International Journal of Research Publication and Reviews, Vol 6, Issue 7, pp 3301-3312 July 2025

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Nexus between Factors of Location of Commercial Land Use and Environmental Quality in Akwa Ibom State, Nigeria

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ABSTRACT

This study examined the relationship between the key factors influencing the location of commercial land use and environmental quality. Such factors include accessibility, transportation, population density, and land cost, and their impact on environmental quality. Businesses prioritize areas with high accessibility and lower land costs, often contributing to urban sprawl, increased emissions, and habitat loss. Using a combination of primary and secondary data, factor analysis, and regression, this research identifies the significant environmental consequences of commercial land use decisions. The study highlights the need for urban planners and policymakers to integrate environmental considerations into commercial land use planning. By promoting sustainable practices such as green building initiatives and regulatory collaboration, urban areas can mitigate the negative effects of commercial expansion on environmental quality. The findings stress the importance of developing resilient cities that balance economic development with environmental sustainability.

Keywords: Location, Factors, Environmental Quality, Commercial Land Use

1. Introduction

The relationship between the factors influencing the location of commercial land use and environmental quality are a web. This web is shaped by economic, social, and ecological considerations. Commercial land use refers to the areas designated for businesses, such as retail shops, offices, and services, which play a critical role in shaping the economic structure of cities. However, the choice of location for these commercial activities is influenced by several factors, such as accessibility, proximity to transportation networks, population density, and land cost. These factors often directly or indirectly impact environmental quality, which defines the health and sustainability of natural resources, ecosystems, and the living conditions of urban populations.

Accessibility and transportation infrastructure are key determinants in the location of commercial activities. Businesses often prefer areas with high accessibility, close to major highways or public transit systems, to attract customers and reduce transportation costs. However, the concentration of commercial activities in accessible areas often leads to higher traffic volumes, resulting in increased vehicular emissions, noise pollution, and a strain on air quality (McGarry, 2018). The environmental consequences of such developments may include higher levels of greenhouse gas emissions, contributing to global warming and local air quality degradation, thereby reducing overall environmental quality.

Population density is another critical factor influencing commercial land use. Commercial areas tend to thrive in densely populated regions where the demand for goods and services is high. This concentration of commercial activities, however, can exacerbate urban sprawl, increase waste generation, and cause a greater demand for water, energy, and other resources (Tavernier and Koontz, 2020). These pressures can negatively affect local ecosystems, leading to habitat loss, reduced biodiversity, and strained infrastructure, which all undermine environmental quality.

Land cost is also a determining factor. In many cases, lower land costs in suburban or peripheral urban areas encourage businesses to relocate or establish commercial ventures away from city centres. While this may reduce immediate costs for businesses, it can lead to the expansion of commercial land use into previously undeveloped or natural areas, causing deforestation, loss of green spaces, and changes in local hydrology (Nguyen, Tran and Le, 2019). These environmental impacts are often long-lasting and difficult to mitigate, significantly affecting the environmental quality of both urban and rural settings.

In conclusion, the location of commercial land use is closely tied to a range of environmental quality issues. The challenge for urban planners and policymakers is to balance the economic benefits of commercial development with the need to protect and improve environmental quality. Sustainable land use policies, such as zoning regulations, environmental impact assessments, and the promotion of green infrastructure, are crucial in achieving this balance. To guide this research, the following null hypothesis is formulated for testing: There is no significant relationship between the factors influencing the location of commercial land use and the environmental quality in the study area.

2. Study area

Uyo, the capital of Akwa Ibom State, serves as the state's administrative center and is located in its most developed region. Geographically, it lies at 5.0333° N latitude and 7.9333° E longitude within the tropical rainforest zone, about 45 kilometers from the Atlantic Ocean (Udo, 2020). Uyo's terrain is flat, with gentle slopes and valleys, and has an average elevation between 50 to 100 meters above sea level. The city experiences a tropical monsoon climate with high temperatures of around 28°C (82°F), high humidity of about 80%, and annual rainfall of approximately 2,400 mm (94 inches) (Etuk, 2018).

Eket is one of Akwa Ibom's 31 local government areas and serves as the headquarters of one of the state's senatorial districts. The indigenous people of Eket village are known as the Ekid's. Located at 4.65° N latitude and 7.93° E longitude, it serves as the headquarters of one of Akwa Ibom's senatorial districts (Ekong, 2015). Covering about 176,000 square kilometers, Eket has a population density of 1,241 people per square kilometer as of 2013. It plays a key role in the local economy as an administrative and commercial hub (Essien, 2014).

Ikot Ekpene, also called "Raffia city," is the second-largest urban center in Akwa Ibom after Uyo. Positioned at 5.17° N latitude and 7.72° E longitude, it is historically significant for being a site of British experiments in local self-governance in 1951 (Usoro, 2017). As the political and cultural capital of the Annang ethnic group, Ikot Ekpene is a major trade center, known for its agricultural products and raffia handicrafts, as well as palm oil exports (Inyang, 2016).

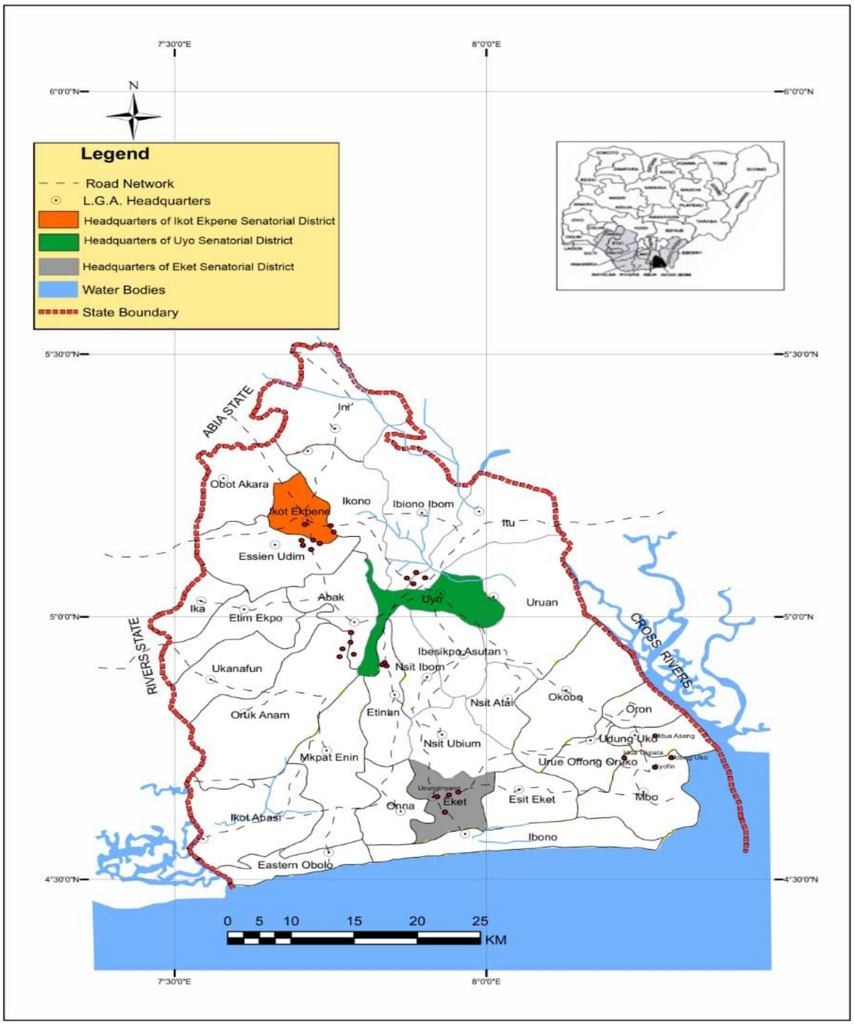


Figure 1: Map showing the three Urban area of the study in Akwa Ibom State

Source: National Population commission (2024)

3. Literature Review

The relationship between the factors influencing the location of commercial land use and environmental quality is indeed complex, encompassing economic, social, and environmental dimensions. One of the primary considerations for businesses when selecting locations is accessibility. Businesses tend to prefer areas close to transportation hubs, major highways, and city centers to maximize customer footfall and ensure efficient supply chain logistics. However, these highly accessible areas often suffer from increased environmental degradation. As McCarthy (2009) points out, increased traffic volumes, heightened pollution levels, and the elevated consumption of resources are common byproducts of commercial concentration in accessible regions. This not only strains infrastructure but also contributes to the degradation of air quality, noise levels, and overall environmental health.

One major consequence of commercial activity in densely accessible areas is the "urban heat island" effect. This phenomenon occurs when built environments characterized by roads, buildings, and paved surfaces absorb and retain heat, making urban areas significantly warmer than their rural counterparts. Newman and Kenworthy (1999) emphasize that the concentration of commercial activities in such areas exacerbates this effect, resulting in higher temperatures, increased energy demands for cooling, and the worsening of air quality, all of which reduce environmental quality. These effects demonstrate how business location choices based on accessibility can inadvertently lead to environmental harm, highlighting the need for more careful urban planning.

Land cost is another crucial factor that shapes the location of commercial land use, driving businesses toward less expensive properties in suburban or undeveloped areas. As McCarthy (2009) explains, developers often seek out cheaper land on the outskirts of urban centers, which contributes to urban sprawl. Urban sprawl has significant negative effects on environmental quality, as it extends development into previously untouched ecosystems, disrupting wildlife habitats and leading to biodiversity loss. This sprawl also strains resources by increasing commuting distances, thereby exacerbating transportation-related emissions and energy consumption. As Zhao (2012) explains, the pursuit of lower land costs encourages low-density, sprawling developments, which consume large tracts of land and increase automobile dependence, leading to higher greenhouse gas emissions and a worsening of climate change.

The environmental consequences of sprawl are far-reaching. Longer commutes between residential and commercial areas increase emissions from vehicles, contributing to both local air pollution and global climate change. Berke, Godschalk and Kaiser. (2006) highlight that sprawl leads to inefficient land use, as natural landscapes are fragmented and converted into built environments. This not only reduces the amount of green space but also diminishes the capacity of ecosystems to provide critical environmental services, such as air and water purification, flood control, and carbon sequestration. Additionally, sprawl puts a strain on infrastructure, increasing the demand for roads, energy, and water, further compounding environmental damage.

McCarthy (2009) underscored that while factors such as accessibility, land cost, and zoning regulations are key to commercial land use decisions, these considerations often come at the expense of environmental quality. His research calls for a more balanced approach to land-use planning, one that integrates economic and environmental factors to promote sustainable development. Similarly, Zhao (2012) emphasizes the need for stricter zoning laws and environmentally responsible land-use policies to mitigate the negative environmental impacts of commercial expansion. Without these measures, commercial development will continue to undermine environmental quality, threatening long-term sustainability.

In summary, accessibility and land cost are significant determinants of where commercial activities are located, but they have profound and often negative consequences for environmental quality. As businesses prioritize access to customers and cost reduction, they contribute to pollution, urban sprawl, and habitat destruction. These trends underscore the importance of integrating sustainability into land-use planning to ensure that economic growth does not come at the expense of environmental degradation. To mitigate these negative impacts, environmentally conscious land-use planning, along with stronger zoning regulations, is essential to protect environmental quality while supporting economic development.

4. Materials and Methods

The study area comprised 76 communities, where a skipping range sampling technique was employed to administer the structured questionnaire in each community. The same method was used for the checklist administration to determine the types and number of commercial land uses present. In total, 1,103 copies of the questionnaire were distributed across the 76 communities. A GIS-generated map of the study area was produced to illustrate the locations of various land uses. Oral interviews and site observations were other methods used in generating primary data, while secondary data were obtained from textbooks, internet sources such as journals, magazines, newspapers, and demographic and geographical information from the National Population Commission (NPC, 2024).

Data collection focused on 24 original variables related to environmental quality, which were used for factor analysis. Responses to these 24 environmental quality attributes were measured on a Likert scale, ranging from '1' (strongly disagree) to '5' (strongly agree). These variables produced seven environmental quality components along with their corresponding scores and index values. Additionally, a one-way Analysis of Variance (ANOVA) was performed to assess the impact of location on environmental quality. For the analysis of commercial land use location, 21 original variables were considered, including factors like accessibility, security, rent, skill base, land ownership, growth potential, proximity to markets, population demographics, infrastructure (power, transport, water), terrain, land value, proximity to the central business district, cumulative causation, non-geographical factors, government policies, commercial inertia, management quality, and financial services (banking and insurance). These variables were also measured on a 5-point Likert scale. Factor and Regression analyses were applied to identify the key factors influencing the location of commercial land uses.

Finally, Canonical analysis was used to find out how these two sets of variables (data) relate with each other to determine the impact of commercial land use on environmental quality of the study area.

5.0 Analyses and Interpretation of Data

The data utilized for canonical analysis is shown in Table 1 indicating 7 location (x) variables and 7 environmental quality (y) variables. These variables are factor scores derived from principal component analysis.

Table 1: Data for canonical analysis

X1	X2	X3	X4	X5	X6	X 7	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**
1.83026	0.26514	0.55459	-0.34723	0.01536	-0.94181	0.19503	0.35366	0.79349	0.14578	-0.36743	-0.52219	1.40062	1.24397
-0.05984	-0.88512	-1.07324	0.24681	0.7784	2.59434	-0.25142	-0.81268	-1.22386	-2.87326	-0.46825	-0.17173	-1.98411	0.79045
0.72189	0.18934	-0.30256	-0.35265	-0.49568	0.0002	0.55298	-0.11608	-0.07321	-0.04955	0.45502	-1.26772	0.67758	0.31842
-3.63153	-2.39391	1.37886	-1.38219	-1.77324	1.72652	2.43006	1.46581	2.48661	-0.53261	2.62401	-0.91538	-1.49974	0.66231
-0.41207	1.38752	-0.57003	-0.40333	-0.75204	0.37233	-1.03281	-0.18759	-0.07122	-0.42273	0.04518	-0.48954	-0.40133	-0.10507
-0.46862	0.58631	0.07949	-1.38968	-0.76091	0.66594	-0.84096	-0.27284	-0.67974	-1.31494	-0.50044	-0.65632	-1.00873	-0.25611
-0.06696	-0.10808	0.5008	1.2138	0.21765	0.83138	-0.4918	0.62081	-0.93248	-0.76729	0.07452	0.85516	-0.62154	0.67165
0.3159	-0.76387	0.19809	0.35148	-1.17297	0.82557	-0.21826	-0.52418	0.61172	-1.10877	-0.94596	0.0342	-0.36666	0.56543
-3.12785	3.21193	-2.13685	-0.43161	-0.26768	0.42898	2.2636	2.24969	1.21997	0.6359	-0.5029	-0.61634	1.06475	-2.91943
-0.01174	0.23573	-0.25325	1.20995	0.10712	-1.98729	-0.06396	-2.0254	0.04197	-1.77134	-0.16388	0.56857	1.44555	1.30537
-0.13795	0.13239	1.39904	1.05011	-0.30071	0.44968	0.82442	1.38469	-2.14882	1.17253	-0.64672	0.15275	2.00163	1.18475
1.96718	0.53733	1.0821	-0.22952	-0.33089	0.9444	0.74325	1.32467	1.47393	0.10028	0.03855	-1.45371	0.79454	-3.44663
-0.04404	1.52779	0.61578	0.71874	2.56274	1.23593	-0.95869	0.15703	-0.08512	-2.26298	1.0135	1.24589	-1.15539	0.20357
-1.39671	0.30322	1.61615	-0.2217	0.21185	-0.27334	1.63817	0.85679	-0.18483	-0.55743	1.41023	0.38142	0.28726	1.27363
-0.91148	0.93896	-1.1936	0.78786	0.4877	-0.11048	0.02845	-0.31472	-0.18592	-1.19935	-1.50518	-0.43426	-0.68402	-0.21697
0.23763	1.27843	-0.5769	-0.52781	1.84537	1.3473	-1.08154	0.67809	0.29323	-0.95263	0.13615	-0.02543	-0.63724	-1.03635
-0.03311	-0.42402	-0.06078	1.98298	0.3479	-0.20984	1.8026	0.69807	0.89963	-0.12403	0.09289	0.79907	1.02129	1.26063
0.48149	0.5244	-1.57186	1.22579	0.84279	2.1286	-2.01579	0.74124	-0.28463	-2.09679	-2.25639	0.33074	-2.58189	-1.35701
-0.19715	1.68143	-1.41452	0.0026	0.41675	0.32918	1.62934	0.96726	-0.01513	0.26077	0.5244	0.54728	-1.3209	-0.17005
0.17121	0.15769	1.07653	-0.80774	-1.18154	0.24574	-0.51354	0.26888	0.23597	-0.01662	-0.42364	-0.76496	-0.75945	-0.51707

-0.44783	**0.92816**	**2.39125**	**0.66029**	-0.46996	**0.10228**	-0.64344	**1.07495**	-1.51474	**0.03563**	**0.87397**	-0.13139	**0.4216**	**0.67454**
-0.17543	**1.62302**	-1.04848	-0.28376	**0.49272**	-0.16101	**0.08982**	**1.14208**	**1.12271**	-0.42731	-0.79807	-0.40575	-0.08852	-0.26341
0.29983	**0.33474**	-0.9143	**0.50833**	-1.72929	-0.60572	**0.77074**	-0.53477	**1.04188**	**0.41941**	-0.12755	-1.36283	**0.71018**	**0.36844**
-1.75288	-1.61113	-1.96226	**0.07598**	-3.48174	**0.06862**	-2.25461	-1.9988	-1.26761	-0.08397	**0.25831**	-1.40107	**1.27544**	**0.44978**
0.90805	**0.56075**	**0.27134**	**0.42823**	-0.49195	-1.11458	**0.85244**	-0.52448	**0.97401**	-0.60105	-0.39595	-1.17797	**0.74962**	**0.12439**
0.74867	-0.44464	**0.06552**	**2.58242**	-1.31158	**0.00458**	-0.49897	**0.03795**	-0.3522	**0.20595**	**0.20378**	-1.71025	**0.37752**	**2.42946**
0.43567	-0.32412	-0.61296	-0.95611	-0.01559	-0.18951	-0.38566	-0.58707	**0.58741**	-0.21727	-1.30207	-0.34732	-0.07214	-0.62854
0.6124	-0.12619	-0.21153	-0.99783	-0.47906	-0.05325	-0.56493	-0.53693	-0.52273	-0.05164	**0.56493**	-0.81011	-0.73539	-0.38228
0.0776	-0.34576	**0.21922**	**0.18287**	**0.70674**	-1.60721	-1.03104	-2.24324	-2.06966	**1.44353**	**0.11304**	**1.74684**	**0.43044**	-0.6982
0.30299	-1.273	-0.99627	**0.49377**	**0.56392**	-1.00147	-0.16177	-0.93081	**0.74475**	**1.1945**	**0.23589**	**1.33894**	-0.01482	-0.50274
-0.46845	-0.39726	**0.24732**	-0.11272	**1.10177**	-2.13727	-1.39019	-1.22292	-0.64671	-0.35452	**1.08469**	-0.02714	-1.09832	**0.09622**
-1.05403	-0.31075	**0.74053**	**1.15321**	**1.61644**	-1.73812	-1.57384	-1.02377	-1.63688	**1.15818**	**0.84632**	**0.7594**	**0.10019**	-0.6004
0.75326	-0.00393	-1.41634	-0.46582	**0.02575**	-0.39789	**0.20521**	**0.49628**	**0.45832**	**0.89263**	**0.04528**	**0.02331**	-0.42155	-0.6271
-1.235	-0.55516	**0.27347**	-1.2121	**0.48815**	-0.13726	-0.79779	-1.33704	-0.54238	**0.17341**	**0.52531**	-1.85274	-0.29472	-0.9406
0.48817	**0.39129**	**0.1864**	-0.23613	-0.28179	**0.0965**	-0.67804	**0.81182**	**0.78285**	-0.01936	**0.26948**	-0.78013	-0.3779	**0.19544**
-1.87644	-0.22829	-0.36167	**0.37777**	**0.28424**	-1.46962	-0.48092	-1.58765	**0.15562**	**0.56662**	**1.57464**	**0.17869**	**1.1942**	-1.41605
-1.30824	-0.41696	**0.2044**	-0.0804	**1.71901**	-1.446	-0.24007	-1.14559	-0.97402	-0.2448	**1.53822**	-0.41288	-0.55638	-0.52446
0.6593	**0.95078**	**1.15619**	**0.18038**	-0.01311	**0.12398**	**0.23557**	**0.28474**	**0.45947**	-0.54081	**1.27476**	-0.36497	-0.1388	**0.29908**
0.96733	**0.12966**	**1.41991**	-0.21614	-1.01412	**2.07794**	-1.77006	-0.16611	**0.45224**	-0.65356	**0.03828**	**0.24402**	-0.30567	**0.27923**
0.1657	**1.20495**	**0.33423**	-0.85071	-0.74059	-0.58062	**0.68079**	**0.09501**	**0.01211**	**1.30583**	-0.06697	-1.03427	**0.7893**	**0.12339**
-0.62147	-0.91177	-0.52698	**0.05365**	**1.4075**	**0.43686**	**1.0078**	-0.63911	**0.33646**	**1.04289**	-1.13065	-0.24818	-0.63255	**0.38572**
-0.03634	-0.30797	**0.85181**	-0.58869	**0.32204**	**0.46099**	-0.43467	-0.00239	-0.6772	-0.69109	-0.3584	-0.3373	-0.14406	-0.39194
-0.60751	-0.31752	**0.19116**	**0.22826**	**0.50564**	-0.43226	-1.66088	-0.51427	-1.42639	**0.68627**	**1.24543**	-0.05851	-0.45375	-1.41196

-0.5749	**0.79318**	**0.74007**	-1.05632	**0.05968**	-1.78046	-1.06417	-0.74991	-0.46138	**0.58391**	**1.59665**	-0.68653	**0.40548**	-0.82516
1.32667	-1.56906	-2.08596	-0.37359	**0.45812**	-0.65249	**1.46991**	-1.59207	**0.96929**	**0.46682**	-2.67138	**2.033**	-0.05916	-0.01002
1.49336	-2.85743	-1.80964	**0.20764**	**1.37576**	**0.35069**	**1.17348**	-1.18688	**0.58479**	**1.45072**	-1.36642	**1.48447**	-1.3594	-0.30321
0.74581	-0.45214	-0.66117	-0.4592	-0.25217	-0.49543	**0.16167**	-0.61636	**0.20147**	**0.38187**	-2.28363	-0.45025	**0.86474**	**0.18162**
-0.98951	**0.01853**	**0.19017**	**0.14419**	**0.76484**	-1.24411	-1.25976	-0.9887	-1.03139	-1.08115	**1.14011**	-0.00197	-0.09163	-0.73792
-0.82595	-0.29007	**1.46086**	-0.53869	**0.61721**	-0.90761	-0.97914	-0.48415	-0.76517	-0.54019	**1.71359**	-0.52318	-0.4239	-1.10793
0.02779	-0.84195	**0.33073**	**1.36293**	-0.72196	-0.11684	**0.34399**	**0.91955**	-1.56113	-0.14109	-0.90505	**0.18394**	**1.76325**	-0.04235
2.03542	-1.24063	-1.2607	**0.99839**	-0.0366	**0.22263**	-0.82794	-0.67012	**0.25455**	**1.30785**	**0.73626**	**0.67582**	-0.13574	-0.64861
1.04831	**0.13102**	**1.01622**	-0.25551	-0.00222	-0.18326	**0.33171**	**0.11005**	**0.58039**	-0.1527	**0.39887**	**0.59259**	-0.18727	**0.83787**
-1.58283	-1.01333	**1.18286**	**1.20619**	-0.03567	**1.579**	**0.37999**	**1.94305**	-1.00236	-0.10321	-0.18566	**0.67017**	**1.0356**	-1.15286
0.87389	**0.18094**	**0.12848**	-0.50815	-0.54091	**0.72114**	**0.19557**	-0.02776	-0.26965	-0.43689	-0.21548	-0.59509	-0.071	-0.47072
-0.85051	-1.12039	**0.30137**	**1.06002**	**0.43431**	**0.0937**	-0.41925	**0.89471**	-1.69381	**0.93193**	**0.7966**	**1.51458**	-1.02102	-0.38389
1.07364	**0.35933**	**0.94412**	**0.10217**	**0.05558**	-0.02824	**0.57593**	-0.47341	**1.01761**	-1.00177	**0.09878**	**0.60462**	**0.61336**	**0.81787**
-0.94911	**1.01025**	-0.93385	-0.67423	**0.46078**	-0.0673	-0.34734	**0.10375**	-0.2448	-0.93454	-0.73797	-0.13331	-0.11537	-0.3172
0.88429	**1.01283**	**0.90193**	-0.48156	**0.52941**	-0.51524	**0.66192**	**0.44754**	**0.52266**	-0.25722	-0.51184	-0.31988	**0.32903**	**0.47829**
0.38176	-1.72281	**0.14345**	-2.7109	**1.06574**	-1.08286	**1.51885**	**0.46359**	**2.40616**	**1.9156**	**1.20647**	**2.88159**	-1.495	**0.14889**
1.09531	**1.21317**	**1.56996**	**1.32008**	**0.07314**	-0.60429	**2.62135**	-0.15826	**1.62165**	-0.80341	**1.90183**	**1.45006**	**1.53264**	**2.38742**
0.57325	**0.9956**	-0.22005	**0.61747**	**0.47827**	**1.57648**	-0.27284	**2.1742**	-0.31892	-0.64522	**0.60356**	**1.00549**	**0.15609**	**0.96011**
0.14179	**0.22291**	-0.37223	**0.28161**	-3.13456	-1.54406	-0.30935	-1.02132	**1.78233**	**0.83839**	**0.53033**	-2.34394	**0.93493**	**0.28006**
-0.11534	**0.45566**	**0.30351**	**0.68517**	**0.69219**	**0.81687**	**0.38597**	**2.17522**	-0.66951	**0.35406**	-0.51353	**0.45214**	**1.07325**	**0.07258**
-0.94196	-1.88147	-0.36112	**0.24238**	**2.27497**	**0.62887**	**0.83013**	**1.08342**	-1.1379	**3.41148**	-1.08823	-2.69265	-3.96015	**2.52668**
-0.0995	**1.1077**	-1.88776	-0.07968	-0.57027	**0.53582**	**0.0016**	**0.48086**	**0.21945**	-0.48942	-0.71044	**0.06078**	-0.21017	-0.3909
0.52296	-0.34373	-0.16533	-0.78376	-0.64994	-1.12029	**0.76771**	**0.26013**	**0.64492**	**0.69625**	**1.04394**	**1.35621**	-0.93531	-0.14516

-0.20791	**0.29871**	-0.89077	-0.65771	**0.4352**	**0.05292**	**0.47091**	**0.27799**	-0.04063	-0.51492	-0.35243	**0.76164**	**0.16647**	**0.47963**
0.69656	-0.69467	-0.71022	-3.04646	**0.03053**	**0.49987**	-0.35734	-0.76209	**0.91879**	**0.32964**	-1.96508	**0.95883**	**0.25107**	**1.07609**
0.55802	-0.64084	**0.23663**	-0.73444	-0.40862	**0.64578**	**0.47816**	-0.09703	**0.56614**	**1.41958**	-0.56041	**0.24358**	-0.00064	**0.16867**
0.47077	**0.49383**	**0.9487**	-0.56805	-0.30625	-0.59904	**0.40073**	-0.49637	-0.26249	0.95447	-0.37753	**1.35467**	**0.06187**	**0.89911**
0.31709	**1.47774**	-1.56283	-0.5424	-0.62675	**0.25538**	-0.04657	**0.25356**	-0.02333	-1.51454	-1.099	**0.41311**	**1.06573**	-0.73624
0.11233	-0.1699	**0.83925**	**1.21976**	**0.09648**	**1.25043**	**0.537**	**1.84051**	-1.16518	-0.07756	**0.18793**	**0.40505**	**1.00871**	**0.69628**
0.09662	-1.06974	**0.60871**	**0.6884**	-0.40682	**1.15717**	**0.16354**	**0.6458**	-0.92123	**0.44171**	-0.32476	-0.74546	**0.85988**	**0.49049**
0.88023	-0.22719	**1.52777**	-2.9349	-0.00169	**0.72082**	-1.04085	-0.46745	**1.06955**	**0.42647**	-0.14964	**0.76162**	**0.29538**	-1.80717
0.43232	-0.29526	-0.38306	**1.84913**	-1.34511	-1.68765	**0.38213**	-1.31171	**1.7906**	**0.24828**	-0.23521	-1.17055	**0.31722**	**0.52491**
-0.71254	-0.2723	**0.08012**	**0.7986**	-0.86579	**0.61832**	-0.84232	**0.56849**	-1.25033	**1.03039**	-0.84758	**0.37292**	**0.94494**	-0.4407

X1; Infrastructure and Commercial Inertia; X2; Protection Policies; X3; Land Ownership; X4; Urban Nexus; X5; Business Infrastructure and Economic Viability; X6; Mobility; X7; Market Synergy; Y1: Infrastructural Quality; Y2: Urban Infrastructural Quality; Y3: Urban Morphology; Y4: Environmental Disamenities; Y5: Environmental Stressor; Y6: Urban Infrastructure and Pollution; Y7: Energy and Urban Form.

The goal of canonical correlation is to analyze the relationships between two sets of variables (location variables and environmental quality variables) which are denoted as x and y variables or independent variables and dependent variables. The aim is to determine how the two sets of data relate with each other. In this analysis, Canonical analysis revealed that there are 5 statistically significant ways that the two sets of variables are related. Although, there are potentially as many ways to recombine the variables as there are variables in the smaller set, usually only the first two or three combinations are statistically significant and need to be interpreted, however, this study has shown that 5 combinations are statistically significant. The interpretation of significant pairs of canonical function is based on its loadings. Each pair of canonical function is interpreted as a pair, with a function from one set of variables interpreted vis-a-vis the function from the other set; by considering the pattern of variables highly correlated (loaded) with it. The loading matrices contain correlations, and because squared correlations measure overlapping variance, variables with correlations of more than .30 (9% of variance) are usually interpreted as part of the function, and variables with loadings of .30 and below are not. This is because correlation coefficients below .32 (10% overlapping variance) are considered poor as their contribution are less than 10%. This is why canonical correlation coefficients lower than .30 were not interpreted. The number and importance of canonical functions were determined using the output from Table 2 where the significance of the relationships between the sets of variables is reported.

Table 2: Canonical Correlations of location factors and environmental quality

Functions	R_c	R_c^2	Eigenvalue	Wilks Statistic	F	Num D. F	Denom D.F.	Sig.
1	**.857**	**.734**	**2.770**	**.015**	**8.348**	**49.000**	**319.186**	**.000**
2	**.822**	**.676**	**2.076**	**.057**	**7.127**	**36.000**	**279.413**	**.000**
3	**.790**	**.624**	**1.662**	**.176**	**5.704**	**25.000**	**239.251**	**.000**
4	**.605**	**.366**	**.578**	**.469**	**3.505**	**16.000**	**199.216**	**.000**
5	**.441**	**.194**	**.241**	**.739**	**2.359**	**9.000**	**160.777**	**.016**
6	.279	.078	.085	.918	1.473	4.000	134.000	.214
7	.070	.005	.005	.995	.332	1.000	68.000	.567

H0 for Wilks test is that the correlations in the current and following rows are zero

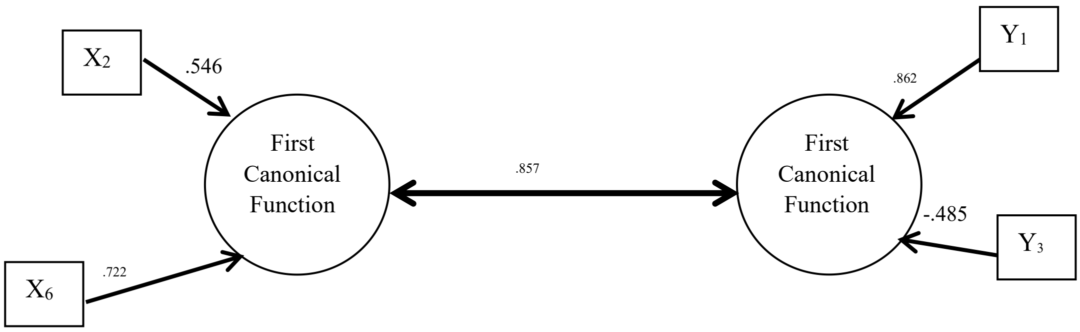
From Table 2, the first 5 canonical correlations have *P value less than* .05 and thus implies that significant relationships are in the first 5 pairs of canonical functions and these are interpreted. Canonical correlations and eigenvalues are also in Table 2. The first canonical function has correlation coefficient of .857, representing 73.4% overlapping variance for the first pair of canonical function. The second canonical function has correlation coefficient of .822 which represents 67.6% overlapping variance while the third, fourth and fifth functions have 62.4%, 36.6% and 19.4% respectively representing overlapping variances. These canonical correlations are highly significant and represent a substantial relationship between pairs of canonical functions.

Table 3: Canonical structure

Set 1 Canonical Loadings							
Variable	1	2	3	4	5	6	7
x1	-.166	-.253	.435	.097	-.472	-.504	-.482
x2	.546	-.114	-.132	.466	.232	-.588	.234
x3	.239	-.207	-.546	-.511	.151	-.174	-.536
x4	.222	-.028	-.354	-.146	-.812	.005	.379
x5	-.017	.578	.235	-.553	.080	-.491	.239
x6	.722	.317	.370	-.001	-.124	.348	-.324
x7	.214	-.667	.421	-.431	.138	.085	.346
Set 2 Canonical Loadings							
y1	.862	-.103	.163	-.292	.133	.161	.302
y2	-.072	-.624	.532	.133	.445	-.090	-.315
y3	-.485	-.222	.102	-.403	.108	.443	.578
y4	-.011	-.118	-.654	-.430	.545	-.127	-.244
y5	-.110	.131	.312	-.497	-.097	-.768	.164
y6	.064	-.624	-.393	.301	-.265	-.349	.411
y7	.029	-.361	-.021	-.460	-.629	.203	-.469

X1; Infrastructure and Commercial Inertia; X2; Protection Policies; X3; Land Ownership; X4; Urban Nexus; X5; Business Infrastructure and Economic Viability; X6; Mobility; X7; Market Synergy; Y1: Infrastructural Quality; Y2: Urban Infrastructural Quality; Y3: Urban Morphology; Y4: Environmental Disamenities; Y5: Environmental Stressor; Y6: Urban Infrastructure and Pollution; Y7: Energy and Urban Form.

The coefficient loading between canonical functions and original variables are shown in Table 3 which presents the canonical structure. Interpretation of the 5 significant pairs of canonical functions is based on their coefficient loadings. Correlations between variables and function loadings in excess of .3 are interpreted. The first pair of canonical function has a total of 4 variables with high loadings on Infrastructural Quality (Y1= .862) and Urban Morphology (Y3= -.485) which are environmental quality variables data set and on Protection Policies (X2= .546) and Mobility (X6= .722) which are location variables data set.



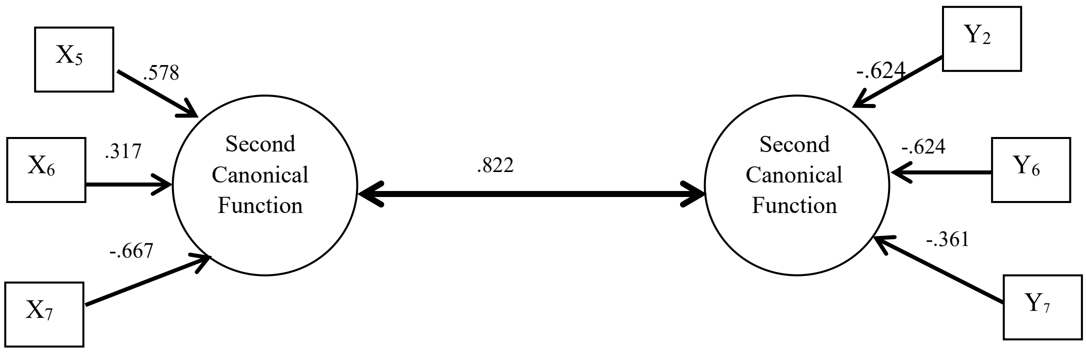


Figure 2: Relationships among variables in the second pair of canonical function

In the third pair of canonical function, a total of 8 variables with high loadings were observed. The environmental quality variables data set loaded high on Urban Infrastructural Quality (Y2= .532), Environmental Disamenities (Y4= .654), Environmental Stressor (Y5= .312), and Urban Infrastructure and Pollution (Y6= .393) while the location variables data set had high loadings on Infrastructure and Commercial Inertia (X1= .435), Land Ownership (X3= -.546), Mobility (X6= .370) and Market Synergy (X7= .421) as significant loadings on the location variables data set. The third canonical function which represents the model that explains the pattern of linkage between the two sets of data is shown in Figure 3.

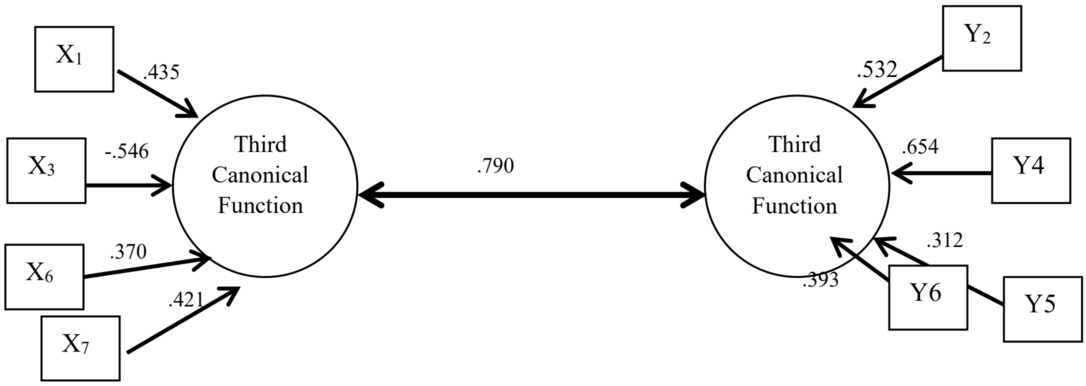
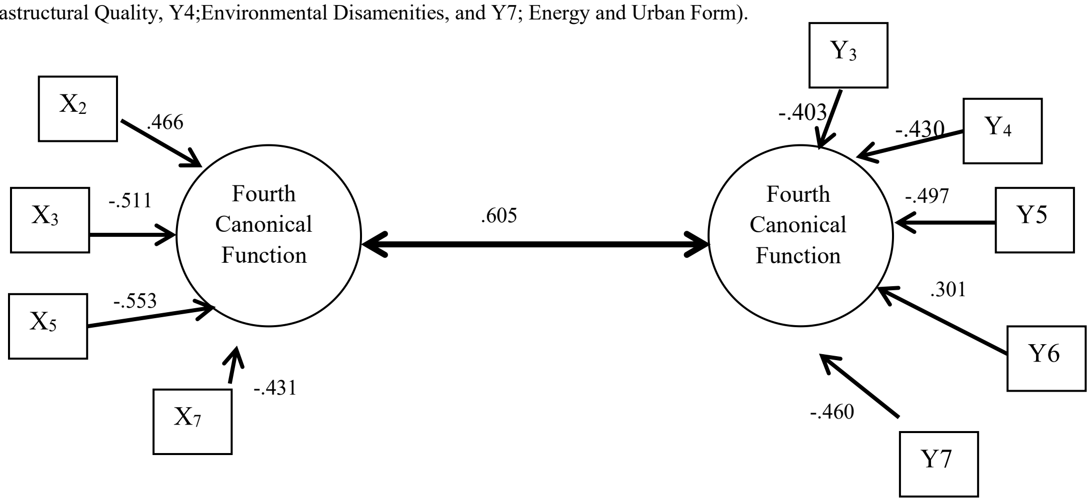
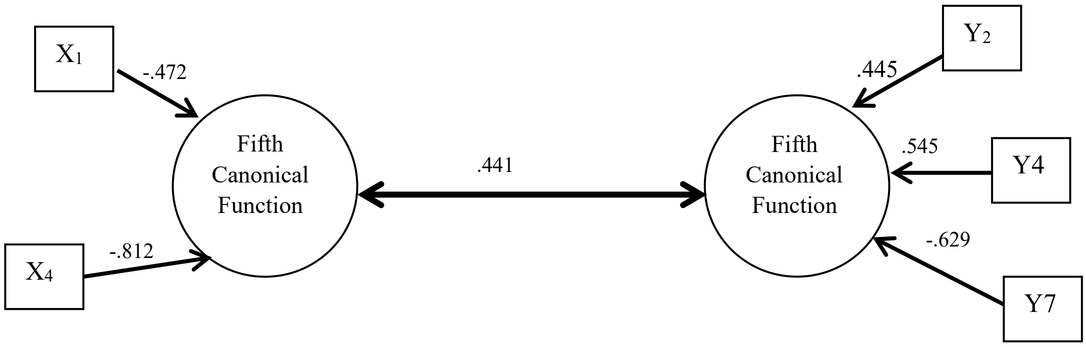


Figure 3: Relationships among variables in the third pair of canonical function

The coefficient loadings between the fourth and fifth canonical functions and original variables as shown in Table 1 are expressed graphically in Figure 4. The fourth pair of canonical function has a total of 9 variables with coefficient loadings of above .3 on Urban Morphology (Y3= -.403), Environmental Disamenities (Y4= -.430), Environmental Stressor (Y5= -.497), Urban Infrastructure and Pollution (Y6= .381) and Energy and Urban Form (Y7= -.460) which are the environmental quality variables data set as well as Protection Policies (X2= .466), Land Ownership (X3= -.511), Business Infrastructure and Economic Viability (X5= -.553) and Market Synergy (X7= -.431) which represent location variables data set. The fifth canonical function shows significant coefficient loadings on only 5 variables (X1; Infrastructure and Commercial Inertia, X4; Urban Nexus, Y2;Urban Infrastructural Quality, Y4;Environmental Disamenities, and Y7; Energy and Urban Form).





Figures 4 and 5: Relationships among variables in the fourth and fifth pairs of canonical functions

These pairs of linear combinations for both the location (X) and environmental quality (Y) variables known as canonical functions are similar to components in principal components analysis, and are extracted to help account for the maximum amount of correlation between the two sets of data. While the first canonical function provides the highest inter correlation that could be possible, the second pair of canonical function accounts for the maximum amount of correlation between the two data sets left un-accounted for by the first pair of canonical function, and so on. This important attribute of canonical correlation analysis enables it to produce pairs of functions that are orthogonal or independent of the preceding pairs of functions Udofia (2011). The first canonical function provides the highest possible inter-correlation between the two data sets accounting for correlation coefficient of .857, representing 73.4% overlapping variance. The second, third fourth and fifth though significant are diminished in importance as they take care of the residual variance. Thus, 5 out of the 7 canonical functions are selected and interpreted on the basis of the magnitude of the canonical correlation and level of statistical significance of the functions.

Table 4: Canonical solutions for the five significant functions

	Function 1		Function 2		Function 3		Function 4		Function 5		h^2	Total %
Variable	Rs	Rs^2	Rs	Rs^2	Rs	Rs^2	Rs	Rs^2	Rs	Rs^2		
x1	-.166	.028	-.253	.064	**.435**	.189	.097	.009	**-.472**	.223	**.513**	
x2	**.546**	.298	-.114	.013	-.132	.017	**.466**	.217	.232	.054	**.599**	
x3	.239	.057	-.207	.043	**-.546**	.298	**-.511**	.261	.151	.023	**.682**	
x4	.222	.049	-.028	.001	**-.354**	.125	-.146	.021	**-.812**	.659	**.855**	
x5	-.017	.000	**.578**	.334	.235	.055	**-.553**	.306	.080	.006	**.701**	
x6	**.722**	.521	**.317**	.101	**.370**	.137	-.001	.000	-.124	.015	**.774**	
x7	.214	.046	**-.667**	.445	**.421**	.177	**-.431**	.186	.138	.019	**.873**	
% variance	.143		.143		.143		.143		.143			**.715(71.5%)**
Redundancy	.105		.096		.089		.052		.028			**.370(37.0%)**
y1	**.862**	.743	-.103	.011	.163	.027	-.292	.085	.133	.018	**.884**	
y2	-.072	.005	**-.624**	.389	**.532**	.283	.133	.018	**.445**	.198	**.893**	
y3	**-.485**	.235	-.222	.049	.102	.010	**-.403**	.162	.108	.012	**.468**	
y4	-.011	.000	-.118	.014	**-.654**	.428	**-.430**	.185	**.545**	.297	**.924**	
y5	-.110	.012	.131	.017	**.312**	.097	**-.497**	.247	-.097	.009	.328	
y6	.064	.004	**-.624**	.389	**-.393**	.154	**.301**	.091	-.265	.070	**.708**	
y7	.029	.001	**-.361**	.130	-.021	.000	**-.460**	.212	**-.629**	.396	**.739**	
% variance	.143		.143		.143		.143		.143			**.715(71.5%)**
Redundancy	.105		.096		.089		.052		.028			**.370(37.0%)**

Rs=structure coefficients, Rs^2=squared structure coefficients, h^2=communality coefficients, Coefficients greater than .3 are bolded and underlined

How much variance does each of the canonical function extract from the variables on its own side is shown in Table 4. How much variance the canonical function from the independent variables extracts from the dependent variables and vice versa is known as redundancy. Thus, redundancy in canonical function is the percentage of variance it extracts from its own set of variables times the squared canonical correlation for the pair. From Table 4, all the 5 canonical functions extract each 14.3% of variance from both the location and environmental quality variables. Together, the 5 canonical functions account for 71.5% of variance for the two data sets. Redundancies for the canonical functions are also shown in Table 4 and indicate that both data set accounts for .370 (37%) of the variance for the 5 functions, although the first function (10.5%) made the highest contribution while the fifth function (2.8%) had the least. A canonical communality coefficient (h^2) is the proportion of variance in each variable that is explained by the complete canonical solution or at least across all the canonical functions that are interpreted. It is computed simply as the sum of the (r^2) across all functions that are interpreted for a given analysis. The significance of canonical communality coefficient (h^2) canonical communality coefficient (h^2) lies in its usefulness regarding the importance of the observed variables in the entire analysis. From Table 4, while variables Market Synergy (X7= .873) and Urban Nexus (X4= .855) had the highest canonical communality coefficient (h^2) on location variables, environmental quality variables of Y4 (.924), Y2(.893) and Y1(.884) were outstanding in terms of their importance in the analysis. Location variable Business Infrastructure and Economic Viability (X5= .513) and environmental quality variable Environmental Stressor (Y5= .328) were the weak in their contributions in the analysis.

6.0 Discussion of Findings

The primary aim of this canonical correlation analysis was to examine the relationship between location-related variables (infrastructure, protection policies, business viability) and environmental quality variables (infrastructural quality, environmental stressors, urban pollution). The results revealed five pairs of statistically significant canonical functions, highlighting the complex, multi-faceted relationships between these variables, all with p-values less than 0.05, indicating significant relationships between factor influencing the location of commercial land use and environmental quality variables. The first canonical function alone accounts for 73.4% of the overlapping variance, reflecting a strong relationship between specific variables from both sets. Subsequent canonical functions (second to fifth) explain progressively smaller portions of the remaining variance (67.6%, 62.4%, 36.6%, and 19.4%, respectively). Together, these five canonical functions explain 71.5% of the total variance in the two sets of variables as follows:

i. The strongest inter-correlation (canonical correlation coefficient of 0.857) occurs between Infrastructural Quality (Y1) and Urban Morphology (Y3) from the environmental quality side, and Protection Policies (X2) and Mobility (X6) from the location side. This indicates that infrastructure quality and the layout of urban areas are heavily influenced by protection policies and mobility within the region.

ii. Second Canonical Function: A significant correlation (0.822) exists between Urban Infrastructural Quality (Y2), Urban Infrastructure and Pollution (Y6), and Energy and Urban Form (Y7) from the environmental variables and Business Infrastructure and Economic Viability (X5), Mobility (X6), and Market Synergy (X7) from the location side. This function highlights how urban infrastructure and pollution are impacted by the economic viability and mobility patterns within commercial areas.

iii. Third to Fifth Canonical Functions: These functions introduce other influential variables like Infrastructure and Commercial Inertia(X1), Protection Policies(X2), Land Ownership(X3), Urban Nexus(X4), Business Infrastructure and Economic Viability(X5), Mobility(X6), Market Synergy(X7), Urban Infrastructural Quality(Y2), Urban Morphology(Y3), Environmental Disamenities(Y4), Environmental Stressor(Y5), Urban Infrastructure and Pollution(Y6) and Energy and Urban Form(Y7). They help explain the more complex dynamics of how environmental challenges like pollution and environmental stressors are related to factors such as land ownership and market conditions.

The redundancy index shows how much variance from each set of variables is explained by the other set. For all five canonical functions, the two data sets accounted for 37% of the variance, with the first function contributing the most (10.5%) and the fifth function contributing the least (2.8%), and Canonical communality coefficients show that variables like Market Synergy (X7), Urban Nexus (X4), and Infrastructural Quality (Y1) have the highest communalities, indicating their strong contributions to the overall correlation pattern.

The null hypothesis: There is no significant relationship between the factors influencing the location of commercial land use and the environmental quality in the study area. Based on the analysis, the following observations refute the null hypothesis, due to the fact that all five canonical functions have p-values below 0.05, indicating significant relationships between the factor influencing location and environmental quality variables. The canonical correlation coefficients for the first five functions are substantial (with the first function having 0.857), demonstrating significant interrelationships, and the explained variance (71.5% of the total variance across both sets) and redundancy values further confirm the strong link between the location factors and environmental quality indicators. Given the strength of these findings, the null hypothesis is rejected, as there is clear evidence of a significant relationship between the factors influencing the location of commercial land use and environmental quality in the study area.

The findings of this study align with Akinwunmi (2019) and Bamidele (2018) using canonical correlation analysis (CCA) highlighted a strong relationship between location-related variables such as infrastructure, business viability, and environmental quality factors like pollution and urban stressors. Akinwunmi's research emphasizes the impact of infrastructural quality and urban form on environmental outcomes, aligning with the first canonical function of the study, while also identifying the role of economic viability in influencing pollution. Bamidele's research agrees with the latter canonical functions by exploring the effects of land ownership, protection policies, and market forces on urban environmental sustainability, further validating the research result.

7.0 Conclusion and Recommendations

Thus, the analyses demonstrate that location factors like protection policies, mobility, market synergy, and business infrastructure significantly impact environmental quality elements such as urban morphology, heat and water quality, and pollution levels. This emphasizes the importance of considering how decisions about commercial land use affect environmental conditions. This information can guide policy and planning in developing more sustainable urban environments, especially regarding how commercial areas are structured and governed.

Based on the findings, it is recommended that urban planners and policymakers prioritize the integration of environmental considerations into commercial land use decisions, as location factors such as protection policies, mobility, market synergy, and business infrastructure have a profound effect on environmental quality. Urban planning should ensure that commercial developments are aligned with sustainability goals by promoting eco-friendly transportation options, limiting pollution-intensive industries, and encouraging green building practices. Cities can reduce negative impacts on heat levels, water quality, and pollution while enhancing urban morphology.

Also, collaboration between commercial stakeholders and environmental agencies is vital to achieving these goals by establishing clear guidelines and incentives for businesses to adopt sustainable practices in site selection and infrastructure development. This can foster market synergy that benefits both the economy and the environment. This approach would not only enhance the quality of life for residents but also create more resilient cities capable of adapting to future environmental challenges.

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