
The Impact of Settlement Spatial Pattern in Fringe Area to Community Movement, Case Study: Bandung City

Iwan P KUSUMANTORO
Institut Teknologi Bandung
Gd. Labtek IX A Lt. 5
Jl. Ganesha 10 Bandung 40132 Indonesia
Fax: +62-22-2509173 ext 3611
Email: ipkus@pl.itb.ac.id

Shanty Y RACHMAT
Associate Professor
Institut Teknologi Bandung
Gd. Labtek IX A Lt. 5
Jl. Ganesha 10 Bandung 40132 Indonesia
Fax: +62-22-2509173 ext 3611
Email: shanti@pl.itb.ac.id

Helmy FAJRI
Institut Teknologi Bandung
Gd. Labtek IX A Lt. 5
Jl. Ganesha 10 Bandung 40132 Indonesia
Fax: +62-22-2509173 ext 3611

Mega RACHMALIA
Institut Teknologi Bandung
Gd. Labtek IX A Lt. 5
Jl. Ganesha 10 Bandung 40132 Indonesia
Fax: +62-22-2509173 ext 3611

Abstract: Fringe area development or sprawl is a phenomenon that will continue to go on in the process of urban development. Unreadiness of spatial planning instruments in dealing with the problem has exacerbated the transportation problem in is connecting corridor, such as the problem of congestion. The negative impact which is assumed to be the result of congestion in the internal city area and fringe area is also increasing and even has exceeded is threshold. One effort that can be done is to conduct ‘internalization of the orientation of the trip in the fringe area’ so that the interaction of the fringe area with its core city can be reduced. Although assessment on this effort has been performed many times, the result is still unsatisfactory. In this perspective, a new different approach should be performed, e.g. assessment of the aspect of ‘residential choice’ and ‘behavioral perspectives in facilities completeness’ should be involved in characterizing the movement in fringe area. The objective of the research is to obtain description on the activities of settlement spatial pattern represented by perception of residential choice and facility completeness, and its correlation with the activities pattern of population movement. The description can be used as an input in directing land utilization in fringe area and at the same time reducing traffic problem in its connecting corridor.

Key Words: Community movements, facilities completeness, compactness, fringe area

1. INTRODUCTION

Fast growth of urban area indicated by physical expansion of the city and its population growth has become a public phenomenon that can be found in various world cities. The core city area has become more crowded with more intensive activities. In addition, land is limited and getting more expensive. As a result, fringe area (urban fringe) development, defined as a ‘hybrid’ area developing outside the urban or suburban area as an alternative for the urban and suburban population to reside as a result of the core city area that is becoming more and more crowded (Daniels, 1999 in Fajri, 2008). In addition to development in fringe area which is close to the core city area, there is the phenomenon of urban sprawl, as a developing area outside the city area as a result of cheap land price in the fringe area, improvement in accessibility, easy property mortgage, fast growth of real estate developers, and mass housing construction (Neuman, 2005).

People who chose to reside in city center area will benefit from various facilities available in the city center, while the condition of city center that is getting crowded has made other people to reside in fringe area. In considering the changes in their residential
locations, each person will always take into consideration rationally their reasons for the changes to achieve satisfaction according to their needs and capabilities. Furthermore, changes in individual or household residential location will result in changes in movement pattern in conducting their activities. This shows that the selection of residential location will determine the changes in spatial pattern and urban form as stated by Frank and Pivot (1994), and Cervero (1996). In addition, facility completeness in the city space will influence the activities related to the concept of compactness which supports sustainable development.

As a consequence, knowledge on the selection of residential location and facilities completeness which will determine spatial pattern and urban form becomes so important in planning assessment. Various previous researches have considered urban spatial pattern and the characteristic of area movement are two related things (Kombaitan, 1999). This research tried to assess further the urban spatial pattern form by taking into account two things that influence them, i.e. the selection of residential location and its facilities in influencing the movement of the area.

Growth and development of large cities in developing countries including in Indonesia, as the case study of this research is the city of Bandung, are increasing rapidly. The growth and development of Indonesian cities are caused by among others high urbanization level from rural area to urban area. As a result, the need of urban infrastructure increases. The provision of urban infrastructure requires land which causes the land in the city center area is getting scarce. With this limitation of land, the city center area is experiencing expansion to the fringe area.

Bandung fringe area has grown not only because of its own population growth, but also as the result of the growth of Bandung in accommodating the spatial needs of the urban population in space utilization in the fringe area (urban back flow). The growth of urban area into the fringe area which is marked by the emergence of settlement area in the urban fringe resulted in the unequal distribution of facilities and services in sub-urban. As a consequence, the level of dependency of the fringe area to the core city is getting bigger which will increase average travel length and in the end will increase the number of traffic interaction in the connecting corridor. The present phenomenon is indicating that the problem is worsening, especially in connecting corridors of the fringe area. Negative impact that is assumed to be the result of congestion at the city internal area and fringe area is also increasing and even has reached its threshold.

Therefore, this research tries to conduct an approach to see how the correlation between the selection of residential location (residential choice) and the level of facility completeness (facilities completeness) in Bandung fringe area contributes to the formation of urban space (urban form) of the city of Bandung or Metropolitan Bandung related to the population movement in the fringe area of Bandung.

2 SETTLEMENT SPATIAL PATTERN AND MOVEMENT

To understand more about the settlement spatial pattern and things that influence it, the definition and description of urban area, urban form, compactness, and urban sprawl should be understood first.

Truman Asa Hartshorn defined urban area as an area that includes city and built-up area
around it, with the existence of public services such as police, fire fighters, clean water network, and solid waste. In other words, urban area includes central city and ‘immediate suburbs’ (Hartshorn, 1980). Although there are various definitions about urban area, the meaning is almost the same.

The structure of city, on the other hand, is considered as the formation of two major elements, i.e. urban form and urban interaction (L.S. Bourne in Kombaitan, 1999). Urban form can be defined as spatial pattern of population activities in a certain time. In general, the characteristics of urban form are density, diversity, and spatial structure. Density refers to the degree of intensity of the activities. Diversity refers to spatial scale in various land use interactions such as mixed land use. Spatial structure can be defined as a form that can be characterized as monocentric or polycentric, centralized or decentralized, and sustainable or unsustainable development. Basically, the characteristics of urban form can influence population activities through trip behavior (Anderson in Tsai, 2005). Space form is an aggregate of various concepts and urban elements depicted in physical structure of the urban area. Research conducted by Jabareen (2006) stated that urban spatial form gives the largest contribution in supporting a sustainable condition of a city.

When the urban form does not support, urban sprawl takes place. One factor that encourages the emergence of urban sprawl is an increase in the heterogeneity of urban social and economic activities which encourages large population migration along with limited urban land and supported by road network connecting the city center and the urban fringe area. Research conducted by Rustiati (2005) mentioned several definitions of urban sprawl, among others:

- The expansion of urban area including land conversion in fringe area from non-urban uses to urban uses.
- The growth of metropolitan area as a process of land use change in the fringe area.

Urban sprawl phenomenon is strongly related to urbanization, i.e. the process of becoming a city. What is meant by this process is the increase of people residing in urban area and the change of fringe area into urban area.

This sprawl phenomenon is a condition which is totally in opposition with the concept of ‘compact city’. Burton (2000) in his article emphasized the dimension of ‘high density’. The definition of ‘urban compactness’ refers to the increase of built-up area and population settlement density, the intensification of economic, social, and urban cultural activities, and the manipulation of city size, urban form and structure and settlement system in order to achieve the benefit of environment, social and global sustainability obtained from the centralization of urban functions (Jenks, 2000).

Spatial intensification, diversity, multi-function and efficiency are perceived as important characteristics in formulating a compact city. This concept is expected to be able to contribute to the achievement of various objectives such as reducing pressure for the development of the fringe area, encouraging more effective use of land, reducing the usage of private vehicle and increasing the existing region by increasing the vitality of the region.

Compactness is an urban form that is able to minimize transportation, water, material, and human energy (Elkin, McLaren, and Hilman 1991 in Jabareen). Intensification is a
strategy to achieve compactness, using land more efficiently by increasing development and activities density. This intensification includes development on non-built land area, redevelopment of existing buildings, subdivision and conservation and expansion. Below are some definitions of compactness:

- Gordon and Richardson (1997) argued that compactness is a high density area with monocentric development.
- Ewing (1997) argued that compactness is the concentration of workers and housing, or mixed land use.
- Anderson (1996) defined that monocentric and polycentric can be compact.
- Another more calculated definition is the statement of Bertaud and Malpezzi (1996) with compactness index, rho – a ration of average distance between the house and CBD.
- Galster (2001), described compactness as a degree of each development cluster and minimalizing the number of land built-area.
- Based on various definitions mentioned above, there is a similarity in the definition of compactness, i.e. concentration of development.

The correlation can also be seen from the benefit of the application of the concept of compact city. These benefits contribute to the achievement of sustainable development goals, in a broader context; encourage social, economic, and environment sustainability (Burton, 2000).

Research by Ivan (2007) concluded that indicators that can be used to measure compactness in the concept of compact city can be grouped into three aspects, i.e. density, mixed function, and intensification. The aspect of density is related to population density, jobs density, built-up area density, sub-center density and housing density. The aspect of mixed function is related to the provision of facilities, horizontal distribution of facilities, land use change and vertical mixed land use. The aspect of intensification includes population growth, development growth, new development growth and density growth in sub-center.

Indicator that will be used in the study is intended to identify the degree of compactness of each part of region, in this case is each sub-district of the city of Bandung, based on physical characteristic. The indicators used in the study can be seen in the table 1 below.

The selection of residential location has become an interesting topic for sociologist, ppsychologist, urban economist, geographic and transportation planners. Theory and empirical research from different perspective produced different views about this topic. The correlation between the quality of life and location, difference in market demand on housing, and environmental quality, and the effect of spatial policy are some views on residential location. The preference of residential location selection is an important factor in urban development pattern in the USA. Based on US censuses between 1970 and 1999, 17% of the population changed residential location. Between 2002 and 2003, 83% of the changes took place in the same region and 63% in the same city. This activity shows that consumer demand is potential in creating major shift in settlement spatial pattern (Weisbrod et.al., 1980).
Table 1
Compactness Indicator to Identify the Degree of Compactness of an Area

<table>
<thead>
<tr>
<th>Aspect/Dimension</th>
<th>Indicator</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population density</td>
<td>Number of population per Ha</td>
<td>Person/ha, per sub-district, 2005</td>
</tr>
<tr>
<td>Household density</td>
<td>Number of household per Ha</td>
<td>Household/ha, per sub-district, 2005</td>
</tr>
<tr>
<td>Population Density of Built-up Land Area</td>
<td>Number of population per Ha of built area</td>
<td>Person/ha of built-up land area, per sub-district, 2005</td>
</tr>
<tr>
<td>Mixed Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility Provision</td>
<td>Ratio of Elementary School Availability</td>
<td>Availability unit/need, per sub-district, 2005</td>
</tr>
<tr>
<td></td>
<td>Ratio of Junior High School Availability</td>
<td>Availability unit/need, per sub-district, 2005</td>
</tr>
<tr>
<td></td>
<td>Ratio of High School Availability</td>
<td>Availability unit/need, per sub-district, 2005</td>
</tr>
<tr>
<td></td>
<td>Ratio of Puskesmas availability</td>
<td>Availability unit/need, per sub-district, 2005</td>
</tr>
<tr>
<td>Land Use</td>
<td>Land use change: Ratio of built-up land area</td>
<td>Built-up area/sub-district area, 2005</td>
</tr>
</tbody>
</table>

Source: Prepare by author (2008)

For urban and transportation planners, public choice in considering the residential location emerges out of public attractiveness toward physical land use pattern and functional housing environment. Decision in selecting residential location is not only determining the correlation between household and urban environment, but also the duration of household activities. Changing land use characteristic may not influence the household movement pattern as expected by the New Urbanism view. Furthermore, the movement characteristic may change after the new residential location is affected by the new land use and internal movement; whereas the old residential location is experiencing land use inconformity that causes external movement (Kitamura, Mokhtarlan and Laidet, 1997; Krizek and Waddell, 2002; Bagley and Mokhtarian, 2002; Lund, 2003).

Some important facilities that can influence settlement pattern in addition to work facilities are education, shopping, and health facilities. In addition to the number and type of facility, the distance to the service should also be considered in planning the facility.
For education facility, there are formal and informal educations, but in terms of movement, the facility for formal education is more important and has their own stages. The stages are set according to someone’s age, since age is capable of determining the stages of growth. As a consequence, there are various types of education – started from playgroup, kindergarten, elementary school junior high school, high school, and universities.

Shopping facility is a facility that has a function of fulfilling public needs on goods, in addition to being a place for selling-buying transaction. Due to its function, shopping facility should receive a special attention since it influences the rate of economic growth. The shopping facilities include market and mall. Market is a meeting place between sellers and buyers and marked with direct transaction and bargaining process. The building is usually consists of kiosks, stalls, and open platform operated by sellers or market management. Mall is a type of shopping center in the form of closed building with regulated temperature and orderly built lanes for walking located among small shops that facing each other.

Health facility is a facility that provides services in health sector in the form of (William A. Reinke, 1994:67 in Puji Astuti, 2004:34):
1. Curative (observation, therapy, nursing)
2. Preventive (disease prevention, health improvement, and health education)
3. Environmental health.

In addition to hospital, other types of health facilities include medication hall, doctor’s practice, community health center (puskesmas), and integrated service post (posyandu). The presence of each facility depends on the area to be served and the number of population in an area. There is no fixed frequency of visitation to these facilities, except below-five-year-old who visit the facilities regularly for immunization. The frequency of visitation is based on the level of public health.

To see the impact of settlement pattern, including compactness, to movement, what is movement and its categories should be assessed. Movement is an activity that we do everyday. This movement is connected to how we move everyday for various reasons and purposes such as study, play sport, shopping, leisure and recreation (Tamin, 2000).

To identify habits, hobby and the tendency of vehicle usage and to describe the characteristics of vehicle usage, the purpose of trips can be grouped into 6 (six) categories:

- Work
- Shopping
- Relax/ utilizing spare time
- Private service
- Social visits
- Walking

The origin and final destination are residential areas in the fringe area from each vehicle user in a week. When comparing vehicle usage, it is expected that the prediction of trip frequency can be found.

3. STUDY AREA

The study area is part of Metropolitan Bandung area. Metropolitan Bandung covers the city of Bandung, the regency of Bandung, the city of Cimahi and 3 (three) districts in the
regency of Sumedang (Cimanggung, Tanjungsari, and Jatinangor districts) with an area of 338,394.38 ha. But in this study, the area is a sub-urban of Bandung which has a high potency of the emergence of urban sprawl.

430 sub-districts in Metropolitan Bandung are grouped based on the theory of compactness. There are 7 (seven) groups in the regency of Bandung based on compactness. Out of 7 (seven) clusters that have been classified, only 4 clusters (cluster 1 – 4) that were selected as the study area, since clusters 5 – 7 are still rural in nature. Clusters 1 – 4 are only 1 km from the border of the city and the regency. The reason for 1 km radius is that the areas receive direct influence from the development of the city of Bandung. The mapping of each study area is as follows.

Figure 1. Study area

This study used the questioner to household, in different areas of clusters. In the study of facility completeness, the survey was based on household questioner with 284 household dispersed to 12 districts. While for the study of settlement reason, the respondents are about 150 household.

4. SETTLEMENT SPATIAL PATTERN AND ITS IMPACT ON MOVEMENT

4.1 Orientation of Population Movement

In this research, the orientation of population movement is based on activities which have been identified before, i.e. work movement, school movement, shopping movement, and access to health facility movement.
In work movement, the share of member of household conducting work movement is 19.95%. Since 30.90% of the population is entrepreneur, travel distance of most of the member of household in their work movements is under 0.5 km. However, based on the destination, most work movements are oriented outside the sub-district area (55.70%). Average travel distance increases after moving to new houses (survey on residential location selection). The increase is 1.3 km. This increase in travel distance is influenced by the orientation of population movement where 63% of the respondents did not change work location after moving to new houses. This tendency in each cluster is showing similar result, i.e. increase in average travel distance after moving to new houses.

School movement has a share of 12.38% of respondents. Share of the number of trips for elementary school is the largest (37.40%) followed by Junior High School (25.60%), High School (21.50%) and Universities (15.50%). Based on destination, most of school movements are outside the sub-districts (53.36%). The Elementary school movement, however, oriented toward the study sub-district area. Based on its travel distance (37.02) are under 0.5 km. Change in residential location causes increase in average trips of 0.3 km for Elementary School and Junior High School and 0.42% for High School and Universities. This is also influenced by the fact that 60% of respondents did not change the location of the school after moving to new houses. A different tendency is seen in the cluster scale with high compactness level which shows decrease in travel distance of 0.22 km for Elementary School and Junior High School, and 5.6 km for High School and University. This indicates that high level of compactness can reduce average travel distance of movement to school.

The share of household member conducting shopping movement is 41.45%. Shopping movement is a movement with the largest share of movement compares to movements for work, school, and health. Utilizing stall (warung) has the largest share (30.90%) of shopping movement, followed by market (28.90%), supermarket (24.10%) and mall (16.10%). Based on its administrative boundaries, 59.40% of the total movements are within the sub-district. From the side of travel distance, most of the household members are conducting shopping movement with distance interval of under 0.5 km (38.97%). Travel distance based on type of shopping facility, for warung is under 0.5 km, market is between 0.5 – 1 km and 1 – 1.5 km with each share of 20.38%, for supermarket is between 0.5 – 1 km (52.03%) and mall 6 – 6.5 km (25.49%).

The pattern of shopping movement for warung and market does not show significant difference in characteristic before and after moving to new houses. The change in distance is 0.09 km. However, all orientation of movement destination changes which shows that movement to warung and market is an internal movement, before and after. There is, however, an increase of 2 km in travel distance for movements to supermarket and mall which is caused by the characteristic of movement to mall which is limited in the destination.

From all movements conducted by the household members, the share of movement to health is 26.22%, with movement to posyandu is 17.30% of the total movements to the health facility, medication hall (9.80%), doctor’s practice (22.20%) and hospital (22.20%). Based on the destination, most of the health movements are oriented outside the sub-district (51.80%). Most of posyandu and puskesmas movements are under 0.5 km, whereas for medication hall is 0.5 km (38.24%), doctor’s practice is between 0.5 – 1 km (37.78%) and hospital is 3.5 – 4 km (18%).
The pattern of movement to health facilities shows an increase in travel distance. In the movement to puskesmas and doctor, there is an increase in average travel distance of 1.86 km; whereas to hospital is 3.34 km. For the case of puskesmas and doctor, the tendency of using the nearest facility to home is the largest, before and after moving to new houses. Movement to hospital is still oriented toward the core city.

### 4.2 Impact of Settlement Spatial Pattern on Movement

To identify the correlation between area compactness and facilities completeness to the movement pattern, the coefficient between number of respondent and trip length is determined. When the result of coefficient in linear equation is more steep, then the length of trip is less in distance while if the coefficient is flat, then the distance is less. In this paper, the impact showed in coefficient equation will be based on trips in activities, e.g. working trip, school trip, shopping trip and health activity trip.

In working trip, cluster 1 has the steepest coefficient. Therefore, the cluster 3 has steeper coefficient than cluster 2. Meanwhile, cluster 4 has linear the mildest coefficient the compare to other clusters. The result shows that there is no correlation between the compactness level with movement pattern. Other things that influence the working trip are type of occupation, working location orientation after moving and working reason background. We may see in the illustration below, with red line is cluster 1, yellow line is cluster 2, green line is cluster 3 and blue line is cluster 4. The tendency is irregular and do not show the relation of compactness and movement pattern.

![Illustration of working trip](image)

### Meanwhile, the school trip has different condition for school activity. Cluster 1 has the shortest trip length, followed by cluster 3, which means that cluster 2 has a milder line coefficient. Meanwhile, cluster 4 has the longest trip length. If we differentiated the activity of school into two parts, i.e. elementary school and Junior high school; and Senior High School and Academy, then the trip in consuming facility in elementary and junior high school existed in cluster 1 has the steepest trip line. Then, the cluster 2, 3 and 4, which have lower compactness, have the tendency to be longer in trip length. We
may see in the illustration below, with red line is cluster 1, yellow line is cluster 2, green line is cluster 3 and blue line is cluster 4. By having this tendency, it can be said that there is a relationship between compactness levels in this activity.

For High School and University movements, cluster that has the shortest trip distance is cluster 2, followed by cluster 1 which has linear line flatter than cluster 2.

![Illustration of school trip for Elementary and Junior High School.](image)

Figure 3. Illustration of school trip for Elementary and Junior High School.

Eventhough in terms of shopping activity cluster 1 has the shortest trip distance and cluster 4 has the longest trip distance, the analysis of shopping activity are based on 4 parts, i.e., shop, market, supermarket and mall. The result of analysis for shop is that the more compact the clusters, the steeper the line coefficient, which means that there is a correlation between the compactness and the coefficient. The results for market and supermarket are almost similar. However, the coefficient result for mall is more varied, where cluster 2 and 4 have distance trip more than cluster 3.

In the access to health facility, overall distance trip showed similar tendency, where cluster 1 has the shortest followed by cluster 2. However, if we differentiated the movement into 5 (five) types, i.e. Posyandu, Health Care Center, Community Health Center, and Doctor’s Practice and Hospital, the posyandu has cluster 3 which has the steepest line coefficient and cluster 1 has the mildest coefficient. For Health centre, the steepest is cluster 4 and the least steep is cluster 3. Meanwhile, the Community Health Centre has cluster 1 as the steepest, then cluster 4, cluster 2 and the least cluster 3. Doctor’s practice has cluster 2 as the steepest and cluster 1 as the least steep. Finally, for hospital movement, cluster that has least far trip distance, then cluster 3, cluster 2 and cluster 4. By having this result, it can be concluded that the correlation between the compactness and the trip distance is not too correlated in the health facility

5. CONCLUSION

To sum up, the compactness in an area do not have direct influence to the community pattern in having internal movement. Only several activities have direct influence, i.e. education and shopping trip. Not all of education and shopping trip have direct
influence, they are only elementary School movement, junior high school movement, shop and supermarket. The rest of activities, such as working trip and health facility access do not show the relation of compactness and movement pattern. As the consequences, in directing the policy in spatial development, especially to fringe area in Bandung, it is important to consider the enhancement to facility which have direct influence to make internal movement, in order to give direction to community having more internally movement.

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