

Changing Physic, Changing Pattern, and Conflicts of Rural-Urban Fringe Using a Combination Model

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ABSTRACT

This study evaluates the physical changes, the patterns, and the conflicts in the rural-urban fringe area based on the combination model and the comparative static analysis. The scope of physical changes focuses on the land use, the built-up, the infrastructure, the utilities and the home environment. The objective of this study was to identify the factors responsible for the physical changes, the patterns, and the conflicts in the rural-urban fringe between 1990 and 2010. Physical changes were mapped using GIS, while the changing pattern was identified using exploratory and population morphology. The results of the study showed that the physical facilities and the infrastructure in the rural-urban fringe area become better but the condition of the environmental healthy is in the bad-level. So, the environmental healthy and green spaces or agriculture-land also needs attention. The pattern of rural-urban fringe is changed by the transportation route and facilities, the land value, the land use and the building function, the distance, and the travel time. There has been an agriculture conflict because of the different commitment of the farmer in the rural-urban fringe: the majority of the farmer in the inner fringe does not want to maintain their agriculture-land and agriculture-activities. In contrast, the majority of the farmer in the outer fringe still wants to maintain their agriculture-land and their job as the farmer.

Keywords: rural-urban fringe; physic; pattern; conflicts; combination model

INTRODUCTION

Land-use change is the most controversial consequences of human action, such as a heated debate on urban sprawl [1,2,3,4]. Land-use change is one relevant factor among the determinants of the climate change. The relationship between land use change and climate change is interdependent where land use change can have impact on climate, while climate change will also affect opportunities for land use in the future [3,5,6]. There are many studies about land-use changes such as urban or rural at the national scale as well as smaller scale [8]; [7,8,9]. These studies have regarded a region as an aggregated system which can be used to estimate only the amount of land-use change [10]. Braimoh and Onishi identified the factors responsible for residential and industrial/commercial land development in Lagos [11]. They classified land use into four: (1) Residential, (2) Industrial/commercial, (3) Non-urban, and (4) Water. Many studies in the area have focused on the residential land development and the private sector in Indonesia [12,13,14,15]. The improvement of the infrastructure in the rural area can contribute to the prosperity of the villagers [16].

The rural-urban fringe is the landscape located just outside of established cities and towns, where the countryside begins. The fringe characterized by diversity in land uses, with many areas in continuous transition [17,18]. The rural-urban fringe 'is the zone of transition in land use, social and demographic characteristics, lying between (a) the continuously built-up urban and suburban areas of the central city, and (b) the rural hinterland, characterized by the almost complete absence of non-farm, dwellings, occupations and land use....'[19].

Pryor suggested four sub-zones in the 'regional city': (a) urban area, (b) urban fringe, (c) rural fringe, and (d) rural area (Fig. 1). The urban area is the area that land use forms dominated by urban, while the rural area is dominated by agriculture. The urban fringe, that sub-zone of the rural-urban fringe in the contact and the contiguous with the central city, exhibits a density of occupied dwellings higher than the median density of the total rural-urban fringe. The rural fringe, that sub-zone of the rural-urban fringe contiguous with the urban fringe, exhibits a density of occupied dwellings lower than the median density of the total rural-urban fringe. Furthermore, the rural-urban land use triangle model combines the concept of urban invasion with the heterogeneous land use typical of the fringe [19]. Measurement of the distance bands of each sub-zone calculated from the total radius of the city. Russwurm suggests three sub-zones: (a) inner fringe; (b) outer fringe, and (c) urban shadow zone [20]. It is shown in Fig. 2. This structure is particularly helpful, since it stresses the notion of a continuum between urban area and rural hinterland [20]. As another opinion, the basic problem is the dominance of the introduction of the existing sub-zone. The inner fringe is marked by a number of agricultural

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land conversions to non-agricultural land. Penetration of land owners rather than farmers happens a great deal in this sub-zone. The outer fringe is the area/sub-zone where village land use is dominant. Provincial land conversion into urban land happens a great deal, but the frequency is not as high as in sub-zone of inner fringe. Infiltration of urban appearance begins to appear in this zone. In the cities of Western countries, cemeteries and land for stacking carcasses are among the characteristics of the outer fringe areas. This is reasonable because such forms require vast land that is plentiful and cheap. Land ownership is still dominated by farmers. The urban shadow zone is the area where the elements of urban morphology begin to infiltrate, but is still minimal. This zone bordered directly with real urban areas. The distributor of its zone is a conceptual model only. Not all cities are marked by a sequence of sub-zones such as in the model and it not always spread evenly in all directions.

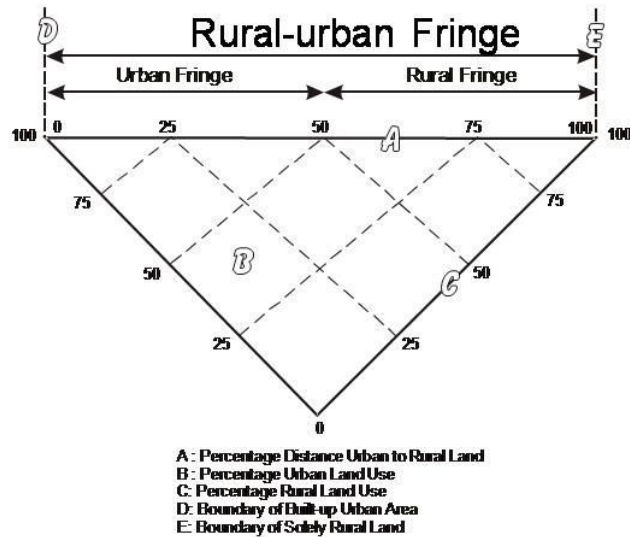


Fig. 1. Rural-urban land use triangle model [19]

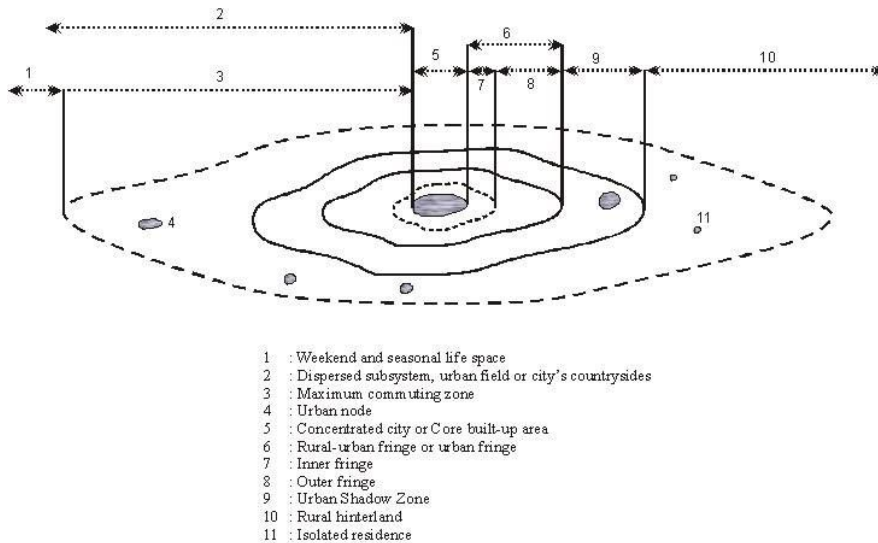


Fig. 2. Spatial structure model [20]

Yunus adds new sub-zones in sub-zone differentiation according to Pryor (Fig. 3). They are located between the urban fringe and rural fringe: (a) urban areas; (b) urban fringe; (c) urban-rural fringe; (d) rural fringe, and (e) rural areas [21]. The urban area is the area where the land use is 100 per cent urban-oriented, while the urban fringe is the area (zone) dominated mainly by forms of urban land use (more than 60 per cent of

urban land use and less than 40 per cent of rural land use). Urban fringe areas are located from the border point of the urban built-up to within 40 per cent of the point (calculated from the overall distance of a 'real urban' to 'real rural'). Rural fringe is a sub-zone of the percentage of its urban land use in balance with its rural land use. The comparison ranges from 40 per cent to 60 per cent where the explanation is more than 40 per cent urban land use and less than 60 per cent of rural land use. In this condition, a zone shows the comparison of urban land use in balance with provincial land and the structural transformation of land use will occur, although it is not as fast in the urban fringe area [22].

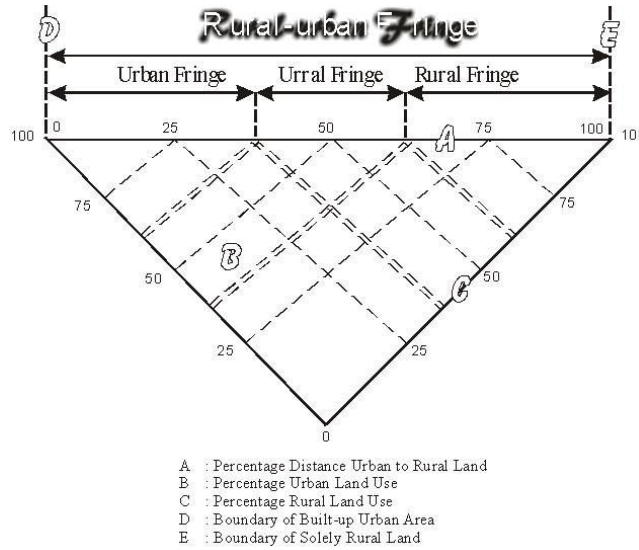


Fig. 3. Urban-rural land use model [22]

The rural-urban fringe area location is determined by the proportion of urban land-use functions and residential properties, the proportion of agricultural land-use, square grid and distance bands [23]. The basic research division of rural-urban fringe area location is divided into two sub-zones. The first is inner fringe, in which non-agriculture land began to be dominant. The built-up environment and the natural environment are balanced (40 per cent to 60 per cent of agricultural and conservation areas). It covers an area of around 2 kilometres from the city centre. The second sub-zone is the outer fringe, in which land use is dominated by provincial features (60 per cent to 90 per cent of agricultural and conservation areas). It covers an area from more than 2 kilometres and up to 5 kilometres (Fig. 4).

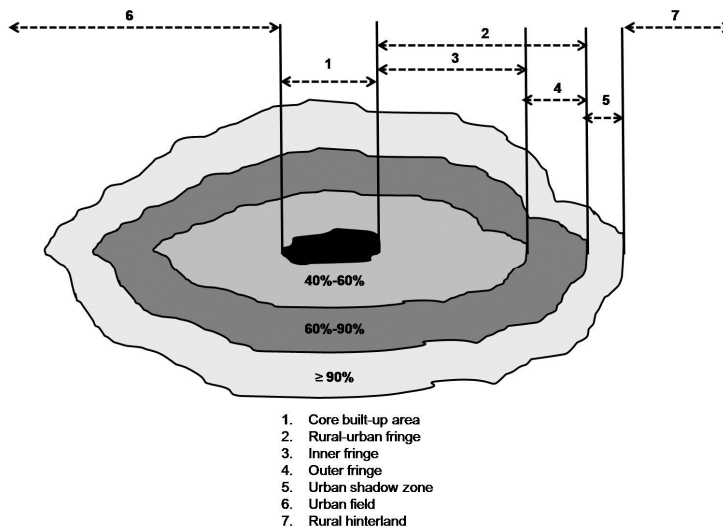


Fig. 4. Combination model [23])

Indonesia is a country with a large population crowded and some problem related to land use and conversion conflicts especially in the rural-urban fringe area. In fact, it is difficult to trace boundaries of the rural-urban fringe area clearly because of the mixing of urban and provincial properties in an area once. This research investigates this problem by comparing result and interpretation of this model using GIS function. Thus, the objective of this research is to identify the factors responsible for the physical changes, the patterns, and the conflicts in the rural-urban fringe area. Firstly, we identify the location of rural-urban fringe area based on the combination model. Secondly, we identify the physical changes and the pattern changes of the rural-urban fringe using the comparative static analysis. Thirdly, we examine the conflicts of rural-urban fringe area using exploratory. Thus, the outcome can be used as an input for the city government in creating a new policy related to sustainable planning of the rural-urban fringe.

MATERIALS AND METHODS

Aerial photographs were taken in 1990, 2000, and 2010 and are used as the data for the research. It was difficult to obtain the data of land use every five years. We created digital maps of four types of land-use with grid data (Fig. 5). The 17 classifications divided into four land-use types: forest/farmland (F); urban-land (U); public-land (P); developing-land (D). The overall classification system is shown in Table 1. The percentage of land-use types in each period obtained by overlaying land-use and grid data. The percentage of dwellings, industry, office-affairs, military, commercial, and public land occupied more than 80 per cent. Forest and farmland occupied less than 20 per cent.

Table 1. Classification of land-use types

Land use types	No.	Classification
Forest and farmlands	1	Paddy field
	2	Moor
	3	Plantation
Urban lands	4	Dwellings
	5	Industrial
	6	Office affairs
	7	Military
	8	Commercial
Public land	9	Terminal
	10	Road/drainage
	11	Education
	12	Liturgy
	13	Recreation
	14	Water reservoir
	15	Healthiness
Developing land	16	Green space
	17	Vacant

This research used combination model to identify rural-urban fringe area location. In this model, the location of rural-urban fringe is determined by the proportion of urban land-use functions and residential properties, the proportion of agricultural land-use, square grid and distance bands [2]. The basic research division of rural-urban fringe area location is divided into two sub-zones. The first is inner fringe, in which non-agriculture land began to be dominant. The built-up environment and the natural environment are balanced (40 per cent to 60 per cent of agricultural and conservation areas). It covers an area of around 2 kilometres from the city centre. The second sub-zone is the outer fringe, in which land use is dominated by provincial features (60 per cent to 90 per cent of agricultural and conservation areas). It covers an area from more than 2 kilometres and up to 5 kilometres (Fig. 4).

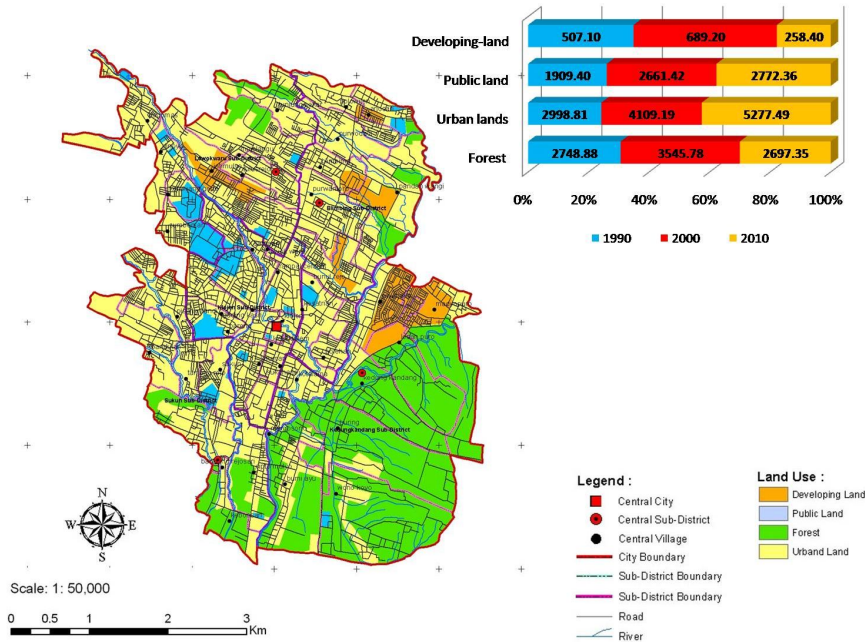


Fig. 5. Land use types

The location of the study is the rural-urban fringe in the City of Malang, Indonesia. The present study selected four sub-districts and 23 villages, which have a total area of about 8164.33 hectare. In 2010, there were 816,637 inhabitants (Statistic of Malang City, 2010). The study area located between 112.06° to 112.07° (East longitude) and 7.06°- 8.02° (South latitude). The study area has a topography that is most flat (96.3%) with slope 0 per cent to 15 per cent and a height of 380 meters to 667 meters above sea level (Fig. 6).

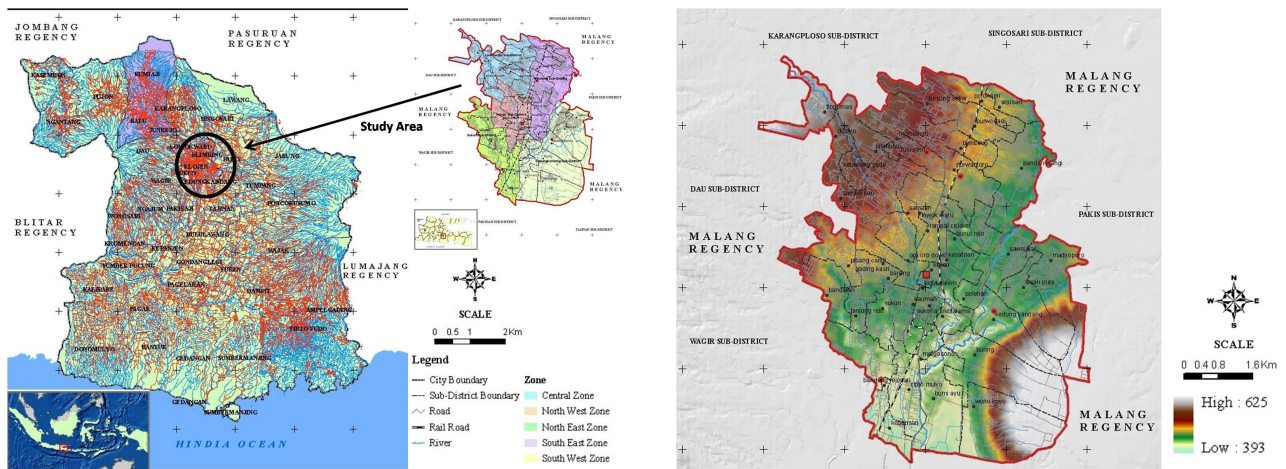


Fig. 6. The location of the study area(right) and Digital elevation model of the study area (left)

In this study, the object of the research is land use in 23 villages in the rural-urban fringe. Changes in physic and pattern in 23 villages are experiencing changes in the land use, the built-up, the infrastructure, the utilities and the home environment in the rural-urban fringe. The unit of analysis is the homeowners around the rural-urban fringe, come-in population who live in the rural-urban fringe, and the farmer. Furthermore, in this study are used as respondents are the farmer and homeowners who live in the rural-urban fringe.

Data regarding come-in population, home-owners and farmer have been collected using a questionnaire that was distributed in September 2009 and July 2010. The region of population sample was taken in the rural-urban fringe area which has been determined using the technique of Non-probability Sampling. Respondents were selected using purposive sampling method where respondents are not determined in advance. The population in the study is the home-owner, farmer, and come-in population who live in the rural-urban fringe

area. Then, the number of samples was determined after the discovery of the location of rural-urban fringe areas. This research is collected 202 the home-owner, 184 farmer, and 202 come-in population that were required to fill in the questionnaire.

RESULTS AND DISCUSSION

The result of analysis has been conducted on land-use change in the rural-urban fringe area. It is shown that the area of paddy field, moor and vacant land is designated for 3040.89 hectare in 1990, and was reduced by 2215.98 hectare in 2000. Furthermore, it reduced again by 1482.71 hectare in 2010. While, the area of 'dwellings' in the rural-urban fringe area increased from 2621.36 hectare in 1990 to 2947.16 hectare in 2000 and it increased to 3344.36 hectare in 2010 (Table 2).

Table 2. Land use type changes in the rural-urban fringe area from 1990 to 2010

Function	Area (Ha)						Changes from 1990 to 2010	
	1990	%	2000	%	2010	%	Ha	%
1. Paddy-field	1001.05	12.26	838.89	10.27	526.86	6.45	474.19	5.81
2. Moor	1532.74	18.77	1057.89	12.96	773.45	9.47	759.29	9.3
3. Dwellings	2621.36	32.10	2947.16	36.10	3344.36	40.96	723	8.86
4. Vacant-land	507.10	6.21	319.20	3.91	182.40	2.23	324.7	3.98



Fig. 7. Asphalt-roads connecting dwellings of rural-urban fringe area

Land use change is also due to the addition of several new roads in the rural-urban fringe. Existing roads in the rural-urban fringe is 36.26 kilometres in 1990. There is the addition of roads throughout 10.92 kilometres in 2000, and there is also the addition of roads throughout 12.84 kilometres in 2010. This means that the length of roads in 2000 to 47.18 kilometres, and in 2010 to 49.1 kilometres. Moreover, other factors that led to strength attraction of the physical development in the rural-urban fringe to the West and the South is the influence of transportation routes that connect the rural-urban fringe area with 'dwellings' (Fig. 7).



Fig. 8. Condition of the neighbourhood road in rural-urban fringe area

The good-condition of neighbourhood road is little. This can be understood, because of the fact that exists in the field, the condition of neighbourhood road that used to be a path/soil will be flooded and muddy in the rainy season because it has not been paved and it has not equipped with tract wasters/drainage. In contrast, in the dry season the dust would fly. This condition has changed, most of the neighbourhood road paved and equipped with 'tract wasters'. Accessibility of people and goods to be smooth, flooding is reduced. So, the condition is much better now. Fig. 8 shows that there is a change in conditions of neighbourhood road. Which was originally just a gravel road or pavement in 1990, it turned into asphalt road in 2010.

The detail of recapitulation of the physical change in the rural-urban fringe area can be seen in the Table 3. The pattern of the growth building in the rural-urban fringe is vertical because of the increasingly high price of land. It gives the impression of the environment looks crowded and irregular. It also is related to the function of the buildings owned by the respondent. "Ground floor" used by the 'function' has the most powerful economy. In this case, the "retail activities" is the most commonly used (Fig.9). The pattern 'layout of buildings' to the building is elongated because it follows the path of transport (road). Meanwhile, building patterns on the buildings are centralized because it is influenced by the 'building plots' that already exist and where the previous building. The detail of recapitulation of the pattern changes in the rural-urban fringe area can be seen in the Table 4.



Fig. 9. The pattern of building growth in the rural-urban fringe

Table 5. Farmer's commitment to their agricultural-land and agriculture-activities in the rural-urban fringe area

Area	Commitment to agricultural-land				Total	Commitment to agriculture-activities				Total
	Yes		No			Yes		No		
	n	%	n	%		n	%	N	%	
Inner fringe (IF)	28	34.57	53	65.43	81	18	22.22	63	77.78	81
Outer fringe (OF)	58	56.31	45	43.69	103	65	63.11	38	36.90	103
Total of rural-urban fringe (RUF)	86	46.74	98	53.26	184	83	45.11	101	54.89	184

*n=person

Land conversion from agricultural-land to non-agriculture land determined by farmer's commitment to their agricultural-land. High motivation of farmers to maintain agricultural-land, it will cause lowest conversion rate of agricultural-land in the rural-urban fringe area. Conversely, if the motivation of farmers is low, the conversion rate of agricultural-land will become easier. The majority of farmers in the inner fringe area do not want to keep their farm and their activities as the farmer. While, many farmer in the outer fringe area who still wants to maintain their agricultural land and their job as the farmer in the amount of 56.31 per cent (Table 5). One of the impacts occur when farmers are not motivated to start their agricultural activities are farmers going to change the use of agricultural-land. They think that it is no longer perceived earning their living. When this happens, it will be easier to land conversion in the study areas.

Table 3. Physical changes in the rural-urban fringe area

No.	Indicator	Changes
1	Land use	79.8% of dwellings: Land-use from agriculture has been changed into non-agricultural of land (residential and home-business)
2	Building area	39.4% Building area: Building area to be increased
3	Function of the building	76.8% Home-business: The function of the building which was originally just ordinary residence changed into home-business
4	Shape of the building	91.6% Good-shape: The shape of the building was better than the previous in 1990
5	Layout of the building	54.5% is not good-layout: The layout of the building is too close, so it affects the air temperature and environmental health
6	Condition of neighborhood road	67.5% Good-condition: The condition of neighborhood road to be better (previously the ground turned into grass-block, and previously Mac-Adam turned into asphalt).
7	Source of water	57.1% Good: Source of clean water most of non PDAM/wells (not from the river)
5	Condition of waste services system	53.2% Bad-service: it is due to systematic waste services have not been going well especially the inadequate number of officers, and the waste hauler has not been precisely the time of transport.
6	The level of demand for electricity	91.6% increase: The need for electricity has increased from 450 VA and 900 VA to 1300 VA
7	The environmental healthy	83% bad-level: The environmental of health at the study site is worst than before
	Total of Condition	Physical facilities and infrastructure to be better, but the condition of health environment is bad-level. So, the health of the environment and green spaces/agriculture land also needs attention.

Table 4. Spatial pattern in the rural-urban fringe area

No.	Indicators	Pattern	Causative Factor
1	Land use	Star-shaped pattern	This is influenced by transportation routes, and transportation facilities.
2	Distribution facilities	Scattered constellation	This is influenced by the distance to the 'fringe-settlements', the travel time, transportation facilities, and land values.
3	Other commercial facilities	Ribbon/linear	This is influenced by the transportation routes (roads) and distance to the dwellings
4	Neighborhood road	Grid system	This is influenced by lots of buildings, land use and building function.
5	Growth of building	Vertical	This is influenced by the value of land and limited horizontal space.
6	Layout of building on the road	Linear	This is influenced by transportation routes (roads) and distance to the dwellings as a center of activity and proximity to settlements.
7	Layout of the home-business of other buildings	Concentrated	Concentrated is influenced by lots of buildings and the location of the previous building that has been established. Elongated is influenced by transportation routes (roads).

CONCLUSIONS

The physical facilities and the infrastructure in the rural-urban fringe area become better but the condition of the environmental healthy is in the bad-level. So, the environmental healthy and green spaces or agriculture-land also needs attention. The pattern of rural-urban fringe is changed by the transportation route and facilities, the land value, the land use and the building function, the distance, and the travel time. There has been an agriculture conflict because of the different commitment of the farmer in the rural-urban fringe: the majority of the farmer in the inner fringe does not want to maintain their agriculture-land and agriculture-activities, so an appropriate concept for the inner fringe area is Tax Deferral and Abatement Laws. Applying a tax on those areas of land on the basis of 'use value' despite having a high sale, as long as the owner retains the form of land use (agriculture), this concept can be done. In contrast, the majority of the farmer in the outer fringe still wants to maintain their agriculture-land and their job as the farmer. Then, an appropriate concept for the outer fringe area is Utility Extension Policy and Police Power Mechanism because the availability of agricultural land is still a lot and the farmers are still committed to agricultural land and agricultural activities.

The authors hope that the outcome of this study can be used as an input for the city government in creating a new policy related to sustainable planning of the rural-urban fringe.

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