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EVALUATION OF THE PUBLIC'S PERCEPTION ON THE FACTORS INFLUENCING URBAN EXPANSION IN BAUCHI METROPOLIS, BAUCHI STATE, NIGERIA

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Uncontrolled urban expansion has become a major challenge in many developing cities, with significant implications for sustainable land use and environmental management. Despite the increasing rate of urban growth in Bauchi Metropolis, there is limited empirical understanding of the factors driving this expansion and the associated environmental and socio-economic consequences as perceived by residents. This study examined public perceptions of the factors driving urban expansion and its associated impacts in Bauchi Metropolis, Bauchi State, Nigeria. A multi-stage sampling technique was employed, with the sample size determined using Yamane's formula and respondents proportionally allocated across wards using Boyle's method. Data were analyzed using descriptive statistics technique. The findings revealed that respondents perceived population growth (97.7%), urbanization (95.1%), economic development (92.5%), land availability (94.0%), and government policies (89.1%) as the principal factors driving urban expansion in the metropolis. Furthermore, respondents identified several significant consequences associated with urban expansion, including alterations in land use (95.1%), habitat loss (91.7%), and an increase in impervious surfaces (81.2%). These findings suggest that urban expansion is reshaping both the physical environment and land-use patterns within Bauchi Metropolis. The study recommends the implementation of effective urban planning policies and regulatory frameworks at all levels of government to promote sustainable urban growth and mitigate the adverse effects of uncontrolled expansion.

Keywords: *Public perception, Urban expansion, key drivers, Bauchi metropolis*.

1.1 Introduction

Urbanization arises primarily from swift economic expansion, the establishment of new industrial zones, and the migration of people from rural regions to urban centers worldwide Winkler *et al.,* 2021. The global population has seen consistent growth, surging from 2.5 billion individuals in 1950 (Al-Thawwad, 2008; Chandio and Shirazi, 2022) to 8 billion at present, as reported by the United Nations (UN, 2014). Unprecedented global population growth is driven by healthcare, hygiene, and nutritional improvements that extend life expectancy. Recent data on global urbanization reveal a notable population rise, particularly over the past two decades (Chandio and Shirazi, 2022). Asia, hosting 4.7 billion people, represents 60% of the world's population. In North America, 82% of the populace, in the Caribbean region 81%, in Europe 74%, and in Oceania 68% reside in urban areas, facilitated by the presence of essential human amenities (UNDESA, 2018; Chandio and Shirazi, 2022). Developing nations have grappled with rapid population growth and urban expansion in recent decades, a trend expected to persist (Ashraf *et al.,* 2022). The combination of high population growth and a lack of fundamental services in rural regions has spurred rural-urban migration and

changes in land use/land cover (LULC) patterns from one form to another (Moazzam *et al.,* 2022; Yousafzai *et al.,* 2022).

Beyond population growth, urbanization expands residential and commercial zones, increasing the demand for vital services like transport, education, water, and sanitation. This process ultimately transforms regions covered by natural vegetation into developed areas (Aliyu and Amadu, 2017; Yousafzai *et al.,* 2022). The expansion of built-up areas contributes to various environmental challenges, including alterations in local and regional temperatures and exacerbation of food security concerns (Sun *et al.,* 2018; Farid *et al.,* 2022).

The expansion of urban areas leads to the enlargement of built-up spaces, recreational parks, and public infrastructure, encroaching upon open spaces in surrounding cities. This growth in the built environment, driven by human interventions, elevates urban temperatures, reduces soil infiltration due to increased impervious areas, and consequently results in water runoff, giving rise to issues like urban heat waves and urban flooding (Rahman *et al.,* 2019; Zou *et al.,* 2021). Surface energy balance and urban flooding have escalated due to urbanization, replacing naturally permeable surfaces with artificial, low-permeable surfaces (Rizwan *et al.,* 2008; Wang *et al.,* 2019; Zou *et al.,* 2021). The rise in Bauchi city's population was exacerbated by shifts in its social, economic, and political dynamics. This surge was not solely attributed to enhanced infrastructure, such as electricity and clean water, but primarily resulted from perceived employment prospects, particularly appealing to individuals formerly residing in rural areas (Usman and Mohammed, 2012).

2.0 Materials and Methods

2.1. The Study Area

Bauchi metropolis, serving as the capital of Bauchi State and the primary traditional emirate, is positioned in the North Eastern geopolitical zone of Nigeria. The coordinates place it between 9°48' 0" and 9°52'30" East of the Greenwich Meridian longitudinally, and 10°16' 30" to 10°21' 0" North of the Equator latitudinally (). At an elevation of 616m, it lies on the northern edge of the Jos Plateau, with the central area characterized by predominantly level terrain (Usman and Mohammed, 2012). As per the Bauchi State Urban Development Board, the Bauchi Urban area extends approximately 120 km in radius and encompasses solely the Bauchi local government region.

2.2 Sample size and sampling technique

This study adopted a descriptive survey research design. The descriptive survey design was considered appropriate because it enables the researcher to collect data from a representative sample of respondents and describe the characteristics, opinions, and perceptions regarding the drivers and impacts of urban expansion in Bauchi Metropolis.

A multi-stage sampling technique was adopted in the study. Stage 1 of the sampling process encompassed the entirety of Bauchi town, with the urban area covering a radius of approximately 120 sq.km, as per the Bauchi State Urban Development Board.

For Stage 2, the study area (Bauchi town) was segmented into wards, namely Old GRA, New GRA, Fadaman Mada, Yelwa, Dan Iya, Makama, Ibrahim Bako, Nassarawa, Dan Kade, Dawaki, Dan Amar, and Hardo. All twelve wards were included in the study.

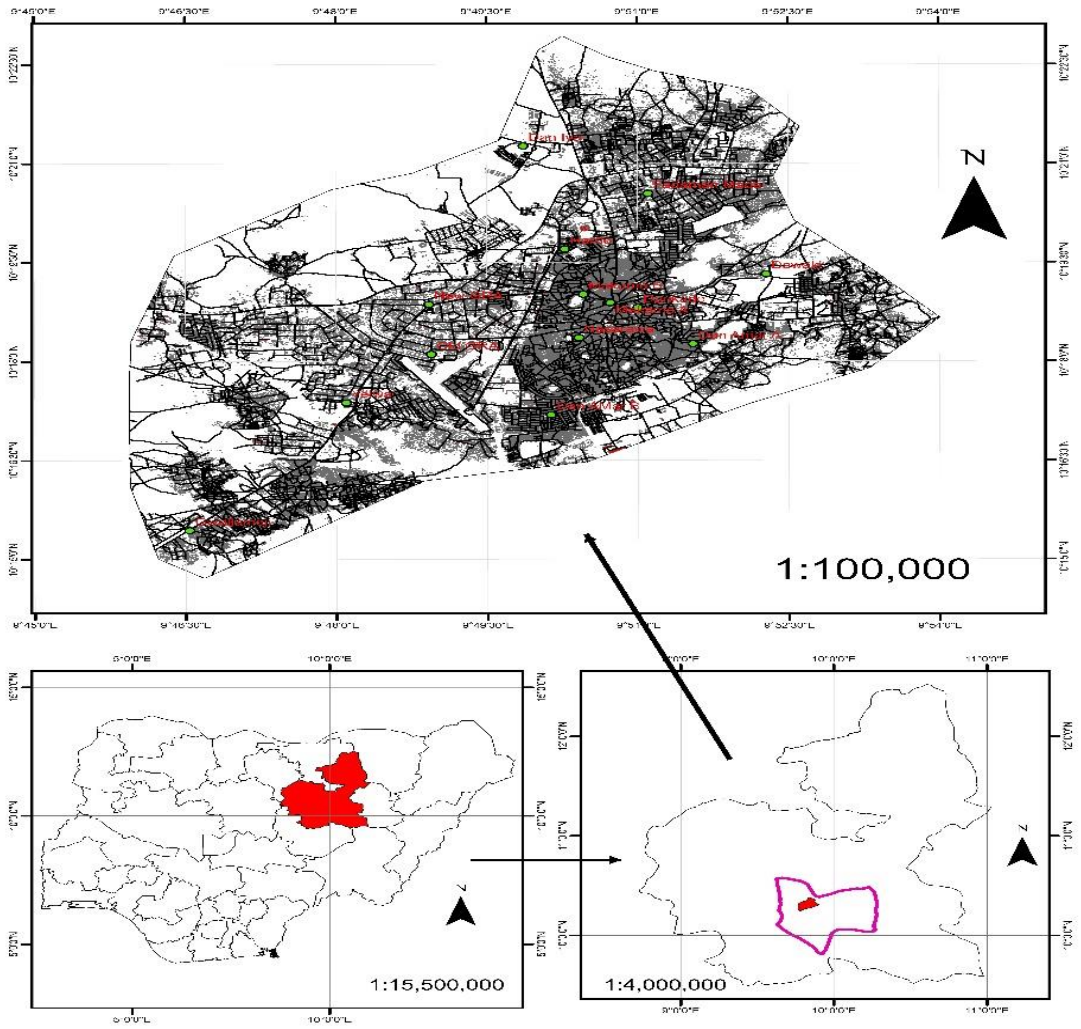

Figure 1: The Study Area

Stage 3 was the selection of households, The Bauchi State Environmental Protection Agency reported a total of 39,675 households in Bauchi, with the distribution across wards as follows: Old GRA (2192 households), New GRA (1197), Fadaman Mada (2885), Yelwa (6563), Dan Iya (3810), Makama (1517), Ibrahim Bako (2250), Nassarawa (4170), Dan Kade (3737), Dawaki (4790), Dan Amar (4816), and Hardo (1748) (Babanyara and Bogoro, 2011).

The sampling process involved determining the sample size through Yamane's (1976) Sample Size Determination technique, expressed mathematically as:

$$n = \frac{N}{1 + N\,(e)^2}$$

Here, n represents the required responses/sample size, $(e)^2$ is the error limit, and N is the population size. With a total population of households in the study area being 39,675 and an acceptable error size of 0.05, the formula yielded a sample size of 396 respondents.

Bowley's (1962) Proportional Allocation technique was employed to ascertain the number of respondents in each ward, given by:

$$n_b = \frac{\mathrm{n}\,(n)}{N}$$

Where n_b denotes Bowley's Proportional Allocation, n represents the population allocated to respondent groups, n is the total sample size, and N is the population of the study. Consequently, 396 households were sampled in the study area, with each ward receiving a proportionate allocation. The questionnaire was distributed randomly to ensure an equal chance of selection for each member of the population under study, thereby minimizing bias. The distribution of household population and sample size for each ward is detailed as follows:

Table 1: Population and sample size

WARDS	POPULATION SIZE	SAMPLE SIZE
Old G.R.A	2192	22
New G.R.A	1197	12
Fadaman Mada	2885	29
Yelwa	6563	66
Dan Iya	3810	39
Makama	1517	15
Ibrahim Bako	2250	23
Nassarawa	4170	42
Dan Kade	3737	37
Dawaki	4790	45
Dan Amar	4816	48
Hardo	1748	18
Total	**39675**	**396**

2.3 Questionnaire

Questionnaire were administered to the target population of the study. The questionnaire comprised of two sections; Section "A" comprised of socio-demographic information of respondents' details such as age, gender, educational level and occupation. The demography of the respondents in a questionnaire is crucial for ensuring representativeness, analysing data patterns and assessing biases.

Section "B" comprised of questions relating to examining the perception of the people about the driving forces of Urban expansion in Bauchi metropolis. The targeted respondents of the questionnaire were the heads of households in the study area, this is because, heads of households are often seen as the decision-makers and most knowledgeable person in the household.

2.4 Method of Data Analysis

Data collected from the field were coded, organized and analyzed using descriptive statistical techniques. The responses obtained from the questionnaires were summarized using frequency counts and percentages to describe the demographic characteristics of respondents and to determine the distribution of responses for each study variable.

A 3-point Likert scale was employed to assess respondents' level of agreement with the identified drivers and impacts of urban expansion. The response categories and corresponding scale values were:

Table 2: Likert scale interpretation

Percentage Range	Scale Value	Mean Range	Interpretation
67% – 100%	3	2.34 – 3.00	High
34% – 66%	2	1.67 – 2.33	Moderate
0% – 33%	1	1.00 – 1.66	Low

The results of the analysis were presented in tables and discussed using frequencies, percentages, Likert scale scores, and their corresponding interpretations to facilitate a clear understanding of the major drivers and impacts of urban expansion in Bauchi Metropolis. Consequently, any variable with a mean score equal to or greater than 2 was considered an impacted variable, while those with mean scores below 2 were categorized as less impacted variables (Nwodu, 2021).

3.0 Results and Discussion

3.1 Socio demographic profile of the respondent.

Table 3: Socio demographic profile of the respondent.

S/N	Variables	Categories	Respondents	
			Frequency	Percentage (%)
1	Gender	Male	353	89.1
		Female	43	10.9
2	Age (years)	<18	3	0.8
		18-25	6	1.5
		26-40	49	12.4
		41-50	128	32.3
		51 and above	210	53.0
3	Occupation	Farming	54	13.6
		Trading	102	25.8
		Civil servants	187	47.2
		Artisans	46	11.6
		Others	7	1.8
4	Marital Status	Single	76	19.2
		Married	273	68.9
		Divorced	28	7.1
		Widower	12	3.0
		Separated	7	1.8
5	Educational qualification	Arabic	18	4.5
		Primary certificate	50	12.6
		SSCE/GCE	89	22.5
		Post secondary certificate	239	60.4
6	Number of years resided in Bauchi metropolis	<5	66	16.7
		6-10	87	22.0
		11-15	120	30.3
		16-20	53	13.4
		21 and above	70	17.7

Table 3 shows the socio demographic characteristics of the respondents. From the data collected, the study was predominantly represented by male respondents, with 89.1% males and 10.9% females. This distribution indicates that males constituted the overwhelming majority of the respondents, which reflect the demographic composition of the study area.

The respondents were largely middle-aged and older adults. The majority, 53%, were 51 years and above, followed by 32.3% respondents aged 41-50 years. Respondents aged 26-40 years accounted for 12.4%, while those aged 18-25 years and below 18 years constituted only 1.5% and 0.8% respectively. This indicates that most participants had attained a level of maturity and were likely to possess substantial knowledge and experience regarding urban development within the metropolis.

Nearly half of the respondents, 47.2%, were civil servants, making them the largest occupational group. This was followed by 25.8% engaged in trading, 13.6% involved in farming, and 11.6% who were artisans. Only 1.8% respondents reported engaging in other occupations. The occupational distribution suggests that the respondents were drawn from diverse socio-economic backgrounds, thereby providing varied perspectives on urban expansion.

Most respondents were married, accounting for 68.9% of the sample. Single respondents constituted 19.2%, while 7.1% were divorced, 3% were widowed, and 1.8% were separated. The predominance of married respondents suggests that many participants were likely to have long-term residential and social ties within the metropolis.

The findings reveal that the respondents were generally well educated. The majority, 60.4% possessed post-secondary qualifications, while 22.5% had SSCE/GCE certificates. Respondents with primary school certificates numbered were 12.6%, whereas 4.5% had Arabic education as their highest educational qualification. The relatively high educational attainment of respondents suggests that they were capable of providing informed opinions on issues relating to urban expansion.

With respect to duration of residence, 30.3% respondents had lived in the metropolis for 11-15 years, representing the largest proportion. This was followed by 22% who had resided in the area for 6-10 years, 17.7% for 21 years and above, 16.7% for less than 5 years, and 13.4% for 16-20 years. The results indicate that a substantial proportion of respondents had lived in Bauchi Metropolis for more than a decade, suggesting that they possessed adequate knowledge and experience of the city's growth and urban expansion over time.

3.2 Familiarity with the concept of urban expansion

Table 4: Familiarity with the concept of urban expansion

Variables	Frequency	Percentage (%)
Very Familiar	108	27.3
Familiar	203	51.3
Not Familiar	85	21.4
Total	**396**	**100**

Table 4, shows the data collected regarding the respondents' familiarity with the concept of urban expansion. The data reveals that 27.3% expressed they were very familiar with the concept, 51.3% indicated that they were familiar with the concept. While 21.4% indicated a lack of familiarity with urban expansion.

Approximately 78.5% of the respondents exhibited familiarity with urban expansion, while the remaining 21.5 % were not acquainted with the concept. Consequently, the response of the respondents who demonstrated familiarity with urban expansion were strictly selected for the subsequent questionnaire questions.

3.3 Expansion of Bauchi metropolis

Table 5: Expansion of Bauchi metropolis

Variables	Frequency	Percentage (%)
Strongly Agree	136	43.7
Agree	130	41.8
Disagree	45	14.5
Total	**311**	**100**

Table 5 shows the data collected on the respondents' opinion on the physical expansion of Bauchi metropolis. The data shows that, 43.7% strongly agree that Bauchi metropolis has physically expanded, 41.8% agree that Bauchi metropolis has physically expanded, while 14.5 % disagree that Bauchi metropolis has physically expanded. This shows about 85.5% agree that Bauchi metropolis has physically expanded, whereas, 14.5% disagree that Bauchi metropolis has physically expanded. The responses of the respondents that agreed that Bauchi metropolis has physically expanded were strictly chosen for the subsequent questionnaire questions.

3.4 Rapidness of the expansion of Bauchi metropolis

Table 6: Rapidness of the expansion of Bauchi metropolis

Variables	Frequency	Percentage (%)
Rapid	133	50
Moderate	108	40.6
Slow	25	9.4
Total	**266**	**100**

Table 6 shows the data collected on the rapidness of the expansion. the data reveals that about 50% indicated that the expansion of Bauchi metropolis is happening at a rapid rate, 40.6% indicated that the expansion is happening at a moderate rate, whereas, 9.4% percent indicated that the expansion of Bauchi metropolis is happening at a slow rate.

3.5 Driving forces of Urban expansion in Bauchi metropolis

Table 7: Driving forces of urban expansion in Bauchi metropolis

S/N	Variables	Frequency	Percentage (%)	Likert Score	Interpretation
1	Population Growth	260	97.7	3	High
2	Urbanization	253	95.1	3	High
3	Economic Development	246	92.5	3	High
4	Land Availability	250	94.0	3	High
5	Government Policies	237	89.1	3	High
6	Others	13	4.9	1	Low

Table 7 shows the driving forces of urban expansion. According to the findings, 97.7% of the respondents identified population growth as a significant driver of urban expansion, with a Likert score of 3 (High), indicating a high level of agreement among respondents. Population growth entails an increase in the number of people within a given area over a specified period, thereby creating greater demand for housing, transportation networks, public facilities, and other urban infrastructure. As the population of Bauchi metropolis continues to increase, the city expands outward to accommodate the growing population. This finding agrees with the studies of Huang *et al.,* (2009), Li *et al.,* (2003), who reported that demographic growth is one of the primary determinants of urban expansion.

The data further revealed that 95.1% of the respondents identified urbanization as a major driving force, with a Likert score of 3 (High), suggesting strong agreement that increasing urbanization contributes significantly to urban expansion by attracting large populations seeking socio-economic opportunities. The continuous migration of people from rural communities to the city in search of employment opportunities, better educational facilities, healthcare services, and improved living conditions contributes significantly to the increasing urban population. Consequently, the growing concentration of people necessitates the development of new residential neighbourhoods, commercial centres, and public infrastructure, thereby accelerating urban expansion. This finding corroborates the findings of Bloch *et al.,* (2015) that identified rural–urban migration and urbanization as major contributors to the rapid spatial growth of cities, particularly in developing countries where urban centres continue to attract large populations seeking socio-economic opportunities.

The findings also showed that 92.5% of the respondents considered economic development an important factor influencing urban expansion. This variable recorded a Likert score of 3 (High), indicating that respondents strongly agreed that economic growth increases demand for residential, industrial, and commercial land. Economic development stimulates investment, industrial activities, commercial establishments, and employment opportunities, all of which increase the demand for urban land and infrastructure. This result is consistent with the findings of Piao *et al.,* (2006) and Li *et al.,* (2013), who emphasized that economic growth is among the strongest determinants of urban expansion because it promotes infrastructural development and increases demand for residential, industrial, and commercial land.

Regarding land availability, 94.0% of the respondents identified it as a key driver of urban expansion. The variable received a Likert score of 3 (High), reflecting respondents' strong agreement that the availability of undeveloped land encourages settlement expansion into peri-urban areas. As demand for land increases due to population and economic growth, these available lands are gradually converted into built-up areas, resulting in the outward expansion of the city. This finding supports He *et al.,* (2008), view that abundant and accessible land resources facilitate urban growth, particularly in rapidly developing cities where development often extends into previously undeveloped peri-urban areas.

The findings further indicated that 89.1% of the respondents considered government policies an important factor influencing urban expansion. With a Likert score of 3 (High), respondents generally agreed that planning regulations, land allocation policies, and development strategies significantly influence sustainable urban development and urban growth patterns. This finding aligns with previous studies that emphasized the significant role of government policies, land administration systems, and planning regulations in shaping urban growth patterns. Effective policy implementation has been identified as essential for promoting sustainable urban development and controlling urban sprawl (Angel, 2023).

Furthermore, only 4.9% of the respondents identified other factors including, climate change, cultural and lifestyle preferences, transportation infrastructure, and environmental conditions, as additional drivers of urban expansion in Bauchi metropolis as contributors to urban expansion. This variable recorded a Likert score of 1 (Low), indicating low agreement that other unspecified factors play a significant role compared with the major drivers identified above.

3.6 Impacts of urban expansion in Bauchi metropolis

Table 8: Impacts of Urban expansion on in Bauchi metropolis

S/N	Variables	Frequency	Percentage (%)	Likert Score	Interpretation
1	Loss of Natural Habitat	244	91.7	3	High
2	Changes in Land Use	253	95.1	3	High
3	Increase in Impervious Surfaces	216	81.2	3	High
4	Others	21	7.9	1	Low

Table 8 reveals the impacts of urban expansion on Bauchi metropolis. The findings revealed that 91.7% of the respondents identified loss of natural habitat as a major impact of urban expansion. This variable recorded a Likert score of 3 (High), indicating a high level of agreement that urban expansion contributes significantly to the destruction of natural ecosystems and biodiversity. The continuous conversion of forests, wetlands, grasslands, and agricultural lands into residential, commercial, and industrial developments has resulted in habitat destruction, biodiversity loss, and ecological imbalance within the metropolis. This finding is consistent with Rahman *et al.,* (2019), which reported that urban expansion contributes significantly to environmental degradation through the destruction of natural ecosystems and the reduction of biodiversity.

The study further showed that 95.1% of the respondents identified changes in land use as a major consequence of urban expansion. The variable obtained a Likert score of 3 (High), reflecting strong agreement that urban growth substantially alters land-use patterns, particularly in rapidly urbanizing areas. The rapid conversion of agricultural land, open spaces, and vegetation into residential, commercial, and industrial uses has considerably altered the landscape of Bauchi metropolis. This finding agrees with Wang *et al.,* (2019) that identified land use and land cover transformation as one of the most direct and visible consequences of urban expansion, particularly in rapidly urbanizing regions.

Similarly, 81.2% of the respondents indicated that the increase in impervious surfaces is an important impact of urban expansion. This factor also recorded a Likert score of 3 (High), demonstrating respondents' strong agreement that urban development replaces permeable surfaces with buildings and paved areas, thereby increasing surface runoff, urban flooding, and heat island effects. The replacement of natural surfaces with concrete, asphalt, and other impermeable materials reduces water infiltration, increases surface runoff, limits groundwater recharge, and elevates the risk of urban flooding. In addition, the expansion of impervious surfaces contributes to higher land surface temperatures through the urban heat island effect. These findings are consistent with those of Zou *et al.,* (2021) and Rizwan *et al.,* (2008), who reported that rapid urbanization and the expansion of built-up areas significantly alter surface energy balance, reduce soil permeability, increase stormwater runoff, and intensify urban flooding and heat island effects.

Finally, only 7.9% of the respondents identified other impacts of urban expansion. This variable received a Likert score of 1 (Low), indicating low agreement that other unspecified impacts are as significant as the major environmental effects identified in the study.

3.7 Regulations or guidelines in place to control or manage urban expansion

The findings reveal unanimous support among respondents for the establishment of regulations or guidelines to oversee urban expansion, with 56.4% strongly agreeing and 43.6% agreeing that such measures are necessary. The absence of any neutral or negative responses underscores a broad consensus that urban growth in Bauchi Metropolis requires formal regulatory frameworks to ensure orderly and sustainable development.

These findings corroborate previous studies that have highlighted the critical role of governance and institutional frameworks in mitigating the negative impacts of urban sprawl. For instance, Angel (2023) observed that weak governance structures and inadequate implementation of planning regulations significantly contribute to uncontrolled urban expansion in cities, emphasizing the need for integrated governance approaches to promote sustainable urban development.

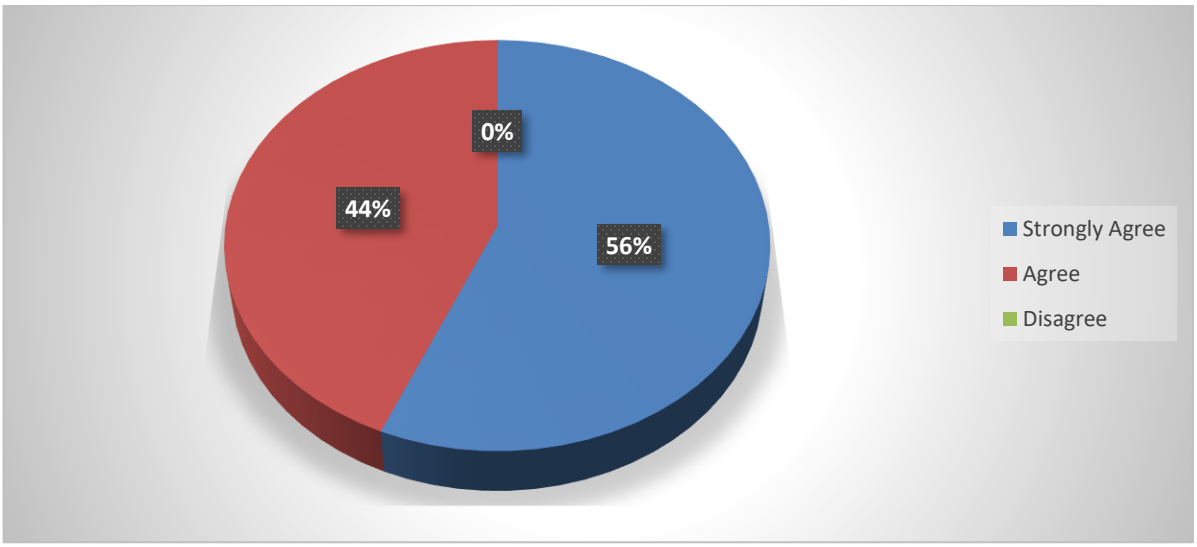

Figure 2: Regulations or guidelines to be put place to control or manage urban expansion

4.0 Conclusion and Recommendations

4.1. Conclusion

This study examined the driving forces and perceived impacts of urban expansion in Bauchi Metropolis, Bauchi State, Nigeria, based on the perceptions of residents. The findings demonstrate that urban expansion in the metropolis is primarily driven by population growth, urbanization, economic development, land availability, and government policies. Among these, population growth emerged as the most influential driver, reflecting the increasing demand for residential, commercial, and public infrastructure arising from rapid demographic change. Similarly, urbanization and economic development continue to accelerate the outward expansion of the metropolis through increased migration, investment, and employment opportunities, while the availability of land and inadequate implementation of land use policies further facilitate unplanned urban growth.

The study further revealed that urban expansion has resulted in significant environmental and land-use changes within the metropolis. The conversion of natural landscapes into built-up areas has contributed to habitat loss, extensive land use and land cover changes, and increased impervious surfaces, thereby posing considerable threats to environmental sustainability and ecosystem functioning. These findings are consistent with previous studies, which have established that uncontrolled urban expansion alters natural landscapes, intensifies flooding risks, degrades ecological resources, and places increasing pressure on urban infrastructure and public services.

Overall, the findings suggest that the current pattern of urban expansion in Bauchi Metropolis is largely uncoordinated and, if left unmanaged, may undermine sustainable urban development. Consequently, there is an urgent need for integrated land-use planning, effective policy implementation, and strengthened development control measures to ensure that future urban growth is properly managed while balancing socio-economic development with environmental sustainability.

4.2 Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. The Bauchi State Government should strengthen the implementation and enforcement of land use planning regulations and development control policies to guide orderly urban expansion and prevent unplanned developments.
2. Comprehensive urban growth management strategies should be developed to accommodate increasing population growth and urbanization while ensuring the efficient provision of housing, transportation, public utilities, and social infrastructure.
3. Environmentally sensitive areas, agricultural land, wetlands, and other natural habitats should be identified and protected through appropriate zoning regulations to minimize habitat loss and uncontrolled land conversion.
4. Public awareness programmes should be intensified to educate residents, developers, and other stakeholders on the environmental consequences of uncontrolled urban expansion and the importance of sustainable land-use practices.
5. Future studies should integrate geospatial analysis, remote sensing, and predictive urban growth models with socio-economic assessments to provide a more comprehensive understanding of the spatial dynamics, future trends, and policy implications of urban expansion in Bauchi Metropolis.

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