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THE SPATIAL INTERACTION OF BANDUNG CITIZENS

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ABSTRACT

Bandung is one of the cities in Indonesia which has rapid population growth. Bandung also has high citizen mobility that comes from both other areas around the city and inside the city itself. This mobility is caused daily activities of the citizen, eitherby studying or working. The objectives of this research are to analyze: 1) the citizen mobility in Bandung, 2) the spatial distribution of land uses in Bandung, and 3) the spatial interaction of Bandung citizens, on the basis of land use and citizen mobility in Bandung. This research uses descriptive analytical method. The data is collected by using interview based technique. The collected data consist of mobility location, type of occupation, modes of transportation, destination location, and land use type. The data are analyzed using percentage and origin-destination matrix. The result of this research indicates that the purpose of the citizen mobility in Bandung is mostly conducted to work by using his/her own vehicle. Most of the mobility is occurred around each developmental area. Furthermore, it is also revealed that there is a massive movement to Cibeunying region,n which is used for educational purposes, offices, and trading areas.

Keywords: spatial interaction, citizen mobility, origin-destination matrix, Bandung city

ABSTRAK

Bandung merupakan kota yang mengalami pertumbuhan penduduk yang cepat. Selain itu, Bandung merupakan kota yang memiliki mobilitas penduduk yang tinggi baik dari daerah sekitarnya, maupun dari dalam Kota Bandung sendiri. Pergerakan ini lebih disebabkan oleh ativitas warga sehari-hari yang bertujuan untuk bekerja atau sekolah. Penelitian ini bertujuan ingin mengkaji bagaimana kondisi mobilitas penduduk di Kota Bandung, bagaimana kondisi penggunaan lahan di Kota Bandung, dan bagaimana interaksi spasial penduduk Kota Bandung berdasarkan penggunaan lahan dan mobilitas penduduk di Kota Bandung. Penelitian ini menggunakan metode deskripsi analitis. Datanya diperoleh dengan menggunakan teknik wawancara. Data yang dikumpulkan adalah data mengenai lokasi pergerakan, mata pencaharian, kendaraan yang digunakan, lokasi tujuan pergerakan, dan data penggunaan lahan. Analisis data menggunakan persentase dan matrik asal-tujuan (MAT). Hasil penelitian menunjukkan bahwa mobilitas penduduk di Kota Bandung sebagaian besar bertujuan untuk bekerja, dengan menggunakan kendaraan pribadi. Pergerakannya sebagian besar masih di wilayah pembangunan masing-masing. Kemudian diketahui pula bahwa terjadi pegerakan yang besar menuju wilayah Cibeunying dengan penggunaan lahannya berupa kawasan pendidikan, perkantoran, dan perdagangan.

Kata Kunci : interaksi spasial, mobilitas penduduk, matrik asal - tujuan, kota Bandung

INTRODUCTION

Bandung is one of the major cities in Indonesia which has very high population density. According to population cencus data of 2010 (*BPS*-statistics of Bandung), Bandung population density is about 14.300/km2. The high number of population of a city in general, is not only determined by the nature of population growth, but also by the migration factor. According to Colby in *Yunus* [2010] rural- urban migration is occurred becauseurban areas attract people to come, mainly due to extensive employment opportunities in various sectors, to gain higher income, to increase access to public facilities (health, education, and recreation), to get easier accessibility, to increase opportunities in career development, and to improve the accessibility to developmental new bussiness activities.

The citizen mobility in Bandung is not only occured in the term of rural-urban mobility, but also in the term of uran-urban mobility, as moving from one area to another area inside Bandung itself. So, it

is clear that there is a spatial interaction in Bandung. This spatial inetraction is influenced by the type of occupation from the citizen.

Daljoeni [1998] stated that spatial interaction in geography is the flow of people, goods, moneys, or informations either from urban-to-urban or rural-urban. There are three components of spatial interactions according to *Ullman and Daldjoeni* [1998]: complementarity, transferability, and intervening opportunity.

Inhabitants mobility is mainly caused by the need of complementarity, which is driven by the existence of demands and offers. The complementarity only occurs when the offer is considered beneficial by the person who ask for demand. The benefit is determined by many aspects such as cultures, sciences, engineering, and life-conditions. In order to be met, offer and demand need to be bridged from the separated distance. The greater the complementarity, the greater the flow of people and goods.

The possibility of goods or people to be moved to another place, not only depends on costs and duration. The rule or order to apply is also need to be taken into account, which includes transferabilities. The easier the tranferability, the greater the flow of people and goods.

Intervening opportunity, means, and disturbances of such events, for example due to natural disaster and infectious deseases epidemic, are often emerging when people are doing such movement from a place to another place, The people therefore choose alternative modes because their original one is considered unsuccessful. Another option to implement the original plan that ended unsuccessully is called the obsence of intervening opportunities. The greater the intervening opportunities, the smaller the flow of people and goods.

Spatial interaction of citizens, in term of social-geography, is known as population mobility. *Kasto* [2002] stated that population mobility is all movement accros the area in certain period of time. Population mobility consists of permanent mobility which is marked by the intention to settle in the destination area, and non permanent mobility which is charactererized by people who has no intention to live in the area of destination. Non-permanent mobility is divided into two: circular and commuter mobility to the area of destination. Based on the above definition, this reasearch focus on the non-permanent's commuter mobility, in which the population are moving to the their destination without taking a nap and coming back in the similar day, for example as going to office, school, and market.

According to *Tamin* [2000], spatial interaction in the urban area can be implemented based on the trip distribution pattern that connect the interaction of land use, transportation network, and traffic flow between the zone of origin (i) and the zone of destinantion (d) as the result of interaction between the zone and land use. The traffic flow will tend to increase if the distance between these two zones is closer. The higher the activity of land use, the higher its ability to attract the traffic flow.

Spatial interaction can be studied by creating a model that links the intensity of movement flow and direction of the current movement flow (no free variables) with the size of the land use structure (independent variables). For instance, the mobility pattern related to the working area inside the city can be modeled by using several variables, such as the distribution of employee locations and location of job opportunities.

The mobility pattern in transportation system is commonly explained by the mobility flow (of transportations, passengers, and goods) which moves from the zone of

origin to the destination zone in certain area and during certain time. Origin-destination matrix (*MAT*) is used by transportation planner to describe the mobility pattern. *MAT* is the two-dimensions matrix whichconsists the number of mobility zone in certain areas. The lines inside the matrix represent the origin zone (Oi), while the columns represent the destination zone. Therefore, the matrix cell indicates the intensity of movement from the origin zone to the destinantion zone. Each of cells requires informations related to distance, duration, cost, or three of them as the measurement of accessibility [*Waters*, 1999; *Tamin*, 2000].

Mobility patterns also can be described by line pattern besides using matrix pattern. It is generated due to the fact that mobility pattern has not only dimension of the number of movements, but also spatial dimension that is easier to be described graphically [*Tamin*, 2000]. The research related to spatial interaction of Bandung citizens is very important. The objectives of this research are as follows: 1) to identify the circumstance of the population mobility in Bandung, 2) to identify the circumstance of the land use type in Bandung, 3) to identify the spatial interaction of Bandung citizens in terms of the connection between the population mobility and the land use.

THE METHODS

Location
The location of this research is all areas in Bandung City. This area consists of eight developmental areas; namely Bojonegara, Cibeunying, Tegallega, Karees, Ujung Berung, Gedebage, Kordon, and Arcamanik.

Instruments and Materials
The main instrument used in this research is a guided interview material, which then applied toeach respondent. The material used in this research is map of the developmental area of Bandung, provided by

Bappeda Bandung, Land use map generated by Quickbird Image Interpretation in 2008. ArcGIS software was utilized for spatial interaction mapping purposes.

Population and Sample
The population of this research is all Bandung citizens, while the sample is about 700 people who are taken proportionally. The population and sample of this research can be seen in Table 1.

RESULT AND DISCUSSION

The population movement from a place to another place is also called population mobility. The mobility of Bandung citizens comes from the settlement area to destination area, such as working place or place for study (school, college, etc.). This kind of population mobility is commonly based on the economy and social purposes, which conducted by passing such administration areas as the borders of the city, district, or even village. Movement to the destination location is conducted commuterly on a daily basis without purpose to settle in destinied area. This movement is also called as commuter mobility. This kind of mobility is implemented by people who are doing mobility for a short distance between their living places and destination area. Moreover, this movement is also supported by the accessibility of transportation facilities.

Respondent Jobs
Job opportunities around urban areas have large variation, and so do with the kinds of job. Job opportunities has a relation with the function of the city itself. Bandung is functioned as city that provide services, educations, industries, trade, and center of administrations. Thus, the respondent jobs are also various, as shown by the data in Table 2.

Based on the table, it can be identified that 43.1% respondents jobs in the Arcamanik region work as a private-employees, in the

Bojonagara region 39.1% of them are work as private employees, in the Cibeunying region, about 35.5% of them work as Entrepreneur, in the Gedebage region, about38.7% work civil servant, in the Karees region, 36.8% of the respondents work as Entrepreneur, in the Kordon region, 29.5% respondents work as private employees, in the Tegallega region about 39.4% respondents work as an entrepreneur, while in the Ujungberung region, 37.3% of the respondents work as civil servants. It can be concluded that the job of the majority of the respondents comes

from private sectors and entrepreneurs. The percentage of the citizens based on their job can be seen in the Figure 1.

Destination of the Daily Movement

Destination of the daily movement has a strong relation with what someone is going to do in everyday life. In the term of daily movement destination, most of respondents states that they are going to work (79.3%), 10% of them are going to study in school or university, and about 6% of them are going to shop. To make it clear, the data can be seen in Table 3.

Table 1. Population and Sample of the Reasearch

No	Growth Center	Development Area	District	Number of Population	Number of Householder	Number of Population Sample
1	Center of the	Bojonagara	A n d i r	94.230	14.851	110
2	city		Cicendo	96.319	15.180	
3			Sukajadi	104.804	16.513	
4			Sukasari	79.211	14.127	
			total	374.564	60.671	
5		Cibeunying	Cidadap	56.312	11.872	124
6			Coblong	127.515	25.018	
7			Bandung Wetan	29.806	7.006	
8			Cibeunying Kidul	104.512	20.508	
9			Cibeunying Kaler	68.808	14.273	
10			Sumur Bandung	34.184	10.225	
			total	421.137	88.902	
11		Tegallega	Astana Anyar	66.649	13.856	160
12			Bojongloa Kidul	82.450	17.144	
13			Bojongloa Kaler	117.218	24.369	
14			Babakan Ciparay	143.151	29.761	
15			Bandung Kulon	138.644	28.824	
			total	548.112	113.954	
17		Karees	Regol	79.127	20.389	114
18			Lengkong	69.307	15.466	
19			Batununggal	115.572	4.365	
20			Kiaracondong	127.521	26.285	
			total	391.527	66.505	
21	Gedebage	Ujungberung	Panyileukan	37.691	7.632	59
22			Ujungberung	72.414	14.663	
23			Cibiru	67.412	13.649	
24			Cinambo	23.683	4.795	
			total	201.200	40.739	
25		Gedebage	Gedebage	34.299	5.227	31
26			Rancasari	72.406	11.034	
			total	106.705	16.261	
28		Kordon	Bandung Kidul	57.398	8.749	44
29			Buahbatu	92.140	14.042	
			total	149.538	22.791	
30		Arcamanik	Antapani	72.006	14.581	58
31			Arcamanik	64.830	13.128	
32			Mandalajati	60.822	12.316	
			total	197.658	40.025	
	Grand Total			2.390.441	449.848	700
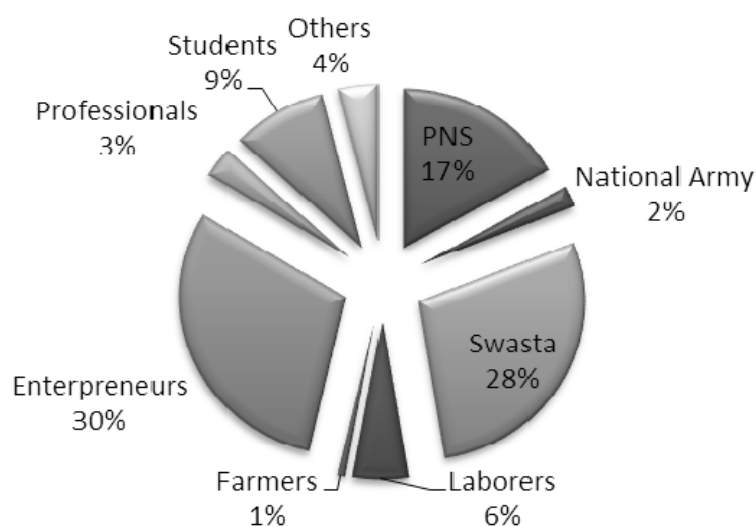
Figure 1. Bandung Citizens Precentage

Table 2. Respondent Jobs in Bandung

Jobs	Arcamanik		Bojonagara		Cibeunying		Gedebage		Karees		Kordon		Tegallega		Ujungberung		Total	
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%
Civilian Servant (PNS)	6	10.3	22	20	16	12.9	12	38.7	22	19.3	5	11.4	13	8.1	22	37.3	118	16.9
National Army (TNI)	1	1.7	4	3.6	1	0.8	-	0	4	3.5	1	2.3	3	1.9	1	1.7	15	2.1
Private-Employees	25	43.1	43	39.1	33	26.6	4	12.9	23	20.2	13	29.5	49	30.6	9	15.3	199	28.4
Laborer	3	5.2	5	4.5	6	4.8	2	6.5	10	8.8	2	4.5	10	6.3	-	-	38	5.4
Farmer		0	2	1.8	1	0.8		0		0	1	2.3	1	0.6	-	-	5	0.7
Entrepreneur	13	22.4	26	23.6	44	35.5	6	19.4	42	36.8	7	15.9	63	39.4	10	16.9	211	30.1
Professionals	2	3.4		0	7	5.6		0		0	5	11.4	5	3.1	3	5.1	22	3.1
Students	6	10.3	7	6.4	8	6.5	7	22.6	6	5.3	9	20.5	8	5	14	23.7	65	9.3
Others	2	3.4	1	0.9	8	6.5		0	7	6.1	1	2.3	8	5	-	-	27	3.9
Total	58	100	110	100	124	100	31	100	114	100	44	100	160	100	59	100	700	100

Sources: Analysis Result, 2012.

Table 3. Respondent Destination of Daily Movement

Movement Destination	Arcamanik		Bojonagara		Cibeunying		Gedebage		Karees		Kordon		Tegallega		Ujungberung		Total	
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%
To Work	51	87.9	87	79.1	104	84.5	24	77.4	94	82.5	36	81.8	128	80	49	83.1	561	79.3
To Study	7	12.1	12	10.9	8	6.2	7	22.6	8	7	7	15.9	16	10	9	15.3	77	10.9
To Shop	0	0	7	6.4	8	6.2	0	0	10	8.8	0	0	12	7.5	0	0	49	6.9
To Involve in Social Activity	0	0	0	0	0	0	0	0	1	0.8	0	0	1	0.625	1	1.7	6	0.8
To Go for Recreation	0	0	1	0.9	1	0.8	0	0	0	0	1	2.3	0	0	0	0	4	0.6
Others	0	0	3	2.7	3	2.3	0	0	1	0.8	0	0	3	1.875	0	0	10	1.4
Total	58	100	110	100	124	100	31	100	114	100	44	100	160	100	59	100	700	

Source: Analysis result, 2012.

Modes of Transportation Used to Working Location

Modes of transportation that are used to the office areaare strongly related to the ownership of transportation vehicle. There are many factors that influence somebody to use particular modes of transportation to their office. Modes of transportation used by the respondent to the working place are shown in Table 4.

According to the modes of transportation data, most of them (77,1%) use their own vehicle; about 16,6% of them use public transportation; and about 5,4% of them going by walking, only 0,6% of them using picking up transportations.

When they are being asked about the reason using personal transportation, most of them claim that it is faster, more economical, cheaper, saver, and more comfortable than public transportation. Another reason is that public transportation follows the specified route, while the route of personal transportation is more flexible since it can be adjusted by the space (distance) and time needed by the owner. The owner of personal transportation has independency to choose the route, especially to avoid the traffic area. The issue of personal transportation really associates with the increasing of income. However, the more the people use personal transportation, the greater the threat of traffic jam so that the government then attempts the people to use mass transportation.

The Location of Movement Destination

There are various respondents destination location according to their job in relation with the distance and. The destination movement of the respondent can be seen in the origin-destination matrix of Bandung citizens in Table 5.

According to the table, it can be found that 18.5% of the respondents in Arcamanik region move to Cibeunying region. In Bojonegara region, 75% of them move daily around the region itself, and so does in Gedebage region. In Karees region, 75% of the inhabitants also move inside the region itself. In Kordon region, 36.4% of them only move around Kordon, while 64.7% and 40% of them moves around Tegallega and Ujung Berung repectively.

There is a great movement to region Cibeunying from this following regions: Arcamanik 18%, Bojonagara 13.7%, Karees 8.1%, Kordon 9.7%, Tegallega 12.1%, and Ujungberung 8.8% (Figure 2).

It can be found that about 55.3% of Arcamanik region is dry field, and 14.2% are open land. In Bojonagara region, about 63.8% is used as settlement, while 13.2% is used for educational area, such colleges as Indonesian Education University, Polytechnic Bandung, and Bandung Institute of Tourism. In Cibeunying region, 54% used as settlement, while 19.6% is used as educational area and governmental office, especially ITB, Governor of West Java office, Mayor of Bandung office, and governmental duty both West Java province and Bandung city. About 57.8% of the land in Gedebage is wetland, while 37% of it is regular settlement.

In addition, it is known that 59.9% of the land use in Karees region used as settlement and 20.4% of the land is used as service area. In Karees, there are many hotels, banks, and ofiices. In Kordon, about 65.7% of the land is used as settlements and 17.4% as wetlands. In region Tegallega about 68.6% of the land is used as settlement and 15.1% of the area is used as industrial area. Tegallega at present becomes the center of industrial area in Bandung. In Ujungberung region, 21.8% of is the land is used as wetlands, while 18,1% of the land is used as dry field, and the rest (16.9%) is used as industrial area (Table 6).

Tabel 4. Kind of Transportations Used by the Respondent to Their Office

Transportations	Arcamanik		Bojonagara		Cibeunying		Gedebage		Karees		Kordon		Tegallega		Ujungberung		Total	
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%
Personal-Transportation	46	79.3	77	70	104	83.9	29	93.5	77	67.5	41	93.3	121	75.6	45	76.3	540	77.1
Picking-up Transportation	0	0	0	0	0	0	0	0	1	0.9	0	0	3	1.9	0	0	4	0.6
Public Transportation	10	17.2	27	24.5	16	12.9	0	0	20	17.5	3	6.8	26	16.3	14	23.7	116	16.6
By Foot	2	3.5	6	5.5	4	3.2	2	6.45	16	14	0	0	8	5	0	0	38	5.4
Others	0	0	0	0	0	0	0	0	0	0	0	0	2	1.3	0	0	2	0.3
Total	58	100	110	100	124	100	31	100	114	100	44	100	160	100	59	100	700	100

Source: Analysis Result, 2012.

Table 5. Origin-destination Movement Area of Bandung People

Destination	Arcamanik		Bojonagara		Cibeunying		Gedebage		Karees		Kordon		Tegallega		Ujungberung		Total
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	
Arcamanik	10	17.2	0	0	23	18.5	0	0	4	3.5	11	25	0	0	10	16.9	58
Bojonagara	0	0	83	75.5	17	13.7	0	0	5	4.4	0	0	3	1.9	2	3.4	110
Cibeunying	25	43.1	14	12.7	36	29	0	0	5	4.4	1	2.3	28	17.5	15	25.4	124
Gedebage	4	6.9	0	0	0	0	20	64.5	3	2.6	4	9.1	0	0	0	0	31
Karees	5	8.6	0	0	10	8.1	0	0	75	65.8	3	6.8	18	11.3	3	5.1	114
Kordon	1	1.7	0	0	12	9.7	1	3.2	7	6.1	16	36.4	3	1.8	4	6.8	44
Tegallega	0	0	13	11.8	15	12.1	0	0	14	12.3	9	20.5	108	67.5	1	1.7	160
Ujungberung	13	22.4	0	0	11	8.8	10	32.3	1	0.9	0	0	0	0	24	40.7	59
Grand Total	58	100	110	100	124	100	31	100	114	100	44	100	160	100	59	100	700

Source: Analysis Result, 2012.

Table 6. Land Use in Arcamanik, Bojonagara, Cibeunying, and Gedebage region

Land Use	Arcamanik		Bojonagara		Cibeunying		Gedebage	
	Ha	%	Ha	%	Ha	%	Ha	%
Urban Forest	5.46	0.3	0	0	71.41	2.4	0	0
Industry	72.75	4.4	172.10	7.4	36.58	1.2	59.29	3.5
Service Area	73.74	4.5	307.80	13.2	595.82	19.6	52.53	3.1
Open land	232.91	14.2	170.98	7.3	130.44	4.3	25.12	1.5
Trade	35.01	2.1	154.52	6.6	179.56	5.9	15.06	0.9
Regular Settlement	576.69	35.1	673.08	28.9	646.61	21.3	460.79	27
Irregular Settlement	332.12	20.2	814.58	34.9	994.06	32.7	107.26	6.3
Wet Field	150.69	9.2	16.52	0.7	9.53	0.3	985.44	57.8
Dry Field	161.76	9.9	22.75	1	379.49	12.5	0	0
Grand Total	1641.11	100	2332.31	100	3043.49	100	1705.49	100

Source: Interpretation of Quickbird Imagery, 2008.

Table 6.(Cont.) Land Use in Region Karees, Kordon, Tegallega, and Ujungberung

Land Use	Karees		Kordon		Tegallega		Ujung Berung		Total	
	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Urban Forest	19.22	0.9	0		0		0		96.09	0.6
Industry	106.66	5.1	32.95	2.7	371.36	15.1	374.75	16.9	851.71	5.9
Service Area	429.46	20.4	107.33	8.6	100.40	4.1	66.05	3	1667.08	11.5
Open land	32.55	1.6	53.09	4.3	143.20	5.8	38.47	1.7	788.28	5.4
Trade	194.95	9.3	28.27	2.3	216.42	8.8	23.99	1.1	823.78	5.7
Regular Settlement	648.19	30.8	567.75	45.7	512.80	20.8	236.59	10.6	4086	28.1
Irregular Settlement	611.84	29.1	236.37	19	958.40	38.8	595.49	26.8	4054.61	27.9
Wet Field	60.01	2.9	216.02	17.4	164.89	6.7	403.45	18.1	1604	11
Dry Field	0		0		0		485	21.8	564	3.9
Grand Total	2102.89	100	1241.78	100	2467.57	100	2223.80	100	14534.64	100

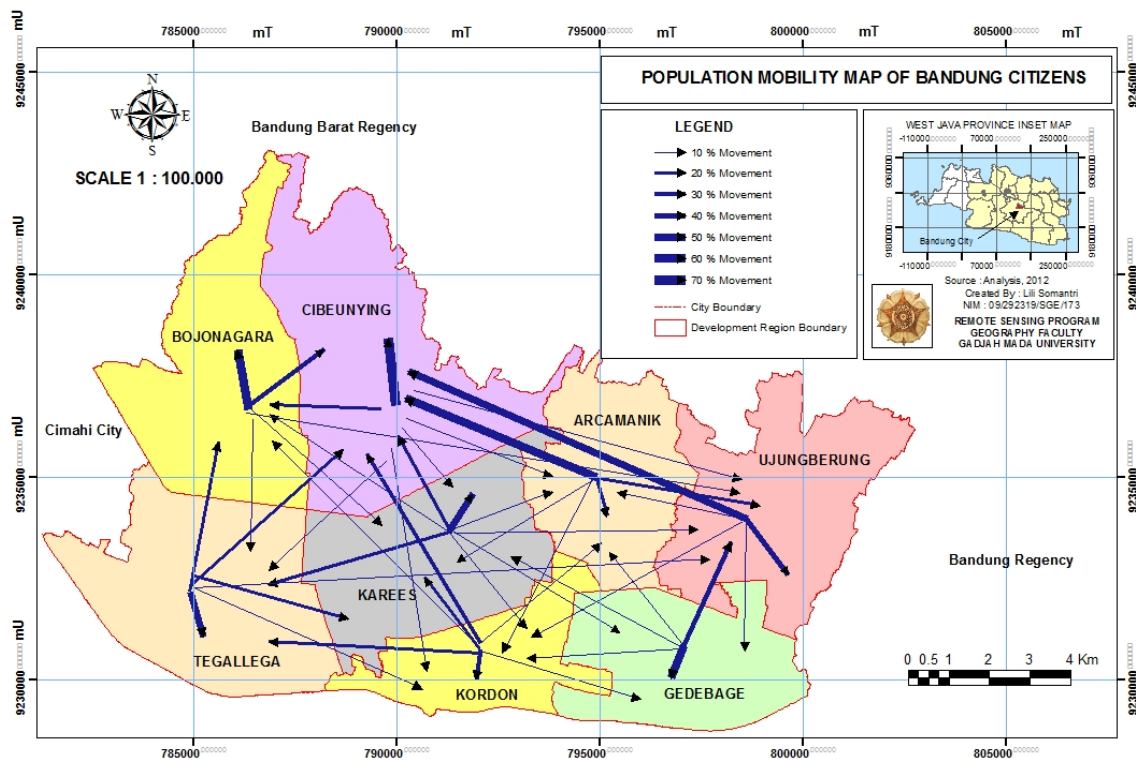Source: Interpretation of Quickbird Imagery, 2008.

Figure 2. Population Mobility Map of Bandung Citizens

CONCLUSION

Mobility of Bandung citizen, in terms of job occupancy, indicates that most of them are entrepreneur and private employees. Their daily movement is to work, and the most dominant transportation used is personal transportation.

There are variations in the land use in Bandung: about 55,3% of Arcamanik region is used as dry field, in Bojonagara region 63,8% of the area is used as settlement, in Cibeunying region 54% of the area is used as settlement, in Gedebage region about 57,8% of the area is used as

wetlands, in Karees region, about 59,9% is used as settlement, in Kordon region about 65,7% of the land is used as settlement, in Tegallega region, about 68,6% of the area used as settlement, and for Ujungberung region about 21,8% of the area is used for wet land.

Most of Bandung inhabintants moves in their own region, however, among the regions in Bandung, most of the citizens are moving to Cibeunying region.   This situation is led by the land use of the Cibeunying area, which is dominated by offices and service areas, such as governmental office, college, public company, and private offices.

ACKNOWLEDGEMENT

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