# Towards an independent city: The role of Ungaran City as a sub-center of Semarang City

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**Abstract.** Semarang City has a strong connection with Ungaran City as they are interlinked and connected by a good transportation system. However, Ungaran City growth is not solely influenced by Semarang City development. Ungaran as the sub-center is able to develop as an independent growth center for its surrounding areas mainly because of the existing industrial activities and its strategic location alongside the main road of Semarang – Yogyakarta – Solo. This paper aims to analyze the growth process of Ungaran City. It is find out that some areas in Ungaran City are able to act as a Counterurbanization of Semarang City and some others act as a Suburbanization.

## 1. Introduction

The concept of a metropolitan city is likely characterized as monocentric pattern of development. It is concentrated on just one growth center exacerbates suburbanization and urban sprawl which will ultimately disturb the ecological balance of the city. It can be predicted that the development of a metropolitan city in this monocentric concept will only "enlarge" its central area instead of developing its buffer zone. The main urban areas (i.e. the growth center) with the rapid urbanization have extensive functions in the development of the urban center to the surrounding area. The diversification of economic activities, infrastructure development, and the development of other urban activities resulted in the expansion of built-up area outside the boundary of the urban center. As a result, the functional boundary of the urban area becomes widespread, it develops the metropolitan area on the scale of a vast territory, known as the Extended Metropolitan Region (EMR). Along with the development of the EMR, the peri-urban area possesses a major role in supporting the urban functions in the metropolitan core area. The urban function is primarily driven by the development of the industrial activities and settlements followed by the development of infrastructure to generate the interaction on the scope of the metropolitan area [1].

In inter-regional interaction, there are two aspects, namely the spatial interaction and sociological and geographic interactions. In spatial aspect, interaction occurs because of the interdependence between the geographic regions with the main focus containing the movement aspects (goods), people (migrate), passengers (mobility), money, ideas, and information. In Ullman's opinion, the spatial interactions emphasize the occurrence of the dependence among several areas and the implications for the occurrence the movement of commodities, goods, people, and others among some regions. The

relationships or interactions that occur between the cities or the regions can be realized through urbanization, ruralization, circulation, and commuting [4].

Unlike the monocentric concept, the development of polycentric urban region (PUR) concept which refers to many centers as a reference of population activity will divide the commuter deployment and will economically have an impact on improving the welfare and the development of the city. This paper aims to analyze the characteristic of the people's mobility in Ungaran City towards Semarang City to determine the independence of Ungaran City as the sub center of Semarang based on Fisher's perspective. Fisher has studied the processes that change peri -urban areas by incorporating the origin of migrants, the connection to metropolitan areas, the motivation behind migration and the quality of residential development. Consequently, she has distinguished between suburbanization, counter-urbanization, population retention (within suburban areas), and centripetal migration (to suburban areas) [6].

Semarang City possesses a strong connection with Ungaran City as they are interlinked and connected by a good transportation system. However, Ungaran City growth is not solely influenced by Semarang City development. Ungaran as the sub-center is able to develop as an independent growth center for its surrounding areas mainly because of the existing industrial activities and its strategic location alongside the main road of Semarang – Yogyakarta – Solo. This may indicate that EMR in Semarang metropolitan area has a potential to have a polycentric concept. [5].

## 2. Methods

### 2.1. The analysis of the availability of service centers in Ungaran City
The analysis of the availability of service centers in Ungaran City is performed by implementing a function analysis of the weighted centrality index. This analysis is intended to determine the structure/ hierarchy of service centers, the number of the existing functions, the number of function types, and the number of people who were served [7].

### 2.2. The Analysis of The Characteristics of People's Mobility
#### 2.2.1 The Breaking Point Model.
It is a modified version of the Gravity Model Reilly which measures the magnitude of the gravity of the intercity. Hereinafter defined the breaking point of the intercity gravity in the region, to find out the area of the influence of a city in the surrounding area.

The background is that every city possesses more than one area of influence due to the type of service level of the city ranging from the low level up to the high level. The higher the level of service, the more extensive the coverage of services will be. The total influence of the city on the surrounding area is reduced in line with the distance from the city. The breaking point formula is as follows [8]:

$$Th = \frac{j}{1 + \sqrt{(px/py)}} \qquad (1)$$

Wherein:
Th     : The breaking point
j        : The distance between the city of x to the city of y
px     : The population number of the city of x
py     : The population number of the city of y

The breaking point analysis is used to determine the limits of the service of Semarang City as the service center. The results will describe the location of people's balanced mobility in Semarang City and Ungaran City.

*2.2.2  The Ravenstein Model.*
It is the method to estimate the value of people's mobility based on the potential attractiveness of the destination region. It is considered appropriate to determine the factors that influence the people's mobility in Ungaran City. The Ravenstein Model formula is as follows:

$$M_{ij} = \frac{P_i}{d_{ij}} \cdot f(Z_j - Z_i) \tag{2}$$

Wherein:
$M_{ij}$     : The mobility of the region of i (origin) to the region of j (destination)
$P_i$        : The population of the region of i
$d_{ij}$     : The distance from the region of i to the region of j
$f(Z_j)$     : The size of the traction of the region of j
$f(Zi)$      : The size of the traction of the region of i

The influential factors of people's mobility are economic potential, social potential and transport potential. Economic potential is a number of economic facilities data, namely banks, markets, industries, and cooperatives. The social potential is a number of social facilities include: education, health, and sports. Transport potential in the form of roads will be classified based on the class of roads and the means of transports, e.g., private cars, buses, and others. All types of the existing facilities on the three potentials were scored based on the size of their potential as a traction factor of mobility.

The value of mobility in Ungaran City and Semarang City was compared to observe the dominant direction of people's mobility. The results of the calculation of the value of mobility will be re-analyzed by using primary data to obtain a more accurate result.

*2.3. The analysis of the type of growth processes in Ungaran City*
The analysis to determine the type of growth process of Ungaran City based on Fisher's perspective is the analysis of descriptive statistic. The analysis is uses the data in a group of data to explain or draw conclusions about the group [9]. The data about the people's activities based on their mobility to Semarang City is obtained from the secondary data processing. The obtained data will be illustrated in the diagram and described in the descriptive form.

It is expected that the researcher can determine the dependency type of Ungaran City and the type of growth processes of research area referring to the Fisher's perspectives, whether Ungaran City will evolve as Suburbanization, Counterurbanization, Population Retention or Centripetal Migration.

## 3. Study Area
The study areas are Semarang City, capital of Central Java Province, which consists of 1.595.267 inhabitants (CBS, 2016) and Ungaran City, the Southern neighboring area which consists of 147.653, located 15 km from Semarang City center.

Ungaran City, the capital of Semarang Regency, as a part of Centre of the National Activities Kedungsepur (Kendal, Ungaran, Semarang, Salatiga, Purwodadi) has a function as the urban area supporting metropolitan area of Semarang in settlement services and the other urban services on the scale of several surrounding sub-districts. The city is passed by the main line of the Central Java province, namely Semarang - Bawen, Bawen - Surakarta, Bawen – Magelang which connects the Southern area to the Western area of Central Java (Surakarta, Yogyakarta and surrounding areas) making Ungaran City strategic within the scope of Kedungsepur region.

## 4. Results

### 4.1. The Analysis of the Availability of Service Centers in Ungaran City

The analysis begins with the Scalogram analysis by identifying the availability of service centers, including the economic, government, and social facilities. Scalogram analysis or known as Guttman Scaling is an analysis used to find the pattern of information in the matrix form. The goal of the analysis is to derive a single dimension that can be used to position both the questions and the subjects [10]. The result becomes the database of the weighted centrality index to analyze the availability of service centers, the facility number, and the city hierarchy. The hierarchical system is used to determine the role of centrality in Semarang Regency which places Ungaran City at the service center of sub-district. The calculation of the weighted centrality index is as shown in Table 1.

**Table 1.** The Weighted Centrality Index of Urban Villages and Villages in Ungaran Timur Sub – District and Ungaran Barat Sub –District

| No | Urban Village/ Village | Amount/ Type of Facilities | The Weights Centrality Index |
|----|------------------------|----------------------------|------------------------------|
| 1  | Ungaran                | 48                         | 4.683,03                     |
| 2  | Bandarjo               | 46                         | 4.165,13                     |
| 3  | Genuk                  | 31                         | 3.298,70                     |
| 4  | Susukan                | 19                         | 2.118,58                     |
| 5  | Langensari             | 23                         | 1.455,67                     |
| 6  | Sidomulyo              | 18                         | 1.129,97                     |
| 7  | Candirejo              | 13                         | 1.086,39                     |
| 8  | Lerep                  | 27                         | 1.075,31                     |
| 9  | Gedanganak             | 20                         | 943,40                       |
| 10 | Kalongan               | 22                         | 872,64                       |
| 11 | Beji                   | 17                         | 852,07                       |
| 12 | Nyatnyono              | 23                         | 659,67                       |
| 13 | Kalirejo               | 9                          | 559,06                       |
| 14 | Leyangan               | 7                          | 541,47                       |
| 15 | Branjang               | 10                         | 474,77                       |
| 16 | Kawengen               | 13                         | 452,35                       |
| 17 | Kalisidi               | 15                         | 415,59                       |
| 18 | Keji                   | 12                         | 413,36                       |
| 19 | Mluweh                 | 8                          | 362,44                       |
| 20 | Gogik                  | 10                         | 302,09                       |
| 21 | Kalikayen              | 5                          | 134,73                       |

Ungaran City is a very dominant city in term of the availability of facilities and the value of the weighted centrality index. It places Ungaran City in the Hierarchy I. Based on the results of scalogram analysis and weighted centrality index analysis, Ungaran City is able to act as a growth center since it owns more comprehensive available facilities compared to the other regions. The growth center lies not only in big cities but also in small towns. Small towns have several functions in regional development, one of which is a generator of economic growth centers [10].

### 4.2. The Characteristics of People's Mobility

The area of influence of Semarang City measured by applying the breaking point analysis has produced the result as described in Figure 1. It is identified that the location of balanced mobility is Banyumanik area. The distance is determined from the kilometer zero point of Semarang City and

Ungaran City. It is also measured by the real distance by utilizing the length of roads and the public transportation route.

According to the analysis, there are three types of the main inclinations of people's mobility as shown in Table 2. The first inclination is to Semarang City with the most influential factors are economy and transportation accessibility.

**Table 2.** The Type of Mobility Inclination

| No | Type of Inclination | Parameters | | |
| --- | --- | --- | --- | --- |
| | | Economy | Social | Transportation Accessibility |
| 1 | Mobility Inclination to Semarang City | 1 urban village | - | 9 urban villages/ villages |
| 2 | Mobility Inclination to Ungaran City | 9 urban villages/ villages | 10 urban villages/ villages | 2 urban villages/ villages |
| 3 | Both Semarang City and Ungaran City | 10 urban villages/ urban villages | 10 urban villages/ urban villages | 9 urban villages/ villages |
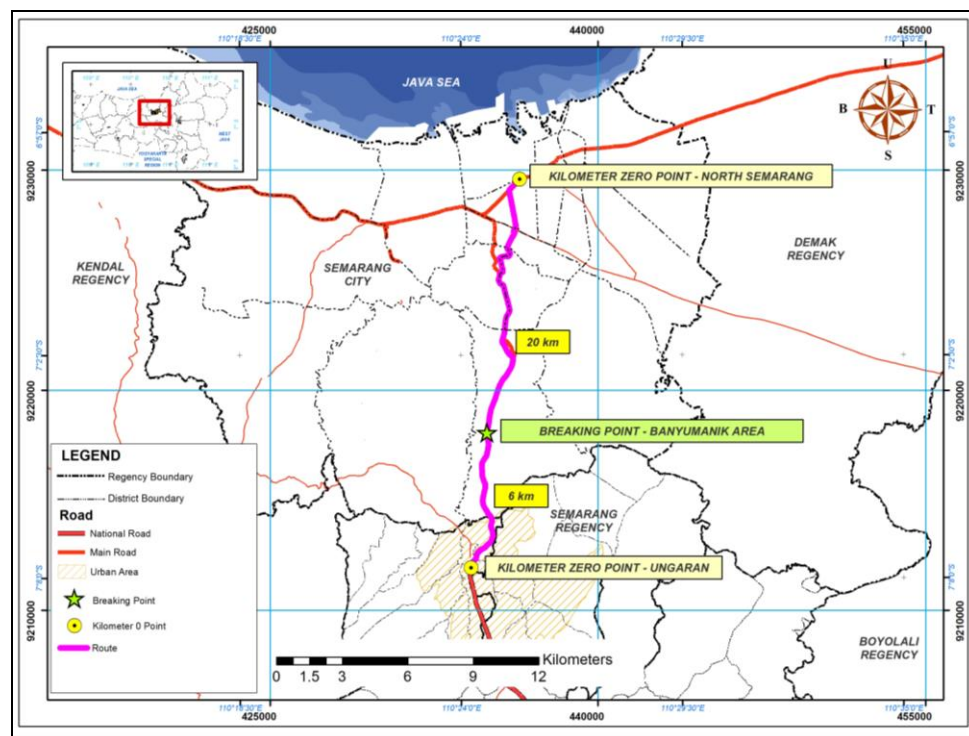


**Figure 1.** The Result Map of Location From Breaking Point Analysis

The second mobility inclination is to Ungaran City with the most influential factors are economic, social and transportation accessibility. This is related to the development of service and trade activities as well as the existence of small, medium and big industries which require a lot of workers, both in Ungaran City and inside the region itself, such as Gedanganak area, and also easy accessibility to Ungaran City because of public transportations, and proper road condition.

The third mobility inclination is to both Ungaran City and Semarang City. The border areas usually are influenced by the economic, social and transportation accessibility factors. Economic activities are divided into two mobility inclinations due to the availability of job opportunities. Although Ungaran City is still able to fulfill daily needs, the reason to commute to Semarang City is the plentiful options in Semarang City. The last factor is transportation accessibility which emphasizes the proximity factor of the location and the traversed condition of the road. Table 3 illustrates the main value of mobility and mobility inclination from the integration of three parameters in Ravenstein Formula.

**Table 3.** The Value of Main Inclination of Mobility

| No | Urban Village/ Village | The Percentage of Mobility Inclination (%) | | | | The Area of Mobility Inclination |
|---|---|---|---|---|---|---|
| | | **Ungaran** | **Category** | **Semarang** | **Category** | |
| 1 | Gogik | 53.35 | M | 46.65 | M | Ungaran |
| 2 | Langensari | 46.11 | M | 53.89 | M | Semarang |
| 3 | Candirejo | 47.24 | M | 52.76 | M | Semarang |
| 4 | Nyatnyono | 55.07 | M | 44.93 | M | Ungaran |
| 5 | Genuk | 70.66 | H | 29.34 | L | Ungaran |
| 6 | Bandarjo | 97.04 | VH | 2.96 | VL | Ungaran |
| 7 | Lerep | 61.86 | H | 38.14 | L | Ungaran |
| 8 | Keji | 64.51 | H | 35.49 | L | Ungaran |
| 9 | Kalisidi | 49.75 | M | 50.25 | M | Semarang |
| 10 | Branjang | 47.14 | M | 52.86 | M | Semarang |
| 11 | Beji | 46.97 | M | 53.03 | M | Semarang |
| 12 | Leyangan | 52.05 | M | 47.95 | M | Ungaran |
| 13 | Kalongan | 47.91 | M | 52.09 | M | Semarang |
| 14 | Kawengen | 44.26 | M | 55.74 | M | Semarang |
| 15 | Kalikayen | 51.72 | M | 48.28 | M | Ungaran |
| 16 | Mluweh | 51.38 | M | 48.62 | M | Ungaran |
| 17 | Susukan | 55.85 | M | 44.15 | M | Ungaran |
| 18 | Kalirejo | 62.34 | H | 37.66 | L | Ungaran |
| 19 | Sidomulyo | 70.91 | H | 29.09 | L | Ungaran |
| 20 | Gedanganak | 845.01 | VH | (745.01) | VL | Ungaran |

Note: VL = Very Low; L = Low; M = Medium; H = High; VH = Very High

Table 3 illustrates that seven areas with mobility inclination to Semarang City due to location proximity factor to Semarang City areas (i.e. Branjang, Kalisidi, and Kawengen). While in Langensari, Candirejo, and Beji, the most influential factor is the availability of artery roads in the areas. While the other thirteen areas with mobility inclination to Ungaran City possess different mobility motives which had been confirmed when the researcher did in – depth interview.

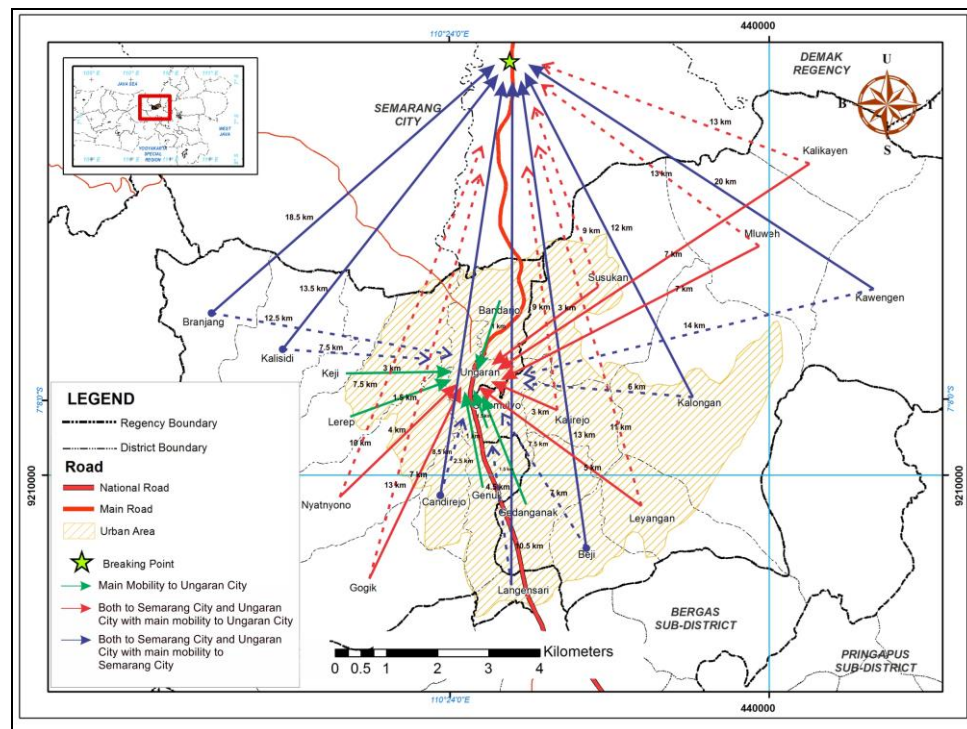The value of main mobility inclination is described in Figure 2.

**Figure 2.** The Map of Main Value of Mobility Inclination

*4.3. The Type of Growth Processes in Ungaran City*

People in the hinterland area of Ungaran City own some motives on the preference to commute to either Semarang City as the city center or to Ungaran City as the sub – center. The calculation result of the main inclination of the mobility is described in Figure 3.
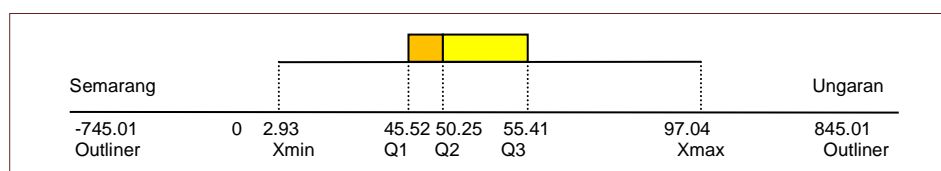


**Figure 3.** The Diagram of The Main Value of Mobility Inclination

In Figure 3, there are thirteen areas in the yellow box from Q1 to Q3 where people commute to both Semarang City and Ungaran City but with the difference in main inclination. Those areas act as Suburbanization areas of Semarang City because the connection with Semarang City is medium and high level in the accessibility value. While the other seven areas are located in Q1 to Minimum Value and Q3 to Maximum Value. These seven areas act as the Counterurbanization area of Semarang City because they possess low linkages and also medium access to Semarang City.

Figure 4 shows the growth process of the areas based on Fisher's perspective and the Polycentricity concept between Semarang City and Ungaran City.
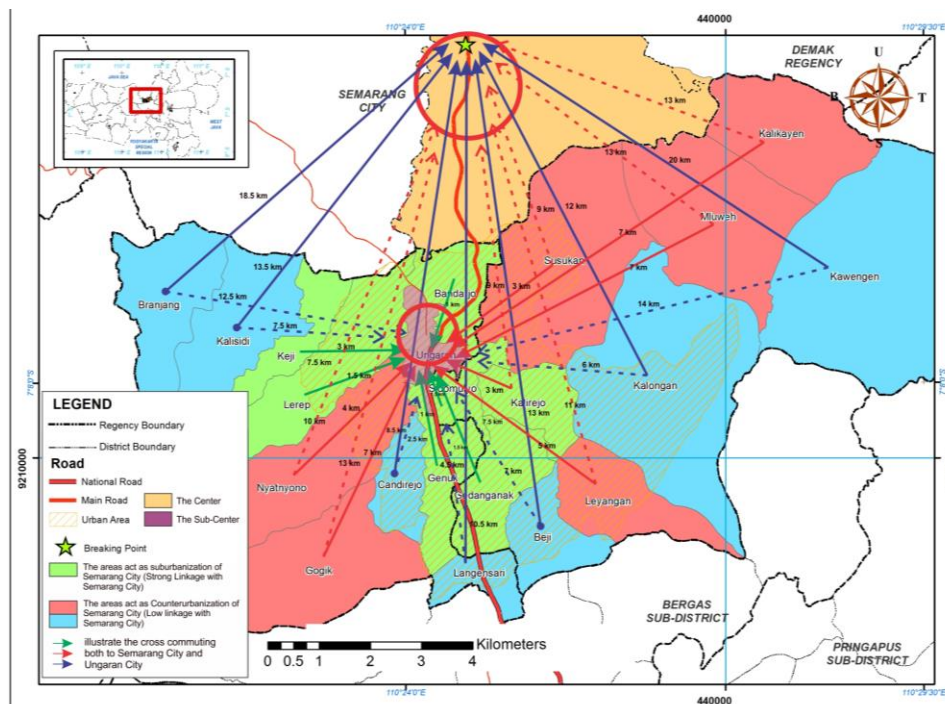
**Figure 4.** The Growth Process of Ungaran City areas based on Fisher's perspective and The Policentricity Concept between Semarang City and Ungaran City

## 5. Discussion

Table 4 describes the correlation of the findings in the main value of mobility inclination with the underpinning theory. Based on Fisher's perspective (2003), it can be concluded the seven areas act as the Counterurbanization areas of Semarang City because they possess low linkages to Semarang City in economic, social and transportation accessibility factor. The other thirteen areas act as Suburbanization areas of Semarang City because of strong linkages with Semarang City proven by the medium level value of mobility inclination, and ongoing mobility to Ungaran City related to the economic, social and transportation accessibility factor.

Referring to the polycentric concept, Semarang City and Ungaran City are considered as polycentric urban region, because there was cross commuting phenomenon as one polycentric characteristic covering an area that includes two or more cities.

**Table 4.** The correlation of the result of mobility inclination occurring in both seven areas and thirteen areas with underlying theories

| No | Type of Main Value of Mobility Inclination | Findings | Underpinning Theory |
|---|---|---|---|
| **1** | Mobility Inclination to Ungaran City → seven areas | Seven areas possess small value of mobility inclination to Semarang City *(Table 3)* | ➤ Fisher: → low-level connectivity with Metro area (Semarang City)→ Counterurbanization |
| **2** | Both Ungaran City and Semarang City → thirteen areas | Thirteen areas have medium value of mobility inclination Semarang City *(Table 3)* | ➤ Fisher: → strong linkages with metro area (Semarang City) → Suburbanization<br>➤ Polycentric concept → cross commuting phenomenon → people's mobility covers two or more cities (Ungaran City |

| No | Type of Main Value of Mobility Inclination | Findings | Underpinning Theory |
|---|---|---|---|
| | | | and Semarang City) →Interurban polycentric |

*Note:*
- Min Value 2.96    Range 0 – 100          20.01 – 40   = Low 60.01 – 80  = High
- Max Value 97.04   0 – 20 = Very Low 40.01 – 60  = Medium    80.01 – 100 = Very High

Following are the brief explanation to further clarify findings in Table 4:

- An Area with many existing industries has an outliner value mainly because most people work in the industries (i.e. Gedanganak)
- Ungaran City, as a growth center and a capital of Semarang Regency, possesses a greater function in providing the public services
- Ungaran City, as a sub-center of Semarang City, accommodates comprehensive availability of service center
- Ungaran City, as a bordering area, is not attractive enough since Semarang City possesses more job opportunities, location proximity factor, and the transportation accessibility.
- Semarang City and Ungaran City, as the center and sub-center, form the interurban polycentric concept connected to an integrated transportation system accommodating the linkage of transportation, social, and economic.
- Semarang City as the capital of Central Java attracts a high rate of urbanization while Ungaran City as a buffer possesses a major role in supporting urban functions. Hence, there are regional interactions that raise population movement related to major aspects such as economic and social.
- Ungaran City with several new growth centers is expected to be a Counterurbanization to barrier the urbanization flows to Semarang City.

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