

# Investigating the Border Effect of Urban-rural Transitional Belts

A Case Study in the Village of Unionville, Ontario, Canada

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**Abstract**—This study is aimed to investigate how the Urban Border Effect can influence the spatial environment, the ecological system, and the cultural value of a city. This paper presents a case study conducted in the village of Unionville, Ontario, Canada, which is located in the border between the city of Toronto and the municipal region of York. A methodology was adapted for scientific specification and identification of urban border. The ultimate goal of this study is to develop thorough understanding of the Canadian experience that we believe is highly inspirational to China, especially when it is essential to activate the Urban Border Effect to slow down the disappearing of farmlands and forests under the pressure of the current ambitious urbanization. The case study presented indicates that optimizing the Urban Border Effect can largely help maintain the vitality of the ecological system critical for the balanced development of society.

**Keywords**—Unionville; urban planning; urban border effect; space vitality

## I. INTRODUCTION

City as the settlement system which is composed of human settlement, the connected zone where between its adjacent or heterogeneous district forms the boundary region throughout different levels space of the city (such as city and city, city and suburb, ancient city and new city). Boundary region has specific locational conditions and ecological characteristics, among urban residents, environmental, societal and economic systems can engender coupling relationship, synergistic effect and integrated effectiveness with dimensions of time, space, process, structure and function. Consequently, the boundary region can surpass the simple sum of systematic effectiveness which generated by each separated district, and this phenomenon belongs to 'boundary effect' [1].

The boundary as the joint part and transition area between rural and urban district, which is both the mixing zone of rural and urban function and the mixed-dwelling area of rural and urban population. The characteristic of mixed

development between rural and urban economy and culture plays an essential part of the city integrative development [2]. It can restrain the spread and expansion of infinite of urbanization, cushion the conflict of unbalanced development between urban and rural area, and become the protective shield of urban ecological environment. However, boundaries between Chinese rural and urban lack the unified plan and impeccable theoretical system in constructions of residential environment. Economic benefits make a mass of agricultural land transforms into non agricultural construction land disorderly, which results in rural and urban boundary ambiguous, waste of cultivated land resource, dissimilation and disruption of traditional village, evanescence of local culture, widespread damage of water and forests resource, and human settlement environment has to confront various problems [3].

This article selects Unionville as the case, which is the boundary area of Canada's financial metropolis Toronto and York Region where mainly agricultural production and residence function-oriented, aims to research the 'border effect' of rural and urban during the process of urbanization and combine with the related issue of current rapid urbanization in China, to discover the healthy and sustainable strategy and pattern.

## II. SPACE MORPHOLOGY ANALYSIS OF UNIONVILLE

Unionville is located at the boundary area and it has hybrid developed characteristics of country and city space, in addition, it is different from the independent space system of country and city. During the process of development and reform which affected by urbanization, Unionville has become compound ecosystem with diversified functions from simplex farming village, what's more, the protection strategy of the historical heritage and natural environment make different period and categories space form are gathered here, and forming various city space forms which include ecological environment, commercial space, farmland landscapes and residential space gradually and also have

functions of ecological, commerce, leisure and recreation, production and living.

#### A. Advantages of Geographical Location

Unionville is a community which located in city Markham, York Region, Toronto, Ontario, Canada; it is about 33 kilometers away from the centre of Toronto in northeastern, and it is situated in the juncture area of York Region and Toronto("Fig. 1".Greater Toronto Area). Toronto is the capital of Ontario province, the economic center in Canada and one of the famous financial centers in the world.

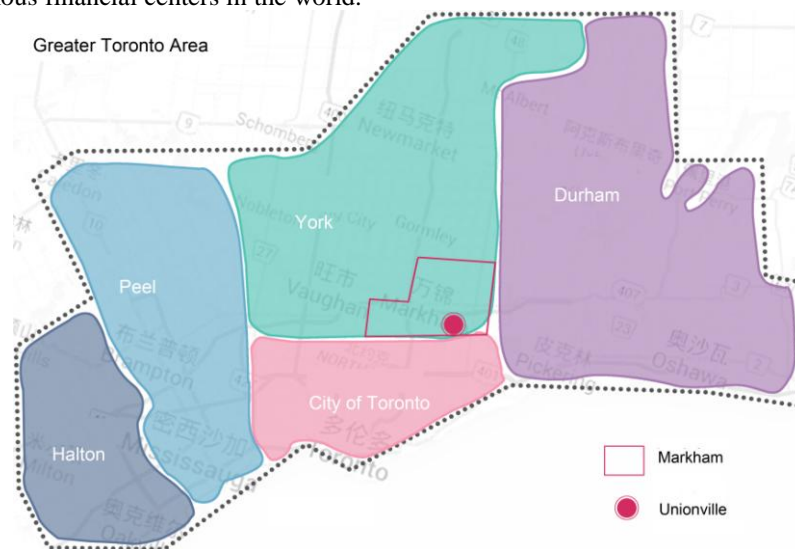


Fig. 1. Greater Toronto Area.

#### B. Diversities of Landscape Morphology

The holistic development of Unionville, space landscape experiences four stages which have distinct characters. The first stage is the formation of some natural landscape including mountains, lakes, and rivers. The second stage is the exploitation of the productive landscape including farmland, fishpond and orchard. The next stage is according to the land plot to construct residential district to form village landscape. Finally, the expansion of urbanization results in urban landscape with centralism construction (such as commercial architecture, square, landscaping and some non-

York Region is a local district lies to the north of Toronto; it has convenient transportation, exquisite environment. Hence, York Region is quite a livable city with more 900 thousand citizens, and its population is the fastest growth in Canada. Unionville as the connecting area of several city systems so that it is convenient for access to the shared resource within two places, fuses the cultural characteristics of York Region and Toronto. In addition, Unionville attracts people from surrounding cities to form diverse and rich spatial pattern and functional combination.

agricultural land). As Unionville is located in the rural-urban fringe and landscape development of these four stages make up the holistic landscape style of the special region together, accumulating the regional historic culture and traditional features. The agriculture, living and commercial exploitation modes are interaction and orderly, step-by-step, organic development and form space mixed-zone with coexistence of multiple functions, which become multiple compound ecosystem with urban structure. Natural landscape, productive landscape and village landscape and urbanization landscape coexist in the whole Unionville community ("Fig. 2" shows the spatial form of Unionville).

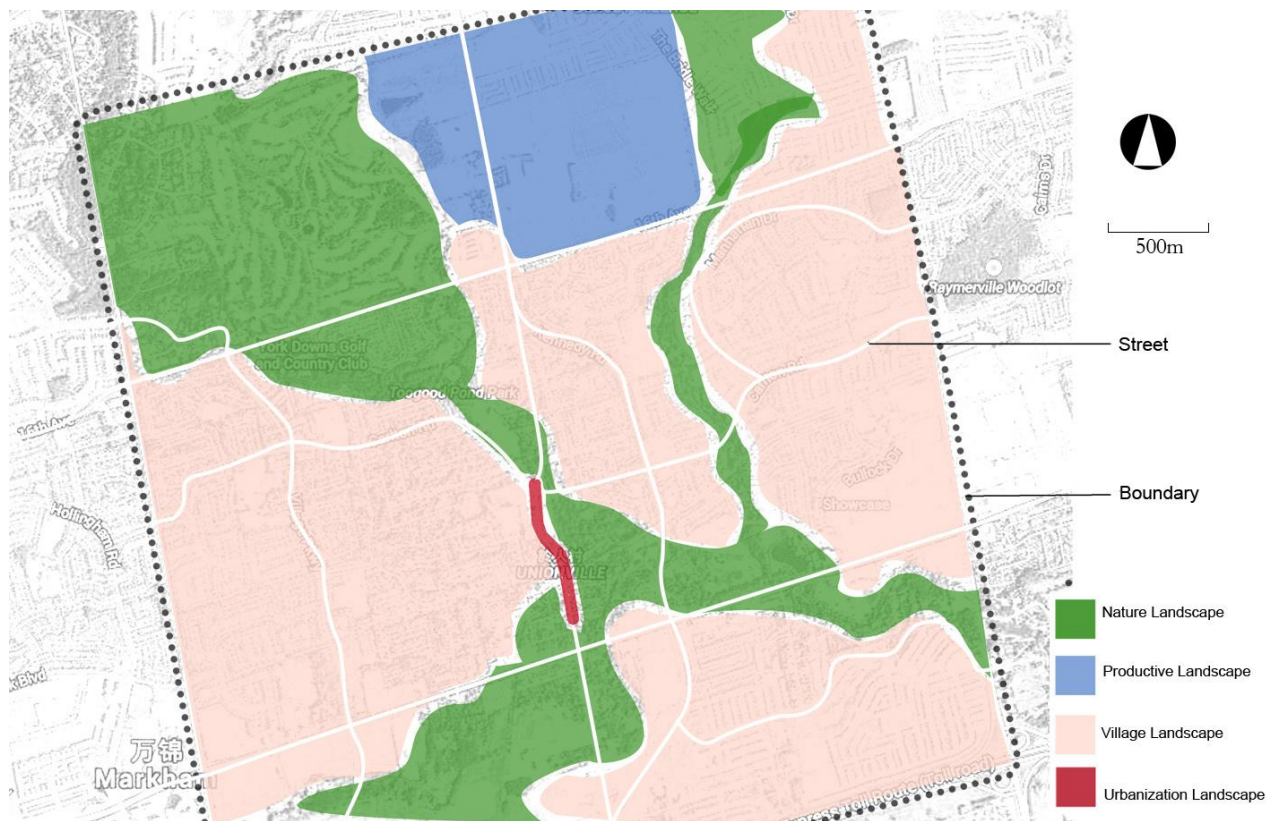


Fig. 2. The spatial form of Unionville.

Natural landscape accounts for 32 percent of the community total area, productive landscape occupies 10 percent of the total area and village landscape represent 57 percent of the total area. However, the commercial center which service for community residents and a few foreign visitors, namely the urbanization landscape takes up less than 1 percent of the total area ("Fig. 3" shows the area ratio of spatial form in Unionville), and urbanization landscape protect the original village pattern which is different from the phenomenon 'village in the city', namely the encroachment on agricultural land by the urban [4].

Hence it can be seen that the land-use scales of Unionville: productive landscape-based in the northern and retain widespread area of natural landscape, the building density is rather low; in the urbanization landscape of center area, the village landscape increased gradually compared to the northern area and the large area of farm is hardly to see, and still have many well-preserved natural landscape; down to the southern is close to the boundary of Toronto and affected by the urban, the area of village landscape is gradually increase, the residential space tends to be increasingly intensive and the architectural style is transform into modern from classic little by little and there is no lack of natural landscape. Natural landscape, productive landscape, village landscape and urbanization landscape protect the natural ecological environment effectively and retain the farming lifestyle and historical architecture style with organic balanced development of land use patterns, which makes the mixed degree of spatial function attain

quite a high level and has the functions of ecology, production, residence, commerce and recreation.

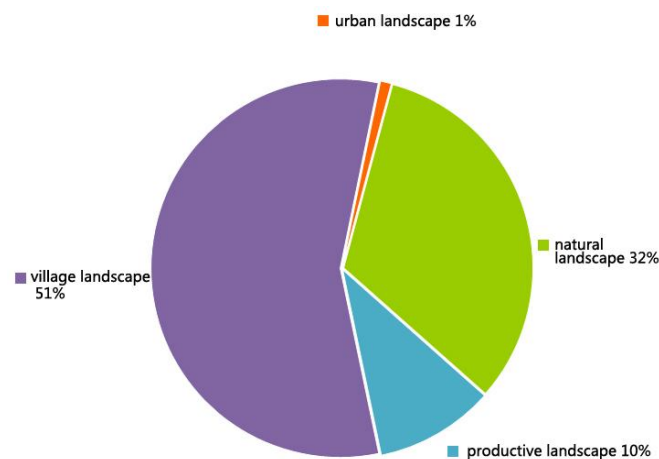


Fig. 3. The area ratio of spatial form in Unionville.

### C. The Principle of Spatial Planning at the Border Between Rural and Urban.

The boundary between rural and urban area is an organic systematic form which is formed by space-crossing cause the line extended to the face. The holistic planning of the boundary ought to consider the need of mixed development to facilitate interpenetration of ecology, society and culture between the two places. Therefore, there



is not the simple space-linking with each element; on the contrary, it is the deeper connection with concept and culture. Expanding urbanization rapidly has caused the boundary of rural and urban ambiguous in China; a mass of ecological vegetation, village and farmland has been replaced by architecture style which lacks regional characters, which result in the separation of nature, production and living space, environmental harmony degree has decreased and humanistic value has been ignored. Referring to the space planning of Unionville; its scale of urbanization land use takes a full consideration of local population, the combination of community driven development and the needs of residents, achieving highly mixing of spatial function. The spatial development makes ecological vegetation, agricultural production and residents' life have a coordinated development and mutual coordination, which contributes to increasing the economic benefit, improves the environment and life quality and adapt to the carrying capacity of ecosystems. Harmonious unified and progressive development patterns of agriculture, forestry and urbanization contribute to overall urban-rural development, maximize the boundary effect. Thus, a majority of rural and urban areas have remarkable ecological resources, farming culture and residential advantages in China. In fact, we can effectively prevent the widespread waste of resource, avoid mechanical division of land usage and realize the optimal utilization of land resource if we combine the current land use condition and regional development need, evaluate the land suitability and compatibility, divide land into constructive and unconstructive, and organic consolidate various land-usage function, reasonable development and take in everything before the development of urbanization.

### III. ANALYSIS OF ECOLOGICAL EFFECT IN UNIONVILLE

Forest land, water system and some natural environment areas play important roles in water conservation, preventing soil erosion, dust removal and noise reduction, cleaning air storage, reducing the heat island effect, provide a favorable

environment for wildlife and offer human entertainment venues. The favorable boundary location benefited from the mutual complementation and combination of adjacent region and unit environmental resource which gives inestimable value. Advantages of geographical habitat are apparent; however, since the expansion of land use and the need of construction, original ecological environment have been occupied, and the continuous existence of wildlife is depend on the control of local proper use of land and urbanization development so that there has formed favorable ecological effects.

#### A. Analysis of Ecology Environment in Unionville

1) *Natural forest land*: Primitive environment is the most comfortable open field, and it is the treasury of natural ecology system information. Owing to ecological protection consciousness of local government and residents, the natural forest reserve of Unionville has not been transplanted or cut down ("Fig. 4" shows the ecological environment of Unionville). On the east side of Main Street has the most prosperous business atmosphere, and reserves a large area of original wooded mountain and natural historical style and features as well. Meanwhile, these wooded mountains offer visitors and hiking enthusiasts to leisure and enjoy, and enrich the outdoor life for residents. What's more, citizens can enjoy the easiness and peace which brought out by the nature, and the natural landscape and artificial landscape blend organically. To avoid commercial activity areas affecting the forest animals and plants, there set the collector streets in front of the wooded mountain, and the parking plot located in the open area between the building backward of Main Street and forest mountain. Hence, this way not only isolates the Commercial Street and natural vegetation, also reduces the pollution of natural vegetation and off-gas ("4-4" in "Fig. 4").

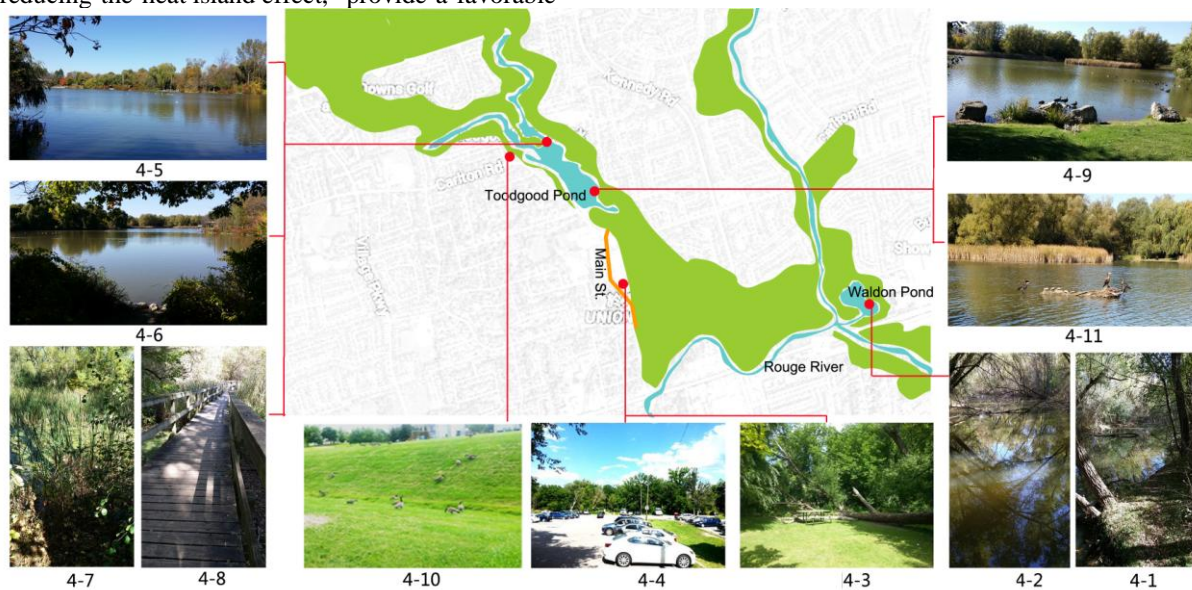


Fig. 4. Ecology environment in Unionville.

2) *Natural water system*: There is a reservoir (Toogood Pond) ("4-5" in "Fig. 4") located in the northwest corner of the main street of Unionville, and the reservoir except makes the water maintains ecological self-circulation, and forbid the industrial wastewater discharge. In addition, it reserves the landscape corridor of the original ecological vegetation around the reservoir within 100 meters' distance ("4-6" in "Fig. 4") and set natural revetment to improve the ability of self-purification of the reservoir ("4-7" in "Fig. 4") and have the walking gallery of waterfront space and rest landscape ("4-8" in "Fig. 4"). What's more, there is a vast ecological park in the west to offer leisure, rambling and stayed place for people to enjoy the charming nature ("4-9" in "Fig. 4"). The wider greening slope (about 10 meters) makes natural ecology and water system isolate from highway and some banded infrastructure to avoid the damage to the ecological environment of the urban pollution ("4-10" in "Fig. 4").

3) *Biocenosis*: Due to the specificity and complexity of the ecological environment in the boundary area, the biology which adjacent to the community probably gathers in the overlapping ecological region, which creates various animals and plant species. Unionville's protection policy of ecological wooded mountain and water resources provide a warm home and natural and safe living environment for wildlife. Man-made sabotage of ecological environment is prohibited strictly in Canada, besides, harmony plant and animal community create healthy and sustainable natural environment together ("4-11" in "Fig. 4").

#### B. Ecological Function Evaluations of Unionville

Island biogeography theory reveals that the close relationship with the number of species survives and the occupied area, namely the island area is the most essential factor decides the number of species. Therefore, the ecological character of embodying and evaluating space can choose individual patch area as the index of biodiversity and ecological function. Studies will choose the comparison of green land area size of Unionville and the size of green land averaged area in many key cities at home and abroad. To reflect that the pros and cons of ecological service function of Unionville, which means the greater the average size of green land area, the ecological function is more integrated (p.s. all the calculated size of green lands are park green lands in this session, and productive green land and street green land are not counted in statistics range).

Through the calculation of GIS, the six parks occupied 256hm<sup>2</sup> of the total green land area in Unionville (every park

area of the total is shown in "Fig. 7" (all parks area in Unionville (hectare) ), and the average green land area is 42.66 hm<sup>2</sup>. Since Unionville is located in the rural and urban area of international metropolis, Toronto, and this paper choose the same level city in China – the park green land area of Shanghai's urban and rural district as the reference points, rather than the average value of single district to reflect the holistic ecological function of Shanghai's urban and rural area to avoid overgeneralization and judge the evaluation of ecological service function of Unionville. Shanghai has 18 districts and 1 country, 9 districts among them belongs to the urban and rural area (which are Minhang district, Baoshan district, Jiading district, Pudong new district, Jinshan district, Songjiang district, Qingpu district, Fengxian district and Chongming country), and every district has 239 parks ( the number of park in each district of Shanghai is shown in "Fig. 5, source from 2011's data), and covering the area of park is 5309 hm<sup>2</sup> ("Fig. 6" is the park green land area of every district in Shanghai (hectare)), we can calculate that the mean area of green land is 22.55 hm<sup>2</sup> in Shanghai rural and urban district.

TABLE I. COMPARISON OF MEAN AREA OF GREEN LAND AMONG THREE PLACES

Region	Average of green land size (unit: hm <sup>2</sup> )
Unionville	42.66
Suburb of Shanghai	22.55
The whole city of London	47.01

Through the comparison of mean area index of green land between Unionville and the suburb of Shanghai (42.66:22.55), we can preliminarily judge that the ecological service function and the species diversity of Unionville precede the suburb of Shanghai. London is a leading city in global ecological environmental protection, and always viewed as an excellent example and ecological goal in various districts. According to the related records, the public green land area has reached 172km<sup>2</sup> in London, and the average size of green land is 47.01 hm<sup>2</sup> [5], which is close to the Unionville's area 42.66 hm<sup>2</sup>. It can be seen that, the area makes Unionville keep the leading position around the whole world as well, which is connected with the protection of the original environment, the limitation of suburban development and the control of green land cutting. While Shanghai as the leading position in national economic development and urban construction sphere, the index of green land area is rather low which only reached a half of the other two places. It can be found that Shanghai is at a more disadvantaged position than Unionville and London, which is related to the national land development method.

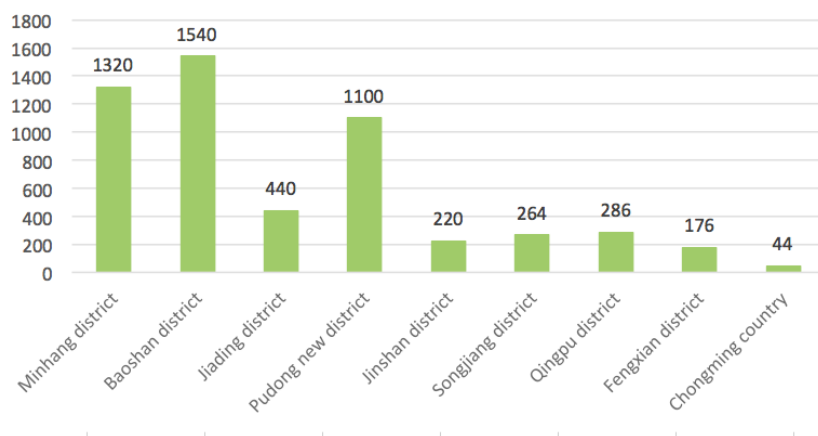


Fig. 5. Source from 2011's data.

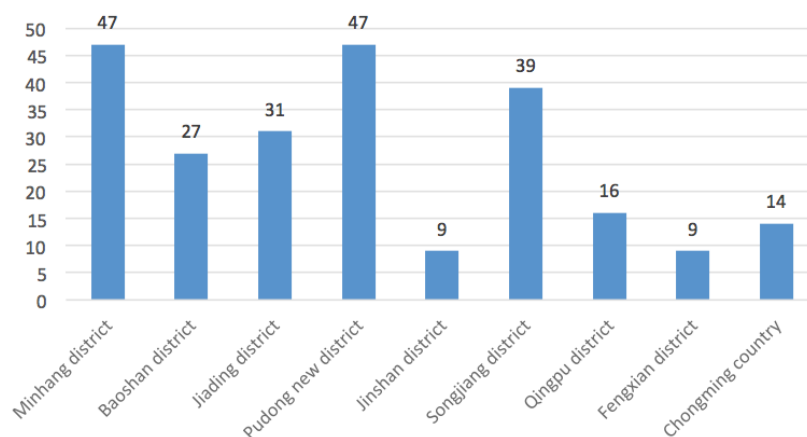


Fig. 6. The park green land area of every district in Shanghai.

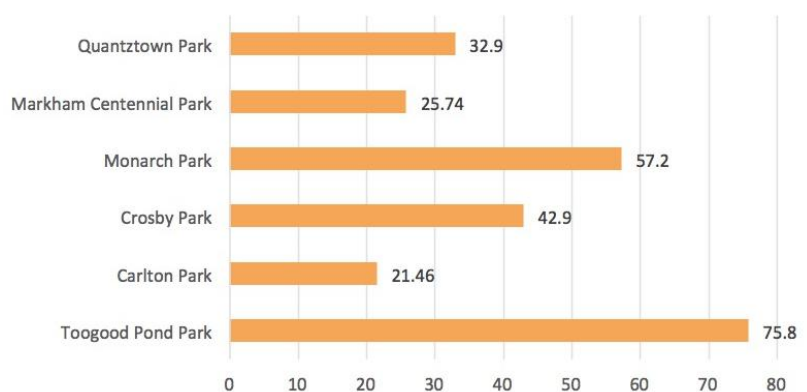


Fig. 7. All parks area in Unionville.

### C. Ecological Protection Principles of the Boundary Between Rural and Urban District

Land is the most essential material carrier of urban construction and the land development method becomes the key issue to urban ecological environment construction. Rapid urbanization causes the boundaries of rural and urban area are mainly development-oriented land pattern in China, which makes surface runoff, erosion, within-channel deposit

and degeneration, and seriously damage of the vegetation (Fig. 8 is the comparison of land-use pattern). The recession of natural ecological landscape and reduction of farmland have destroyed the population diversity and environmental self cleaning capacity of overlap region of the ecological environment, and the city has lost green protective barrier. In addition, air pollution, soil contamination and water pollution are all breed in the each district of the city, which reflects fragile ecological security pattern.

	land development method	Diagrams
<i>natural-oriented land use pattern</i>	ecological environment	
	development mode of ecological agriculture	
<i>development-oriented land use pattern</i>	development mode in suburbs	
	Urbanization development mode	

Fig. 8. The comparison of land-use pattern.

While Unionville reasonably uses the natural-oriented land use pattern to protect the massive original environment and the development mode of ecological agriculture, and protect the ecological environment and diversity (shown in "Fig. 8"). Furthermore, it facilitates harmonious and sustainable development of natural protection area, and achieves the balance between the ecological protection and community development, which improve the ecological benefits, economic benefits and social benefits and bring out the best in each other. Therefore, the key point to the ecological protection is land development method; urbanization extensive construction in the boundary ought to combine the current vegetation, water body condition, field crops and organic correlation of some ecological resources. Retaining the ecological space, protect the species diversity and ecological security as far as possible to realize the combination of regional species and ecological culture, add some recreational facilities properly, recreational facilities and meet the needs of residents at the same time with environmental protection.

#### IV. ANALYSIS OF CULTURAL CHARACTERISTICS IN UNIONVILLE

Unionville is the village with Germany flavor and accepts the residential group from different regions and social classes (according to the Canadian Real Estate Bureau ([www.mls.ca](http://www.mls.ca)), the average family income of the community is 80 thousand to 200 thousand Canadian dollars) and Unionville has highly inclusiveness as well. Meanwhile, the economic development has attracted many foreign visitors to take a holiday, and the advantaged condition of the boundary region, namely most residents shuttling from York Region and Toronto to live, work and study and collect the cultural features from the two places. Besides, there form the special cultural atmosphere due to carrying diverse social economic activities. With the positive social cultural atmosphere, various cultures get mutual promotion and form the diversity and integration of culture. Particularly worth mentioning is, with the increasing population of Chinese citizens, Chinese elementary has been more and more embodied with every level and corner of the society.



### A. Cultural Origin of Unionville

Unionville was built in 1794, groups of Germans chose York Region because of the advantaged natural condition and aimed at avoid the crowded urban area, and they built and lived along Oshawa River. They brought European life style and architectural style [6] and formed the prototype of Unionville which was Main Street Unionville as well, and then formed the center of Main Street with the evolution of nature and become the development pattern of radiating out from the village. Owing to the specialty of boundary location, namely the economic radiation of southern Toronto and the consumption demand by a number of residents of northern York Region, coupled with the local government's protection and updating strategy of ecological environment and historical building, Ministry of Municipal Affairs and Housing transformed the Main Street which with historical and cultural value into the commercial service area where the urban landscape region occupied less than 1 percent of the total village area to improve the environment of neighborhoods and the living quality of residents. Union Kill opened since 1840, which was the first commercial shop established at Main Street in Unionville and its crops exported to the whole nation. In 1849, Unionville established post office; the railway from Toronto to Nipissing opened to Unionville in 1871. Every great event provides opportunity for promoting the development of tourism and economy. Unionville has rich historical accumulation, unique city and town's morphology and the combination of European and American of building style. Nowadays, Unionville is full of historical and cultural flavor, and it is a vibrant community with modern function as well. Early spatial form and architectural style with modern facilities are complemented with each other, and provide the best cultural background for maximizing the boundary effect.

### B. Space Vitality of Unionville

How to take advantage of the border effect and exploit regional advantages within limited commercial space to enhance community energy and improve competitive force of the commercial district is the key challenge in the development of the city and town. When some performance and activities opened on the weekend and holiday, there will be filled with various open-air Street Markets in Unionville, and the artists who is native or coming from far to perform various interactive programs so that it can enhance street vitality an enrich residential life to promote the harmony of neighbors ("9-1" in "Fig. 9": a flying community poster attached to the lamp pole to build street area brand).

The government has set up annual Unionville Heritage Festival, and the artists who performed in the show, the crowd concert, disguised parade, the folk cultural feast and the tasting activity of fresh vegetable and fruits can be seen at the any corner of the block at this time, without a doubt, these has put various, new and cultural vigor for the town. Besides, Unionville designs many interactive programs and games to enhance propaganda of block culture: the professional tourist guide tells the history of the street, village and town, and historical origins and transition of each building for visitors with no charge ("9-4" in "Fig. 9"); the experienced game and the recreation of toy train in the Millhouse ("9-2" in "Fig. 9"), which aim to make residents understand the importance of Millhouse and railway to the regional economic development and prosperous. Furthermore, sightseeing bus imitates the classical train to offer experience of historical block for visitors with no charge. All above is deeply affected by most residents and children's favorite especially. Thousands of travelers come to have a visit at this time, and famous bands make original arrangements for the history and culture for the town and directed and acted by themselves ("9-3" in "Fig. 9").



Fig. 9. A flying community poster attached to the lamp pole to build street area brand.



The effective combination of interesting activity forms and historical culture, and unique street scene corresponds with the architectural features. Unionville attracts native and foreign tourist came to visit in an endless stream and block cultural vitality is increasingly flourishing, which rely on the all-inclusive all-embracing of Unionville.

### C. Model of Cultural Utility at the Boundary of Rural and Urban

There are two significant advantages on prosperous holidays in Unionville. The one is objective factor: the advantage of the juncture of multiple places is distinct and 'border effect' is outstanding. The other one is the human factor: the region makes full use of the geographical advantage. Unionville is located in Markham, which is distinct from the dense commercial atmosphere of downtown in Toronto and differs from industrial and agricultural-based in York Region. While Unionville is continuation of the advantages between Toronto and York Region, and it enhances community's vitality and attraction by mining regional historical values. However, many urban boundaries have been expanded and reclaimed without any limitation and be viewed as insignificant blind zone in China, and nothing left with regional culture and 'border effect' has no way to play an essential role.

There are many boundaries between urban and rural area, and these regions are quite distinct. We have to consider the need of the urbanization development as well as the regional cultural characters of village, particular in the combination of village landscape and historic culture to set different development types and construct independent spatial system with specific qualities and unique function by the publicity of governments and common joint operation of residents. Furthermore, the government ought to lead the boundary between urban and rural to diversified and symbiotic development, avoiding unrealistic competition and all cities in the same key.

## V. CONCLUSION

Due to the expansion of urbanization is intensified in China, the change of land use is frequently on the favorable area of the boundary between urban and rural area, which makes fragmentation and fuzziness of the border area and lose the organic connection between urban and rural. What's more, a quantity of agricultural land and ecological environment has become a part of city space; the space texture and configuration of village have been broken; urban green lung and the spatial function of openness and leisure have been deprived; architectural style and cultural character are getting assimilation; the optimization function boundary area and 'border effect' is hard to exert.

Therefore, the effective land use pattern, ecological protection mode and the cultural inheritance's development strategy of boundary area play an important role in urban holistic development. Meanwhile, favorable 'border effect' can become a complementary of urban life, it can keep the sustainable and updated development, it can alleviate conflicts of unbalanced development of rural and urban and

it can form protected barriers of urban ecological environment. Given the limited length of the paper, this article takes Unionville as the case, and analyzes the strategy of exploitation and utilization of boundary between rural and urban from spatial form, ecological environment and cultural characteristics, and active the 'border effect' from the border area between urban and village and so as to the following deepen study and provide instructional strategy for overall planning of urban and rural area in China.

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