Urban settlement growth factors through ekistics element approach (Case study: Jember City)

I A Farizkha¹, RR D J Koesoemawati¹, R A Suprobo¹, R N Listyawati¹ and N N Hayati¹

¹ Urban and Regional Planning Department, Universitas Jember

Email: ivanagustafariska@gmail.com

Abstract. Urban Sprawl phenomenon occurs because of the uncontrolled development of urban settlements. The uncontrolled development of these settlements has resulted in a decline in environmental quality due to changes in certain land functions. Ecistic is a tool that is considered appropriate for understanding the settlement. Research uses ecistic elements to see a settlement in one large frame, namely total settlements patterns with a classification scheme related to elements of settlements, namely nature, anthropos, society, shells, networks. This research was conducted to understand the conditions of residential growth to find out the growth factors that occur. Several stages of analysis carried out in this study include identification of settlement characteristics, trend analysis using periodic regional image analysis, as well as analysis of factors that influence settlement development using AHP techniques. The results showed that settlement development began to occur sporadically in the period 2006-2018 to the south with the highest density concentration remaining in the city center. In the physical organization of space, the development of settlements forms an octopus pattern (Octopus/Star Shape Cities). The results of the AHP analysis strengthen these conditions where the location of settlements and activities is the main factor that causes the growth of settlements.

Keywords: Ecistic, Urban Sprawl, Housing Development.

1. Introduction

Urban areas always develop dynamically along with the increase in population due to growth and migration. The dynamic development of urban areas will emerge urban problems. One of the problems that often take place in urban areas is the uncontrolled growth of settlements, without the planning process, and tends to form a dirty environment. The phenomenon of the development of settlements like this is called urban sprawl [1].

In fact, Urban Sprawl has many negative effects on the physical development of the city [2]. Urban sprawl contributes a lot in decreasing the quality of settlements because most settlements that grow due to urban sprawl are not efficiently served by infrastructure, reduce catchment areas, increase pollution (land, water and air) and are the beginning of the formation of slums if the development continues to be left without the right planning process [3].
One of the areas in East Java that experienced the development process of the region from rural to urban areas and the increase in land conversion was Jember. Land conversion that occurs is in the area around the urban center and is spread. The high level of activity in the urban areas of Jember, has led to a pull of human movement towards the city. Pulling human movement coupled with increasing population growth, will also increase the needs of the house. However, when viewed from the price of land, prices in the city are relatively high, causing housing providers to prefer to build housing in an area that is a little further from the city center to get affordable land prices. The fertile land conversion occurs in many of these conditions.

Jember is a potential area in housing development [4]. This is based on various factors including the area, location, population, activity attraction, home ownership status and the number of developers who have grown up. Demographically, Jember has a population of 2.3 million with a growth rate of 0.31% (BPS, 2012). However, when viewed from the status of home ownership there was a decrease from 88.93% in 2010 to 88.37% in 2011. REI (Real Estate Indonesia) is a formal institution engaged in housing. According to REI (2013), the number of housing developers in Jember Regency reached 23. Through the number of formal housing developer institutions, the potential for housing development can be ascertained to continue to increase if not offset by the Jember government control measures.

A control measure for the development of urban settlements is an urgency that must be implemented to minimize the phenomenon of urban sprawl. The focus of this study is focused on settlements because the starting point of the development of a city is settlement. Settlement growth will determine how a good city structuring quality can be realized. In a process of drafting a control concept, it is necessary to formulate the right concepts and strategies based on a comprehensive understanding of the settlement growth process as well as what factors influence the development of settlements so that a concept of control is targeted.

The approach to understanding the condition of settlements is done by looking at the aspect of forming a settlement. Aspects of the formation of these settlements are explained by the understanding of the ecological theory proposed by Doxiadis (1976). According to Doxiadis, understanding the characteristics of settlements must be carried out comprehensively in one large frame, namely "total settlements patterns". Economics studies settlements in two-way classification schemes. The first classification relates to the hierarchy of settlements based on scale while the second classification relates to elements of settlements, namely nature, anthropos, society, shells, networks [5]. In the process of controlling the development of settlements, in addition to understanding the characteristics of settlements, it is also necessary to pay attention to the time dimension in the process of understanding settlements, namely the historical and approximate how these settlements will be in the future [6].

Referring to the understanding of the problems above, the objectives of this study are:
1. Identification of the characteristics of settlements in the urban areas of Jember
2. Analysis of the spatial pattern of settlement development
3. Analysis of the factors causing the growth of settlements in Jember urban areas through an ecological element approach.

The results of this journal discussion are expected to be able to contribute ideas to the determination of urban structuring policies. Jember urban settlement is an appropriate study area for understanding the growth pattern of urban settlements because Jember urban is one part of the Besuki Raya region which has the potential to develop into a metropolitan area such as Gerbangkertasusila and Jabodetabekpunjur. Unanticipated developments will cause problems in the future such as those occurring in big cities in Indonesia such as Jakarta or Bandung. In the context of controlling the development of urban settlements, it is necessary to formulate the right concepts and strategies based on a thorough understanding of the settlement growth process and the causes of the development of these settlements so that the concept of proper control can be formulated to anticipate the challenges of these developments.
2. Study of literature

2.1 Definition of urban sprawl
In general, urban sprawl is uncontrolled settlement growth as a result of the development of a city. The process of urban sprawl occurs due to the need to persuade residential facilities due to urban activities that use the population to find a place to live. According to Setioko [7] sprawl can be described as unplanned, diffuse, low density and unstructured development in the periphery. The suburbs are suspected as the center of urban sprawl growth because the city center area has become saturated with the existence of various facilities and services centers.

According to Yeates and Garner [8], in addition to being caused by an increase in space requirements, sprawl is also caused by changes in the ability of the transportation system, housing construction and infrastructure. There are three types of urban area expansion processes (urban sprawl), namely [9]:

1. Concentric development is characterized by a uniform spillage to all existing urban areas and slow types of perforations.
2. The elongation of the ribbon (ribbon development) is characterized by the development of cities that follow the existing transportation network so that the role of the transportation network plays a very important role in the process of trapping this type of city.
3. A jumping leap (leap frog development/checker-board development) is characterized by irregular city traps or jumping from the parent city. This type of trapping is a city that is ineffective and inefficient.

2.2 Ekistics theory
Ekistics theory is a theory to explain settlement (human settlement) developed by doxiadis [10]. Human settlement is a place that is inhabited by humans that includes content elements and container elements. Elements of ekistics are divided into five parts, namely nature (human), human (antrophos), society (society), reflection (shells) and networks (networks).

a. Natural. Nature is the first element of settlement due to several reasons, namely nature is the oldest element compared to settlement, after that settlements are formed by nature which produces a system [10]. Theoretically, it can be said that settlements are part of nature. The research was carried out by looking at natural elements related to physical appearance of the earth, availability and ability of the environment.

b. Human. Humans are the second element of the element ekistic, because this element follows nature but escorts three other elements [10]. Humans initially started by changing nature by building huts. After that, began to have expertise in the agricultural revolution which subsequently created various types of houses. In research, the human element examined is related to the conditions, numbers, and relationships between individuals.

c. Community. Society is a kinship system among many people who form a network [10]. To understand society as an element of the settlement, first look at its relationship with the physical conditions of the environment such as nature, protection and networks. This study examines the elements of society through sub-variables in the form of social conditions that exist in the scope of settlements (such as livelihoods, income, education level, economic conditions and cultural characteristics that exist in the community in the scope of the research room)

d. Protection. Protection or shells in this case are interpreted as conditions, types and home services. Protection is divided into several categories, namely education, health, administration, security, industry, storage and others [10].

e. Network
The network is a utility aspect which consists of transportation, electricity, water facilities etc. All types of networks are used and utilized by humans as a residential support facility. The choice of a comfortable dwelling will take into account the availability of the network, especially the transportation network that contributes to the access of occupancy to centers of activities and clean water networks as a means of basic human needs.
2.3 Settlement development theory

Settlements are part of the environment in protected areas, both in the form of urban and rural areas that function as neighborhood units of residence or residential neighborhoods and places of activities that support per life and livelihood [11]. The development of settlements can be interpreted as an increase in the size of the residential environment caused by an increase in the population and an increase in the economy of the community so it will increase the demand for housing needs. The choice of settlement location is essentially through various considerations such as location factors, completeness of facilities and infrastructure, and the environmental conditions of the community.

2.4 City morphology and settlement growth

Literally, morphology means the science of form. In urban contexts, morphology is the study of forms and shapes from neighborhoods. Form means a form that can be observed and is a configuration of several objects, while a shape is a geometric feature or an external form and an outline of an object. The settlement environment becomes an important keyword, because in the science of planning and designing the city it is stated that civilization starts from settling activities. The complexity in the growth of settlements then forms larger environmental units, namely cities. So the city environment cannot be separated from the neighborhood [12]. So it can be concluded that the development of a good city must begin with good settlement planning. If settlement growth control can be carried out with certain treatments, the formation of an urban area will run well and meet the principles of sustainable development.

The most influential element of city morphology is the road pattern [12]. Where there are 3 (three) known types of road pattern systems, namely: (1) irregular road pattern system (irregular system); (2) a concentric radial road pattern system (radial concentric system); (3) a system of elbow angles or grids (rectangular or grid systems).

The growth and development of the city can be understood by observing morphological components. Functionally and economically, regional growth is affected by land use, buildings, plots and road networks. Urban areas are formed from a system of activities that are complexly linked by movement networks. The interaction between these two systems, the activity system and the movement system makes urban areas have economic value or property values whose distribution is strongly influenced by natural physical characteristics and the support of the two systems. City growth can be observed geographically assisted by map science (cartography). Using maps, the distribution of natural and artificial physical potential can be easily observed and analyzed. For land use, building density, land size and control and the road network can be mapped and logically explained in relation to each other.

3. Method

The research variables used in this study are derived from the synthesis of literature studies related to the exploration of ecological theory and sustainable development approaches. The variables in this study can be seen in Table 1.

The research mindset is the process of research stages starting from the background of the research carried out to the stages of the analysis process. The research mindset is discussed to facilitate understanding of the research flow. For more details, the research flow can be seen in Figure 1.

### Table 1. Research Variables

| Variables       | Sub Variables          | Indicators                                      |
|-----------------|------------------------|-------------------------------------------------|
| Physical        | Natural conditions     | - Availability of natural resources             |
| - Nature        | - Natural conditions   | - Natural conditions                            |
| - House / housing| - Type of housing (permanent or non-permanent) | - Housing Model                                |
| - network       | - Location of settlements| - Density of residential areas                  |
4. Discussion

4.1 Identification of the characteristics of settlements in the urban areas of Jember based on the variables determined, observations of the characteristics of settlements

a. Nature

- The growth of settlements in the study area can occur evenly basically, except in conditional terms on some areas that have land slopes of 10-25% which are in part of Kaliwates, Patrang and Sukorambi Sub-Districts. Whereas the criteria are not suitable, there are in the Patrang and Sukorambi Sub-Districts which have a slope of > 25%.
- The attraction of natural resources which is the driving force that causes the growth of settlements is fertile soil conditions (argopuro bran and argopuro tuff).

b. Home / housing
• In the area of research in the model of the house does not significantly influence the development of settlements. The model of the house in the average research area is in the form of a modern one, the majority are in the Kaliwates, Patrang and Sumbersari Sub-Districts.
• In terms of settlement location, the fastest growth is in activity centers, especially in areas including urban areas (Kaliwates, Patrang and Sumbersari sub-districts). The development in the next stage is more dominating with the opening of new lands in the suburbs of urban areas. Whereas in Ajung and Sukorambi sub-districts the majority of the intensity of growth follows the area that has natural resources in the form of fertile land.
• At the density level, the study area has different levels of density. In areas including urban areas, Jember has a complex level of density and land use. While in areas not included in the Jember urban area it has a smaller density level.

c. Network
• In terms of the electricity network, the research area has been fulfilled well in various sub-districts. There are households that do not use electricity as lighting does not reach 1%.
• For the road network, residential growth follows the road network in the beginning. Whereas in the future the development of the settlement is more in the suburbs by opening new land.
• Based on solid waste infrastructure, the research area has been fulfilled properly with the presence of officers carrying garbage from home. Whereas in the sanitation system, Ajung Sub-district has a number of households that do not have the highest defecation facilities.
• For the telecommunications network has been fulfilled.

d. Community Social Conditions
• Based on the population and density of Kaliwates and Sumbersari sub-Districts which have the highest population density. Meanwhile, in terms of density, Kaliwates Subdistrict and Ajung have the highest density ratings. Population and high density indicate that the area has a high number of residential needs.
• The livelihoods that affect the growth of settlements are agriculture and trade.
• The existence of social institutions that have the most influence on community activities are the Jember City square and the Jember Sport Garden area. This identifies the Kaliwates, Patrang, Ajung and Sumbersari sub-district have better quality of community compared to Sukorambi Sub-district because of the fulfillment of community facilities to interact.

e. Economic conditions of the community
• The risk of improper settlement formation can be calculated based on the number of families according to their class (pre-prosperous and prosperous I), namely: Kaliwates sub-District 20.7%, Patrang sub-District 40.1%, Sumbersari sub-District 30%, Ajung sub-District 38% and Sukorambi sub-District 55.7%.

f. Characteristics of community culture
• Habits of living in the study area specifically do not have certain habits. Community living habits tend to develop at first by following the pattern of the road with a linear pattern and growing by opening new land in the urban suburbs.
• The culture found in Ajung District is the habit of parents to buy a house that is majority in one district.

The descriptions of the existing settlements in the case study are:
a. Formal and non-formal settlements in urban areas
Formal settlements in urban areas are scattered in various regions including the sub-districts of Jember (Kaliwates, Patrang and Sumbersari). Middle-class formal settlements and above are located in the suburban strategic areas included in certain housing. Whereas for the middle and lower housing areas is located in the suburbs (Urban periphery), namely Ajung and Sukorambi districts. The tendency of settlement conditions in the urban periphery region is related to the intensity and density which tend to be lower. Non-formal settlements or settlements are residential areas that grow without the existence of a developer or not included in a particular
residential area. Village settlements are scattered in various sub-districts that are urban areas. The location of non-formal settlements tends to follow the road network and activity center.

b. Urban Slums

There are slums in the city of Jember which are usually illegal for the establishment of settlements. The slum settlements of Jember City are found in part of the border area of the railroad in Patrang sub-districts, Bedadung River in Sumberari sub-District. As according to the Regent's Decree regarding the slum area of Jember City which is included in the study area, it is spread in the Jember Kidul Village (Kaliwates Sub-district), Karangrejo (Sumberari sub-District), Baratan, Bintoro and Jumerto (Patrang sub-District). Slums in rural areas in the study area (Ajung dann Sukorambi) are located in areas close to agricultural land. Slums in rural areas do not form a large area but are mostly scattered dots.

4.2 Spatial analysis of settlement development patterns

Spatial development patterns can be seen on the periodic map from 1997 to 2018 below.

Figure 2. Urban Formal and Non-Formal Settlements

Figure 3. Urban Slums

Figure 4. Growth Points in 1997

Source: Analysis, 2018
Figure 5. Growth in Settlements in 2003-2015

Source: Analysis, 2018
The development of settlements at the beginning of the research year in 1997 showed that there were concentrations of settlements in the city center, namely Sumbersari sub-District, Patrang sub-District and Kaliwates Sub-district with horizontal forms from west to east following arterial roads. But in the period 2006 to 2018 the development of settlements began to spread southward sporadically, but the highest density concentrations remained in the city center. In the physical organization of space, the development of settlements forms the octopus pattern (Octopus / Star Shape Cities) where in this octopus pattern there are several dominant transportation routes, namely the arterial road that connects Jember-Bondowoso and Jember-Lumajang.

The development of Jember Airport (Notohadinegoro Airport) and Jember Sport Garden starts where according to the 2015-2035 Jember Regency Spatial Plan both regions are planned as strategic areas for the benefit of economic growth. The planned development of the two regions as a strategic economic area can be a trigger for the development of settlements to the south (Ajung sub-District) which began since 2012.

4.3 Analysis of the factors causing the growth of settlements in Jember (through an ekistic element approach)

Based on the theoretical theory developed by Doxiadis (1968), five elements were proposed which later became variables in the study, namely natural factors, human factors, community factors, protection factors and network factors. The five variables are then analyzed using AHP (Analytic Hierarchy Process) analysis. AHP is a process that has been used to assist numerous corporate and government decision makers. The following are the results of the AHP analysis on five research variables based on 15 experts.

The results of the AHP analysis state that the factors that most influence the development of spatially settlements in the urban areas of Jember are factors of housing / housing conditions with an assessment value of 0.261

The condition of housing / housing is a factor that has the highest influence in the development of settlements. This is because people who want to own a house have the greatest consideration of the factors of settlement location, type of housing, location of settlements, level of density and availability of housing infrastructure. The results of the analysis of the sub-variables of the condition of the house / housing stated that the sub-location variable settlement is the most influential sub-variable among other sub-variables with the sub-variable assessment value of 0.385.

Furthermore, the second factor that has an influence on the development of settlements is the human factor with an assessment value of 0.260. The magnitude of the influence of human factors on the development of settlements can be viewed from four supporting sub-variables, namely age, population, human growth and activity. In addition, the assessment value of the largest sub variable is human activity of 0.412. This value means that the higher density of human activity, the more acceleration of the settlement growth will increase.

The third factor that has an influence on the development of settlements in the urban area of Jember is the network condition factor with an assessment value of 0.235 and the sub-variables in it, namely the natural human transfer network, transportation network (land, water, air), the goods transfer network and the energy transfer network. Judging from the sub-variables, the sub-variables with the highest assessment values are land, sea and air transportation networks of 0.415. This means that land, water and air transportation networks have an important role to accelerate settlement growth. One aspect of community support in determining the location of the place of residence they will choose is the completeness of the infrastructure network, especially the easy access to the housing location. This is also the reason why the development of settlements in Jember urban areas tends to follow the road network.

The fourth factor that influences the development of settlements in Jember urban areas is the community factor (eco-culture) with an assessment value of 0.198. Community factors have sub-variables including community quality, income distribution, livelihoods, history and culture. The four variables are then carried out AHP analysis again which results in the distribution of income as a sub
variable with the highest assessment value of 0.422. The community aspect is also included in one aspect that influences the choice of settlement location by the community according to the character of the community for convenience. In addition, the sub-variables of culture, livelihoods and income distribution also have an influence on the choice of location of residence by the community.

The smallest factor that influences the development of settlements in Jember urban areas is the natural factor with an assessment value of 0.046. This is because natural factors with sub-variables in them are natural conditions and the availability of natural resources is not an important factor in the development of settlements or the last aspects of the community's final consideration in determining the location of settlements for housing.
4. Conclusion
The growth of settlement in Jember happen in peri-urban areas. Based on the results of the analysis, the characterization of urban sprawl occurs in the urban areas of Jember, namely in the Ajung sub-District, precisely in the Ajung Village. These conditions began to appear in 2012 to 2015 where initially concentrated settlements concentrated in Patrang sub-District, Kaliwates Sub-District and Sumbersari sub-District, began to spread sporadically to the south (Ajung District) due to a better road network so that settlement access is getting better too, as well as the strategic area of economic importance according to the RTRW of Jember Regency (Notohadinegoro Airport and Jember Sport Garden). In addition, the development of settlements to the south is also caused by the activities of the factory which become a drag, and the price of land is relatively cheap (based on the results of the stakeholder interview survey).

Ekistic elements contribute as a variable that is measured in finding factors that cause settlement development through AHP analysis. Based on the results of the AHP analysis, the variables of housing conditions and human conditions are the main factors causing the growth of settlements. The results of the AHP analysis produce a variable condition of the house and human condition as the main factors causing the growth of settlements. This result is justified by the conditions in which settlement and human activity locations become indicators of the causes of settlement growth. Fast-growing residential areas need to be a priority for handling, because the existence of fast-growing residential areas is an indication of the beginning of urban sprawl in the region. And if the treatment is not carried out as early as possible, it will create an unsustainable environment. Actually that condition not a problem if the area of settlement (in fast growth area) doesn’t indicate slum. Some settlement conditions due to urban sprawl indicate a deterioration of environmental quality. and understanding of the causes of growth becomes very important.

The handling of settlement problems must be based on a thorough understanding of the conditions and characteristics of settlements. Characteristic conditions of settlements with classifications and stages of development with one another will certainly have different influential aspects. Different aspects of influence will certainly require different concepts and strategies. Based on the results of the study, the recommendations for follow-up advice provided are:
1. Concepts and policy strategies must be developed by looking at the root causes of settlement growth. The policy formulated further becomes the responsibility of all parties involved in the sustainability of the settlement. There must be integration between the government, the community and the private sector in the process. The government as a public policy maker can pay more attention to the main triggers for the growth of settlements, namely settlement locations (strategic location of settlement locations) and activities (location of the distribution of economic institutions).
2. The Ajung sub-district area as the area affected by the growth of downtown settlements must immediately formulate a plan to determine the allocation of spatial use in order to control growth and minimize the occurrence of land conversion and the formation of slums.

5. References
[1] Salvatia, L. 2012. Low-density settlements and land use changes in a Mediterranean urban region. Landscape and Urban Planning vol 105.
[2] Ardiwijaya, Vevin S. 2014. Bandung Urban Sprawl and Idle Land: Spatial Environmental Perspectives. APCBEE Procedia 10 (2014) 208-213.
[3] Moitra, M. K. 1991. Environmental improvement of slums The Calcutta experience.. Pergamon press Vol 26 (Building and Environment); 253-257.
[4] Pratomo, Gigih and Sony Kristiyanto. 2013. Analisis Sistem dan Peranan Kelembagaan Sektor Perumahan di Kabupaten Jember: Paradigma New Institutional Economics (nie). Jurnal Equilibrium, Volume 11 Nomor 1, page 42-56
[5] Doxiadis, C. A. 1976. Ekistic Elements, Action for Human Settlements: 11-27.
[6] Quarterly, T. 1963. ekistic and traffic. 439-457
[7] Setioko, Bambang. 2009. Growth of Urban in Finger Areas (Case Study: Semarang City). Sustainable Slum Upgrading in Urban Area. Informant Settlement and Affordable Housing. Unit of Research and Empowerment of Housing and Human Settlements Resources, Center for Information and Regional Development, Universitas Sebelas Maret, Surakarta PIPW LPPM UNS. p79-88

[8] Yeates, Maurice; Garner, Barry. 1980. The North American City. New York: Harper & Row Publishers.

[9] Yunus, Hadi Sabari. 1999. Struktur Tata Ruang Kota. Penerbit Pustaka Pelajar: Yogyakarta.

[10] Doxiadis, C. A. 1968. Ekistics: an introduction to the science of human settlements. New York: Oxford University Press.

[11] Undang-Undang Nomor 4 Tahun 1992. Pemerintah Republik Indonesia.

[12] Pontoh, N. K. 2009. Pengantar Perencanaan Perkotaan. Bandung: ITB.

[13] Yunus, Hadi S. 2005. Megapolitan Konsep, Problematika, dan Prospek. Yogyakarta: Pustaka Pelajar.