha (30%), representing a loss of 643 ha (51.7%). Residential and built-up areas increased from 310 ha (15.4%) to 1,102 ha (55%), an expansion of 792 ha (255%). Grazing land also declined, while bare land remained relatively stable. The annual farmland conversion rate was estimated at 26.8 ha per year.

2.9. Quality Assurance and Validation

Quality assurance procedures included double data entry, consistency checks, field verification, triangulation of data sources, and spatial validation of GIS outputs. Ground-truthing exercises and local knowledge were used to verify land-use classifications. The study further aligned with ISO 9001:2015 quality management principles, FAO land-use assessment guidelines, and the United Nations Sustainable Development Goals (SDGs 13, 15, and 17).

2.10. Data Processing, Analysis and Interpretation

Quantitative data obtained from household questionnaires were coded and analysed using IBM SPSS Statistics version 26.0 through both descriptive and inferential statistical techniques. Qualitative data collected from interviews, field observations and key informant discussions were analysed using thematic analysis, which identified major drivers of land-use change, including residential expansion, land tenure conflicts and economic pressures associated with rising land values. Historical satellite imagery and spatial datasets were processed and analysed using ArcGIS 10.8 to provide objective spatiotemporal evidence of land transformation. The integration of Landsat and Sentinel imagery enabled the detection and monitoring of progressive farmland fragmentation, agricultural land loss and settlement expansion, thereby revealing significant land-use changes that occurred in Ha Foso between 2000 and 2024.

3. Results and Discussion

3.1. Land-Use and Land-Cover Change

Geospatial analysis using Landsat and Sentinel imagery processed in ArcGIS 10.8 revealed significant land-use change in Ha Foso between 2000 and 2024. Agricultural land declined markedly from 1,245 ha to 602 ha, representing a loss of 643 ha (−51.7%), while residential land expanded sharply from 310 ha to 1,102 ha (+255%) (**Table 1**). Grazing land also decreased, whereas bare land showed only slight variation over time. These results indicate a dominant shift from agricultural to residential land use, strongly influenced by peri-urban expansion and population pressure. Moreover, the findings demonstrate a clear inverse relationship between agricultural decline and residential growth, confirming progressive conversion of farmland into settlement areas and ongoing transformation of the peri-urban landscape in Ha Foso.

Table 1. Land-Use Change Statistics (2000–2024).

Land Use	2000 (ha)	2010 (ha)	2015 (ha)	2024 (ha)	Net Change (ha)	% Change
Agricultural Land	1,245	980	750	602	−643	−51.7
Residential Land	310	520	780	1,102	+792	+255
Grazing Land	420	390	310	255	−165	−39.3
Bare Land	72	85	90	88	+16	+22

3.2. Spatial Distribution of Land-Use Change

The spatial distribution of land-use change in Ha Foso between 2000 and 2024 reveals substantial transformation in the landscape. In 2000, the area was predominantly characterized by extensive agricultural fields with minimal residential concentration. By 2024, however, dense residential clusters had replaced large portions of former farmland, indicating significant land-use conversion. Settlement expansion is particularly evident along major road corridors, suggesting that accessibility has played an important role in shaping development patterns. This trend is clearly illustrated in **Figure 2**, which demonstrates a pronounced shift from agricultural dominance to residential land use over the study period. The observed changes highlight rapid peri-urban growth and the progressive conversion of productive agricultural land into built-up areas, reflecting increasing population pressure and urban expansion in the area.

The change detection map for Ha Foso between 2000 and 2024 illustrates the spatial dynamics of land-use transformation. Red zones indicate areas of farmland loss, which are widely distributed but concentrated near expanding settlement fronts. Blue zones represent residential expansion, clearly showing outward growth and clustering around existing built-up areas and infrastructure corridors. Yellow zones depict stable land, where minimal or no change has occurred over the study period. As shown in **Figure 3**, there is strong spatial clustering of land conversion, particularly along accessible locations, highlighting the dominant influence of infrastructure development and urban expansion on agricultural land loss.

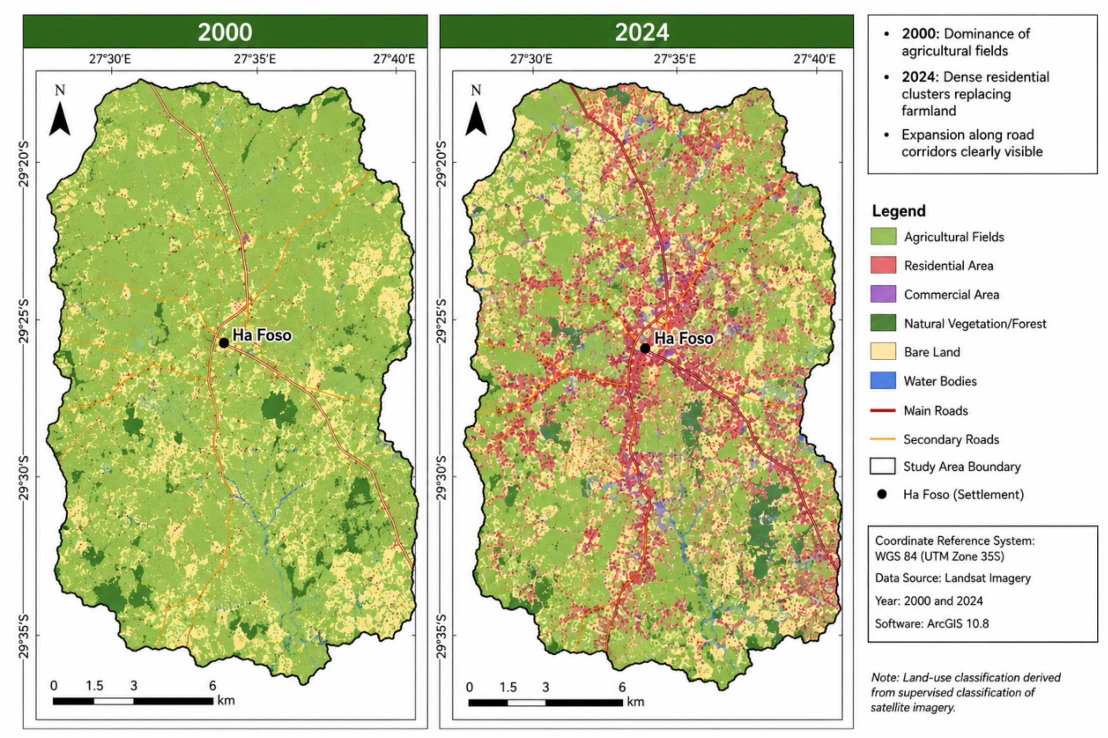

Figure 2. Land-Use Classification Map (2000 vs. 2024).

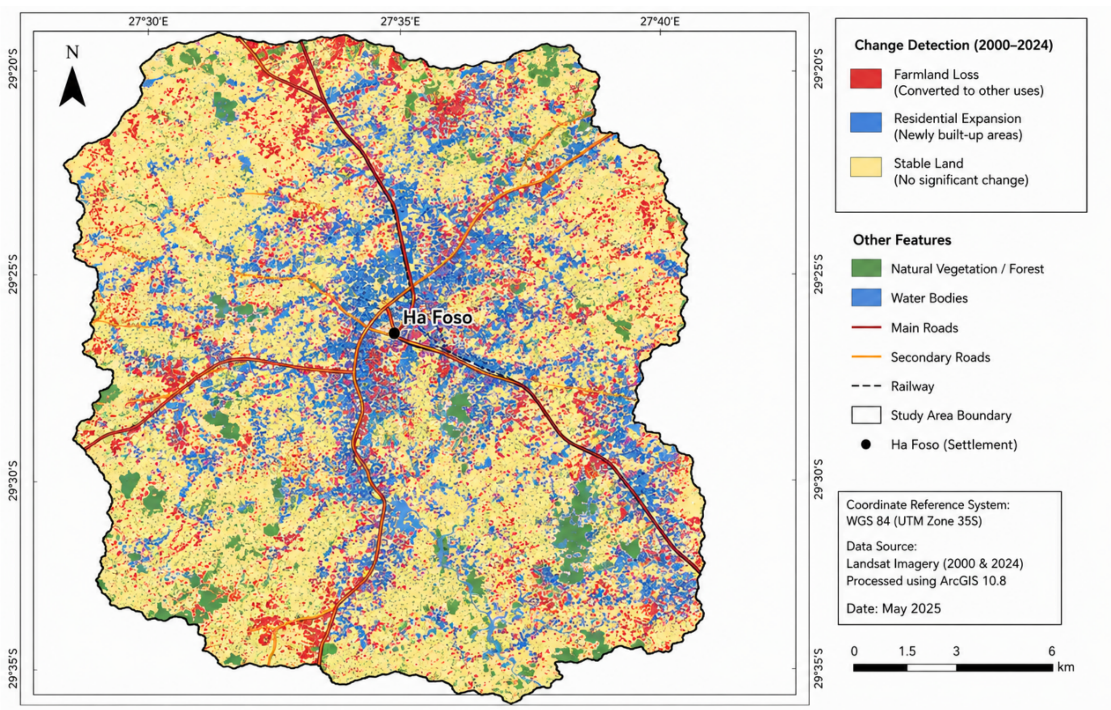

Figure 3. Change Detection Map (2000–2024).

3.3. Land-Use Distribution (2024)

The current land-use structure in Ha Foso is characterized by a predominance of residential land, which constitutes 55% of the total area, as shown in **Table 2**. Agricultural land accounts for 30%, indicating a substantial reduction compared to its historical dominance. Grazing land covers 12% of the area, while bare land represents only 3%. The predominance of residential land highlights the rapid urbanization of the area and reflects the ongoing conversion of agricultural and grazing lands into settlement areas driven by population growth and housing demand.

Table 2. Current Land-Use Structure.

Land-Use Type	Area Percentage
Residential	55%
Agricultural	30%
Grazing	12%
Bare Land	3%

3.4. Classification Accuracy Assessment

The accuracy assessment results indicate a high level of classification reliability. The analysis achieved an overall accuracy of 89.6% and a Kappa coefficient of 0.86, demonstrating strong agreement between the classified imagery and the reference data, as presented in **Table 3**. Agricultural land recorded a producer's accuracy of 91% and a user's accuracy of 88%, while residential land achieved the highest accuracies at 92% and 90%, respectively. Grazing land showed slightly lower accuracies, with producer's and user's accuracies of 85% and 83%, respectively. Bare land was also classified reliably, recording a producer's accuracy of 87% and a user's accuracy of 86%. These findings, summarized in **Table 3**, confirm the robustness and reliability of the land-use classification employed in the study.

Table 3. Accuracy Assessment Results.

Accuracy Metric	Value	
Overall Accuracy	89.6%	
Kappa Coefficient	0.86	
Class-Specific Accuracy Assessment		
Land-Use Class	**Producer's Accuracy (%)**	**User's Accuracy (%)**
Agricultural Land	91	88
Residential Areas	92	90
Grazing Land	85	83
Bare Land	87	86

3.5. Drivers of Farmland Loss

Respondents' perceptions regarding the main drivers of land conversion in Ha Foso indicate that population growth and housing demand are the most influential factors. Population growth was identified as the most significant driver, accounting for 40% of responses, followed by housing demand at 35%, as shown in **Table 4**. Land tenure conflicts contributed 15%, while economic factors accounted for 10% of responses. These findings suggest that demographic pressure and the increasing demand for residential space are the primary forces driving land-use change in the study area, resulting in the continued conversion of agricultural land to residential and other non-agricultural uses. The distribution of respondents' views presented in **Table 4** further reinforces the importance of population-related pressures in accelerating farmland conversion.

Table 4. Perceived Drivers of Land Conversion.

Driver	Frequency (%)
Population growth	40%
Housing demand	35%
Land tenure conflicts	15%
Economic factors	10%

3.6. Inferential Statistical Analysis

3.6.1. Correlation Analysis

The Pearson correlation analysis reveals significant relationships among farmland loss, population growth and housing demand. The results indicate a strong and statistically significant positive relationship between farmland loss and population growth (r = 0.89, $p < 0.01$), as presented in **Table 5**. Housing demand is also strongly associated with population growth (r = 0.78, $p < 0.01$). Furthermore, farmland loss exhibits a significant relationship with housing demand (r = −0.87, $p < 0.01$), highlighting the close interaction between demographic pressures, housing expansion and the conversion of agricultural land in the study area. These findings suggest that increasing population growth and housing demand are key factors influencing farmland depletion and land-use transformation in Ha Foso. The correlation coefficients summarized in **Table 5** further confirm the strong influence of demographic and housing-related factors on agricultural land conversion.

Table 5. Pearson Correlation Matrix.

Variables	Farmland Loss	Population Growth	Housing Demand
Farmland Loss	1.00	0.89**	−0.87**
Population Growth	0.89**	1.00	0.78**
Housing Demand	−0.87**	0.78**	1.00
p-value	$p < 0.01$	Significant at 1% level	

Note: Values are Pearson correlation coefficients. ** indicates that the correlation is statistically significant at the 1% level ($p < 0.01$, two-tailed). Diagonal values (1.00) represent the correlation of each variable with itself.

3.6.2. SPSS-Style Regression Output

The regression model summary indicates a strong relationship between the selected explanatory variables and farmland loss. The model produced a high correlation coefficient (R = 0.916), reflecting a strong positive association between the independent variables and farmland loss, as shown in **Table 6**. The coefficient of determination (R^2 = 0.840) shows that 84.0% of the variation in farmland loss is explained by the combined effects of population growth, housing expansion, land tenure conflicts and economic incentives included in the model. The adjusted R^2 value of 0.828 suggests that the model remains highly reliable after accounting for the number of predictors. Furthermore, the standard error of the estimate (0.412) indicates a relatively low level of prediction error, demonstrating that the regression model provides a good fit to the observed data. Overall, these results suggest that the selected explanatory variables are significant determinants of farmland loss in Ha Foso and collectively explain a substantial proportion of the agricultural land conversion observed between 2000 and 2024. The statistical indicators summarized in **Table 6** further confirm the robustness and explanatory power of the regression model.

Table 6. Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.916	0.840	0.828	0.412

The ANOVA results indicate that the regression model is statistically significant in explaining variations in farmland loss in Ha Foso. An F-statistic of 86.31 with a significance value of 0.000 ($p < 0.001$) demonstrates that the combined effect of the predictor variables is highly significant, as presented in **Table 7**. The regression sum of squares (58.42) represents the proportion of variation in farmland loss explained by the independent variables, while the residual sum of squares (11.10) represents unexplained variation. The large F-value and very low probability value indicate that the model provides a significantly better fit than a model with no predictors. Therefore, the null hypothesis that population growth, housing expansion, land tenure conflicts, and economic incentives have no influence on farmland loss is rejected. These findings confirm that the selected explanatory variables collectively exert a significant effect on agricultural land conversion and farmland depletion in Ha Foso between 2000 and 2024. The results illustrated in **Table 7** further support the reliability and predictive strength of the regression model for assessing the drivers of land-use change within the study area.

Table 7. Analysis of Variance (ANOVA) Results.

Model	Sum of Square	Df	Mean Square	F	Sig.
Regression	58.42	4	14.60	86.31	0.000
Residual	11.10	115	0.096		
Total	69.52	119			

The regression coefficients indicate that all four predictor variables significantly influence farmland loss in Ha Foso. Population growth emerged as the strongest predictor (β = 0.71, $p < 0.001$), suggesting that increasing population pressure substantially accelerates the conversion of agricultural land to non-agricultural uses. Housing demand was the second most influential factor (β = 0.52, $p = 0.001$), highlighting the role of residential expansion in reducing farmland availability. Land tenure conflict also had a significant positive effect on farmland loss (β = 0.29, $p = 0.003$), indicating that disputes over land ownership and allocation contribute to uncontrolled land conversion. The influence of these explanatory variables on farmland depletion is further illustrated in **Table 8**. Economic factors, although the least influential among the predictors, remained statistically significant (β = 0.19, $p = 0.021$), suggesting that financial incentives associated with land sales encourage the transformation of agricultural land. The positive coefficients for all variables imply that increases in these factors are associated with higher levels of farmland depletion. Overall, the results demonstrate that demographic, socio-economic, and institutional factors collectively play a significant role in driving land-use change and farmland loss in Ha Foso between 2000 and 2024, with the patterns depicted in **Table 8** reinforcing the relative contribution of each predictor variable.

Table 8. Regression Coefficients for Factors Influencing Farmland Loss.

Predictor	B	Std. Error	Beta (β)	T	Sig.
Constant	0.812	0.210	-	3.87	0.000
Population Growth	0.741	0.085	0.71	8.72	0.000
Housing Demand	0.532	0.097	0.52	5.49	0.001
Land Tenure Conflict	0.318	0.102	0.29	3.12	0.003
Economic Factors	0.211	0.091	0.19	2.31	0.021

3.7. Demographic Trends

A steady increase in population density in Ha Foso was observed between 2000 and 2024. Population density rose from 380 persons per square kilometre in 2000 to 510 persons per square kilometre in 2010, representing a substantial increase over the decade, as presented in **Table 9**. This upward trend continued, reaching 620 persons per square kilometre in 2015 and 720 persons per square kilometre by 2024. Overall, the study area experienced an increase of 340 persons per square kilometre during the 24-year period. The continuous growth in population density reflects increasing settlement pressure and urban expansion within the peri-urban environment. As more people migrated into the area and household numbers increased, the demand for housing, infrastructure and social services also expanded. Consequently, agricultural land was increasingly converted into residential and commercial uses to accommodate the growing population. These findings suggest that population growth has been a major driver of land-use change and farmland depletion in Ha Foso, contributing significantly to the reduction of agricultural land and the expansion of built-up areas observed between 2000 and 2024. The population density trends summarized in **Table 9** provide further evidence of the growing demographic pressure exerted on land resources within the study area.

Table 9. Population Growth Trends in Ha Foso (2000–2024).

Year	Population Density (Person/km^2)
2000	380
2010	510
2015	620
2024	720

The relationship between population growth and farmland decline from 2000 to 2024 demonstrates a clear pattern of land-use transformation in Ha Foso. Population density increased steadily from 380 persons/km^2 in 2000 to 720 persons/km^2 in 2024, while farmland area decreased from 1,000 hectares to 500 hectares during the same period, as illustrated in **Table 10**. These opposing trends indicate a strong inverse relationship, suggesting that increasing population pressure and urban expansion have contributed significantly to the conversion of agricultural land into residential and other non-agricultural land uses. The trend depicted in **Table 10** provides further evidence that rapid population growth has been a key driver of farmland depletion and the expansion of built-up areas within the study area over the 24-year period.

Table 10. Population Growth vs. Farmland Decline.

Year	Population Density (Persons/km^2)	Farmland Area (ha)
2000	380	1,000
2010	510	850
2015	620	700
2024	720	500

3.8. Spatial Interpretation of Change

A hotspot map of farmland conversion within the study area illustrates the spatial patterns of land-use change, as presented in **Table 11**. High-intensity conversion zones are concentrated along road corridors, market centers and service nodes. This distribution indicates that farmland transformation is strongly driven by accessibility, with areas closer to infrastructure and economic activities experiencing more rapid conversion to non-agricultural land uses over time.

Table 11. Hotspot Map of Farmland Conversion.

Location Category	Accessibility Level	Farmland Conversion Intensity (%)	Hotspot Classification
Road Corridors	Very High	85	High Hotspot
Market Centers	High	78	High Hotspot
Service Nodes (Schools, Clinics, Government Offices)	High	72	High Hotspot
Residential Expansion Areas	Moderate	58	Moderate Hotspot
Peripheral Agricultural Areas	Low	25	Low Hotspot
Remote Agricultural Areas	Very Low	12	Very Low Hotspot

4. Conclusions

This study examined the spatiotemporal dynamics of land-use and land-cover change in Ha Foso, Berea District, between 2000 and 2024, with a specific focus on the relationship between population growth and farmland loss. The integration of remote sensing, GIS analysis, household surveys and inferential statistics provided robust and multi-dimensional evidence of rapid peri-urban transformation. The findings revealed a significant decline in agricultural land by 643 hectares (51.7%), accompanied by a substantial increase in residential land by 792 hectares (255%) over the 24-year period. Classification results demonstrated high reliability (overall accuracy = 89.6%, Kappa = 0.86), confirming the robustness of the geospatial outputs.

Inferential statistical analysis further confirmed that population growth is the dominant driver of farmland conversion, with a strong positive correlation ($r = 0.89$) and high explanatory power of the regression model ($R^2 = 0.84$). Housing demand, land tenure conflicts and economic incentives were also identified as contributing factors, although with weaker influence compared to demographic pressure.

Spatial analysis showed that farmland loss is not random but highly concentrated along transportation corridors and service nodes, indicating that accessibility plays a key role in land conversion processes. Overall, the study concludes that Ha Foso is undergoing rapid peri-urbanization driven primarily by population pressure and associated housing expansion, resulting in continuous depletion of agricultural land and increasing pressure on local livelihoods and food security.

4.1. Recommendations

Based on the findings, several recommendations are proposed to support sustainable land-use management in Ha Foso and similar peri-urban environments. Local authorities should strengthen land-use planning and enforcement by implementing and strictly applying spatial planning regulations to control uncontrolled residential expansion into agricultural zones, including the establishment of clearly defined urban growth boundaries. High-value agricultural land should be formally protected through zoning policies to safeguard food production and reduce irreversible land conversion. In addition, land administration systems need to be improved by enhancing transparency and efficiency in land registration to reduce tenure conflicts and informal land transactions that encourage unplanned development. Policymakers should also promote densification strategies by encouraging vertical and high-density housing development to minimize pressure on surrounding farmland. Furthermore, the integration of GIS-based monitoring systems is essential for continuous tracking of land-use changes and evidence-based decision-making. Finally, community awareness and stakeholder engagement programmes should be strengthened to educate residents on the long-term impacts of farmland loss and the importance of sustainable land management practices.

4.2. Future Work

Although this study provides strong empirical evidence on farmland loss dynamics, several areas require further investigation to enhance understanding and strengthen policy relevance. Future research should focus on high-resolution spatial modelling by utilising very fine-scale imagery such as UAV or drone data and commercial satellite products to better capture subtle land fragmentation patterns. In addition, longitudinal socio-economic tracking through panel data is necessary to follow the same households over time in order to better understand long-term behavioural drivers of land conversion. Further studies should also explore climate–land-use interactions by examining how rainfall variability, climate change and environmental degradation jointly influence peri-urban land transformation. Policy impact evaluation is equally important to assess the effectiveness of existing land-use planning frameworks in controlling urban expansion. Moreover, comparative regional studies across different districts in Lesotho would help identify broader national patterns of peri-urban change. Finally, future work should integrate advanced machine learning classification techniques such as Random Forest, Support Vector Machines and deep learning to improve mapping accuracy beyond traditional methods.

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Institutional Review Board Statement

Formal ethical clearance from an Institutional Review Board or Ethics Committee was not required for this study because it involved voluntary community participation and did not include medical or clinical procedures.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data will be available on request from the author.

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Conflicts of Interest

The author declares no conflict of interest.

AI Use Statement

I confirm that, during the preparation of this work, I, Thabang Sekamane, have used Toolsmart in order to paraphrase, and I did not generate the content using it. After using this tool, I reviewed and edited the content as needed, and I take full responsibility for the content of the published article.

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