
BANDA ACEH METAMORPHOSIS: ANALYZING THE IMPACT OF URBAN SPRAWL IN MEURAXA DISTRICT

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ABSTRACT

The rapid development of Banda Aceh City has led to a surge in population growth, causing unstructured development in suburban areas, particularly in Meuraxa District, where the land use has undergone a significant transformation. This research aims to analyze the impact of urban sprawl on the form of the city of Banda Aceh in terms of the physical condition of Meuraxa District. Utilizing a quantitative approach with geographic analysis, the study employs remote sensing and GIS (Geographic Information System) applications, specifically ArcGIS SHP map data. The analysis covers the period from 2010 to 2020, revealing a noteworthy increase in housing land use in Meuraxa District. The findings indicate that Meuraxa District has experienced urban sprawl, evidenced by the reduction in undeveloped land, there was an increase in land use for housing, improved accessibility, and increased availability of facilities. The GIS data-based urban sprawl development model categorizes Meuraxa District as an "edge expansion" type, with a calculated T value falling in the $0 < T < 0.5$ range.

Keywords: city development, land use, urban sprawl, city form.

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INTRODUCTION

As the provincial capital of Aceh, Banda Aceh offers several public amenities that draw in residents from other areas and entice them to live therein. Banda Aceh experienced rapid growth after the earthquake and tsunami disaster at the end of December 2004. Previous research has produced a growth model for Banda Aceh using the CA-Markov process with simulation results showing that after the Tsunami, the City of Banda Aceh tended to grow towards the coast (Tursina et al., 2022). Especially for coastal areas local governments must immediately prepare special coastal area spatial plans to control growth in these areas and ensure that the economic benefits of disaster mitigation and coastal protection are maintained (Achmad et al., 2018). The 2018 Banda Aceh City Detailed Spatial Plan explains that the priority areas include parts of Meuraxa District. One of the considerations for determining this area as a priority Urban Area Subdivision is because this area contains the strategic area of Banda Aceh City, namely the Tsunami Tourism Area, which includes the Mass Graves of Tsunami Victims and is part of the historical witness to the tsunami disaster so this area is necessary. Preserved and protected. This area will later be directed to become a unified beach tourism area. This is supported by the plan to build a remembrance tourism area in the coastal area adjacent to the Baitul Rahim Mosque (Ulee Lheue Mosque).

The number of residents living in Meuraxa District, Banda Aceh City, increases from year to year. In 2016, the population was 19,388 people; in 2017, it was 19,770 people; in 2018, it was 20,166 people. Furthermore, in 2020 the number increased to 26,861 people, and in 2021, the population rose to 27,273 people (Aceh, 2022). The increase in population indicates that there is development or development in the suburban areas of Banda Aceh (urban sprawl).

Urban Sprawl is random, unplanned development in a city using empty land in suburban areas (Setyawati et al., 2022). Currently, the development of the city of Banda Aceh is experiencing growth in suburban areas. The outskirts of Banda Aceh City are developing with the growth of various new housing and settlements. The aftermath of the earthquake and tsunami 17 (seventeen) years ago had an impact on settlements, buildings, population movements, and changes in development patterns. Urban development in the city of Banda Aceh is shifting to the urban fringe. The increasing need for space in the city of Banda Aceh has helped the growth of urban sprawl. Urban sprawl reduces the amount of available fertile land, resulting in uneven patterns of urban form variation (Fadhly et al., 2016). On a broader scale, the overall form of a city reflects its geographical position and the characteristics of its place. Based on this theory, the development of a city can be determined by its geographical position and the characteristics of the place where an activity process takes place so that it can form patterns that follow the conditions of that area. The physical characteristics of urban areas include population density, distance to CDB, changes in built areas, and road network patterns (Widodo & Sunarti, 2019).

Forms of city development that influence urban sprawl are (a) Infilling type (square type), (b) Edge expansion, and (c) Outlying type (Hai et al., 2019). Calculation of the ratio between the Length of the common edge of the newly developed urban patch and the urban patch, namely:

$$T = L_c / I$$

Where L_c (km) is the length of the shared edge between the newly developed urban patch and the existing urban patch, and I (km) is the perimeter of the newly developed urban patch. The T value is between 0 and 1.

A field called T is defined as a field whose value is equal to the ratio L_c to I , and L_c is the common length between the new urban patch and the old urban patch, and I is the perimeter of the corresponding new urban patch. The T value is between 0 and 1. If $T > 0.5$, it means that the old urban patch surrounds at least 50% of the new urban patch, and this represents the infill type; if $0 < T < 0.5$, the new city tile grows from the edge of the old city tile, and its Length along it is less than 50% of its boundary. If $T = 0$, it means that the new urban patch has no spatial relationship with the old urban patch, and this is an outlying type (Hai et al., 2019).

This research was conducted to find out the physical condition of Meuraxa District, Banda Aceh City, based on satellite imagery in 2010, 2015, and 2020. The results of the satellite imagery show the development of urban sprawl in Meuraxa District. The variables used in this research are population density, distance to the Central Business District (CBD), housing demand, changes in land use, accessibility, and availability of facilities. This research aims to analyze the impact of urban sprawl on the form of the city of Banda Aceh in terms of the physical condition of Meuraxa District.

METHOD

The location of this research was in Meuraxa District, Banda Aceh City. The method used in this research was a quantitative geographic method, which conveyed objectively to answer the research objectives. The quantitative data were supported by urban sprawl theory; data processing was carried out using a descriptive approach. This research was carried out systematically and conducted measurably to achieve accurate results.

The data collection technique in this research was quantitative. Data collection was carried out by collecting and studying published reports from the Banda Aceh City Government related to research such as Banda Aceh City BPS, Banda Aceh City Public Works and Settlements Service, Banda Aceh City RTRW 2009-2029, Banda Aceh City administrative maps, journal articles, and books that were relevant to this research.

Then, qualitative data analysis was carried out, namely by data recapitulation and data analysis using the Geographic Information System (GIS) application to obtain land use results in Meuraxa District, Banda Aceh City. Time series map data collection was carried out using SHP Arcgis, which shows objects on the earth's surface, such as the shape of islands, administrative boundaries, rivers, roads, etc. (Zendrato & Ginting, 2017). Next, researchers identified factors that influence the development of urban sprawl based on the following indicators: density, distance to CDB, housing demand, changes in land function, accessibility, and availability of facilities. Based on the results of data collection, an analysis of the type of urban sprawl development was also carried out by looking at the condition of the spatial structure of the Meuraxa District area, namely: (a) infilling type, (b) edge expansion, and (c) outlying type.

RESULTS AND DISCUSSION

The following are the results of data acquisition on the influence of increasing development growth rates based on satellite imagery in 2010, 2015, and 2020, showing indications of the development of urban sprawl in Meuraxa District, Banda Aceh City.

Population Density

In accordance with the increase in population in Meuraxa District, the density value also increases. Population density is the total number of residents in each village compared to the village area. The highest population density in Meuraxa District was found in village Punge Jurong at 81 people/Ha in 2010, which then increased to 91 people/Ha in 2015 and 98 people/Ha in 2020. Results of analysis of population density data in Meuraxa District from 2010, 2015, and 2020 (See Figure 2).

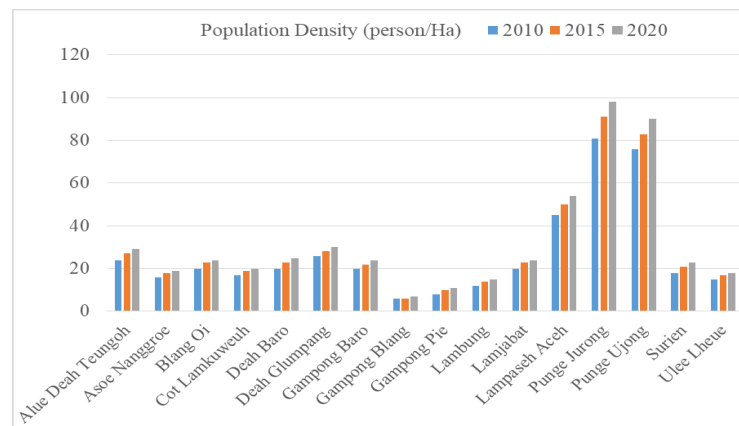


Figure 2. Land Function Change

Distance to Central Business District (CBD)

The distance to the Central Business District (CBD) varies from Meuraxa District to Peunayong Market, Banda Aceh City. Peunayong Market is the central point of Banda Aceh. The distance between the Central Business District (CBD) and the trade and services zone, office zone, and public facilities service zone also influences the occurrence of urban sprawl in Meuraxa District. Peunayong is a one-stop shopping area, so it is able to become a transit point for the people of Meuraxa to shop for their daily needs. Table 1 presents an analysis of the distance to the city center, which was carried out by measuring the distance from buildings in village in Meuraxa District to the CBD point in Banda Aceh City using network analysis.

Table 1. Distance from Village in Meuraxa District to Central Business District Point

Village	Distance to CBD (km)
Surien	4,7
Aso Nanggroe	5,7
Gampong Blang	5,7
Lamjabat	5,1
Gampong Baro	4,3
Punge Jurong	2,9
Lampaseh Aceh	3,6
Punge Ujong	3,8
Cot Lamkuweuh	5,4
Gampong Pie	6,4
Ulee Lheue	6,0
Deah Glumpang	5,6
Lambung	5,2
Blang Oi	4,4
Alue Deah Teungoh	4,6
Deah Baro	4,9

Source: Analysis Results 2023

Occupancy Request

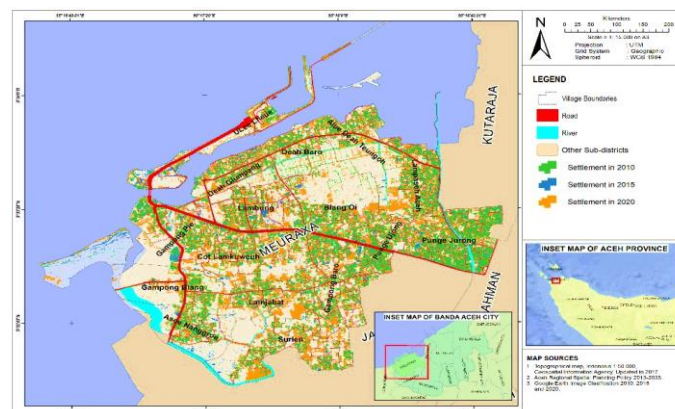
The increasing demand for housing in the Meuraxa District area in 16 Vilaage can be seen by the increasing use of land where housing has been built. Table 2 presents data on land use for housing from 2010 to 2020.

Table 2. Land Use for Housing in Meuraxa District

Village	Land area for housing (Ha)		
	2010	2015	2020
Alue Deah Teungoh	2,8	3,28	7,17
Asoe Nanggroe	2,89	2,9	4,69
Blang Oi	8,58	9,29	18,46
Cot Lamkuweuh	3,13	3,75	9,04
Deah Baro	2,07	2,16	4,43
Deah Glumpang	2,19	2,84	6,13
Gampong Baro	4,99	5,31	10,64
Gampong Blang	2,75	2,8	5,42
Gampong Pie	2,43	3,15	4,37
Lambung	3,64	3,9	8,71
Lamjabat	2,6	3,38	9,23
Lampaseh Aceh	5,56	7,22	13,98
Punge Jurong	14,57	15,68	22,18
Punge Ujong	4,88	5,18	7,41
Surien	4,17	4,77	12,29
Ulee Lheue	3,41	4,33	7,05
Amount	70,66	79,94	151,2

Source: GIS Analysis Results for 2023

Land use for housing increased from 2010 to 2020. Land use in 2010 was 70.66 Ha, increasing to 79.94 Ha in 2015. Then, in 2020, there was an increase in residential land use, namely to 151.2 Ha. Physical development to the west of the city, namely Meuraxa District, shows the existence of urban sprawl in that area. The increase in development is marked by the use of empty land for building houses. The use of empty land to build houses has increased significantly in Village Alue Deah Teungoh in 2010, amounting to 27,958.49 m², increasing in 2015 to 32,791.21 m². The increase in housing also occurred in Village Blang Oi; in 2010, it was 85,767.20 m², increasing in 2015 to 92,851.48 m². The same thing also happened in Village Lampaseh Aceh; in 2010, it was 55,612.38 m², increasing in 2015 to 72,167.71 m². For Village Punge Jurong, in 2010, it was 145,717.98 m², increasing in 2015 to 156,753.84 m². A significant increase also occurred in Village Surien; in 2010, it was 41,743.77 m², increasing in 2015 to 47,703.34 m². Figure 3 shows a map of housing distribution in Meuraxa District in 2010, 2015, and 2020.

**Figure 3. Layout of Urban Sprawl, Comparison of houses in 2010, 2015, and 2020 in Meuraxa District**

Changes in Land Function

Land use in Meuraxa District consists of built-up land use and undeveloped land use. The increasing population in Meuraxa District means that land use conditions are also affected. This increase in population is directly proportional to the activities generated, so land is needed to accommodate the activities that occur (NINGSIH, 2018). Table 3 presents changes in land function from 2010, 2015, and 2020.

Table 3. Changes in Land Function in Meuraxa District

Village	Undeveloped Land Area (Ha)		
	2010	2015	2020
Blue Deah Teungoh	26,44	25,95	22,06
Asoe Nanggroe	24,40	23,25	16,75
Blang Oi	74,83	66,08	63,38
Cot Lamkuweuh	27,89	27,27	21,98
Deah Baro	21,47	16,62	15,30
Deah Glumpang	13,86	13,21	9,92
Gampong Baro	29,93	29,62	24,28
Gampong Blang	50,37	47,18	41,81
Gampong Pie	15,03	14,30	13,09
Lambung	37,43	37,18	32,36
Lamjabat	33,66	33,26	27,82
Lampaseh Aceh	32,54	30,89	24,13
Punge Jurong	27,24	26,14	19,63
Punge Ujong	12,88	12,60	10,38
Surin	50,2	49,4	36,71
Ulee Lheue	30,90	29,97	27,25
Amount	509,06	482,93	406,84

Source: GIS Analysis Results for 2023

There has been a reduction in undeveloped land in Meuraxa District due to increased development in the area. The area of undeveloped land in 2010 was 509.06 Ha. In 2015, it decreased to 482.93 Ha. Furthermore, in 2020, the remaining undeveloped land will be 406.84 Ha. Physical changes in Meuraxa District in terms of changes in land function, namely from empty land to built-up land, can be an indication of urban sprawl in Meuraxa District, Banda Aceh City.

Accessibility

Based on data from the Central Statistics Agency contained in Meuraxa District in Figures 2021, Meuraxa District residents' access to public facilities such as education, health, and other public facilities can be reached easily. This ease of accessibility is also supported by the existence of good transportation infrastructure, namely roads. The layout of roads and other facilities in Meuraxa District is shown in Figure 4 below.

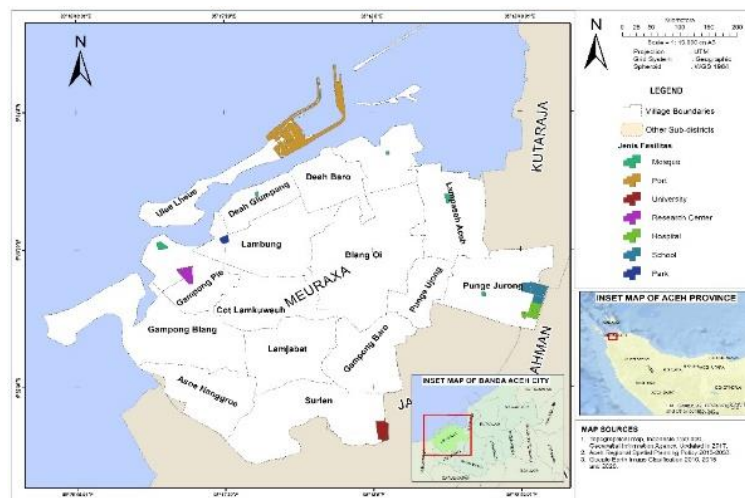


Figure 4. Layout of Public Facilities in Meuraxa District

Availability of Facilities and Availability of Land

Based on data from the Central Statistics Agency (BPS) contained in Meuraxa District in Figures 2021, the educational facilities available in Meuraxa District consist of 9 elementary school units, three junior high school units, three high school units, and one academy/college unit. For health facilities in Meuraxa District, there are two hospital units, one community health center located in Blang Oi village, three auxiliary health center units, three doctor's practices, and 18 integrated service post units spread across each village. Meanwhile, there are no polyclinics and village health posts in this sub-district. Almost all public facilities and infrastructure, such as health facilities, educational facilities, worship facilities, facilities/efforts to anticipate/mitigate natural disasters, and other facilities, are available in Meuraxa District. The availability of facilities and land availability reflects the geographical position of an area and the characteristics of the place. The development of a city can be determined by its geographical location and the characteristics of the place where an activity process takes place, thus forming patterns that follow the conditions of that region (Langoy et al., 2019).

Analysis of the Impact of Urban Sprawl on Changes in City Form

Analysis of physical conditions in Meuraxa District based on satellite image map data for 2010, 2015, and 2020, as well as facility and population statistics, shows that there is a development or shift in urban functions to this area, which is a suburban area of Banda Aceh city, which is an indication of urban sprawl (Amri & Giyarsih, 2022). The increasing population in Meuraxa District means that land use conditions are also increasing. Based on the results of regional development in Meuraxa District, there is a change in landform following the spatial structure and pattern of regional space based on density, increasing demand for housing, changes in land function, accessibility, and availability of facilities influencing the occurrence of urban sprawl in Meuraxa District, Banda Aceh City. Analysis of the development of urban sprawl in Meuraxa District, Banda Aceh City, in terms of the development model, namely expansion patterns: (a) infilling type, (b) edge expansion, and (c) outlying type. Table 4 presents an assessment of the level of physical change in Meuraxa District obtained by calculating the value of the T based on data collected with the help of the Geographic Information System (GIS) application.

Table 4. T Value for The Level of Physical Change in 2015 - 2020

Village	LC Length (Km)	Long l (Km)	Mark	Sprawl Type
Blue Deah Teungoh	12,57	40,67	0,309	edge-expansion
Asoe Nanggroe	8,31	20,81	0,399	edge-expansion
Blang Oi	19,87	55,03	0,361	edge-expansion
Cot Lamkuweuh	14,91	58,43	0,255	edge-expansion
Deah Baro	8,04	22,95	0,350	edge-expansion
Deah Glumpang	11,76	37,1	0,316	edge-expansion
Gampong Baro	21,6	64,04	0,337	edge-expansion
Gampong Blang	7,4	30,18	0,245	edge-expansion
Gampong Pie	8,44	24,77	0,340	edge-expansion
Lambung	12,38	39,83	0,310	edge-expansion
Lamjabat	8,88	34,92	0,254	edge-expansion
Lampaseh Aceh	21,43	58,98	0,363	edge-expansion
Punge Jurong	34,63	65,92	0,525	infilling
Punge Ujong	11,88	27,96	0,424	edge-expansion
Surin	14,34	52,66	0,272	edge-expansion
ULee Lheue	11,09	39,75	0,278	edge-expansion
Total	227,53	674	0,337	edge-expansion

Note: Lc = Length of the same edge between the newly developed urban plot and the existing urban plot; l = Perimeter of the newly developed urban plot

Source: Analysis Results 2023

Based on Table 4, the type of sprawl that occurred from 2010 to 2020 was edge expansion, namely development extending towards the road and the outside. Where there has been urban development towards the outside of the city, it has occurred horizontally and invaded land on the outskirts of Meuraxa District.

CONCLUSION

The results of identifying physical conditions in 16 Gampongs in Meuraxa District show that there has been an increase in population density from 2010 to 2020. In addition, there has been an increase in land use for housing. The increasing population in Meuraxa District means that land use conditions also have an influence. Increasing development in the area has resulted in a reduction in the amount of vacant (undeveloped) land. Then, the accessibility of the people of Meuraxa District to public facilities such as education, health, and other public facilities can be reached easily, and the availability of facilities is adequate. This physical development influences changes in landforms that follow the structure and spatial patterns of urban sprawl areas. The results of calculating the T value for the level of physical change in Meuraxa District show that there is only 1 village with the sprawl infilling type, and 13 other villages show the sprawl edge expansion type. Therefore the development model for urban sprawl in Meuraxa District, Banda Aceh City is edge expansion.

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