



The impact of agglomeration to spatial configuration in industrial zone

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ABSTRACT

Background: Bantaeng Industrial Area (KIBA) is an industrialization area located in the Pa'jukukang District. There are 6 smelter industry companies and 5 other companies that are concentrated in one area. The KIBA settlement is characterized by an increasingly expanding industrial development and a penetration towards community settlements, which increases space capacity and eventually forms a spatial agglomeration. This study aims to analyze the impact of KIBA agglomeration on the development of spatial configuration. **Methods:** The study uses tools of space tendency analysis, double regression analysis, and qualitative descriptive analysis to deduce the occurrence of the phenomenon. **Findings:** The results describe the formation of an agglomeration integrated from spatial style, site style, situational style, and evolutionary style, forming a linear-oriented morphology of the agglomeration following the road network with industry as CBD. Double regression tests show the presence of uncompact chained cities influenced by population, labor force, land value, wage rates, corporate size, transportation, and government policies. The Bantaeng Industrial Area agglomeration emits centrifugal and centripetal forces, forming a semi-concentric zone structure consisting of: a) industrial zone (CBD), b) second zone as transition zone (trade), c) third zone as working-class settlement, d) fourth zone as educational zone, e) fifth zone as middle-class settlement, and f) sixth zone as agricultural zone. **Conclusion:** The agglomeration of the Bantaeng Industrial Area has influenced urban morphology, with increasing industrial activity making it more complex and dynamic, forming six semi-concentric zones. **Novelty/Originality of this article:** The novelty of this study lies in emphasizing the centrifugal and centripetal spatial development style of the Bantaeng Industrial Area agglomeration, integrating economic, social, and political conditions with advanced spatial analysis methods.

KEYWORDS: agglomeration; industrial zone; spatial configuration.

1. Introduction

Urbanization is the characteristic of the agglomeration dynamics that can form urban formations. Agglomeration is the spatial concentration of economic activity in a region as a result of economies of proximity associated with the space clusters of companies, workers and consumers (Syah, 2020). Agglomeration occurs as a result of an increase in the population, the development of land use every year, forming unplanned territories.

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Basically, agglomeration is closely related to industrialization, even there is a definition that suggests that agglomeration comes from an industrial point of view.

Bantaeng Regency is a regency in South Sulawesi Province that is prepared as an industrial area for economic growth to rise, it is characterized by the presence of Bantaeng Industrial Area/*Kawasan Industri Bantaeng* (KIBA) as proof of the seriousness of the government. Bantaeng Industrial Area (KIBA) is an industrialized area located in the Pa'jukukang District where there are several emerging companies. Development of the Industrial Area of Banteng is supported by the legislative and executive authorities that have legal reference Perda No. 1 in 2024 on the Plan of Territorial Space/*Rencana Tata Ruang Wilayah* (RTRW) of Bantaeng in article 42 on changes to Perda No. 02 in 2012 on Regional Space Plan in Bantaeng In article 38 paragraph 2 that mentions the industrial area established in the Bantaenge Industrial Zone which is located in Pa'jukukan District and Gantarangkeke District as the Area Service Centre/*Pusat Pelayanan Kawasan* (PPK) of the districts of Battaeng district, supported with the Regional Regulations/*Peraturan Daerah* (PERDA) No. 3 in 2022 on the Regional Space Planning for South Sulawesi Province 2022-2041 which establishes in the pattern of the area of South Slawesi Province that the area is located as an industrial resource. In addition, there are the Regulations of the Minister of Economy Coordinator No. 21 of 2022 concerning the Second Amendment to the Regulation of the Ministry of Economic Coordination No. 7 of 2021 concerning Changes to the List of National Strategic Projects establishing the Bantaeng Industry Area as the Projection of the National Strategy for the Year 2022 and the Decision of the RI Minister of Energy and Mineral Resources No.102.K/Mb.01/Mem.B/2022 on the South Sulawesi Province Mining Territory which includes the district of Bentaeng as one of the areas established as the mining area in the South sulawesi province.

Government Regulation No. 1 of 2024 on the Regional Space Plan of Bantaeng Regency establishes the Bantaang Industrial Area as a strategic district area/*Kawasan Strategis Kabupaten* (KSK) from the point of view of economic interest. This makes the Bentaeng Industrial Area as one of the concentrations of economic activity in Bantaengu district in supporting the Regional Real Income/*Pendapatan Asli Daerah* (PAD) that attracts investors and labour. This fact makes the activity of the population begin to be centralized so that its existence can affect development and development.

The increase in the population is influenced by the influx of labor from outside the Bantaeng Regency, which will transition into KIBA (growth center) and settle in the area. This population growth leads to the proliferation of buildings with various forms and functions, creating new clusters that will boost urbanization. This aligns with the Neo-Classical Theory, which introduces the idea that agglomeration arises from the behavior of economic actors seeking the benefits of agglomeration, including localization and urbanization economies.

The development in the Bantaeng Industrial Area (KIBA) not only affects the Pa'jukukang district, but also affects Gantarangkeke district and Bulukumba district that borders its administrative territory. The high change in land use patterns is observed from the increase in settlements and public facilities so that the development around the Bantaeng Industrial Area (KIBA) undergoes rapid growth every year to form a new pattern of space. At this time, the value of a region will increase more and more as the increasing capacity of space will surely give an influence to a region that eventually forms an agglomeration of space (Syah, 2020).

The Bantaeng Industrial Area, which is located on the corridors of the primary arterial road and directly borders the fluorescent sea, makes the process of export distribution of imports faster and more efficient, this condition emits a centripetal force. The access of the primary arterial path that connects districts/cities plays a role in forming an agglomeration. (Kuncoro, 2006). On the other hand, supported by the planning of the railway network that crosses the district of Pa'jukukang and the marine transportation network such as special energy terminals and special terminal smelter bantaeng is increasingly supporting the development of the Bantaeng Industrial Area (KIBA) as a base of urban growth makes the

surrounding area develop both in terms of the number of buildings to the number the population because it has a centripetal appeal to resemble the city.

Based on these realities, the focus of the research is on the Bantaeng Industrial Area/*Kawasan Industri Bantaeng* (KIBA) as a new agglomeration center. The research aims to describe the development of the Bantaeng Industrial Zone (KIBA) as the new agglomeration of Bantaeng District, analyze the factors that play a role in the development, and analyse the impact of the existence of Bantaeng Industrial District (KIBA) as new agglomeration on the spatial configuration development of Bantaeng District through a spatially reduced approach that will reduce the capacity of land utilization in the Bantaeng Industrial Area, which produces spatial patterns or space development models that occur.

2. Methods

2.1 Research design and location

The research approaches used are qualitative-quantitative approaches and spatial approaches. Qualitative methods are descriptive and use analysis with scientific methods because they have met the principles - scientific principles that are concrete/empirical, objective, measurable, rational, and systematic (Sugiyono, 2018). Then it is described in more detail that is rooted in a phenomenological approach where the process of reproduction results more focused on the phenomena of agglomeration that occur to respond to the orientation of space development more emphasizing on the centrifugal or centripetal forces. The quantitative approach leads to the value of the factor that plays a role in the development of KIBA as a new agglomeration as well as the spatial approach that deals with the change of wastewater through the physical approach of space morphology that will subsequently produce space patterns or models of development of space structures of land use at the research site.

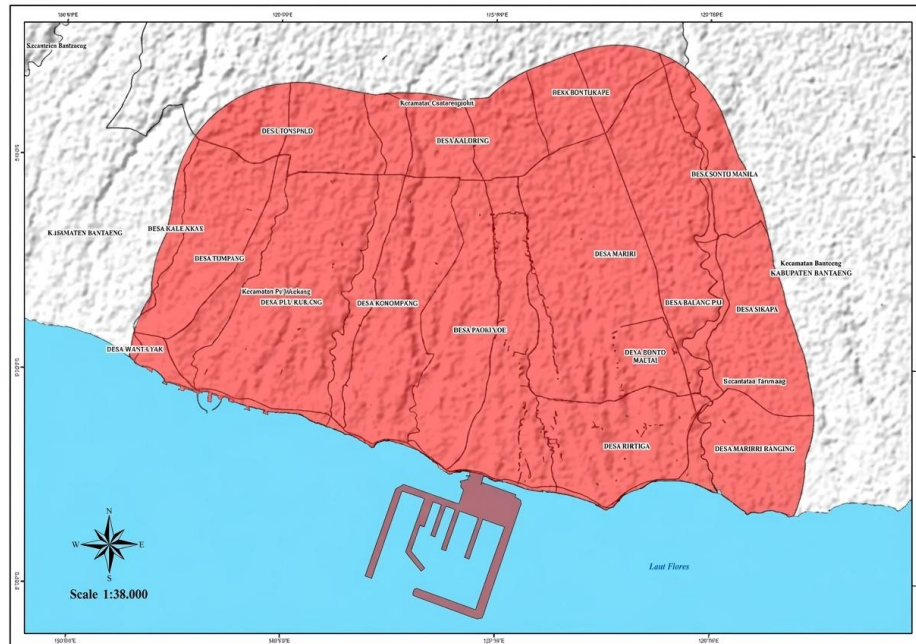


Fig. 1. Research location

The research was carried out in the Bantaeng Industrial Area (KIBA) located in Bantaeng Prefecture, South Sulawesi. The location of the research is based on the presence of symptoms – symptoms that indicate the existence of a concentration of activity without any restrictions, which will result in space gaps. The area of Bantaeng Industrial Area (KIBA) is 6,970.39 ha. Basic consideration of location determination based on boundaries of influence of Bantaeng Industrial Area (KIBA) is by considering the Regulation of the

Minister of Industry No. 35 of 2010 on the Industry Area Guidelines and the Regulations of the Ministry of Industries No. 40 of 2016 on the Technical Guideline for the Development of the Industrial Area as well as the study of the journal on the impact of the development of industrial agglomeration on spatial change, so that the boundary of influences of the Bantaenga Industrial Area is determined by drawing a distance of 0-2 km from each outermost industry.

2.2 Population, sample, and data

Population is a group of elementary units that have similar characteristics or characteristics that can reflect the form of a certain size that in a region can be population, agricultural land, settlement land, river - river, hill, pits and the like (Yunus, 2010). In the Bantaeng Industrial Area (KIBA) research using methods where researchers use only a portion of the population but aim to know the character of population, this type of research is called sampling research. The population in this study is the entire population that is on the delineation of the area of 35,650 people.

A sample is a part of the whole as well as a characteristic of a population to be studied and used to give an idea of the characteristics of the population. Purposive sampling is a method used in determining the number of samples by using non-random samplings with purposive methods of sampling or purposive sampling/judgemental sampling. Purposively sampled is a sample withdrawal performed by selecting the subject based on criteria that have been established by the researcher. The sample determination in this study uses the Slovenian approach so that the number of samples produced is 100 samples with classification: 1) the community 15 samples; 2) the workforce consisting of local and migrant workforce 56 samples; 3) the government apparatus consists of the head of the village, the Camat, the heads of the associated service, and the laity apparatus involved 9 samples.

A research variable is an attribute, object, value and property of an object or activity that has a certain variation that has been established by the researcher (Sugiyono, 2013) to measure a study by studying and drawing conclusions based on the results obtained. The development of the Bantaeng Industrial Area (KIBA) as a new agglomeration in the district consists of land-use variables with physical development indicators of the area, which will deduce the spatial style, site style, situation style and evolutionary style of space using a tool for analyzing the trend of development of space. The impact of the existence of the Bantaeng Industrial Area (KIBA) as a new agglomeration on the evolution of the spatial configuration of the district consists of spatially configurable variables to see the occurring space deformation (centrifugal/centripetal) described using qualitative descriptive analysis.

Primary data is data obtained from direct field research using observation methods, questionnaires and interviews. Primary Data in this study are the phenomena of land change, land value, wage rate, and transportation. Secondary data are the data acquired from the offices of the agencies or related institutions as well as data from previous research results which are raw data in nature and using the method of documentation/surveillance of documents/journal secondary data in this research is the development of the population, the number of workers, the rate of wages, the size of the company, transportation and government policy.

2.3 Data analysis methods

The overlapping process, often called the superimpose, is one of the methods of spatial waste analysis used in this study to determine the physical development of the area. The overlay process consists of several methods: identify, intersct, union, update, erase, and symmetrical difference. Spatial analysis with overlay techniques considers the existence of interregional relationships shown by such spatial data. Spatial analysis is very helpful in describing the phenomenon of manufacturing agglomeration.

Spatial evolution tendency analysis is one of the geographical analyses that uses a reservoir approach based on indications of spatial change. This analysis seeks to answer the question of which direction (spatial orientation) a shift in debris through a physical approach to spatial morphology that will subsequently produce a space pattern or model of the evolution of the space structures of land use at the research site. The development trend of land use can be seen from the comparison of maps of image land use in the past and the use of land existing today, where this study has a time interval of 10 years which is expected to show the orientation and trend of the land use occurring. The results of the spatial analysis (overlay) will be used to find out the tendency of the evolution of space based on theories so that it can be known the development of the wastewater occurring on the object of the research, namely the Bantaeng Industrial Area/*Kawasan Industri Bantaeng* (KIBA) emitting a senstifugal force or centripetal force.

Regression analysis is a type of statistical data processing to test the relationship between one variable and one or more variables. Regression analysis in this study uses double linear regression analysis. This analysis is used to determine the direction of the relationship between a free variable and a bound variable, whether the respective free variables are positively or negatively related.

The situation when the values of regression coefficients, i.e. b_1 and b_2 have values (Yuliara, 2016) is as follows: Value = 0. That means in this case y variables are not affected by X_1 , X_2 and X_3 ; Value = (-). This means that there is a reverse-directional relationship between the bound variable (Y) and the free variable (X_1 , X_2 dan X_3); Value = (+). This means that there is a directional relationship between the bound variable (Y) and the free variable (X_1 , X_2 dan X_3).

Table 1. Correlation interpretation

Coefficients interval	Relationship level
0.00-0.199	Very low
0.20-0.399	Low
0.40-0.599	Medium
0.60-0.799	Strong
0.80-1.000	Very strong

(Arianto, 2020)

Qualitative descriptive analysis is an analysis that provides an overview of conditions and situations from various data that have been collected such as the results of interviews, observations and analysis of the problem being studied. Qualitative descriptive analysis emphasizes on meaning rather than generalization where describing the phenomenon yang captured at the research site accompanied by media evidence. The descriptive analysis of the quality of this research is a description or explanation of the impact of space development and the development of land use spatially on the research site. This analysis is used to respond to the orientation of space development with more emphasis on centrifugal or centripetal forces.

3. Results and Discussion

3.1 Development of the Bantaeng Industrial Area (KIBA)

The analysis of land use changes in the Bantaeng Industrial Area (KIBA) was carried out by comparing the land use maps in time series between 2014, 2019, and 2024, which have been validated using the Superimpose/Overlay Geographic Information System (GIS) analysis method. The land changes that occurred in the bantaeng industrial area due to the concentration that took place in the area as seen from the last 10 years changes that initially only as empty land now changed as awakened land used as settlement, trade & services, and others. The existence of KIBA sangat gave a significant influence on the development of the land around its hiterland territory.

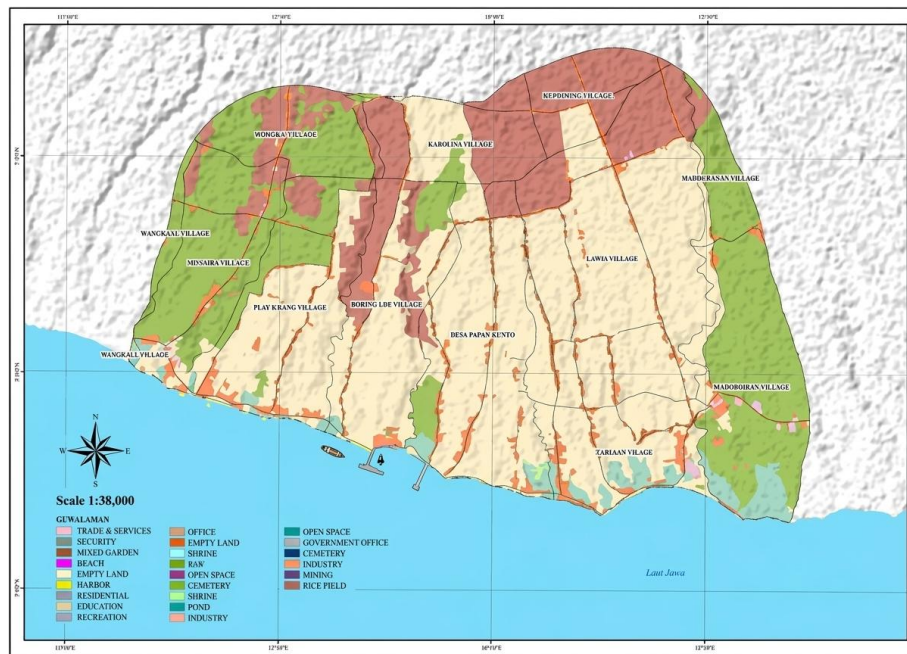


Fig. 2. Land usage map 2014

Based on the results of the analysis known for land use changes in the Bantaeng Industrial Area (KIBA), every type of land use is subject to change in the form of area addition or area reduction. In the period from 2014 to 2024, the use of industrial land from 2014 amounted to 6,650 ha, in 2019 had a development of 237,521 ha and in 2024 the development of industry increased rapidly with an area of 294,964 ha. This shows the continued increase of industrial activity resulting in continued industrial expansion. As stated (Priambudi & Pigawati, 2014) that the expansion of the industrial area continued to be carried out along with the demand for increased industrial yields. Besides, expansion continued along with so rapid economic development that sparked the occurrence of expansion to the periphery horizontally, (Saleh et al., 2023).

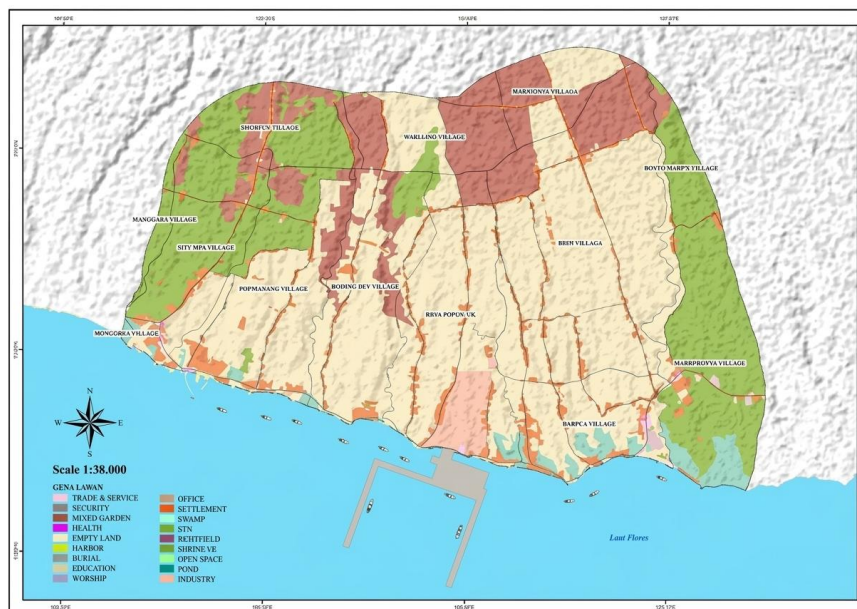


Fig. 3. Land usage map 2019

The development of a region can be seen through the physical development of an area that includes the addition of buildings within a certain period of time. Industrial activity will affect its surroundings. The function of the industrial area as one of the main factors causing

increased activity to resemble the activity of the city. The existing activity in the industrial area will ultimately have a decisive impact on the shape and use of the land, such as the change in the use of land that is not awakened to the land for trade and services and settlements. The impressive industrial activity produces more complex and dynamic activity because it is a major attractive factor so that it more influences the development of other activities in particular settlement as well as commerce and services. The large number of people who are transformed into the Bantaeng Industrial Area demands the fulfilment of its future facilities as a residence. This work of fulfilment of the dwelling place is realized by the growth of the sale of houses and houses for rent. This condition indicates that industrial development not only changes the physical structure of the area but also stimulates the transformation of surrounding land functions. The increasing demand for housing is accompanied by the need for supporting infrastructure and commercial services, which further accelerates the conversion of previously undeveloped or agricultural land. Therefore, the expansion of the Bantaeng Industrial Area has broader implications for the spatial development and land-use pattern of its surrounding areas.

The analysis of land-use changes in the Bantaeng Industrial Area indicates substantial transformations in the spatial utilization of land during the 2014–2019 period. The most prominent change was the conversion of sea areas into industrial land, accounting for 60% of the observed changes. This substantial transformation reflects the expansion of industrial activities into areas previously characterized by marine or coastal functions. In addition, mixed gardens were converted into settlement areas, representing 32% of the changes during the same period. This conversion suggests that industrial development was accompanied by increasing demand for residential land, particularly as employment opportunities attracted workers and other populations to the surrounding area. Other changes, including the conversion of vacant land into settlements, further demonstrate that the development of the industrial area was not limited to the expansion of industrial facilities but also stimulated the growth of supporting residential functions. These changes indicate an interaction between industrial development and the increasing demand for space for housing and other human activities.

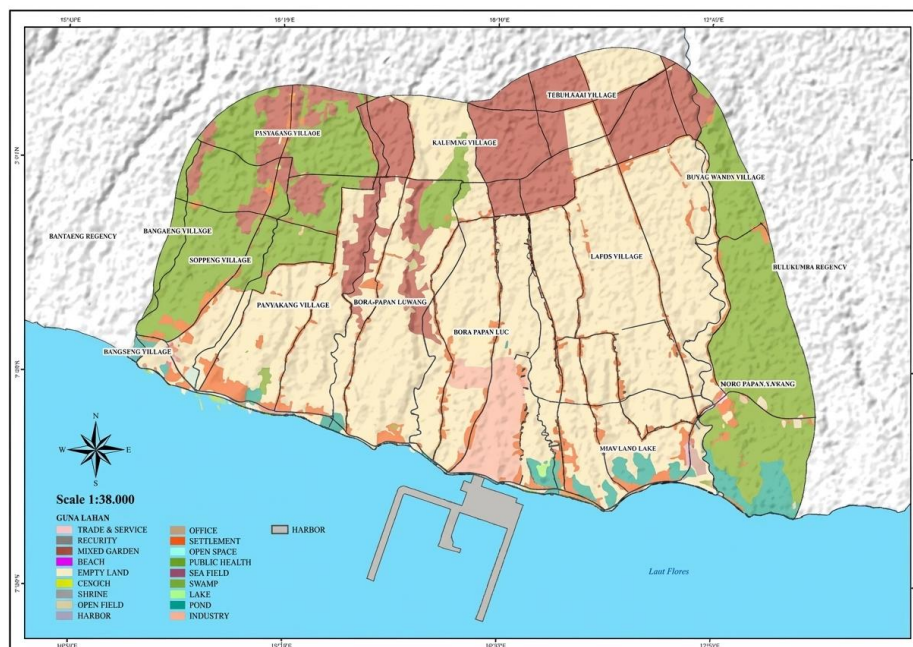


Fig. 4. Land usage map 2024

A broader spatial transformation is evident when comparing land-use changes over the 2014–2024 period. During this ten-year period, converting vacant land to industrial land accounted for the largest share of land-use change at 24%, followed by converting mixed gardens to vacant land at 18%. Meanwhile, the conversion of sea areas into industrial land

and the transformation of suburban areas into vacant land each accounted for 14% of the observed changes. These patterns indicate that the development of the Bantaeng Industrial Area has progressively altered the composition and function of surrounding land. Continued expansion of industrial activities has been accompanied by population growth, particularly due to the annual influx of workers seeking employment in the industrial sector. Consequently, land-use changes have extended beyond the industrial zone and affected adjacent areas, particularly Pa'jukukang District and parts of Gantarang Keke District. The spatial influence of industrial development can therefore be observed through the increasing demand for residential areas, the emergence of supporting activities, and the gradual transformation of previously non-industrial land into areas serving industrial and settlement functions.

3.1.1 Space style

The Bantaeng Industrial Area (KIBA) is located along the Poros Bantaeng–Bulukumba road, a type 2/2UD road with two lanes for two-way traffic and no median separator. The road is approximately 6 m wide, with a left-side shoulder of 2.3 m and a right-side shoulder of 2.5 m, and features relatively high roadside barriers. This road serves as an important transportation route connecting the industrial area with surrounding settlements and other regional activity centers. As industrial activities continue to increase, the road must accommodate various types of traffic, from private vehicles and public transportation to heavy vehicles transporting industrial raw materials and products. The increasing intensity and diversity of traffic indicate that the existing road infrastructure plays an important role in supporting industrial activities while simultaneously creating additional pressure on road capacity and traffic flow.

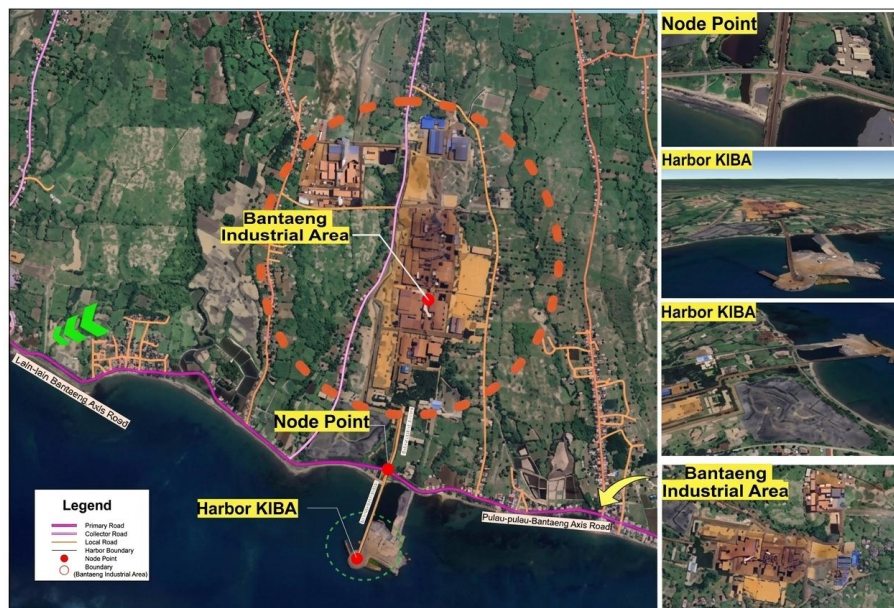


Fig. 5. Space style

The increasing intensity of activities within KIBA has contributed to various traffic disturbances along the Poros Bantaeng–Bulukumba road. These disturbances include vehicles stopping or parking along the roadway, heavy vehicles entering the industrial area from the direction of the jetty, and public transportation vehicles picking up or dropping off passengers on the road shoulder and stopping abruptly. Traffic conditions are further affected by light vehicles and motorcycles travelling at relatively high speeds, as well as the transportation of ferro-nickel products to Makassar for subsequent export to destination countries. KIBA's presence has therefore influenced overall road performance, particularly because many workers from outside Pa'jukukang District commute to and from the

industrial area daily. In addition, heavy vehicles from Makassar transport industrial raw materials to KIBA, increasing the volume and composition of road traffic. The combination of worker mobility, industrial freight transportation, public transportation activity, and private vehicle movement has consequently intensified interactions between industrial and non-industrial traffic, contributing to congestion, reduced traffic efficiency, and potential safety risks along the surrounding road network.

Based on the known spatial picture, the activity of space in the Bantaeng Industrial Area (KIBA) continues to increase with the presence of KIBA on the arterial corridor roads that influence the style of space identified by the level of intensity of the road corridor, where there are disturbances of awareness, such as vehicle stops, air pollution, water pollution, and noise. The arterial corridor is developing rapidly, as it is the main route to the industrial area. In 2014, there were still few shops, cafes, ATMs, health facilities, or dining rooms along this street, but now buildings along this road host a variety of trade and service activities. Development in one of the most intensive areas occurs along the transportation route, forming an inter-city corridor (Yunus, in Saleh, 2023). In accordance with the opinion of Priambudi & Pigawati (2014), the process of land use change is the development of a vast area in a region that is affected by a road axis that is on the arterial path, which increases the intensity of the wastewater, supporting the theory of focus that emphasizes the role of the transport hub that connects the Central Business District(CBD) and its outer part, where the territory that passes through the transport route will undergo a different development than the territories that do not pass the transport path.

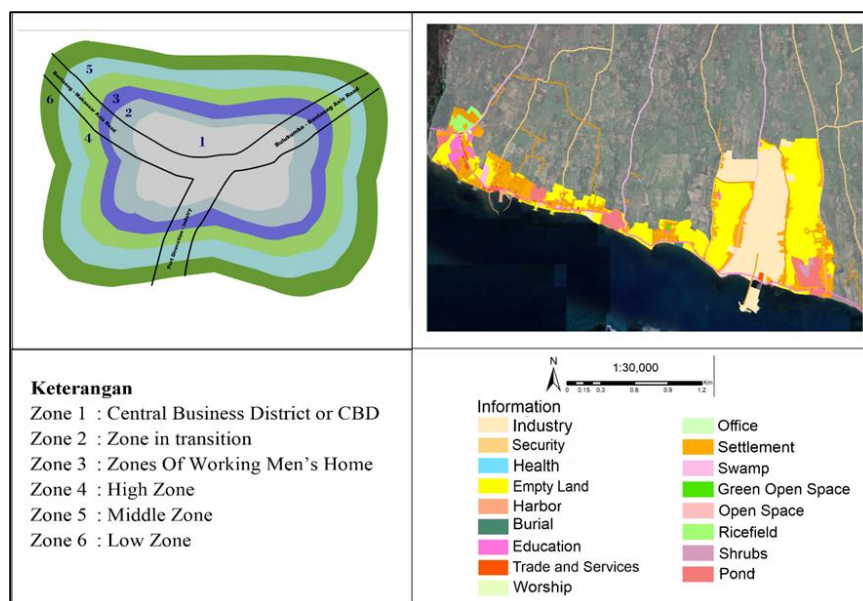


Fig. 6. Form of the Axis theory

The Axis Theory emphasizes the role of transportation in shaping the spatial structure of the Bantaeng Industrial Area, which is divided into 6 zones following the road network pattern, one of which is influenced by workforce mobility. The industrial area, with its centripetal style, plays a key role in the continuous development of the axis in KIBA by offering economic growth, tax incentives, infrastructure, and investment

3.1.2 Site style

Changes in space use in the Bantaeng Industrial Area (KIBA) have increased land-use productivity through transfer functions, as well as increased space intensity. Activities in the Bantaeng Industrial Area indirectly boost business in the trade and services sectors, settlements, education, and ports around the Industrial Area, which can expand its hinterland because industrial activities require support from the surrounding area.

The Industrial Area's intensity and its need for supporting facilities, along with increasing patterns of buildings with different shapes and functions, result in new clusters. This increases space intensity in the Bantaeng Industrial Area, making the space increasingly intense and capable of forming a new city. The workforce from outside the region is also increasingly supporting the space intensity in KIBA, increasing due to the migration process carried out, in line with Syah (2020) that there is an increase in space and change in land use in an area due to increased population

KIBA also increases public purchasing power and supports Bantaeng's economic growth. In particular, the community also receives benefits in improving the economy of the community around KIBA, the absorption of labor, partnerships and environmental building as well as improved community well-being around the KIBA. In addition to attracting and/or creating new space functions, KIBA will also undergo expansion which will require sufficiently large land so that the population settlements will be affected by such expansion.



Fig. 7. Site style

One of the outbursts of industrial growth is the construction of large-scale housing, which is due to the demand for housing by industrial operators/workers who want to settle around the area to reduce the cost of transportation. The high level of activity in the KIBA area is due to the existence of medium and large industrial areas, the growth of centres of trade and services and the availability of adequate access and facilities to give the population the choice to live under such control. The rise in demand for housing is a consequence of the expansion of industrial areas to reduce the density of industrial activities in the center of the area (Hermawan, 2010).

3.1.3 Situational style

The development of the Bantaeng Industrial Area (KIBA) is driving economic growth. It is the impact of the economic activity of KIBA that extends industrial activity or other sectors to sub-urban areas, and in general the development of settlements, trade and services is highly dependent. The condition of the Bantaeng Industrial Area (KIBA) before the establishment of the Pa'jukukang Industrial District was dominated only by empty land, there was agricultural land but it did not last long because when other areas rain, not necessarily in Pajukang rain also occurred. KIBA's presence has influenced the development of significant spaces by protecting buildings with different functions such as office, education, health, trade and services and other small industries as drivers of industrial

activity. It is in line with what Colby (Sholihah et al., 2018) put forward that the development of land use is influenced by the power of wastewater, i.e. the presence of concentration of activity, accessibility and initiatives of developers.



Fig. 8. Situational style

The Bantaeng Industrial Area (KIBA) is close to the sea, so the process of import and export distribution is faster and more efficient. Ports and road networks are key drivers of KIBA's development, so the Bantaeng Regency government is working to meet these needs through a special road construction plan for heavy vehicles, a secondary collector road plan, and urban-scale transportation.

The high level of activity at KIBA attracts other activity to the area, as shown by the emerging presence of other activity functions. In addition to reinvigorating and/or creating new space functions, KIBA will also expand, which will require sufficient land and affect nearby settlements. This forces people living close to the industry to leave their settlements and move forcibly because of increasing industry intensity, and the presence of new space functions makes the space increasingly dense. Some settlements are even located very close to industry. It is planned that, in line with Judge (2013), the turmoil caused by the center's excessive intensity prompted the activity to move to the suburbs away from the center.

3.1.4 Spatial evolution style

The development of the Bantaeng Industrial Area (KIBA) is seen through the physical development of an area that includes the addition of buildings within a certain period of time. KIBA's activities will affect its surroundings. This industrial area's function is unique because it is a major driver of changes in surrounding activity. Activities in the industrial area will ultimately have a decisive impact on land use, such as changes in land use that are not naturally developed for trade and services and settlements. The increase in population growth around the research site in line with the development of various activities, both supporting industrial activities and non-related activities

The development of the Bantaeng Industrial Area (KIBA) is reflected in the physical development of the area, including the addition of buildings over time. KIBA's activity will affect its surroundings. This industrial area's function is unique because it is a main driver of changes in surrounding activities. Activities in the industrial area will ultimately have a decisive impact on land shape and use, such as changes in land use that are not naturally developed for trade and services and settlements. The increase in population growth around the research site is in line with the development of various activities, both supporting industrial activities and non-related activities.

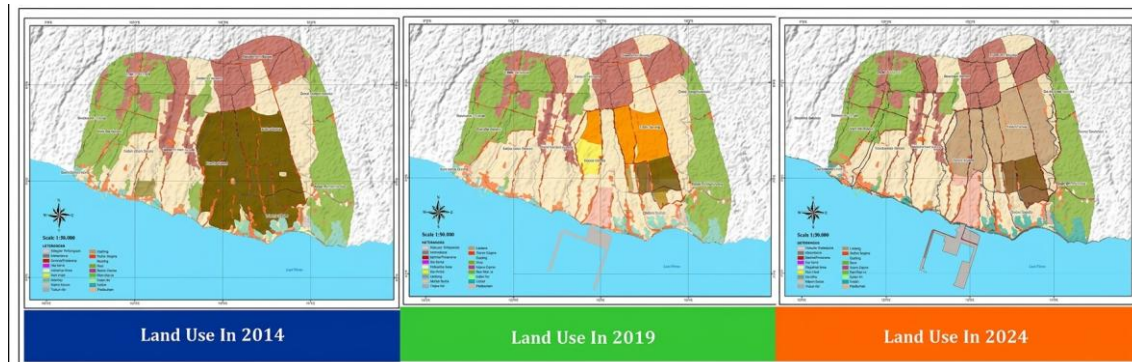


Fig. 9. Spatial evolution style

Based on the spatial pattern, new spatial functions continue to emerge. One of them is the Bantaeng Manufacturing Community Academy, which gives the district government room to contribute to the preparation of a highly skilled workforce and the growth of smart private enterprises. These are expected to strengthen the regional and national economy of the Bantaeng Industrial Area, which is one of the National Strategic Projects (Proyek Strategis Nasional/PSN), the Indonesian infrastructure projects designated by the President. One purpose of establishing AK-Manufaktur Bantaeng is to support *Sumber Daya Manusia* (SDM) in the Industrial Area. AK – Bantaeng Manufacturing was established in May 2018 to support KIBA's industrial workforce needs. Since its inception, *Automatic Kalashnikov* (AK) Manufacturing has graduated four times with exit. It also includes other functions such as trade & services, health, and open space.

The KIBA morphological shape, seen through Landsat images over the 10 years from the industrial awakening to the present, shows a spatial visualization of differences in the intensity of the change process. In the western part of the region, the physical appearance of the morphology of the township has been exacerbated with the increase of residential buildings and trade & services. The morphological shape of the Bantaeng Industrial Area (KIBA) is linearly oriented, following the road network, with industry as the CBD. This shows that the KIBA morphology is not a compact pole-chain (chained cities). Delvis (2021) described a sequence form occurring along a particular route connected by a transport route, with the distance between the mother town (Bantaeng Prefecture) and the new city site (KIBA) not far. Transport lines play a dominant role in the development of urban growth areas. In future developments, it may form a big ribbon city.

3.2 Factors influencing the development of the Bantaeng Industrial Area (KIBA)

Statistical tests using double regression analysis show that social, economic, and policy variables influence the occurrence of agglomeration or concentration in the district. This is indicated by a significance level below 0.10, meaning the three independent variables affect the dependent variable.

The social variable's significance is 0.002, with an unstandardized coefficient of 0.170, indicating that the social variables identified by the labour force and population influence the occurrence of space agglomeration in Bantaeng Regency. This aligns with the reality that population growth is influenced by the labour force entering the industrial territory. Recruitment of industrial workforce gives more priority to the workforce that comes from Bantaeng Regency by considering the skills they possess. Therefore, many residents from outside the district change their population data or migrate in (in-migration). Besides, labor from outside Bantaeng Regency also plays a role in forming agglomerations, with the need to return, which increases movement networks in the area, also called commuter migration (ulang-alik). This makes the activity increasingly centralized, as its existence influences development, where the quality and quantity of the workforce greatly influence production and distribution processes. This aligns with Noe Klasilk's theory that agglomeration

formation is influenced by economic actors (labour) seeking gains from the economy of location and urbanization.



Fig. 10. Labour migration

Labour wages increase with length of service, without excluding workers' ability. However, some members of the labour force have not received a wage increase, or their wages still reflect what they have earned. Wage increases are uneven across KIBA. Besides, companies in the region include large, medium, and small industries, with large companies under the shadow of PT Huadi Nickel-Alloy Indonesia and small industries scattered across the region. The collapse of industries in a region creates new knowledge and innovation as the economy accelerates. According to dynamic externality theory, the benefits of industrial diversity in a particular region encourage knowledge dispersion and facilitate innovation.

The industrial district's transportation system uses land transport to carry ferro-nickel products by truck, first to the city of Makassar and then exported to the destination country. This is shown by dozens of truck boxes constantly passing by, carrying industrial necessities and products on the road from Bantaeng to Makassar, 120 km away, at a high cost. The Bantaeng export port will reduce transportation costs for industrial raw materials. In line with dynamic external theory, corporate advantage arises from the geographical concentration of industry and industry diversity that creates positive externalities, supported by efficient transportation, communication, and coordination. However, the Company's cost reduction is still significantly lower because the port and raw-material transportation are in the shadow of PT Huadi Nickel-Alloy Indonesia, while other companies under PT Huadi Nickel-Alloy Indonesia still have to pay transportation costs. This is backwards, as it diverges from Alfred Weber's theory, where industrial location should be based on cost minimisation, taking transportation costs into account.

The significance level of the policy variable is 0,000, meaning policy variables influence the occurrence of space agglomeration in Bantaeng Regency. Faisal (2019) proposes a policy on industrialization, import-export restrictions, and equal taxes. Industrial progress in a country is shaped by government industrial policy that supports industrial development through tax provisions and import and export restrictions, along with policies that influence and support the existing industry. Close collaboration between the Government and industry aims to overcome existing barriers and identify appropriate forms of intervention to address them. However, the unstandardized coefficient of -0,274 indicates that policy's influence on agglomerations runs in the opposite direction. The state of the field indicates that the established policy is determined; however, its limitation is that society still commits many violations. Settlement, trade, and service development in the Industrial Area is still ongoing, which should not align with the 2021-2041 Industrial Area Planning Details Plan in pursuit of economic benefits.

3.3 Bantaeng industrial area spatial development trends (KIBA)

The development of space in the Bantaeng Industry Area began in 2019, with PT Huadi Alloy Indonesia as the first company to set up in Bantaeng Regency continues to experience

development every year with the conditions of the field there are 6 smelter industry companies operating and supported by 5 other companies with a focus on one industrial area. The settlements that occurred caused a lot of activity around the area, so it can be classified that the existence of agglomeration events emerging in Bantaeng Regency that tends to resemble a city or the formation of a new city, supported by the view of Tarigan (Soebagiyo & Hascaryo, 2015) that agglomeration occurs when there is an internal connection of various kinds of activities; there is a double effect: the occurrence of its geographical concentration, characteristic, and the driving force behind the region.

The Bantaeng Industrial Area (KIBA) is characterized by industrial development that is increasingly expanding and penetrating towards community settlements. Industrial development is seen from land utilization 2014-2024, where expansion continues, and the purchase of land belonging to the community is still continuing, with the method of purchasing land from the outermost boundary so that the community settlements are beginning to be encircled; on the one hand, the high industrial activity that increasingly has a negative impact (air pollution, water contamination, and noise) makes the community increasingly uncomfortable to settle. This disturbance makes people in the Bantaeng Industrial Area uncomfortable living there and choose to move to the suburbs (Gantarang Keke Subdistrict), creating a centrifugal force. On the other hand, industrial development attracts people from outside the region to settle there to drive economic growth. The industrial sector provides high economic income to Bantaeng Regency, where KIBA's strategic location on the Arteri corridor road and proximity to the port make it easily accessible. It exerts a centripetal force, where attractions hold certain functions in one area (centre) and draw other functions into it, as well as being near ports and the emergence of trade activity. The centripetal power shown by agglomeration savings is all economic activity entering the central region.

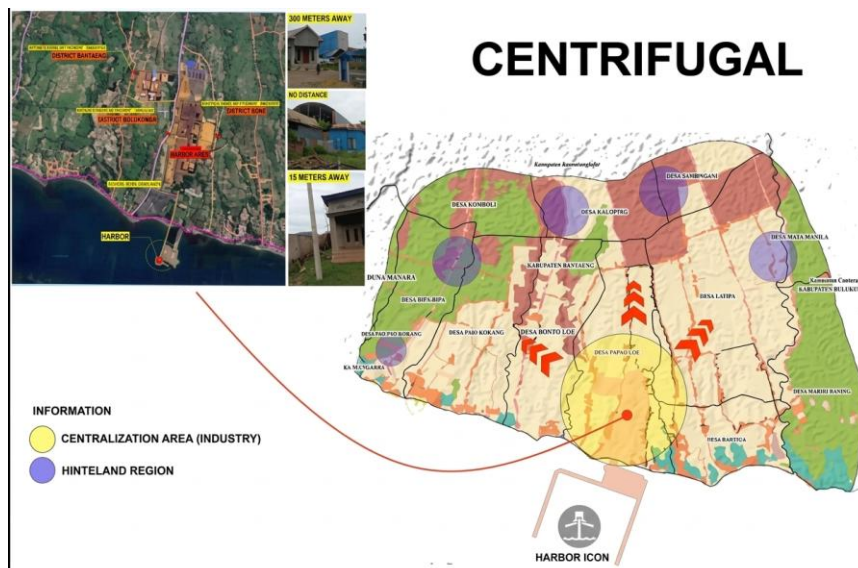


Fig. 11. Centrifugal power

The Kiba Industrial Area Agglomeration triggered a change in the spatial conditions of the surrounding area. The impact caused by the development and expansion of ports, the emergence of trade and service activities, the development of small industries and housing construction continues to be carried out, as well as the planning of the railway network that crosses the district of Pa'jukukang and the marine transportation network in the form of Special Energy Terminal Bantaeng and Special Terminal Smelter Bantaeng. Arterial road transfer has become a major issue in Bantaeng Regency; the community that passes on the Aterti Bantaeng – Bulukumba Road will be relocated to Bulumbba Collector Road – Bantaeng, located in the village of Layoa, Gant Karangeke District. According to the Perroux Theory, growth does not occur simultaneously; it occurs at the point of development and

spreads through the effects of diversified money across the entire economy, arising from concentration/agglomeration.

The development of the Bantaeng Industrial Area (KIBA) is based on a double regression analysis which is heavily influenced by the number of workers and population. Besides, it is also influenced by the value of land, the size of the company, the level of wages received, transportation and policy. Transportation as a facilitator for the development of KIBA related to accessibility, good accessibility will encourage private interest to implant its modalities in the framework of regional development. It will thus advance the economic activities of communities, and can bridge or at least reduce the development gap between regions that have the same or different potential. A good accessibility role will help in the time it takes to interact with each other, so the time that it takes will be more efficient and this will also be a factor in the quality of urban areas.



Fig. 12. Centripetal power

The development of industry, which has been hampered by economic aspects, has brought about changes in the shape of wastewater in Bantaeng Regency, both physically and non-physically, as a reservoir of community activity. KIBA as the location of the economic center has a great influence on the direction and development of space, due to the emergence of a centripetal style that will generate activity with different forms and functions to the hinterland region. The election of the KIBA which is located on the east side of the capital of Bantaeng Regency can be set as a new Central Business District (CBD) or *Daerah Pusat Kegiatan* (DPK) because it has a role in the physical formation of urban areas characterized by very high economic activity and potential, leading to the formation of new territories that can be categorized into urban areas. In line with Burgess's concentric theory, the zone is a layered sequential zone in which the concentric theory believes that the development of the city begins from its center, which then extends to areas far from the center. Therefore, the development of KIBA can be understood as a new growth center that influences the spatial expansion and functional transformation of surrounding areas. The increasing concentration of industrial and economic activities in KIBA may further stimulate the development of supporting infrastructure, settlements, and other economic activities in its surrounding areas. This condition indicates that KIBA has the potential to contribute not only to industrial growth but also to broader regional spatial transformation.

In terms of the structure of the Bantaeng Industrial Area (KIBA) has relevance to the concentric model, where the spatial structure starts from the central zone of activity or Central Business District (CBD), there is a transition zone (trade), a working-class settlement zone, an educational zone, a middle-class settlement area, and a booster zone

(agriculture and plantation), but not like the concentric theory in general, where, after the center zone of activities, there is a zone of transition, a worker class settling zone, and a border zone. In terms of spatial arrangement, KIBA has relevance to concentric theory in terms of space arrangement but is not relevant as far as zones are concerned. By using simple logic, KIBA has relevance to some of the concentric theories in terms of structure, and some of it has no relevance for the Burgess theory assumptions, so the two theories are assimilated into an integral unity. From the result of the assimilation of two different forms of theory, a new theory results with the name of semi-concentric, where the structure of space resembles the concentric theory, and in the sense of the zone is no longer concentric. Structures formed in an area are considered to be undergoing a new stage of development towards urban form. Here's an overview of the semi-concentric theory.

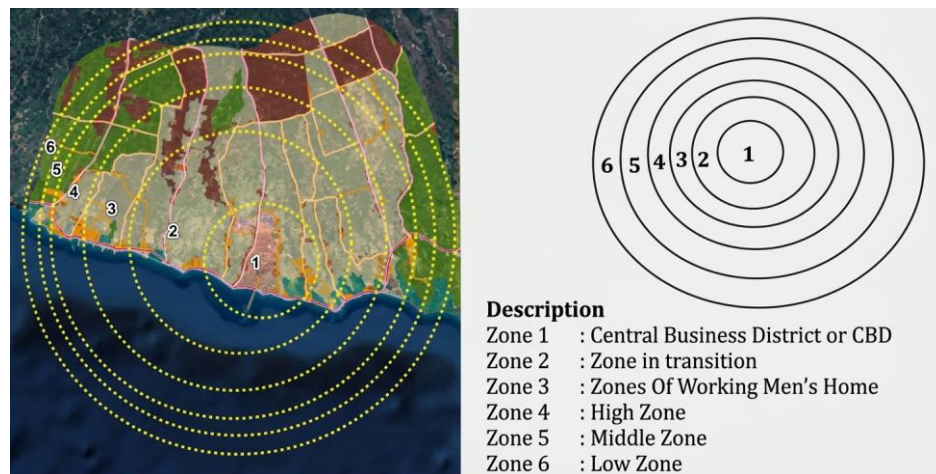


Fig. 13. Bantaeng industrial area space structure model

The semi-concentric theory proposed in this study illustrates that the spatial development of KIBA cannot be fully explained by the conventional concentric model. Although the arrangement of activity centers and surrounding areas retains a pattern that resembles the hierarchical structure of concentric development, the functions and characteristics of each zone are shaped by the specific economic, industrial, and geographical conditions of the region. This finding suggests that industrial development can modify the conventional spatial sequence of urban growth by creating new activity centers and distinctive functional zones. Therefore, the semi-concentric model provides a spatial perspective that reflects the transitional development of KIBA, where industrialization, accessibility, economic activity, and surrounding land uses interact to form a distinctive spatial structure.

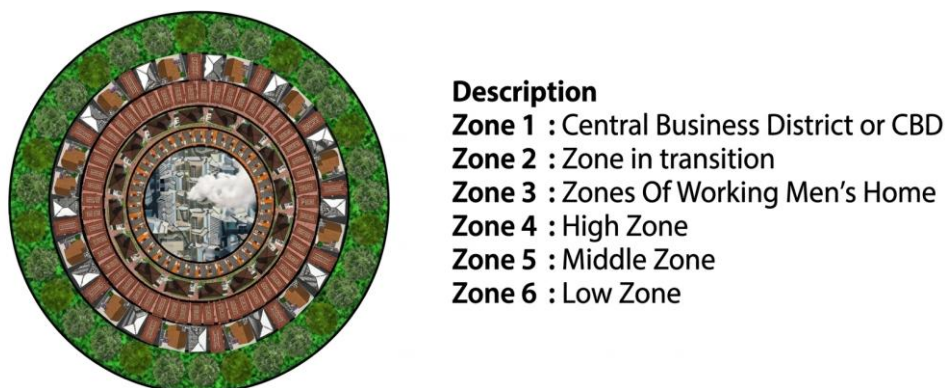


Fig. 14. Semi-concentric model illustration

Semi-concentrism produces theoretical assumptions that have similarities and differences with concentricism in general. As to the assumption of the theory as the basis for

the formation of a new and different theory from the concentric itself is as follows: The CBD zone is more homogeneous; The zone outside the CBD is in transition to trade & services (economic perspective) Zone in transition; Zones of Working Men's Home; High Zone, high role in supporting industrial activity; Middle-class settlement zone (Middle Zone); The area outside the settlement is dominated by agriculture and plantation. (Low Zone).

4. Conclusions

The development of space in the Bantaeng Industrial Area, reviewed from the physical development of the area from 2014-2024, indicates the existence of a concentration or agglomeration characterized by increasing activity in its hinterland area. The agglomeration of the Bantaeng Industrial Area has an impact on the formation of urban morphology. Increased industrial activity resulted in more complex and dynamic activity as a major trigger of other activity entering the region. The style of space formed gives a picture of increased industrial activity one of which is influenced by the location of the strategic industrial location by being on the east side of the capital district of Bantaeng which borders directly with the Bulukumba district and the Sea of Flores supported by being at the Arteri Corridor Road and directly bordered with the port. Increased activity drives economic growth as the largest supply in Bantaeng Regency to the Regional Real Income (PAD). The situation shows that there is another impact of the KIBA agglomeration where increased industrial activity affects the community settlement area (sub-urban area) as an expansion of the area in accordance with the Bantaeng Industrial Area Area Details Plan 2021-2041.

The formation of an agglomeration in the Bantaeng Industrial Area based on the results of statistical tests was influenced by an increase in population and labour force. The value of the land, the rate of wages, the size of the company and the transportation also influence by not excluding the effect that the increasing concentration / agglomeration of KIBA there are rights of the public forcibly deprived in this case the place of residence and the payment of transportation that the company remains carried out in the region even though it is in the shadow of PT. Huadi Alloy Indonesia. Agglomeration is also affected by government policy, the increasing development of industrial areas should be in line with government policy to enforce regional spatial arrangements. The number of violations of the spatial arrangements surrounding the area that are not in accordance with the detailed plan of the Bantaeng Industrial Area Plan 2021-2041, is considered a lack of clear and rigorous development control and supervision, in addition to the lack of public understanding of the importance of spatiality, and economic factors. The development of trade and housing around the area that should be the industrial and reserve area is clear evidence of the violations that have taken place.

The Agglomeration of Bantaeng Industrial Areas reviewed the trend of spatial development showing the continuously increasing development of space around the area which increases the intensity of development. The Bantaeng Industrial Area agglomeration emits a centrifugal and centripetal force characterized by the expansion of the area, high industrial activity, the formation of new clusters, population growth, land use change and accessibility. The structure of the space formed describes the formation of a semi-concentric zone consisting of a) the industrial zone as the center of activity or Central District Business (CBD), b) the second zone as a transitional zone (trade), c) the third zone as an occupational settlement of the working class, d) the fourth zone as educational zone, e) the fifth zone as middle class settlement, and f) the agricultural zone.

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Author Contribution

Conceptualization of the framework of the research, H.H.S., N.W.; Methodology, H.H.S., N.W., A.R.F.H.; Spatial Analysis, N.W.; Field Survey, N.W.; Draft Preparation, A.R.F.H.

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The authors did not use generative artificial intelligence (AI) or AI-assisted technologies to write, analyze, or prepare this manuscript. All content presented in this article was conceived, written, and reviewed solely by the authors, who take full responsibility for the content of the publication.

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References

- Arianto, A. (2020). *Hubungan perkembangan pariwisata pantai tanjung bira, Kecamatan Bonto Bahari, Kabupaten Bulukumba, terhadap perubahan sosial ekonomi pedagang kaki lima yang aktif di sekitarnya*. [Skripsi, Universitas Islam Negeri Alauddin Makassar]. Repositori UIN Alauddin Makassar.
- Faisal, A. (2019). Analisis kebijakan pembangunan industri berbasis aglomerasi (kawasan industri). *Bappenas Working Papers*, 2(2), 248-269. <https://doi.org/10.47266/bwp.v2i2.44>

- Hakim, D. H. (2013). *Daya tarik dan daya dorong perkembangan wilayah terhadap persebaran pemanfaatan lahan Kota Sinjai*. Thesis, Universitas Hasanuddin. <https://repository.unhas.ac.id/id/eprint/10570/>
- Hermawan, A. (2010). *Stagnasi perkembangan permukiman (studi kasus kawasan siap bangun di Kecamatan Maja, Kabupaten Lebak, Banten)*. Masters thesis, Universitas Diponegoro. <https://eprints.undip.ac.id/23612/>
- Kuncoro, M. (2006). Aglomerasi perkotaan di Daerah Istimewa Yogyakarta. *Unisia*, (59), 3-18. <https://doi.org/10.20885/unisia.vol29.iss59.art10>
- Priambudi, B., N., Pigawati, B. Factors affecting changes in land use and socio-economic conditions in the surrounding Mutiara Garden apartments. Students of the department of regional and urban planning, faculty of engineering, *Diponegoro University Technical Journal Pwk Volume 3 No. 4 2014* Online: <http://Ejournal-S1.Undip.Ac.Id/Index.Php/Pwk>
- Saleh, M. M., Surya, B., & Syafri, S. (2022). Dampak urban sprawl terhadap dinamika sosial ekonomi (Studi kasus koridor jalan Tun Abdul Razak). *Urban and Regional Studies Journal*, 5(1), 15-22. <https://doi.org/10.35965/ursj.v5i1.1962>
- Sholihah, D. A., Soedwihajono, S., & Kusumastuti, K. (2018). Dampak perkembangan aglomerasi industri Gondangrejo, Karanganyar terhadap perubahan spasial. *Region: Jurnal Pembangunan Wilayah dan Perencanaan Partisipatif*, 13(2), 115-132. <https://doi.org/10.20961/region.v13i2.20960>
- Soebagiyo, D., Hascaryo, A.S. (2015). *Analisis sektor unggulan bagi pertumbuhan ekonomi daerah di jawa tengah*. In University Research Colloquium. Muhammadiyah University of Surakarta.
- Sugiyono (2017). *Quantitative, qualitative, and r&d research methods*. Bandung: Alfabeta.
- Syah, A. N. S. (2020). *Studi perkembangan pola ruang pada kawasan pendidikan UINAM sebagai pusat aglomerasi baru di Kecamatan Somba Opu, Kabupaten Gowa*. [Undergraduate (S1) thesis], Universitas Islam Negeri Alauddin Makassar. <http://repository.uin-alauddin.ac.id:443/18002/>
- Yuliara, I. M. (2016). *Modul regresi linear sederhana*. Fakultas Matematika dan Ilmu Pengetahuan Alam. Universitas Udayana Bali.
- Yunus, H. S. (2010). *Metodologi penelitian wilayah kontemporer*. Yogyakarta: Pustaka Pelajar, 251.
- Zulfa, E. (2017). *Determinan aglomerasi industri manufaktur di Provinsi Jawa Barat*. Prosiding Pengabdian Kepada Masyarakat. Zam-zam Tower, Bandar Lampung. <http://repository.lppm.unila.ac.id/8132/>

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