Urban Renewal
at Neighborhood Level

A case study of Huangjiadun neighborhood in Wuhan city

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by

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Abstract

The specific character of urbanization in China made a different kind of neighborhoods have appeared from 1949 to 1978 in Chinese cities, compared with the slums or squatter settlements in other developing countries. Houses in this kind of neighborhoods are not elegant, but usually look decent; most of the children go to school; and there are clinics, community centers and other necessary facilities. However, compared to the living conditions in other neighborhoods in China in the 1980s, many residents of the designated neighborhoods do suffer. In this study, they are called as the "distressed neighborhoods". Although urban renewal in China as a term of urban planning has been formally used in the City Planning Act of 1989, this kind of distressed neighborhoods is still ignored by municipal governments and other organizations till now.

In order to compensate the gap, a research about how to develop a GIS-based methodology for urban renewal in the distressed neighborhoods is done in this thesis. In this methodology, the variables and indices for evaluating physical condition at neighborhood scale are defined firstly. Then, the weights of the physical variables are assigned and the evaluation rule of MCE is selected, in order to evaluate the serious level of physical problems in a neighborhood.

A case of Huangjiadun neighborhood in Wuhan city, as a distressed neighborhood, is applied to show how to use processed GIS map to analyze the physical problems and their serious level in case study area. At the end of this study, conclusions and recommendations about this methodology are described, by evaluating the feasibility and limitations of this methodology.

At the same time, considering urban renewal is not only relevant to physical factor, the legal, social, economic problems in case study area are shortly analyzed, which can be helpful to understand the distressed neighborhoods more thoroughly, and urban renew them more effectively.

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1. Introduction of Research

1.1. Background

Over the past two decades, China has experienced rapid urban growth, with the increase of non-agricultural population in urban areas from 172 million in 1978 to 389 million in 1999, a 126 percent increase(Song, 2002 p.2317). This urban expansion indeed has resulted in some urban problems in Chinese cities, such as growing congestion and chaos in inner city, overcrowded and poorly equipped urban housing, old neighborhoods deterioration without proper maintenance and so on. Therefore, in the early 1980s research on old city redevelopment, especially the redevelopment of old city center, was undertaken by researchers involved in planning and construction (Wang, 1994 p.301).

However, it was in the City Planning Act of 1989 in China that the term of urban renewal appeared formally and was listed as an item of master plan (Yeh, 1999 p.180-181). At the same time, the attitude toward older housing began to change. "Newer, more realistic, and constructive approaches began to evolve, led by the Municipal Housing Administration Bureau, with an emphasis on upgrading and renovation of the existing stock" (McCallum, 1993 p.14). For example, some districts in the center of Shanghai have been urban renewed with a combination of reconstruction, renovation, upgrading and a small part of redevelopment during the period from 1992 to 1993, such as the Jing An District, the Lu Wan District, and the Nan Shi District (McCallum, 1993 p.15-17). However, most of the areas paid attention to by politicians and planners are the typical residential areas in the center of Chinese cities, especially of Chinese metropolises, which were built up before the liberation of 1949, with the population of urban citizens and the land ownership of State.

Contrasted with the neighborhoods mentioned above, the areas focused on in this study are the residential areas built up between 1949 and 1978, beyond the city center and within existing urban boundaries. Some people called these neighborhoods informally as "villages in the city". This is because that these neighborhoods are identified with narrow roads; lower, crowded and poorly equipped houses; combination of large number of low-income citizens and rural immigrants; and unclear land ownership of State or peasant collectives.

Because few researches have been done about them, this kind of neighborhoods has no terminology even now. Moreover, it is not suitable to use some existing terminologies for these neighborhoods too, such as squatter settlements, informal settlements, slums and so on. The reasons are that houses in this kind of neighborhoods are not elegant, but usually look decent; most of the children go to school; and there are clinics, community centers and other necessary facilities. However, compared to the living conditions in other neighborhoods in China in the 1980s, many residents of the designated neighborhoods do suffer. This situation is similar to the residential neighborhoods in Israel that Carmon and Hill focused on when evaluating the Project renewal from 1977 to 1984. They mentioned

these neighborhoods as "distressed neighborhoods" in their article (Carmon, 1988 p.470). Therefore this kind of Chinese neighborhoods tend to be called as the "distressed neighborhoods" in this study.

The goal of this study is to develop a methodology for the urban renewal in these distressed neighborhoods.

1.2.　　Research problem

Although the general condition of these distressed neighborhoods is not so bad as that of slums in some other developing countries, still many problems exist in these areas. Generally speaking, most of these problems come from social, economic, physical, and legal aspects. From the social point of view, the problems are dense population, indifference to physical environment, crime, and increase of immigrants combined with low-income citizens etc. From the economic point of view, the problems include poverty and lack of finance assistance to support maintenance. From the legal view of point, the problems are unclear land ownership, little attention from governments and ineffective plans and so on. From the physical point of view, the problems tend to be narrow roads, crowded houses, lack of infrastructure, and poor environment etc.

Although the goal of urban renewal in neighborhood scale tends to be improvement of inhabitants' living condition in all these aspects, the emphasis in this study is to develop a methodology helpful for planners and governors to analyze the physical problems in the distressed neighborhoods.

At the same time, the short analyses about the social, economic, and legal problems of the distressed neighborhoods in this study can be helpful to understand this kind of neighborhoods more thoroughly, and urban renew them more effectively.

1.3. Objectives and research questions

- Main objective

To develop a GIS-based methodology for urban renewal in the distressed neighborhoods in Chinese cities by means of a case study of a distressed neighborhood in Wuhan.

- Sub-objectives and research questions

Table 1.1   Sub-objectives and Research problems

Sub-objectives	Research Questions
• To review the definitions, historical development, factors and variables, and techniques about urban renewal	•What are the definitions, historical development, factors and variables, and techniques about urban renewal?
• To develop a GIS-based methodology for analyzing physical problems in the distressed neighborhoods	•What types of GIS analyses are suitable for analyzing physical problems? •What are the variables relevant to physical condition? •What are the logical criteria for the analyses? •How to analyze physical problems?
• To apply this methodology to the case study area and to get the analyses about physical problems	•How to use GIS technique to process the data about case study area? •What are the results of analyses?
• To analyze social, economic, and legal problems in case study area	•What are the problems about social, economic, and legal aspects in case study area?
• To get conclusions and recommendations about this methodology.	•What conclusions can be got after applying this methodology to case study area? •How to improve the methodology?

1.4. Research structrure

In order to reach the objectives of this thesis, the following research steps are defined:

Step I: Literature review and build theoretical background about urban renewal. There are four literature contents relevant to urban renewal, which are definition of urban renewal, historical development of urban renewal, factors about urban renewal and variables in physical aspect, and techniques relevant to urban renewal.

Step II: Design GIS-based methodology for analyzing physical problems.

Step III: Apply the methodology to the case study area and process the collected data.

Step IV: Evaluate the processed data, maps and figures to get the detailed analysis about physical problems. Moreover, analyze the legal, social and economic problems in the case study area shortly.

Step V: Get conclusions and recommendations about this methodology by evaluating its feasibility and limitation.
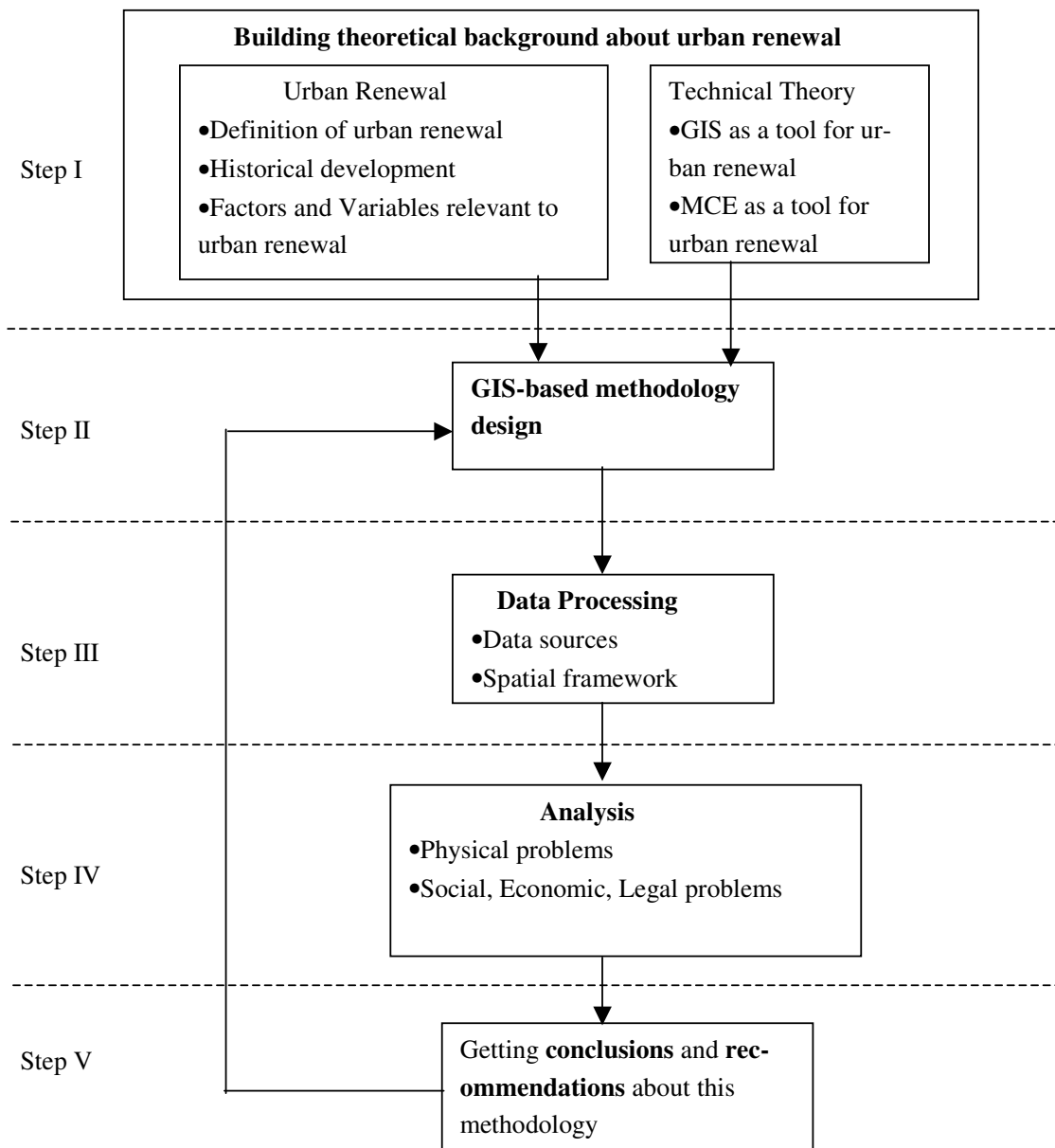
Figure 1.1   Flowchart of research structure

1.5.　　　Structure of thesis

Chapter 1. This chapter deals with an introduction of the research problem, research objectives, research questions, and research structure.

Chapter 2. This chapter builds the theoretical background of urban renewal, such as the definition of urban renewal, historical development of urban renewal, factors about urban renewal and variables in physical aspect, and techniques relevant to urban renewal. All these are helpful to frame how to develop a GIS-based methodology for urban renewal at neighborhood scale.

Chapter 3. This chapter deals with the development of the GIS-based methodology for analyzing physical problems in the distressed neighborhoods.

Chapter 4. This chapter deals with applying the GIS-based methodology to case study area and getting the analysis about physical problems, which is the emphasis in this study; then shortly analyzing the legal, social and economic problems in the case study area, since urban renewal is a broad subject not only relevant to physical factor.

Chapter 5. This chapter presents the conclusions and recommendations about the GIS-based methodology, by evaluating its feasibility and limitations.

2. Theoretical background about Urban Renewal

2.1. Introduction

In this chapter, there are four parts around the keyword of this study, urban renewal. The first part is the definition of urban renewal, used to explain what is urban renewal. The second part is about historical development of urban renewal, which is used to explain why urban renewal appeared. The third part is about factors and variables relevant to urban renewal and the final part is about techniques relevant to urban renewal, which is used to frame how to develop a GIS-based methodology for urban renewal.

2.2. Definition of urban renewal

Urban renewal as a term of urban planning is American in origin. An Advisory Committee founded by Eisenhower used it for first time in 1954. Studies were undertaken to analyze the older parts of the American cities with problems of urban decay. As Buissink (1985) has said, "the recommendation of this committee was incorporated in the Housing Act of 1954. This Act and the one previous to it in 1949, are generally considered the foundation stones of urban renewal policies" (Buissink, 1985 p.14).

Urban renewal is a broad subject because it encompasses different aspects of intervention namely physical, social, economic, politic, culture, health, and environmental to redress a complex of urban problems including unsanitary, deficient, or obsolete housing, inadequate transportation, sanitation and other services and facilities; haphazard land use; traffic congestion and others (Britannica, 1994 p.201).

Just because of the complexity of issues involved in the process, it is impossible to find an absolute satisfactory definition of urban renewal. The definition of urban renewal varies from different countries and also from different time. As Buissink (1985) has said, urban renewal "…is a term that means different things to different people, especially if these different people are from different countries" (Buissink, 1985 p.42). At the same time, it has changed in different time, which can be proved by the following definitions. Generally speaking, there are three kinds of definitions about urban renewal, from the viewpoint of the scope involved in.

The first one is a classic or narrow concept of urban renewal belonging to the field of physical planning and housing policy. For example, Buissink (1985) had defined it as "… the complex of building activities aimed at restoring the decayed and obsolete physical urban elements and thereby making them functionally sound again according to the standards of the time" (Buissink, 1985 p.56).

At the same time, a common and specific definition of urban renewal from the physical point of view, has been given in **Table 2.1** by Buissink (1985).

Table 2.1   Urban renewal Matrix

Project Designation	Range of activities	Purpose	Physical environment	Included in the concept
Maintenance	Painting, Repairs; Replacement of decay parts	Up-keep, Safeguarding the function value	Not affected	No
Improvement	Adding new elements: balcony, attic, central heating, shower; Bring existing elements up-to-date	Modernization, Adjusting the building in accordance with a new set of values	Not affected	No
Restoration	Abolishing the shortcomings; Replacing old and adding new elements	Modernization, Adjusting the buildings to meet modern standards	Not affected	Yes
Rehabilitation (upgrading)	Largely as under "restoration"	As under "restoration"	Not affected	Yes
Reconstruction	Improving and Adjusting the internal structure while retaining the external appearance	Making the building suitable for new uses	Minor adjustments following from the changes in use	Yes
Total renewal (Redevelopment)	Partial or total demolition of the buildings in an (limited) area followed by new construction	Making run-down and decayed areas again suitable for use	Reconstructed according to plan	Yes

Source: (Buissink, 1985 p.45)

In this case, urban renewal includes restoration, rehabilitation (upgrading), reconstruction, and redevelopment four kinds of activities.

However, in the modern times, more and more people have realized that urban renewal does not just encompass the physical aspect, but also relates to social and economic aspects as well. In 1990, another concept defined urban renewal as a dynamic process of physical change (redevelopment, rehabilitation), change in use (shift from one use to another more profitable), or intensity of use of the land and building, as the effect of the interaction of economic and social forces upon the urban areas (Couch, 1990 p.1) (Arteaga, 2000 p.10). It is a relative wider concept than the previous one, with a social-economic point of view, where the intervention in the decayed urban areas does not stress only the physical aspect.

The final one is the broadest and newest one among these three kinds of definitions. It is defined as "a systematic effort in the field of planning and building as well as of the social, economic, cultural, and environmental standards of living, in order to preserve, repair, improve, restructure, or clear

built-up areas within municipalities" (Metselaar, 1992 p.5). In this case, urban renewal does not only encompass the classic fields like physical planning, housing policy and building activities. It depicts an integral background with a multi-disciplinary participation, in order to have a good built-up environment, including small villages in the countryside (Arteaga, 2000 p.10).

2.3.   Historical development of urban renewal

Although, some urban problems caused by sub-urbanization and urban expansion are similar between developed countries and developing countries, the processes of the historical development of urban renewal, especially the appearance of urban renewal are far different in these two kinds of countries.

In this section, the historical developments of urban renewal in developed countries and developing countries will be described through comparing the difference between them, and then the development of urban renewal in China will be focused on.

2.3.1.   Different historical development of urban renewal between developed and developing countries

Generally speaking, developed countries have a relatively earlier start of urbanization than developing countries, i.e. England in the last century since the Industrial Revolution, United States after the Depression of the 1930s (Eisner, 1993 p.496), while most Third World nations have been urbanising rapidly since 1950 (McAuslan, 1985 p.127).

Just the urbanization resulted in the problems of slums appearance, inner city deterioration, and land dereliction and so on in the developed countries. These problems do not go on only in the residential areas, but have overflowed this scope and include all kinds of buildings like commercial, industrial, etc. The situation is described by Eisner, S. et al. (1993)as follows:

"…Lack of planning, poor subdivision practices, excessive land values, ineffectual zoning, archaic streets, and inadequate transportation have created a condition of congestion, unplanned and incompatible mixed land use, and economic distortion that render whole section of the city in a process of built-in physical decay and social disintegration…" (Eisner, 1993 p.494)

Moreover, the similar problems caused by urbanization in developing countries are described by Yaakup and Healey (1994) as "high rates of population growth (produced by natural increase and migration), continued rural-urban migration…poverty and inequality, slums, squatting, deficiencies in basic infrastructure and transport, pollution, and the growing inability of government agencies to administer and finance development" (Yaakup, 1994 p.21).

Initially, developed countries focused on slums clearance and redevelopment. However, with the gradual improvement of neighborhoods in these years, the emphasis has been moved from redevelopment to rehabilitation or upgrading. By now, the redevelopment almost has been discarded as a way to

revitalize the old city areas in developed countries. Just as Eisner, S. et al. (1993) have said, after the 1960 Housing Act in America, "concern about the displacement of families from renewal areas and the destruction of socially viable communities led to a new emphasis on rehabilitation rather than wholesale clearance…Redevelopment programs were almost completely modified to favor the development of commercial structures. Only a minor effort was directed toward the construction of housing, which was the original intent of the redevelopment legislation passed in 1949" (Eisner, 1993 p.502).

Following with the developed countries, urban renewal, as a response to urban decay and a strategy to solve slums problem, has been paid attention to in the developing countries too.

However, if urban renewal in these two kinds of countries is studied more, the different process of urban decay between them, which is the direct cause of urban renewal, can be found as following.

In developed countries, urbanization was caused by the Industrial Revolution that made many industrial areas located in the city center and provided large quantity of employment to the immigrants. Then the urban expansion resulted in high land value in city center, which made many industrial activities have moved outside of inner areas to cheaper land. At the same time, poor environment and less attraction in inner city caused by urban expansion led many high and middle-income people have leaved for the suburbs of city, and then some commercial activities have shifted to the best locate areas together with high and middle-income people following. All these contributed the land dereliction in city center and the slums appearance. Finally, urban renewal appeared in order to solve the problems. The detailed process of urban decay in developed countries is showed in **Figure 2.1**

```
┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│ The Industrial Revo-│─────▶│ Suburb urbanization │─────▶│ As the city ex-     │
│ lution began in     │      │ and urban expansion │      │ pands, the land     │
│ cities              │      │ appeared            │      │ value in the inner  │
│                     │      │                     │      │ areas rose rapidly  │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
                                        │                            │
                                        ▼                            ▼
┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│ Pollution, conges-  │      │ As the city expands,│      │ Some industrial     │
│ tion and decay rein-│◀─────│ the area becomes    │      │ activities moved    │
│ force the process-  │      │ less attractive to  │      │ outside of inner    │
│ area becomes less   │      │ affluent families   │      │ areas to cheaper    │
│ attractive. Com-    │      │ who move to subur-  │      │ land                │
│ merce begin move to │      │ ban location        │      │                     │
│ sub-center.         │      │                     │      │                     │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
          │                            │                            │
          ▼                            │                            ▼
┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│ Rent control imposed│      │ Low-income jobs re- │      │ Large quantities of │
│ by government to pro-│─────▶│ main in central area;│◀────│ urban land and      │
│ tect tenants. Owner │      │ poor families seek ac-│      │ buildings are       │
│ of building cannot  │      │ commodation in older │      │ abandoned and       │
│ afford to carry out │      │ buildings; densities │      │ left dereliction    │
│ repairs.            │      │ increase.           │      │                     │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
          │                                                         │
          ▼                                                         ▼
┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│ Lack of maintenance │      │ Property becomes dan-│      │ Site is redeveloped if│
│ causes further dete-│─────▶│ gerous and uninhabit-│─────▶│ market value is high, or│
│ rioration. Population│      │ able or it may collapse│      │ is allowed to be vacant│
│ growth & house      │      │ while still occupied.│      │ possibly inviting squat-│
│ shortage create     │      │                     │      │ ters.               │
│ overcrowding.       │      │                     │      │                     │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
                                                                    │
                                                                    ▼
                                                         ┌─────────────────────┐
                                                         │ Urban renewal       │
                                                         │ appeared            │
                                                         └─────────────────────┘
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Figure 2.1   **Process of Urban Decay in developed countries**

Source: Adapted from (Huang, 1993 p.18, quoted from Habitat News, 1986)

However, in developing countries, urban growth was not caused by such obvious industry development and the cities could not absorb or provide enough employment to the immigrants, which led to more problems on economic and social aspects. At the same time, the problem of land dereliction is not as common in developing countries as in developed ones. McAuslan (1985) has talked about three kinds of squatter appearances in the Third World, which are private urbanization[1], squatter invasions[2]

─────────────────────

[1] A process of illegal subdivision and sale of land by developers in some developing countries, such as Bogota, Colombia,

and squatter infiltration[3] (McAuslan, 1985 p.51-58). None of them resulted from land dereliction as those of developed countries did. Finally, urban renewal in developing countries appeared for solving the urban problems, specially the problem of squatter settlements appearance. The detailed process of urban decay in developing countries is showed in **Figure 2.2**
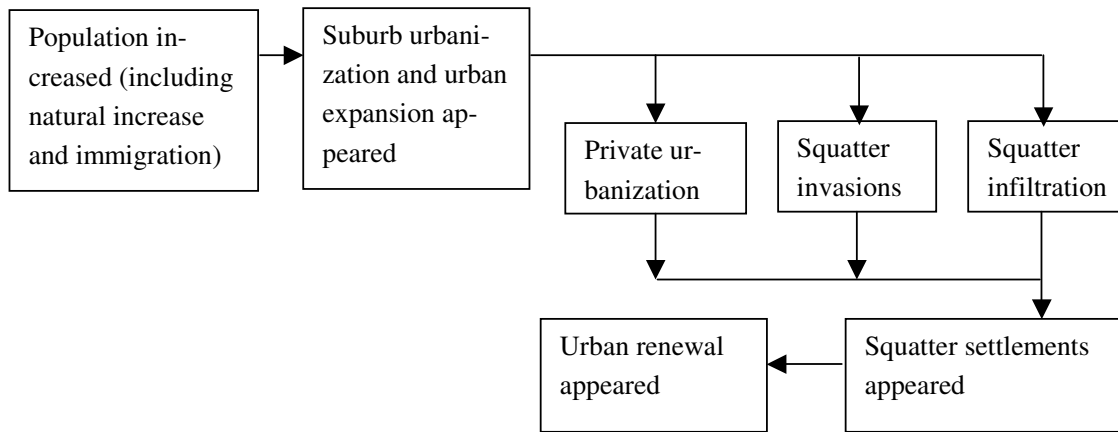
Figure 2.2   Process of Urban Decay in developing countries
Source: Concluded from (McAuslan, 1985 P.51-58)

2.3.2.   Urban renewal in China

The appearance of urban renewal in China is relatively later. In the early 1980s, the research topic on old city redevelopment mainly concerned the protection of historical and cultural relic cities. Comprehensive research on the issue did not begin until the latter half of the 1980s when the proportion of studies on old city redevelopment to urban construction gradually increased. The main topics were measures and implementation methods for specific redevelopment projects, such as sources of funds, ways to realize reproduction, the readjustment of old city land use planning, determination of cost structure and prices, resettlement of old residents, and the supply of land for housing (Wang, 1994 p.301).

It was in the City Planning Act of 1989 that urban renewal as a term of urban planning was first used formally in official document of China (Yeh, 1999 p.180-181). Then, as McCallum has said, the attitude toward urban renewal in neighborhood scale has changed from the initial total redevelopment with to the later combination of selective redevelopment with systematic rehabilitation and upgrading of the older housing (McCallum, 1993 p.14).

However, when focusing on the cause of urban renewal appearance in China, urbanization, some different characters can be found, compared with other developing countries. As a member of the developing countries, China has an apparently similar process of urbanization as the others. Nevertheless, as Leaf has said, "If we accept the stereotypical view of the Third World city as being beset by sharp socio-economic cleavages, spatial segregation by income class and a large component of the

which leads to illegal housing built by purchasers without legal formalities.
[2] An organized land-invasion widely used by the poor in Lima, Peru to get land for housing.
[3] A slow-and-almost-individual spillage onto land, which is common throughout the developing countries.

population resident in poorly served slum or squatter settlements, the Chinese city appears as a clear exception. Despite the low space and quality standards of the average Chinese urban household, the spatial disparities and the degree of 'informalization' which are found in cities with market economies have until recently been largely absent" (Leaf, 1995 p.149).

The **Table 2.2** of a periodization of urban housing production in China illustrated by Leaf (1995) has showed the special process of Chinese urbanization, and from it, it can be found how the distressed neighborhoods[4] appeared in Chinese cities. There are two important periods about emergence of the distressed neighborhoods in this study. First is the Phase II when rapid urban growth made new residential compounds at edge of city or as infill. Many of the compounds are private houses with land occupied by the private. With the lapse of time, the areas at the edge of city in Phase II have evolved to a relative central part of city, some of which are even nearby to the city center now. Moreover, during the Phase III, the private houses in the above areas were expended in informal self-help processes. Therefore, the distressed neighborhoods appeared.

Table 2.2   A periodization of urban housing production in China

Period	Characteristics of urbanization	Characteristics of urban housing
Phase I: pre-1949	•Wide local variation •Dense urban cores	•Diversity of locally adapted house types •Low-rise (1-2 storeys)
Phase II: 1949-1958/61	•Rapid urban growth •Post-war reconstruction •Expropriation of private property	•State sector production •4-5 storey apartment blocks •Soviet modernist planning •New residential compounds at edge of city or as infill
Phase III: 1961-1977/78	•Restricted urbanization (due to 'hukou[5]' system) •Major drop in state financing for housing •Planning emphasis on 'producer' cities	•Little large-scale development •Further crowding •Internal division of existing units •Reliance on informal, self-help processes for expansion of existing housing
Phase IV: 1978-present	•Opening of cities •Planning for influx of private capital •Satellite towns to absorb new population	•Outer ring of high-rise housing blocks •Greater separation of land uses and increasing commuting times
Phase V: 1988-	•Redevelopment of inner cities	•Accelerated displacement of inner

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[4] This term was mentioned by Carmon and Hill (1988). In my study, the distressed neighborhoods tends to mean the kind of neighborhoods, in which the houses are not elegant, but usually look decent; most of the children go to school; and there are clinics, community centers and other necessary facilities. However, compared to the living conditions in other neighborhoods in China in the 1980s, many residents of the designated neighborhoods do suffer.

[5] China's *hukou* means a kind of residency license in China. (Household or residential registration) system has been used as a means of social control, especially in regulating domestic migration. It has survived two decades of rapid economic growth and market-oriented institutional and cultural changes, playing a critical role in maintaining sociopolitical stability. Under the *hukou* system, Chinese citizens are divided into urban and rural residents. All leaders and cadres, college graduates, and military officers (active duty or retired) are urban *hukou* holders.

1989-present	•Continued growth of outer ring and satellite towns	city populations
		•Growing spatial segregation by 'danwei[6]' income level

Source: (Leaf, 1995 p.150)

As mentioned before, urban renewal in China has evolved from redevelopment to the combination of redevelopment with systematic rehabilitation and upgrading. At the same time, many researches and projects on urban renewal have been done in some big Chinese cities, such as Beijing (Lu, 1993), Shanghai (McCallum, 1993) and so on.

However, these researches and projects mainly focus on the residential areas in city center, while still few measures have been taken to this kind of distressed neighborhoods. This is the reason why the kind of distressed neighborhoods are focused on in this study, considering that they have relatively more problems, compared with the old neighborhoods in city center, such as poor living condition, the combination of large number of low-income citizens and rural immigrants, unclear land ownership of State or peasant collectives and so on.

2.4. Factors and variables relevant to urban renewal at neighborhood scale

In this section, others' definitions about factors relevant to urban renewal will be introduced firstly, in order to get the definition of them in this study, and then the selection of variables about physical factor will be focused on, since the physical condition is an emphasis in this study.

2.4.1. Definition of factors relevant to urban renewal at neighborhood scale

Through the literature review, it can be found that the physical, social, and economic factors have been paid more attention to. For example, when discussing about the data for upgrading informal settlements, Abbott and Douglas have said: "The integration of the shack data with the physical data for the site, and the social and economic data pertaining to the community members enables a detailed analysis of needs to be carried out" (Abbott, 2001 p.iii). That means the physical, social and economic factors were thought as emphases in their case.

Moreover, other researchers mentioned the legal factor in article about urban renewal projects. For an instance, the Legislative Edict 696 and the normative Supreme Edict 11-95 in Peru have done a list of variables grouped into four classes, for treatment area defining, which are technique variables, social variables, economic variables, and legal variables (Arteaga, 2000 p.32).

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[6] A kind of work unit in China, which includes firms, factories, companies, offices, and so on. The "danwei" is an arm of state administration insofar as it is charged with providing education about and enforcement of various government policies, particularly the implementation of family planning regulations by monitoring fertility, distributing birth control, issuing birth quotas, disbursing single-child bonuses, and so on.

Still some people defined more than these four factors about urban renewal that includes neighborhood renewal. For example, when giving explanation about what is urban renewal, Britannica has mentioned physical, economic, politic, culture, health, and environmental aspects (Britannica, 1994 p.201).

All above show that different people have different definitions, because of their different intentions. According to these different definitions of factors relevant to urban renewal, the factors in this study are selected and shown in **Table 2.3**.

Table 2.3   Selection of factors relevant to urban renewal

People Number	Abbott (2001)	Arteaga (2000)	Britannica (1994)	The Factors selected in this study
1	Physical	Technique	Physical	Physical
2	Social	Social	Culture	Social
3	Economic	Economic	Economic	Economic
4		Legal	Politic	Legal
5			Health	
6			Environmental	

In order to make the meaning of these factors in this study clearer, the definitions of them are given as follows:

•**Physical factor**: It includes land use, public and commercial service, road, building, infrastructure, and environment six aspects. Problems on physical situation will prevent community development seriously.

•**Social factor**: This factor includes social-economic status, view and attitude of people. The social-economic status means salary, property, position, educational background and so on. The view and attitude of people in this research tends to indicate the willingness of people's living in this neighborhood and the willingness of people's caring about physical situation of the neighborhood.

•**Economic factor**: In this study, this factor tends to be the finance assistance from governments or other organizations. Analyzing this factor is first to find the source of finance assistance and then to find what these assistances contribute to. This factor will be helpful for finding why this neighborhood is in poor maintenance.

•**Legal factor**: In this study, this factor focuses on land policy in China, which is greatly relevant to the problem of unclear land ownership in the distressed neighborhoods. Analyzing the factor will assist us in finding the historical reason of this problem.

2.4.2.　　　Selection of variables relevant to physical condition

As mentioned above, four factors relevant to urban renewal have been selected in this study, which are physical, social, economic and legal factors. All these factors will be analyzed in the later chapters, in order to study the distressed neighborhoods broadly. However, the goal of this thesis is to develop a methodology helpful for planners or governors to analyze the physical problems in this kind of distressed neighborhoods as mentioned in chapter 1, the selection of variables about physical condition is quite important and will affect the methodology directly.

Some people have given their selection. For example, Yaakup and Healey (1994) have given a table about data requirements for the squatter geographic information system. They have listed a series of required data in a table, according to the different potential use (Yaakup, 1994 p.24). Different data are focused on at different scale of the potential use. In the table, the scale of squatter upgrading emphasizes on the data about road, utilities and buildings. Since the scale of urban renewal in distressed neighborhoods is similar to that of the squatter upgrading listed in the table, it can be referred in this study.

Moreover, the Policy Action Team 18 in London mentioned nine kinds of data in its neighborhood information checklist, which are access to service, social environment, crime, economic deprivation, education /skills /training, health, housing, physical environment, and work deprivation (PAT18, 2000 p.42-58). However, only three of them belong to physical factor, which are access to service, housing, and physical environment (including land use).

After evaluating the two different selections, the variables relevant to physical factor are selected in this study showed in **Table 2.4**, which are land use, public and commercial service, building, road, infrastructure, and environment.

Table 2.4　　Selection of variables relevant to physical factor

People Number	Yaakup and Healey (1994)	Policy Action Team 18 (PAT18 2000)	The Variables selected in this study
1		Land use	Land use
2		Service	Public and commercial Service
3	Building	Housing	Building
4	Road network		Road
5	Utilities		Infrastructure
6		Physical environment	Environment

2.5.　　　Techniques relevant to urban renewal at neighborhood scale

Two important techniques are involved in this study, GIS and MCE (multi-criteria evaluation). However, The reasons why these two techniques are selected and why they have different use in this study are decided by their different advantages and features.

2.5.1.   Potential of GIS in urban renewal analysis

GIS technique is important in this study, as a tool of data management, data analysis and visualization helpful in decision-making process.

• **Data management**: In this study, there are several different kinds of data, such as digital map, spatial data, and attribute data and so on. As Yan (1995) has said, "All spatial /attribute data, subjective /objective assessments, past /current /future data can be stored, retrieved and displayed in a GIS" (Yan, 1995 p.11). According to this function, GIS is suitable for this study.

• **Data analysis**: The emphasis of this study is to develop a methodology for analyzing the physical problems in the distressed neighborhoods, and most of the data about physical condition are spatial data. As Pettit (1999) has said, the GIS environment provides many of the required operators about the collection, manipulation, and analysis of spatial data, in order for planners to generate and evaluate development options (Pettit, 1999 p.342). Thus, GIS as a tool of data analysis is still suitable for this study.

• **Visualization helpful for decision-making process**: Why a GIS-based methodology for urban renewal at neighborhood scale tends to be developed in this study is that this methodology can be used or improved by other planners or politicians when they carry out urban renewal in neighborhoods. As Ghose (2001) has said, "Ease of visualizing and analyzing neighborhood-based spatial data makes GIS especially useful to neighborhood planner, citizen, and professional alike. With this technology, both planning agencies and community organizations can play an increasing significant role in implementing neighborhood revitalization programs and in assessing neighborhood markets and needs" (Ghose, 2001 p.142)

2.5.2.   Potential of MCE in urban renewal analysis

In this study, six variables have been selected in Section 2.4.2, which are land use, public and commercial service, building, road, infrastructure, and environment. However, not all of them have the same weighting of importance to the case study area. Thus, MCE is selected to evaluate to the different variables relevant to the physical factor in this study. As Pettit (1999) has said, "Important features of MCE are its relative simplicity (as compared with the other decision support methodologies) and its ability to handle the discrete decision situations where the choice-possibilities are measurable and the data have a quantitative and /or a qualitative character. Quantitative values related to the weighting of importance to data, whilst the qualitative character of the data can be described in terms of environmental, social and economic importance" (Pettit, 1999 p.349)

In this study, the serious level of physical problems will be analyzed by using MCE, from the viewpoint of six variables (land use, public and commercial service, building, road, infrastructure, and environment). Then, agglomerating these variables with individual weightings of importance together, the serious level of the total physical problems can be found, which can help us to decide a renewal order.

2.5.3.   Combination of GIS and MCE techniques in urban renewal

In this study, analyses of physical problems are used to answer three questions that are what are the physical problems, where are the physical problems, and how serious are the physical problems. Generally speaking, using GIS in this study tends to answer the first two questions, and using MCE tends to answer the final one.

As what have mentioned before, GIS has relatively more powerful functions of data management and analysis, especially for spatial data, compared with other planning techniques. Moreover, ease of visualizing and analyzing neighborhood-based spatial data makes it especially useful for urban planning at neighborhood scale. Therefore, the GIS technique is used to collect, manipulate and analyze spatial data in this study, in order to get the analysis of physical problems from different aspects respectively.

At the same time, because of the relatively more powerful evaluation function of MCE, especially when variables are more than one, it is selected to analyze the serious level of physical problems in this study.

As Sharifi and Herwijnen have said, "GIS and MCE are both tools that can support the decision maker in achieving greater effectiveness and efficiency in the spatial decision-making process. GIS and MCE together can support the decision maker in all three phases of a spatial decision-making process, from intelligence, design and decision /choice" (Sharifi, 2003).

What should be mentioned that although the GIS and MCE two techniques are both involved in this study, the emphasis is to develop a GIS-based methodology. This is because the GIS technique is used as an environment throughout the whole process of the methodology for analyzing physical problems in the case study area, while the MCE is only used together with GIS for analyzing the serious level of physical problems.

2.6.   Conclusion

This chapter builds the theoretical background about urban renewal at neighborhood scale.

From others' definitions of urban renewal, it can be found that urban renewal is a broad subject, which not only compasses physical aspect, but also relates to social, economic, legal aspects and so on. At the other side, from the physical point of view, urban renewal includes restoration, rehabilitation (upgrading), reconstruction, and redevelopment four kinds of activities.

From the literature review about historical development of urban renewal, the different characters of urban renewal between developed developing countries can be got. Focusing on China, it can be found that the degrees of spatial disparities and 'informalization' are far lower than those in other developing countries, and a different kind of distressed neighborhoods appeared in Chinese cities in the period from 1949 to 1978, compared with the slums in other developing countries. A problem

about urban renewal in China is that most researches and projects mainly focus on the residential areas in city center, while the distressed neighborhoods are ignored seriously, which shows the importance of this study on certain degree.

From others' definitions about factors relevant to urban renewal and physical variables, four factors (physical, social, economic and legal factors), and six variables (land use, public and commercial service, road, building, infrastructure and environment) are selected in this study, which will be used to frame the methodology for urban renewal in the distressed neighborhoods in next chapter.

Finally, GIS and MCE techniques are selected in this study, which can help to frame the GIS-based methodology and to apply this methodology to case study area later.

3. Methodology for analyzing physical problems

3.1. Introduction

This chapter deals with the development of the methodology for analyzing physical problems in the distressed neighborhoods. In this chapter, the methodology and indicators of different variables will be discussed in detail, which will be applied for the case study area later.

3.2. Methodology for analyzing physical problems

The methodology for analyzing physical problems is divided into two parts in this study. One is to analyze general physical problems on the scale of a whole neighborhood, which can help people get a general impression of physical problems in a neighborhood. The other is to analyze detailed physical problems on the scale of sub-areas, which is finally used to help planners or politicians to evaluate which region is relatively more urgent to renew, and which region is in better condition. The process of methodology showed in **Figure 3.1** can be described as following:

Stage I: To define the variables relevant to physical factor selected in section 2.4.2, which are land use, public and commercial service, building, road, infrastructure, and environment; and to collect the needed data about each variable.

Stage II: To define the indices of the variables.

There are two important parts on this stage. One is to define indices for analyzing general physical problems on the scale of a whole neighborhood. The other one is to define indices for analyzing detailed physical problems on the scale of sub-areas.

At the same time, to process the data collected on Stage I by using GIS technique, and to compare the results with the defined indices.

On this stage, the description of general physical problems on the scale of a whole neighborhood can be got, by comparing the processed data with the indices for analyzing general physical problems. However, with regard to the analyses of detailed physical problems, only the general condition on the scale of a whole neighborhood but not sub-areas can be got.

Stage III: To divide the whole neighborhood into different sub-areas.

On this stage, the data for analyzing detailed physical problems can be processed and the description of detailed physical problems on the scale of sub-areas can be got.

Stage IV: To assign the weights of variables, according to the statistics of Questionnaires (see Appendix I).

On this stage, the serious level of physical problems in different sub-areas can be got, by using MCE (multi-criteria evaluation) technique.
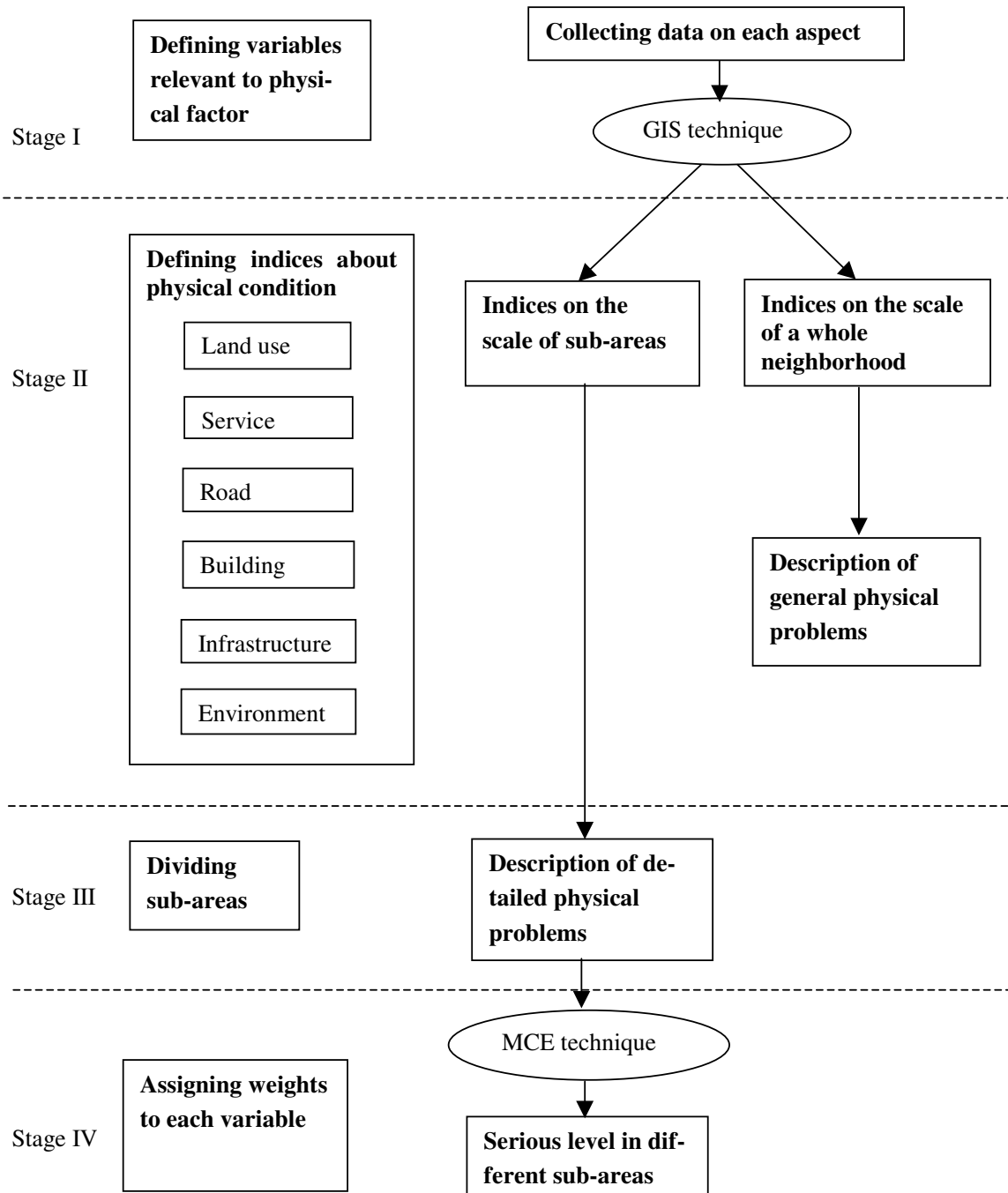
Figure 3.1   Flowchart of Methodology

3.3.   Defining variables relevant to physical factor

Analyzing the physical factor in the distressed neighborhoods is to improve the physical condition from lower level to relative higher level. However, as an abstract concept, it is difficult to explain what is a high-level physical condition. After the selection of variables relevant to physical factor in Section 2.4.2, the criteria for evaluating physical condition level can be got from these aspects, which are reasonableness of land use, convenience of public and commercial service, accessibility of road, quality of building, sufficiency of infrastructure and comfort of environment (see **Table 3.1**). At the same time, the sub-variables of each criterion are also given in this table, which will be described more detailedly in section 3.4.

Table 3.1   Criteria for evaluating physical condition

Major Variables	Sub-variables	Criteria
• Land use	Land use proportion	Reasonableness
	Open area ratio	
	Floor area ratio	
• Public and commercial service	Service kinds	Convenience
	Needed area	
	Service radius	
• Road	Access ratio of fire engines	Accessibility
	Pavement ratio	
	Drainage system ratio	
• Building	Building condition	Quality
	Building age	
• Infrastructure	Sanitation ratio	Sufficiency
	Water pipe ratio	
	Electric net ratio	
	Telephone network ratio	
• Environment	Noise	Comfort
	Pollution zone	
	Safe place	
	Good sights	

•**Land use**: This variable includes Land use rate, Open area ratio, and Floor area ratio. A reasonable land use should have a suitable area proportion, enough open area ratio, and low floor area ratio.

•**Public and commercial service**: This variable includes amount of kinds, needed area of every kind service, and service radius. Convenient service means that inhabitants can get every kind of service relevant to their living easily.

•**Road**: This variable includes access ratio of fire engines, pavement ratio, and drainage system ratio. Accessibility means that people, cars or fire engines can go to every place of the neighborhood conveniently.

●**Building**: This variable includes building condition and building age. In order to get the total level of building quality in a neighborhood, it can be analyzed in what condition the majority of buildings are and what age the majority have. Generally speaking, good quality means good condition and young age.

●**Infrastructure**: This variable includes sanitation ratio, water pipe ratio, electric net ratio and telephone network ratio. Sufficient infrastructure means owning all kinds infrastructures a neighborhood needs, and serving all the area in a neighborhood.

●**Environment**: This variable includes Noise, Pollution zone, Safe place, and Good sights four sub-variables. A comfortable environment means away from noise and pollution zone, located in safe place, and having good sights.

3.4.　　　 Defining indices of variables

　　According to the criteria and variables to evaluate physical condition defined in section 3.3, the indices of the variables will be given in this section.

　　As mentioned before, there are two important parts of indices in this section. One part is the indices for analyzing general problems, which tends to get the general impression and description of physical problems on the scale of a whole neighborhood.

　　The other part is the indices for analyzing detailed problems with scores attached to them, which tens to get detailed description and serious level of physical problems on the scale of sub-areas.

　　In accordance with the scale of area they focus on, the two kinds of indices have different characters showed in **Table 3.2**.

Table 3.2　　Characters of indices for evaluating physical condition

	Index	Scale	Nature of index	Index source
I	**Land use index**			
01	Land use proportion	Neighborhood scale	Ratio	*Norm of neighborhood design*
02	Open area Ratio	Sub-area scale	Ratio	According to specific condition
03	Floor area Ratio	Sub-area scale	Ratio	Regulations in Wuhan
II	**Public and commercial service index**			
04	Service kinds	Neighborhood scale	Ordinal	*Norm of neighborhood design*
05	Needed area	Neighborhood scale	Interval	*Norm of neighborhood design*
06	Service radius	Sub-area scale	Interval	*Norm of neighborhood design*
III	**Road index**			
07	Access ratio of fire engine	Sub-area scale	Ratio	According to specific condition
08	Pavement Ratio	Sub-area scale	Ratio	According to specific condition

09	Drainage Ratio	Sub-area scale	Ratio	According to specific condition
IV	**Building index**			
10	Building condition	Sub-area scale	Nominal	According to specific condition
11	Building age	Sub-area scale	Interval	According to specific condition
V	**Infrastructure index**			
12	Sanitation ratio	Sub-area scale	Nominal	According to specific condition
13	Water pipe ratio	Sub-area scale	Nominal	*Wuhan Statistical Yearbook 2001*
14	Electric net ratio	Sub-area scale	Nominal	*Wuhan Statistical Yearbook 2001*
15	Telephone network ratio	Sub-area scale	Nominal	According to specific condition
VI	**Environment index**			
16	Noise	Sub-area scale	Nominal	Regulations in Wuhan
17	Pollution zone	Sub-area scale	Nominal	Regulations in Wuhan
18	Safe place	Sub-area scale	Nominal	Regulations in Wuhan
19	Good sights	Sub-area scale	Nominal	Regulations in Wuhan

In this table, it can be found that there are four different index sources. One is the *Norm of neighborhood design* in China, which can be used for all kinds of neighborhoods in China. Another two are the regulations about neighborhood design in Wuhan and the *Wuhan Statistical Yearbook 2001*, which can be used for neighborhoods in Wuhan or some similar cities.

However, still some indices have not been regulated in Norms or regulations, and cannot be got from the *Wuhan Statistical Yearbook*. In this study, they are defined according to the specific condition of the case study area. In order to distinguish the serious level of physical problems in different sub-areas and avoid subjective influence as far as possible, a method similar to statistics is used in this study to define this kind of indicators.

In this method, the maximum value and minimum value are the largest ratio and smallest ratio respectively that will be got in chapter 4 after processing the data about the variables on the scale of sub-areas. Then, the interval between the maximum and minimum values can be calculated, since all these variables are ratio variables, which means that the values of them can be calculated by using mathematical operation. Finally, the classified indicators can be defined in **Table 3.3**.

Table 3.3   Classified indicators defined according to specific condition

Classification	Indicators
High level	>= Max - 20% (Max –Min)
Moderate level	> Min + 20% (Max –Min) and < Max - 20% (Max –Min)
Low level	<= Min + 20% (Max –Min)
Min means the minimum value that is equal to the smallest ratio of the variable. Max means the maximum value that is equal to the largest ratio of the variable.	

3.4.1.   Index of Land use

The index of land use criterion includes Land use proportion, Open area ratio, and Floor area ratio. A reasonable land use should have a suitable area proportion, enough open area ratio, and slow floor area ratio.

The reasons why these three sub-variables are selected are following:

First, Land use proportion can be used to analyze general condition of land use on the scale of a whole neighborhood.

Second, Open Area Ratio and Floor Area Ratio can both be used to analyze detailed condition of land use on the scale of sub-areas. Combination of these two variables can be used to reflect the condition of ventilation and sunlight in buildings indirectly, since in a common sense, higher Open Area Ratio and lower Floor Area Ratio mean more ventilation and sunlight. The former one tends to evaluate the land use condition from a two-dimensional point of view, while the latter one from a three-dimensional point of view.

<u>Land use proportion (Scale: neighborhood)</u>

The Land use proportion is a variable to evaluate the reasonableness of land use on the scale of a whole neighborhood. Generally speaking, there are four kinds of land uses on the scale of neighborhoods, which are residential land, public building land, traffic land and green land. A character of a reasonable land use is that the kinds of land uses should be no less than these four kinds, and would better have a suitable proportion as showed in **Table3.4**.

Table 3.4   Suitable Land Use proportion

Scale / Land use	Neighborhood	
Total Area	100%	10-30m^2/person
Residential Land	55-65%	
Public and Commercial Building Land	18-27%	
Traffic Land	7-13%	
Green Land	5-12%	

Source: *Norm of neighborhood design* (Ministry of construction P. R. China, 1993)

Comparing the Land Use proportion in case study area with the suitable Land Use proportion showed by this table, it can be evaluated if the land uses in the case study area are suitable, and then the reasons that make the both different will be analyzed.

Open Area Ratio (Scale: sub-areas)

The definition of Open Area Ratio is the ratio of the Open Area to the Total Plot Area. In this case, the definition of Open Area is the Total Plot Area minus the Ground Floor Built Area. Open Area Ratio can be calculated by the following equation:

$$\textbf{OAR} = [(TPA-GFBA)/TPA]$$

Where:

OAR = Open Area Ratio
TPA = Total Plot Area
GFBA = Ground Floor Built Area

According to the needs of ventilation, sunlight and so on, enough space should be left between buildings. However, with the gradual invasion by the private houses, open area has become less and less in the distressed neighborhoods. Using this variable, it can be found in which region the problem of invading open area is more serious, which means this area is less suitable for living. Then, the planners and politicians can decide if some measures should be taken to solve the problem in this region.

Floor Area Ratio (Scale: sub-areas)

The definition of Floor Area Ratio in China is the ratio of the Total Built Floor Area to the Total Plot Area. It can be calculated by the following equation:

$$\textbf{FAR} = [TBFA/TPA]$$

Where:

FAR = Floor Area Ratio
TBFA = Total Built Floor Area
TPA = Total Plot Area

Floor Area Ratio is another variable reflecting the reasonableness of land use. Compared with the Open Area Rate that describes a two-dimensional land use, the Floor Area Ratio describes a three-dimensional land use.

Three indicators of this variable focusing on the neighborhoods with multiple-floor buildings[7] or low-rise buildings[8] have been given by the Wuhan Urban Planning Bureau: First, they sorted the neighborhoods with multiple-floor or low-rise buildings into three building-density degree zones, which are "First (High) degree zone", "Second (Moderate) degree zone", and "Third (Low) degree zone". Then, they regulated three indicators of Floor Area Ratio that are not more than 1.6 in the first degree zone, not more than 1.4 in the second degree zone, and not more than 1.2 in the third degree zone (Wuhan Urban Planning Bureau, 1999). This variable is useful to distressed neighborhoods, be-

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[7] The buildings with not less than 4 and not more than 8 floors
[8] The buildings with not more than 3 floors

cause most of the distressed neighborhoods are occupied with multiple-floor buildings and low-rise buildings.

It is also regulated that the real Floor Area Ratio in a neighborhood should not exceed the indicator given by Wuhan Urban Planning Bureau. Therefore, the relevant indicator of the case study area can be found at first, according to its sorts. Then, it can be analyzed if the land use in the neighborhood is reasonable, by comparing the Floor Area Ratio of case study area with the relevant indicator given above.

Since the case study area has been sorted as a part of "Second degree zone" by Wuhan Urban Planning Bureau, it can be said that if the part of built area in the case study area has a reasonable land use, the floor area ratio should be not more than 1.4.

Composite Index of Land use:

As mentioned above, the classified indicators about floor area ratio can be got from the regulations about neighborhood design in Wuhan. However, the indicators about open area ratio cannot be got from Norm, regulations or Statistics Yearbook, but only can be defined according to the specific condition in the case study area.

In order to distinguish the level of open area ratio in different sub-areas, and avoid subjective influence as far as possible, the method similar to statistics is used in this study, which has been described before (see Table 3.3 in section 3.4). Therefore, the composite index of land use can be defined (see **Table 3.5**) from the viewpoint of open area ratio and floor area ratio. However, the detailed value about indicators of open area ratio only can be got in Chapter 4, after the data about this variable are processed.

Table 3.5   Composite index of Land use

Score on each variable	Variable Class	Open Area Ratio	Floor Area Ratio
3	Reasonable	>= Max - 20% (Max –Min)	<= 1.4
2	Moderate	> Min + 20% (Max –Min) and < Max - 20% (Max –Min)	
1	Unreasonable	<= Min + 20% (Max –Min)	>1.4
Min means the minimum value that is equal to the smallest ratio of variable.			
Max means the maximum value that is equal to the largest ratio of variable.			

3.4.2.   Index of Public and commercial service

The index of service criterion includes amount of kinds, needed area of every kind and service radius. The reason why these three variables are selected in this study is that convenient service has three contents: First, all needed service kinds should exist in the neighborhood. Second, the service extend should be enough to all inhabitants in the neighborhood, which means each service should

reach the area standard. Third, all the inhabitants should access the services relevant to their daily life in a suitable distance.

According to the *Norm of Neighborhood Design* in China, the service kinds, needed area and service radius corresponding to the case study area can be selected, which will be described in detail as following.

Service kinds and Needed area (scale: neighborhood)

According to the *Norm of Neighborhood Design* in China, the original indicators about service kinds and needed area corresponding to the case study area can be selected and showed in **Table 3.6**. In this table, it can be found that 16 kinds of services are needed to be located in case study area and 14 of them are regulated the needed area per thousand persons.

Table 3.6   Needed kinds and area of service

Sorts	Amount	Needed area Name	Land area per thousand persons (m^2)	Floor area per thousand persons (m^2)
Educational services	1	Nursery	32~60	80~120
	2/3	Primary school	175~270	490~900
Health services		Health center		
Cultural and gymnastic services		Activity center		
Commercial services	1	Grocery		45~55
	3	Restaurant		60~80
	1	Salon		10~12
	1	Repairman shop		8
	1	Recycle bin	10	5
Financial and communicatory services	1/2	Bank		6~7.5
	1	Post office		10~15
Public services	1~2	Pubic toilet		3~6
	4~5	Dumping ground	1.5~2	
	4~6	Parking space for bicycle		76~152
Administrative services	1	Commission		20
	1	House keeping department		20~25

Source: *Norm of Neighborhood Design* (Ministry of construction P. R. China, 1993)

Service kinds and needed area are two variables to evaluate the convenience of public and commercial service on the scale of a whole neighborhood. According to the population in neighborhood, the needed service area in case study area can be calculated. Then, comparing the service situation in case study area with the calculated indicators, it can be found what kinds of services are absent and what kinds have not reached the area standards needed in the case study area.

Service radius (Scale: sub-areas)

This variable is used to evaluate if all the inhabitants can access the services relevant to their daily life in a suitable distance. According to the *Norm of Neighborhood Design* in China, the radius of each service that is relevant to inhabitants' daily life can be got (see **Table 3.7**).

From the table, it can be found that besides the services that need to be located in case study area, still some services are listed in the table, which are relevant to inhabitants' daily life but needn't be located in case study area.

Table 3.7   Index of Service radius

Function	Need to be located in case study area	Service	Radius threshold (m)
Educational services	Yes	Nursery	500
	Yes	Primary school	500
	No	Middle school	1000
Health services	Yes	Health center	200
	No	Hospital	1000
Cultural and gymnastic services	Yes	Activity center	500
Commercial services	No	Vegetable market	1000
	Yes	Grocery	500
	Yes	Restaurant	200
	No	Department store	1000
	Yes	Salon	500
	Yes	Repairman shop	500
	Yes	Recycle bin	500
Financial and communicatory services	Yes	Bank	500
	Yes	Post office	500
Public services	Yes	Pubic toilet	200
	Yes	Dumping ground	200
	Yes	Parking space for bicycle	200
	No	Bus station	1000
Administrative services	No	District office	1000
	No	Police office	1000
	Yes	Commission	200
	Yes	House keeping department	500

Source: *Norm of Neighborhood Design* (Ministry of construction P. R. China, 1993)

Using this index to evaluate the current situation of services one by one, it can be found what buildings are beyond the radius threshold of certain services. It is regulated that even if one building in the sub-area is beyond the threshold of certain service radius, the problem exists in this sub-area. Finally the serious level on service aspect in different sub-areas can be got from the viewpoint of service radius, attached with different scores.

In this case, score 1 means that certain service problem exists in this sub-area; while score 3 means the problem does not exist in this sub-area.

3.4.3. Index of Road

This criterion includes access ratio of fire engines, road pavement ratio, and drainage system ratio. The reason why these three variables are selected in this study is that access ratio of fire engines is used to evaluate road accessibility from the viewpoint of fire engines, while the road pavement ratio, and drainage system ratio are used from the viewpoint of people.

In this study, the sub-variables of access ratio of fire engines, pavement ratio and drainage system ratio are all the variables for analysing road problems on the scale of sub-areas. The composite index will be given at the last of this section, after describing the three variables as following:

Access ratio of fire engine (Scale: sub-areas)

The definition of access ratio of fire engines is the ratio of the Access Area of fire engines to the Open Area. It can be calculated by the following equation:

$$\mathbf{ARFE} = [AAFE/OA]$$

Where:

ARFE = Access Ratio of fire engines
AAFE = Access Area of fire engines
OA = Open Area

This variable is used to evaluate on which degree the fire engines can permeate the neighborhood, since it is dangerous for inhabitants to live in the area that fire engines cannot reach. Unfortunately, this problem exists in many old neighborhoods more or less, with the character of narrow space between buildings. Therefore, the variable of access ratio is important for urban renewal in old neighborhoods, including the distressed neighborhoods, according to the goal of improving inhabitants' living condition.

According to the *Norm of Road Design* in China, the minimum road width fire engines can pass is 3.5 meters (Ministry of construction P. R. China, 1990). Using this standard, it can be analyzed which roads fire engines cannot pass and what region fire engines cannot reach. Using GIS technique, this problem can be reflected visually. At the same time, comparing the access ratios in each sub-area with the classified indicators that will be defined at the last of this section, the accessibility level of road on the scale of sub-areas can be evaluated from the viewpoint of fire engines.

Pavement Ratio and Drainage system Ratio (Scale: sub-areas)

Pavement Ratio is the ratio of the Area of Roads with Pavement to the Total Road Area, which can be calculated by the following equation:

PR = [ARP/TRA]

Where:

PR = Pavement Ratio

ARP = Area of Roads with Pavement

TRA = Total Road Area

Drainage system Ratio is the ratio of Area of Roads with Drainage System to the Total Road Area, which can be calculated by the following equation:

DSR = [ARDS/TRA]

Where:

DSR = Pavement Ratio

ARDS = Area of Roads with Drainage System

TRA = Total Road Area

The pavement ratio and drainage system ratio are the other two variables to evaluate the accessibility of road, but from the viewpoint of people. This is because the roads exposed with dust will be muddy and the roads without drainage system will lead to backwater when it rains, which both make it difficult for inhabitants to go through the neighborhood.

Composite index of Road:

Since the indicators of these three variables cannot be got from any Norm, regulations or Statistics Yearbook in China. In this study, they can be defined (see **Table 3.8**) according to the specific condition in the case study area, by using the method described before (see Table 3.3 in section 3.4). In another word, the indicators about access ratio, pavement ratio, and drainage system ratio in this study cannot be used to other neighborhoods directly. It should be mentioned that the detailed values of each indicator only can be got in Chapter 4, after the data about these three variables are processed.

Table 3.8   **Composite index of Road**

Score on each variable	Variable Class	Access Ratio of fire engines	Pavement Ratio	Drainage system Ratio
3	High Accessibility	>= Max - 20% (Max –Min)		
2	Moderate Accessibility	> Min + 20% (Max –Min) and < Max - 20% (Max –Min)		
1	Low Accessibility	<= Min + 20% (Max –Min)		
Min means the minimum value that is equal to the smallest ratio of variable. Max means the maximum value that is equal to the largest ratio of variable.				

3.4.4.   Index of Building

This criterion includes building condition and building age. The total level of building quality in a neighborhood can be got by analyzing in what condition the majority of buildings are and what age

the majority have. The reason why these two variables are selected is that in a common sense, good quality means good condition and young age.

In this study, the variables of building condition and building age are both the variables for analyzing building problems in detail on the scale of sub-areas. The composite index will be given at the last of this section, after describing the two variables as following:

Building condition (scale: sub-areas)

Building condition is one of the important variables to reflect the quality of buildings, because it is an outcome of high (or low) intensity of the use and the existence (or lack) of maintenance activities carried by the owner or the occupant, which both can lead to the conversation (or deterioration) of buildings directly (Arteaga, 2000 p.44).

The criteria of the classification of this variable has been given by Arteaga (2000) and adapted in this study showed in **Table 3.9.** However, this classification is too abstract to operate. It should be changed into some quantitative indicators, according to the specific situation about building in the case study area. Because of the limit of data in this study, this variable cannot be defined by giving quantitative indicators here. Even so, the table is still left as a reference for other researches.

Table 3.9   Classification of building condition

Class	Building condition
Good	Buildings with periodical maintenance activities
Moderate	Low frequency of maintenance and low level of disrepair
Bad	Lack of maintenance and high level disrepair

Source: Adapted from (Arteaga, 2000 p.44)

Using this variable, it can be found what buildings are in bad quality and then some measures can be taken by planners or politicians to solve this problem.

Building age (scale: sub-areas)

This variable is the other one to evaluate the quality of buildings. This is because the younger buildings are usually in a relatively better quality than the older ones. Using this variable, it can be found what buildings are old, which can help planners and politicians to judge whether to maintain or rebuild them.

Since the building condition variable cannot be used here because of the limit of data, the building age variable is the only criterion for evaluating the quality of buildings in this study on the scale of sub-areas. Using this variable, the average building age in each sub-area can be calculated. Then comparing with the classified indicators, the level of building age in each sub-area can be evaluated.

However, as mentioned before, since this part of indicators cannot be got from Norm, regulations or Statistics Yearbook, the method described in section 3.4 (see Table 3.3) is used here. Therefore, the

classified index of building age can be defined (see **Table 3.10**), with the detailed value of each indicator being got in Chapter 4, after the data about this variable are processed.

Table 3.10   Index of building age

Score	Variable Class	Building age
3	Young	<= Min + 20% (Max –Min)
2	Moderate	> Min + 20% (Max –Min) and < Max - 20% (Max –Min)
1	Old	>= Max - 20% (Max –Min)
Min means the minimum value that is equal to the smallest ratio of variable. Max means the maximum value that is equal to the largest ratio of variable.		

3.4.5.   Index of Infrastructure

This criterion includes sanitation ratio, water pipe ratio, electric net ratio and telephone network ratio. The reason why these four variables are selected is that generally speaking, basic infrastructure is made up of sanitation, water pipe, electric net and telephone network, which are closely relevant to inhabitants' daily life. Insufficiency of infrastructure is a common and serious problem in old neighborhood. It is always preventing the community development. Sufficiency can be measured by the variable of service ratio of each kind infrastructure.

The definition of service ratio of each infrastructure is the ratio of the Ground Floor Built Area of Buildings with the Infrastructure to the Total Ground Floor Built Area. It can be calculated by the following equation:

$$\textbf{SR} = [GFBABI/TGFBA]$$

Where:

SR   = Service Ratio of each infrastructure

GFBABI   = Ground Floor Built Area of Buildings with the Infrastructure

TGFBA   = Total Ground Floor Built Area

From the *Wuhan Statistics Yearbook 2001*, it can be found that percentage of population with access to tap water and that to electricity are both 100% (Wuhan Statistics Bureau, 2001). Therefore, the classified indices about water pipe ratio and electric net ratio can be defined (see **Table 3.11**).

Table 3.11   Composite index of Water pipe ratio and Electric net ratio

Score on each variable	Variable Class	Water pipe ratio	Electric net ratio
3	Sufficiency	100%	100%
1	Insufficiency	<100%	<100%

At the same time, the indicators about sanitation ratio and telephone network ratio cannot be got from Norm, regulations or Statistics Yearbook, but only can be defined according to the specific condition in the Huangjidun neighborhood.

Using the method described before (see Table 3.3 in section 3.4), the classified indices of sanitation ratio and telephone network ratio can be defined (see **Table 3.12**). The detailed value of each indicator only can be got in Chapter 4, after the data about these two variables are processed.

Table 3.12 Composite index of Sanitation ratio and Telephone network ratio

Score on each variable	Variable / Class	Sanitation ratio	Telephone network ratio
3	Sufficiency	>= Max - 20% (Max –Min)	
2	Moderate	> Min + 20% (Max –Min) and < Max - 20% (Max –Min)	
1	Insufficiency	<= Min + 20% (Max –Min)	
Min means the minimum value that is equal to the smallest ratio of variable. Max means the maximum value that is equal to the largest ratio of variable.			

Using GIS technique to analyze these variables, planners and politicians can find where the problem of lack of infrastructure exists and what infrastructure is absent, which is helpful to improve the condition of infrastructure pertinently.

3.4.6. Index of Environment

Generally speaking, a comfortable neighborhood should have the following four characters:

First, it should be away from noise, such as the noise from main roads or schools. Even if some areas are near the noise source, green belt should be arranged to reduce noise. In another word, the areas near noise source and without green belt don not belong to the class of comfort.

Second, the comfortable neighborhood should be away from some pollution zone, such as large garbage dumps and polluted channels and so on. Even if some areas are near the pollution zone, green belt is needed for protecting the neighborhood. Therefore, the areas near pollution zone and without green belt do not belong to the class of comfort too.

Third, the comfortable neighborhood must be located in safe place, but not flood-prone areas, landslide-prone areas, and areas with poor geographic quality.

Fourth, the comfortable neighborhood would better be near some good sights, such as park, and green square and so on. This is because that these good sights are good at adjusting residents' psychology, which can make people more comfortable.

From the characters mentioned above and the regulations about neighborhood design in Wuhan, the classification of environment index can be got and shown in **Table 3.13**.

Table 3.13   Composite index of Environment

Score on each variable	Variable Class	Noise	Pollution zone	Safe place	Good sights
3	Comfortable	15m Away Distance is below 15m but with Green belt	15m Away Distance is below 15m but with Green belt	In safe place	Distance is below 15m
2	Moderate				15m Away
1	Uncomfortable	Distance is below 15m and without Green belt	Distance is below 15m and without Green belt	Flood-prone areas, landslide-prone areas, areas with poor geographic quality	

Source: Regulations about Neighborhood Design in Wuhan (Wuhan Urban Planning Bureau, 1999)

Using these variables, it can be found what buildings are influenced by noise, polluted zone, good sights and not in safe place. It is regulated in this study that even if one building in the sub-area does not reach the regulated standard, the problem exists in this sub-area. Finally, the serious level on environment aspect in different sub-areas can be got, attached with different scores.

3.5.   Dividing sub-areas

Generally speaking, the division of sub-areas in distressed neighborhoods is a complicated process that not only relates to land ownership (from the legal point of view) and population components (from the social point of view), but also should be considered about the integrity of land use and the similar proportion of land area (from the spatial and economic point of view).

Land ownership:

The first factor that should be considered when dividing sub-areas is land ownership, since the necessity of dividing sub-areas in the distressed neighborhoods basically comes from the problem of unclear land ownership.

Generally speaking, there are two kinds of land ownership in China, state-owned and collectively owned. Land Administration Law of People's Republic of China has regulated that "Land in the urban areas of cities shall be owned by the State…Land in rural and suburban areas shall be owned by peasant collectives…"(Zeming, 1998)

As mentioned in section 2.3.2, the distressed neighborhoods began to develop at edge of city or as infill in the period from 1949 to 1961, with the land ownership of peasant collectives. Many private houses were built by local peasants and the land was occupied by the private. With the lapse of time,

these areas have evolved as urban areas within the boundary of cities, and belong to the state-owned land according to the Land Administration Law.

However, it is interesting to find that although these areas belong to state-owned land and should be administrated by municipal governments; their nominal land ownership is still collectively owned that means these areas should be still under the control of villagers' committee. The problem is that these areas have become one part of urban area without villagers' committee existing there, while the municipal governments will not govern them too according to their nominal land ownership, which means a legal gap existing in the distressed neighborhoods.

Just the problem of unclear land ownership has a great influence on the physical condition in the neighborhood. For example, it leads to a different land use change, different building characters, imbalance infrastructure distribution and so on between the state-owned land and collectively owned land.

In order to analyze the different characters of physical problems between the state-owned land and collectively owned land detailedly, dividing sub-areas in this kind of distressed neighborhoods according to their different land ownership is necessary and important in this study.

Moreover, with regard to the urban renewal strategies, the division of sub-areas according to different land ownership is important too, which can help planners and politicians formulate and carry out different strategies in different kind of sub-areas.

Population components:

Since still some marginal region between the state-owned land and collectively owned land is mixed and not clear, only the factor of land ownership is not enough. Facing to this problem, the second factor of population components can be considered, since the social aspect is another one that influences the physical condition in the distressed neighborhoods.

At the same time, it is difficult to make all these people willing to accept the same strategy of urban renewal, because their different social characters lead to their different responses. Therefore, dividing sub-areas on the basic of different population components can help planners and politicians to select different policies or strategies on urban renewal, according their different social characters.

It should be mentioned that in the distressed neighborhoods, the distribution of different population components is generally consist with that of different land ownership. People who live in the state-owned land are mostly employees, while others who live in the collectively owned land are mostly the inhabitants evolved from local peasants and the immigrants from suburb. Therefore, population components can be considered as the accessorial factor of land ownership in this study.

Integrity of land use and Similar proportion of land area:

Integrity of land use means the land shape should be regular, similar to square or round. Similar proportion of land area means that the land areas should be balance, enough for construction and

avoid too small plots. This is because that the regular land shape can make the constructions easier to arrange and plan, compared with fragmentary plots; and the similar proportion of land area can avoid the appearance of too small plots that not only constrains the flexible arrangement of constructions, but also reduces the economic attraction of urban renewal.

Sometimes the first two factors (land ownership and population components) are enough for dividing a neighborhood into different sub-areas, while sometimes they are still not enough. However, whether they are enough or not, the third factor of integrity of land use and similar proportion of land area should be considered. This is because that urban renewal needs plots in regular shape and plots with enough area.

Even sometimes the first two factors are enough for dividing a whole neighborhood into different sub-areas, still some little adjustments should been done, according the factor of integrity of land use and similar proportion of land area. In fact, regular shape and enough area for construction are more important than a neglect of population components in small range. For urban renewal at neighborhood scale, the boundary of each sub-area as the result of a subject definition need not be very accurate.

3.6. Assigning weights of variables

MCE problems typically involve variables of varying importance to decision makers, which can be achieved by assigning different weights to different variables. In MCE process, the derivation of weights is a central step in eliciting the decision maker's preferences. In one word, a weight can be defined as a value assigned to an evaluation variable that indicates its importance relative to other variables under consideration. The larger the weight, the more important is the variable in the overall utility (Malczewski, 1999 p.177).

In this study, although the six major variables (that are land use, public and commercial service, building, road, infrastructure, and environment) and most of the followed sub-variables are all involved in evaluating the serious level of physical problems on the scale of sub-areas, the weights of them are different, which is decided by the goal of urban renewal. Since the goal of urban renewal at neighborhood scale tends to be the improvement of inhabitants' living condition in specific neighborhood, the weights of variables should reflect which variables are relatively more important or urgent for improving the living condition. According to this goal, the method for assigning the weights of variables in this study is the statistics of questionnaires.

Generally speaking, there are many methods for assigning weights, such as the Direct determination method (DDM), the Ranking methods, the Rating methods, the Pairwise Comparison method, the Trade-off Analysis method and so on. Why a different method, the statistics of questionnaires, is selected in this study is mainly because that urban renewal at neighborhood scale tends to solve the relatively more urgent problems firstly, which only can be answered by the inhabitants in the neighborhood. Therefore, the statistics of questionnaires answered by local inhabitants undoubtedly is the most objective way to evaluate which variables are more urgent or important in the case study area.

The questionnaire (see Appendix I) is designed for finding on which aspect the problems are reflected by more inhabitants, according to the six major variables. The basic assumption of this method is that the aspect, on which the problems are reflected by relatively more inhabitants, can be considered to be more urgent or important.

The sample size of questionnaires is 65 families and the householder in each family, occupying 2.8% of the total families in the case study area. In order to reduce the impact of bias of different population components, an conscious accidental sampling technique is adopt based on the three different population components (residents in State-owned land, residents in collectively owned land, and immigrants), which means accidental interviews on one side and covering different kind people and most places of the neighborhood consciously on the other side. According to the inhabitants' relatively lower educational level, the questionnaires were filled based on face-to-face interviews.

At the same time, in order to make the inhabitants clearer about the questions in questionnaires, each aspect has been designed several alternatives to choose. In this study, selecting any alternative of an aspect means that the aspect has been reflected. After statistics, the percentage of reflection on each aspect is got, and the weighs of all aspects can be calculated and showed in **Table 3.14**, according to their different proportion about reflection.

Table 3.14   **Percentage of reflection and Weight on each aspect**

Variable	Land use	Service	Road	Building	Infrastructure	Environment	Total
Num of reflection	65	7	65	48	33	63	65
Percentage (%)	100	10.8	100	73.8	50.8	96.9	100
Weights	0.231	0.026	0.231	0.171	0.117	0.224	1

It can be found in this table that the problems on road and land use aspect are most urgent ones, followed by the environment aspect, and the problem on service aspect is the lightest one among the six physical aspects.

Two points should be mentioned here:

First, this method for assigning weights can be used for urban renewal in other neighborhoods, but the designed questionnaire and the final weights are specific to the case study area in this study. If used in other neighborhoods, the content of this questionnaire should better be adapted, according to the specific local condition.

Second, the weights that have been assigned above mainly focus on the major variables (that are land use, public and commercial service, building, road, infrastructure, and environment). With regard to the followed sub- variables, the corresponding weights should be considered too.

However, because of limit of time, no investigation about these sub-variables is made. Therefore, the corresponding weights of these variables in this study are assigned equally. For example, with regard to the criterion of land use, the weights of open area ratio and floor area ratio account for 50% of that of land use respectively.

3.7. Evaluation rule

In this study, the simple additive weighting (SAW) method is selected, since it is the most often used technique for tackling spatial multi-attribute evaluation (Malczewski, 1999 p.199).

For each sub-area, the final score A can be got by the following formula:

$$A = \sum_i (\sum_j X_{ij} W_{ij}) W_i \qquad \text{and} \qquad \sum_j W_{ij} = W_i, \; \sum_i W_i = 1$$

Where,

A is the total score of the whole physical variables in each sub-area.

X_{ij} is the score of the jth sub-variable under the ith major variable.

W_{ij} is the corresponding weight of the jth sub-variable under the ith major variable.

W_i is the weight of the ith major variable.

According to this evaluation rule, the theoretic minimum value of A will be 1 and maximum value will be 3. In order to rate the serious level of total physical problems more detailedly, the final scores about serious level are divided into five ranges (see **Table 3.15**). In this table, the less the score A is, the more serious physical problems the sub-area has, which means the physical problems in this area need to be solved more urgently. On the contrary, the more the score A is, the less serious physical problems the sub-area has, which means the physical condition is relatively better.

Table 3.15 **Final scores about serious level**

Value of A	1~1.4	1.4~1.8	1.8~2.2	2.2~2.6	2.6~3
Serious level	Very serious	Serious	Moderate	Unserious	Good

3.8. Conclusion

In this chapter, methodology for analyzing physical problems in distressed neighborhoods is developed. It is made up of four stages that are defining variables relevant to physical factor, defining indices about physical condition, dividing sub-areas and assigning weights to each variable.

At the first stage, the major variables, sub-variables and criteria for evaluating physical condition are defined.

At the second stage, the indices of all variables are defined, including their scale (neighborhood or sub-area) and source (Norm, regulations, yearbook or according to specific condition). At the same time, a method for defining physical indices according to specific condition is described and used.

At the third stage, three factors about dividing sub-areas are used, which are land ownership, population components, and the integrity of land use and similar proportion of land area. The process

about how to divide a distressed neighborhood into different sub-areas is described, by presenting these three factors one by one.

At the fourth stage, the weights of major variables are assigned according to the method of statistics of questionnaires. Because of the limit of data, the weights of sub-variables are assigned equally.

At the end of this chapter, an evaluation rule of simple additive weighting method (SAW) is selected and five serious levels about total physical problems are defined, for calculating and rating the final scores about serious level in the next chapter.

In sum, the methodology developed in this chapter will be applied to the case study area for analyzing physical problems and their serious level in the next chapter.

4. Analyses of problems in case study area

4.1.　　　Introduction

In this chapter, the methodology developed in Chapter 3 will be applied to the case study area. In order to make the analysis process clearer, three main contents are included in this chapter: First, a general description about case study area and collected data will be given. Second, the physical problems in the case study are will be analyzed in detail, which is the emphasis in this chapter. Third, considering urban renewal is not only relevant to physical factor, the problems on legal, social and economic aspects will be shortly analyzed too, which contribute to the physical problems more or less.

4.2.　　　Case study area

In this section, the description of case study area will be given on two scales. One is the historical development of distressed neighborhoods in Wuhan, which gives a description about the background of case study area on the scale of the whole Wuhan city. The other one is the general description only focusing on the region of case study area, which represents the current condition of case study area on geographic, physical, and social aspects.

4.2.1.　　　Historical development of distressed neighborhoods in Wuhan

Before the establishment of the People Republic of China in 1949, the majority area of Wuhan city was centralized along the Yangtze River and surrounded by the old railway. Beyond the railway are there many lakes and much vacant land, which belonged to the edge of city. At that time, very few people but some peasants lived in this region.

After 1949, with the significant change of society and strategy of urban development, large scale suburban development took place under the name of "new villages" in Chinese cities (Yeh, 1999 p.175, quoted from Kwok, 1981). But the Soviet land use and housing construction standards were not suitable to the local situation. Building in many state construction projects occupied only 20% of the land within the compound and some even took up an astoundingly low 4.6% and caused urban sprawl (Yeh, 1999 p.175, quoted from Fung, 1981).

Wuhan city is just one of these cities, and the areas at the edge of city began to develop as well after 1949. Low-density neighborhoods started to form. The common characters of this kind of neighborhoods are the following: First, the region belonged to some state enterprises or large industrial departments. Second, a few low buildings were located and much vacant land remained. Third, the vacant land, belonging to the enterprises or departments, was not governed carefully and marked

out. All these paved the way for lots of occupation houses to insert in the region during the following 30 years, especially in the period from 1958 to 1978.

Two important events took place in the period from 1958 to 1978. One is the Great Leap Forward (1958-1959), in which Grand Urban Master Plans were made and led to rampant growth of cities and an influx of peasants into the large cities (Yeh, 1999 p.175).The second is the Cultural Revolution (1960-1978), in which urban planning was totally abandoned (Yeh, 1999 p.175). These two events undoubtedly stimulated the invading of occupation houses in the above region.

With the urban sprawl and influx of immigrants, the region at the edge of city has become part of Wuhan city in 1980s. In this study, the neighborhoods in this part of area are called as the distressed neighborhoods. However, still relatively less researches about this kind of neighborhoods have been done, even though the problems of overcrowded population and occupation houses have been gradually paid attention to, especially after the latter half of the 1980s, in which the proportion of studies on old city redevelopment to urban construction gradually increased (Wang, 1994 p.301).

Therefore, the case of the Huangjiadun neighborhood in Wuhan is selected as a representative to show how to analyze the physical problems in distressed neighborhoods for urban renewal, and what is the relationship between the physical problems and the legal, social, economic factors.

4.2.2.   The Huangjiadun neighborhood

The case study area, Huangjiadun neighborhood, is one of the distressed neighborhoods in Wuhan city that is located in central China and in the middle reaches of the Yangtze River.

From a more microcosmic point of view, the location of Huangjiadun neighborhood in Wuhan can be found. As **Map 4.1** shows, Wuhan city has been divided into three regions that are called as Hankou, Hanyang, and Wuchang, by the Yangtze River and the Han River. Three main bridges, which are the first Bridge of Yangtze River, the second Bridge of Yangtze River, and the first Bridge of Han River, connect these three regions of Wuhan and from the first ring road. The Huangjiadun neighborhood is just located near the second Bridge of Yangtze River in Hankou.

Only focusing on the Huangjiadun neighborhood, its geographic characters can be found as following: At the east of case study area, there is a main road called as the Liberation Road, which is connected with the first ring road in Wuhan city. At the same time, two small paths with width of 4 and 5 meters are located at the north and south of case study area respectively, separating the Huangjiadun neighborhood with other neighborhoods. The residential region of the No. 2 artillery engineering college is at the west of case study area, only separated by a wall.
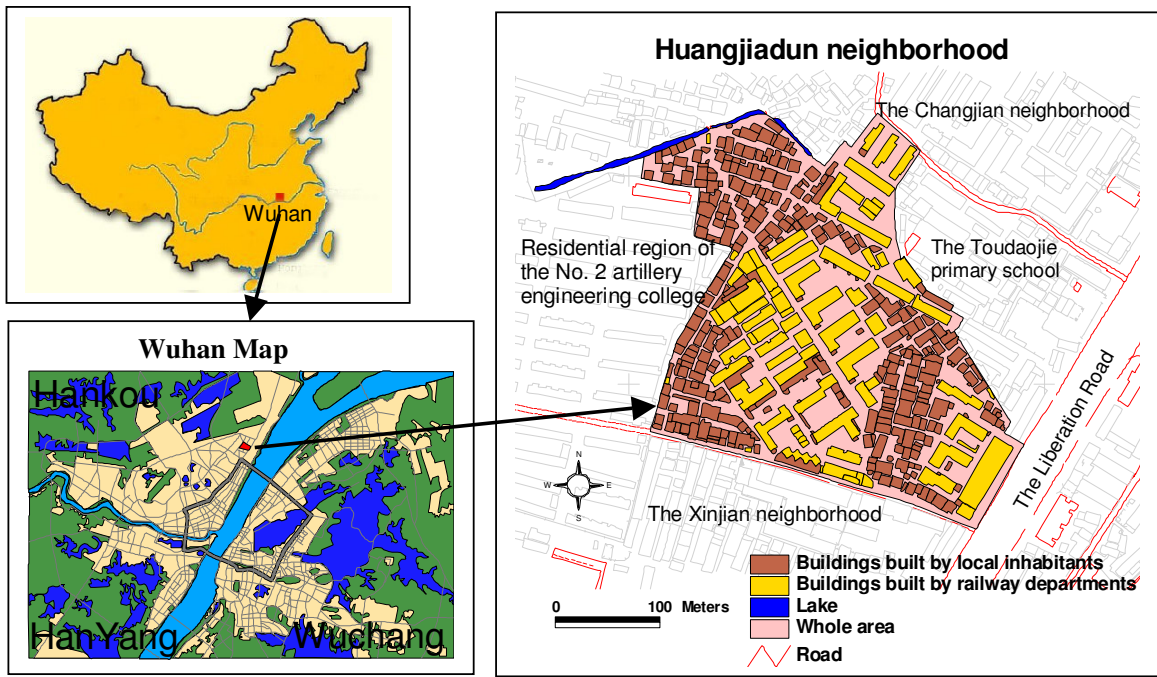
Map 4.1   Case study area

From the physical point of view, the total area of the Huangjiadun neighborhood is about 9 ha, which can be divided into two parts according to the different land ownership. One is the state-owned land with the buildings built by the railway departments. The other one is the land with a nominal ownership of peasant collectives, with the buildings built by local inhabitants.

Moreover, from the social point of view, the total population in the Huangjiadun neighborhood is about 7460 in 2002, with three population components that are employees in railway departments (concentrating in the state-owned land), local inhabitants evolved from peasants (concentrating in the collectively owned land), and immigrants (in collectively owned land) respectively. The population of inhabitants evolved from peasants is largest with an amount about 4500, while the population of employees in railway departments and that of immigrants are about 1500 and 1460 respectively.

4.3.   Data description

Generally speaking, there are four parts of data needed in this study, which are data on physical aspect, data on social aspect, data on economic aspect, and data on legal aspect. This is because analysis of physical problems as an emphasis, and analyses of social, economic and legal problems as the supplement of urban renewal are both involved in this study. The general information about the data is shown in **Table 4.1**.

Table 4.1   General information of data

Aspect	Collected Data	Source /Method	Output
Physical	CAD map of neighborhood (1:2000, in 1980, 1998, 2002)	Wuhan Urban Planning Bureau	Physical condition in the neighbor-

	Detailed spatial data	Field survey	hood
	Norm of Neighborhood Design (Ministry of construction P. R. China, 1993)	Architecture library in China	Criteria for evaluate physical problems
	Regulations about neighborhood design in Wuhan (Wuhan Urban Planning Bureau, 1999)	Wuhan Urban Planning Bureau	
Social	Socioeconomic status of people in the neighborhood	Questionnaire	Current social condition in the neighborhood
	View and attitude of people in the neighborhood		
	Socioeconomic statistics of Wuhan	*Wuhan Statistics Yearbook 2001* (Wuhan Statistics Bureau, 2001)	Criteria for evaluate social problems
Economic	Finance assistance	The Jiangan Construction Bureau of Wuhan Railway Department	Economic problems
Legal	Land policy in China	Literature review	Legal problems

4.4. Sub-areas in the Huangjiadun neighborhood

According to the process of dividing a whole neighborhood into different sub-areas described in section 3.5, eight sub-areas of Huangjiadun neighborhood are got (see **Map 4.2**).
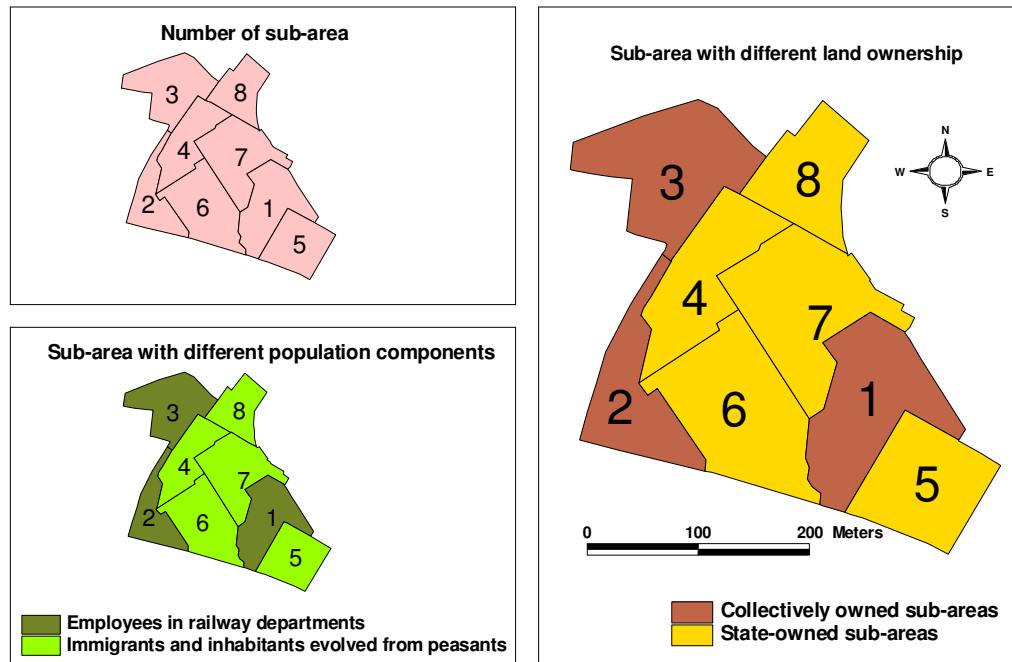
Map 4.2 Sub-areas in Huangjiadun neighborhood

Since three aspects that are land ownership, population components, and the integrity of land use and similar proportion of land area, are considered when dividing sub-areas, the characters of the sub-areas (described as following) reflect these three aspects in turn.

First, with regard to the land ownership, the state-owned land under control of the railway departments includes sub-area 4, 5, 6, 7 and 8, while the collectively owned land includes sub-area 1, 2 and 3.

Second, with regard to the population components, the employees in railway departments concentrated in state-owned sub-area 4, 5, 6, 7 and 8, while the immigrants and the inhabitants evolving from peasants mostly concentrate in collectively owned sub-area 1, 2 and 3.

Third, with regard to the integrity of land use and similar proportion of land area, the state-owned sub-area 4 and 7 are distributed with a majority of state-owned areas and a small part of collectively areas. Although this operation perhaps has some influences on the characters of the state-owned sub-area 4 and 7, compared with other state-owned sub-areas (sub-area 5, 6 and 8); it will do good to the implement of urban renewal later on.

4.5.   Analyses on Physical Problems

In this section, physical problems in the case study area will be analyzed, by using the methodology developed in Chapter 3. Generally speaking, the physical problems will be analyzed from six aspects (land use, public and commercial service, road, building, infrastructure, and environment), which will be described in detail as following.

4.5.1.   Analysis on Land use

The land use problem will be analyzed by using three variables that are land use proportion, open area ratio and floor area ratio. Using these three variables, the land use problem can be evaluated not only generally on the scale of a whole neighborhood, but also detailedly on the scale of sub-areas.

Analysis on Land use Proportion (scale: neighborhood)

The variable of land use proportion is used to evaluate the reasonableness of land use on the scale of a whole neighborhood. Comparing the proportion in case study area and the suitable proportion from *Norm of neighborhood design* in China (see **Table 4.2**), two characters about land use proportion can be found as following:

Table 4.2   Land use proportion in the Huangjiadun neighborhood

Regulated in Norm	Land use	Suitable proportion (%)	Proportion in study area (%)
	Total Area	100	100

Yes	Residential Land	55-65	75.6
Yes	Public Building Land	18-27	9.3
No	(Residential-mixed Land[9])		4.5
Yes	Traffic Land	7-13	10.1
Yes	Green Land	5-12	1.2
No	(Water Land)		0.3

First, the kinds of land use in the Huangjiadun neighborhood have met the basic kinds regulated in *Norm of neighborhood design* that are residential land, public building land, traffic land and green land. Moreover, two other kinds of land uses exist in the Huangjiadun neighborhood, which are residential-mixed land and water land.

Second, the ratio of residential land is higher than the suitable ratio, while those of public building land and green land are far below the ratios in table.

In order to make the condition of land use proportion clearer, a land use map is used here and shown in **Map 4.3**.
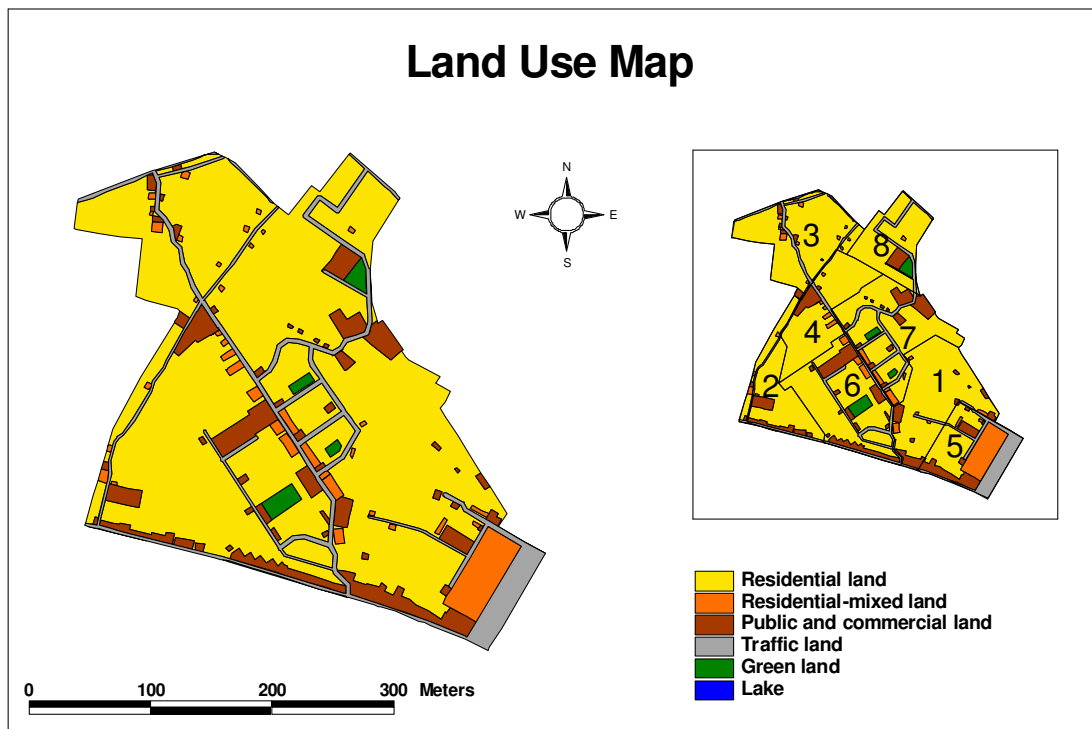
Map 4.3   Distribution of land use in the Huangjiadun neighborhood

From this map, it can be seen that only a little green land exists in state-owned sub-area 6, 7 and 8, which can explain why the ratio of green land is far below the suitable ratio in Table 4.2. It also can

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[9] The land shared by residential function and public function. On this land, the buildings have a common character that only

be found that although the distribution of public building land is throughout the whole neighborhood, the size of them is small and most of them distribute unbalanced, which can explain why the ratio of public building is below the suitable ratio in Table 4.2 visually.

In a conclusion, the lack of green land and public building land is the problem in the Huangjia-dun neighborhood.

Analysis on Open area ratio (scale: sub-area)

The variable of open area ratio reflects a two-dimensional density of land use. Comparing open area ratio in case study area (see **Map 4.4**) and the classified indicators (see Table III.1 in Appendix III), the reasonable level of open area ratio can be got and two characters can be found as following:
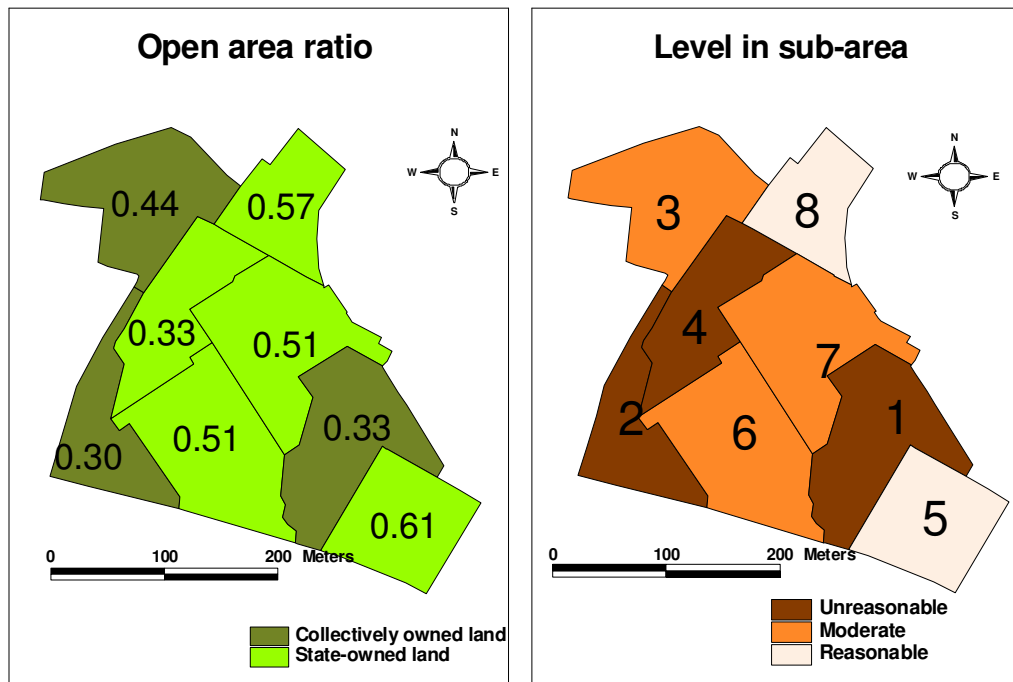
Map 4.4   Open area ratio in different sub-areas

First, generally speaking, most of the state-owned sub-areas (sub-area 5, 6, 7 and 8) have a rela-tively higher open area ratio than that of the collectively owned sub-areas (sub-area 1, 2 and 3).

Second, one of the state-owned sub-area (sub-area 4) has a very low open area ratio of 33%, which is contributed by the part of mixed collectively owned areas in this sub-area. This influence has been mentioned in section 4.4 when the aspect of integrity of land use and similar proportion of land area is considered in the process of dividing sub-areas.

the first 1 or 2 floors are used for public function, while the rest above floors are used for living.

In order to make the situation about open area ratio clearer, a historical change from 1980 to 2002 is showed in **Figure 4.1**. The sub-area scale open area ratios in three different years are selected, which are 1980, 1998 and 2002.
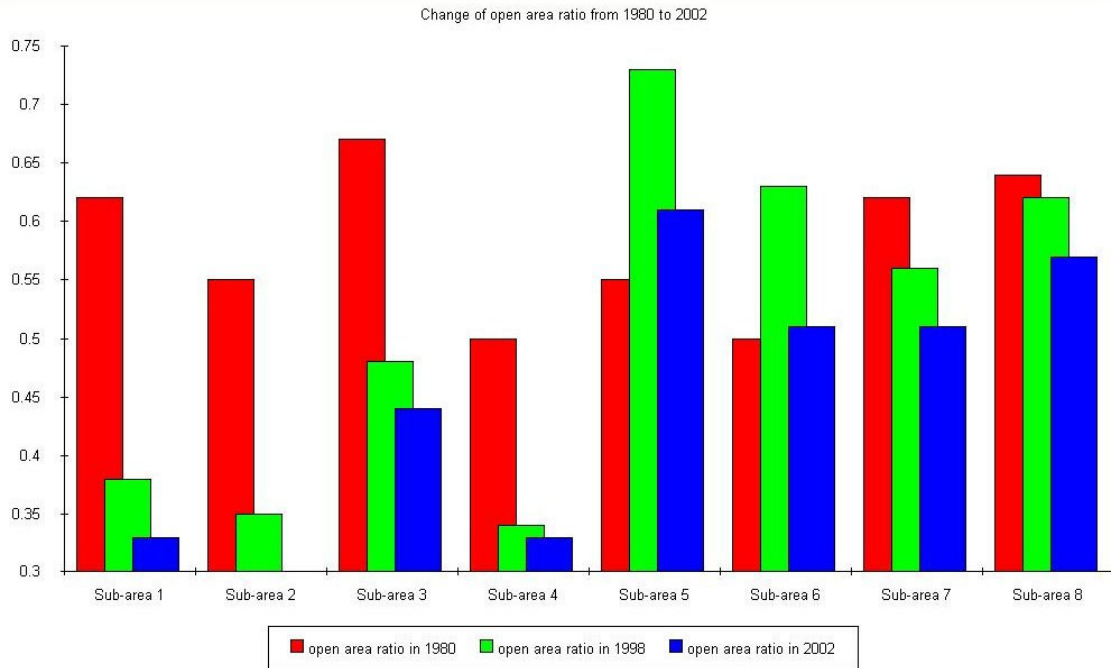
Figure 4.1   Historical change of open area ratio

From this figure, three characters about the historical change of open area ratio can be found as following:

First, in most of the sub-areas, the general tendency of the change is decreasing gradually, except for state-owned sub-area 5 and 6. The sudden increasing in state-owned sub-area 5 and 6 in 1998 can be explained by two large-scale redevelopments that happened in these two areas respectively during the period from 1980 to 1998.

A common character of the two redevelopments is the construction of multiple-floor buildings with more space between them, replacing the original low-rise buildings by demolishing them totally. Therefore, there is a sudden increase in state-owned sub-area 5 and 6, because of the two-dimensional character of open area ratio.

Second, although a large-scale redevelopment of 1991 happened in state-owned sub-area 7 with a similar character to the redevelopments in state-owned sub-area 5 and 6, the open area ratio of state-owned sub-area 7 in 1998 still has not exceeded that in 1980. This phenomenon is contributed by the part of mixed collectively owned areas.

Third, generally speaking, from 1980 to 1998, relatively larger change has happened in the collectively owned sub-areas (sub-area 1, 2 and 3) than in the state-owned sub-areas (sub-area 4, 5, 6, 7 and 8). This is because that in the collectively owned sub-areas, much open area has been invaded by

the local inhabitants in the period from 1980 to 1998, without control from municipal governments or other organizations.

On the contrary, from 1998 to 2002, relatively larger change has happened in the state-owned sub-areas, especially in state-owned sub-area 5 and 6, than in the collectively owned sub-areas. This is because that little open area has been left for local inhabitants to invade in the collectively owned sub-areas, which made local inhabitants begin to invade the state-owned land from 1998 to 2002.

In a conclusion, the invasion of open area is serious in the Huangjiadun neighborhood, not only in the collectively owned sub-areas, but also in the state-owned sub-areas. Although the invasion speed in the collectively owned sub-areas has been in slowdown, the problem is still urgent, since the open area ratio in these areas is far low. With regard to the state-owned areas, although the open area ratio is not so low as that in the collectively owned sub-areas, the tendency of fast invasion from 1998 to 2002 has given an alarm about this problem.

Analysis on Floor area ratio (scale: sub-area)

The variable of floor area ratio reflects a three-dimensional density of land use. Comparing the floor area ratio in case study area (see **Map 4.5**) and the classified indicators (see Table 3.5 in section 3.4.1), the reasonable level of floor area ratio can be got and two characters can be found as following:
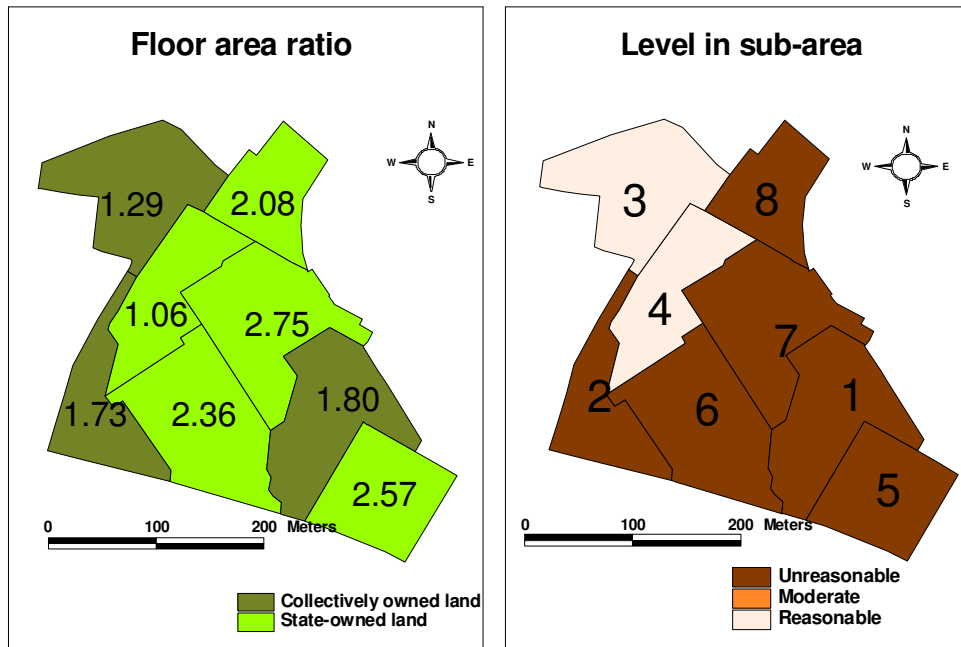

Map 4.5   Floor area ratio in different sub-areas

First, most of the state-owned sub-areas (such as 5, 6, 7 and 8) have a relatively higher floor area ratio than the collectively owned sub-areas (sub-area 1, 2 and 3).

Second, one of the state-owned sub-area (sub-area 4) has a lowest floor area ratio of 1.06, because of many old low-rise buildings in this area.

In order to make the situation about floor area ratio clearer, a historical change from 1980 to 2002 is showed in **Figure 4.2**. The sub-area scale open area ratios in three different years are selected, which are 1980, 1998 and 2002.
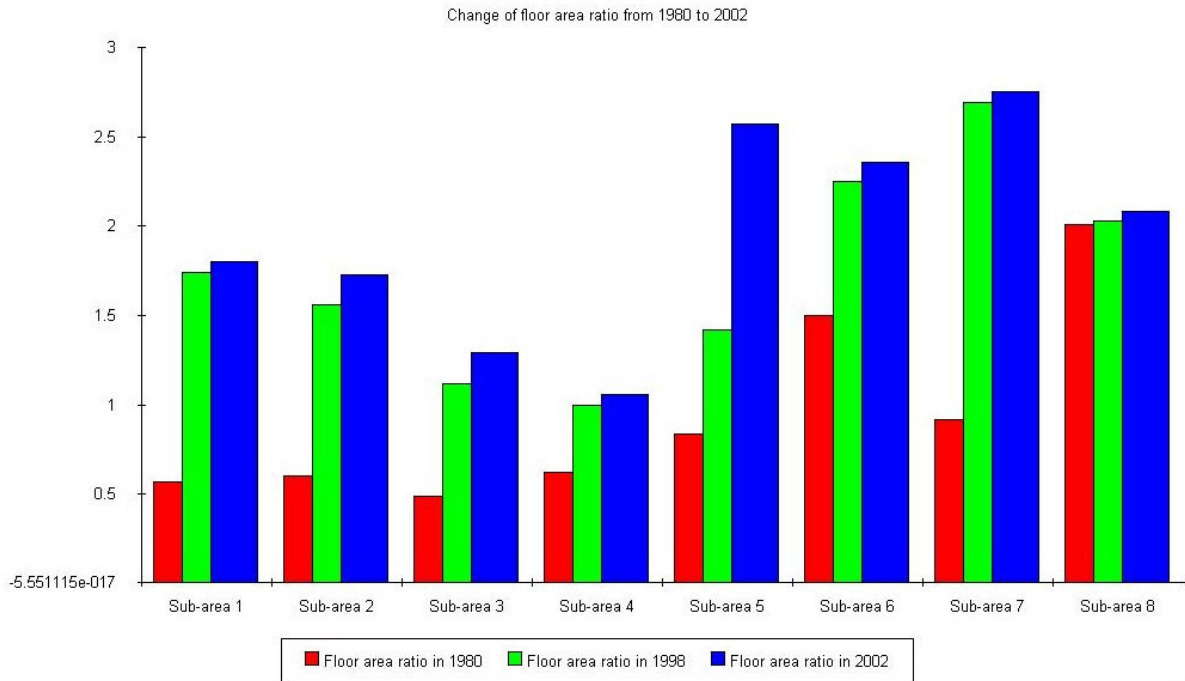
Figure 4.2   Historical change of floor area ratio

From this figure, four characters about the historical change of floor area ratio can be found as following:

First, the general tendency of the change is increasing gradually, except for that in state-owned sub-area 8, whose buildings have been finished before 1980 and kept intact so far.

Second, although the floor area ratios have an obvious change not only in the collectively owned sub-areas but also in the state-owned sub-areas, the ways of change are different. In the collectively owned sub-areas, buildings still have relatively lower floors with a rapid increase of ground floor built area, while in the state-owned sub-areas, the increase of floor area ratio is mainly caused by the increase of buildings' floor.

Third, generally speaking, a relatively larger change happened in the collectively owned sub-areas than in the state-owned sub-areas from 1980 to 1998, except for the state-owned sub-area 7.

This phenomenon is contributed by the mixture of collectively owned areas in state-owned sub-area 7, which not only leads to the increase of buildings' floor (that is the character in the state-owned sub-areas), but also an obvious increase of ground floor built area (that is the character in the sub-

areas without clear land ownership). Just the two parts of increase make the state-owned sub-area 7 have a largest change of floor area ratio in the period from 1980 to 1998.

Fourth, a little change happened in both collectively owned sub-areas and state-owned sub-areas from 1998 to 2002, except for the state-owned sub-area 5. A new eight-floor building was completed in state-owned sub-area 5 in 2002, which is the main reason for the obvious change in this area.

In a conclusion, the floor area ratios in most sub-areas are too high, especially in the state-owned sub-areas.

Conclusion about land use problem

After analyzing the condition of land use, from the viewpoint of land use proportion, open area ratio, and floor area ratio, the conclusions about land use problem are following:

First, green land and public building land is too little in the Huangjiadun neighborhood.

Second, the problem of invading open area is serious both in the collectively owned sub-areas and the state-owned sub-areas.

Third, the floor area ratios in most sub-areas are too high to reach the standard of reasonableness, especially in the state-owned sub-areas.

Fourth, the composite scores about serious level of land use problem in different sub-areas can be got, from the viewpoint of open area ratio and floor area ratio (see **Table 4.3**).

Table 4.3   Composite scores about serious level of land use problem

Sub-area	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4	Sub-area 5	Sub-area 6	Sub-area 7	Sub-area 8
Open area ratio	1	1	2	1	3	2	2	3
Floor area ratio	1	1	3	3	1	1	1	1
1-serious, 2-moderate, 3-unserious								

4.5.2.   Analysis on Public and commercial service

The service problem will be analyzed by using three variables that are service kinds, needed area and service radius. Using these three variables, three questions can be answered: if all the needed services exist in the case study area, if the extend of each service is enough to all inhabitants in the case study area, and if all the inhabitants can access the services in a suitable distance.

Service kinds and Needed area (scale: neighborhood)

Comparing the current service kinds and area in the case study area with the indicators calculated from Norm (see **Table 4.4**), two conclusions can be got as following:

Table 4.4 Service kinds and area in the Huangjiadun neighborhood

Sorts	Amount	Name	Needed area in Norm (m^2)		Area in case study area (m^2)		Reach the standard or not
			Land area	Floor area	Land area	Floor area	
Educational services	1	Nursery	598~896	239~448	(80)	(160)	**No**
	2/3	Primary school	3660~6723	1307~2017	400	322	**No**
Health services		Health center			85	46	Yes
Cultural and gymnastic services		Activity center			575	368	Yes
Commercial services	1	Grocery		336~411		827	Yes
	3	Restaurant		448~598		590	Yes
	1	Salon		75~90		298	Yes
	1	Repairman shop		80		421	Yes
	1	Recycle bin	75	37	43	43	Yes
Financial and communicatory services	1/2	Bank		120~150		(145)	**No**
	1	Post office		75~112		(78)	**No**
Public services	1~2	Public toilet		22~45		123	Yes
	4~5	Dumping ground	11~15		14		Yes
	4~6	Parking space for bicycle		568~1135		179	**No**
Administrative services	1	Residents' committee		149		85	**No**
	1	House keeping department		149~187		887	Yes
2/3 means that two neighborhoods can share 2 services.							
1~2 means that one neighborhood should own one or two services.							
( ) means the service is not located in the case study area.							

First, most needed service kinds exist in the Huangjiadun neighborhood, except for nursery, bank and post office. Since it is also regulated in the *Norm of Neighborhood Design* that two neighborhoods can share one bank, the service of bank can be located near the case study area. In another

word, only nursery and post office are lack in the Huangjiadun neighborhood from the viewpoint of service kinds.

Second, the areas of primary school and parking space for bicycle are deficient seriously, and area of residents' committee is not enough too. Moreover, not only the nursery, bank and post office do not exist in the case study area, but also with regard to the nearby nursery and post office in other neighborhoods, the areas of them are still deficient.

Service radius (scale: sub-area)

After processing data about the services relevant to inhabitants' daily life, it can be found that four kinds of services do not reach the standard for all inhabitants in the case study area, which are post office, public toilet, parking space for bicycle and residents' committee. The area beyond the service radius can also be found in **Map 4.6**.
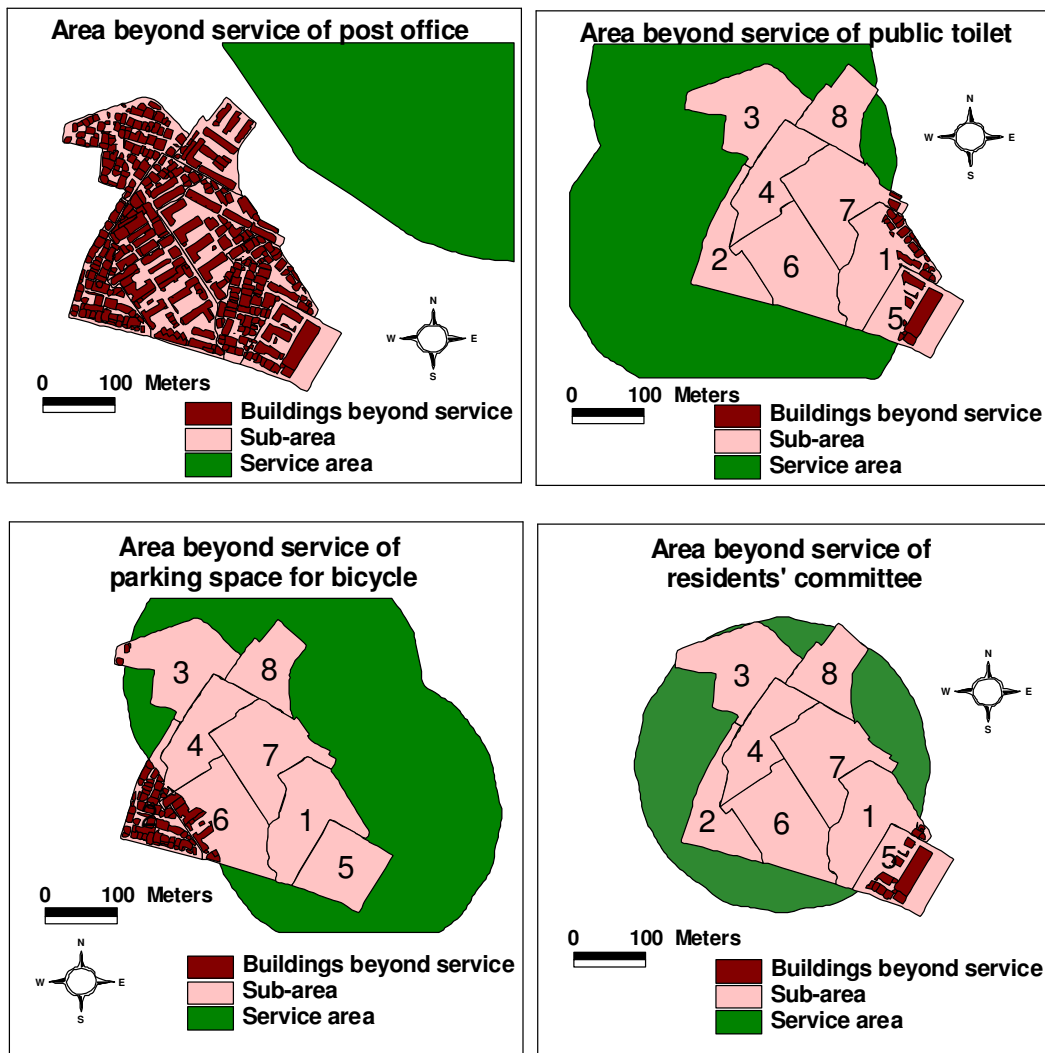
Map 4.6　　Area beyond service radius

As regulated in methodology, it means the problem of inconvenient service exists in the sub-area that even one building is beyond the threshold of certain service radius. Therefore, conclusions about service radius can be got as following:

First, all the sub-areas are beyond the standard service radius of post office.

Second, collectively owned sub-area 1, and state-owned sub-area 5 and 7 are beyond the standard service radius of public toilet.

Third, collectively owned sub-area 2 and 3, and state-owned sub-area 4 and 6 are beyond the standard service radius of parking space for bicycle.

Fourth, collectively owned sub-area 1 and state-owned sub-area 5 are beyond the standard service radius of residents' committee.

Conclusion about service problem

After analyzing the condition of public and commercial service from the viewpoint of service kinds, needed area and service radius, the conclusions about service problem can be got as following:

First, nursery and post office are lack in the Huangjiadun neighborhood from the viewpoint of service kinds.

Second, the areas of primary school and parking space for bicycle are deficient seriously.

Third, the need of post office is urgent. Since all the sub-areas are beyond the standard service radius of post office, it will not be used in this study for evaluating serious level of physical problems in different sub-areas.

Finally, the composite scores about serious level of service problem in different sub-areas are got, from the viewpoint of the service radius of public toilet, parking space for bicycle and residents' committee (see **Table 4.5**).

Table 4.5   Composite scores about serious level of service problem

Sub-area	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4	Sub-area 5	Sub-area 6	Sub-area 7	Sub-area 8
Service radius of public toilet	1	3	3	3	1	3	1	3
Service radius of parking space for bicycle	3	1	1	1	3	1	3	3
Service radius of residents' committee	1	3	3	3	1	3	3	3
1-serious, 2-moderate, 3-unserious								

4.5.3. Analysis on Road

There are three variables can be used to evaluate road problem, which are access ratio of fire engines, road pavement ratio, and drainage system ratio. By using these three variables, road problem can be analyzed not only from the viewpoint of fire engines, but also from the viewpoint of people.

Because of the shortage of data, the variable of drainage system ratio cannot be used in this study for evaluating serious level of road problem in different sub-areas. Therefore, the serious level of road problem on the scale of sub-areas will be evaluated from the viewpoint of access ratio of fire engines and road pavement ratio.

Access Ratio of fine engines:

The variable of access ratio of fire engines is used to evaluate on which degree the fire engines can permeate the neighborhood. As mentioned in section 3.4.3, only the roads with a width over 3.5 meters can be passed by fire engines.

In order to make the situation about access ratio of fire engines clearer, the condition of access road is showed in **Map 4.7** at first, to give a visual impression that in the most area of the Huangjiadun neighborhood, especially in collectively owned sub-area 1, 2 and 3, and state-owned sub-area 4 and 6, little area can be reached by fire engines, which makes those areas dangerous for people to live.
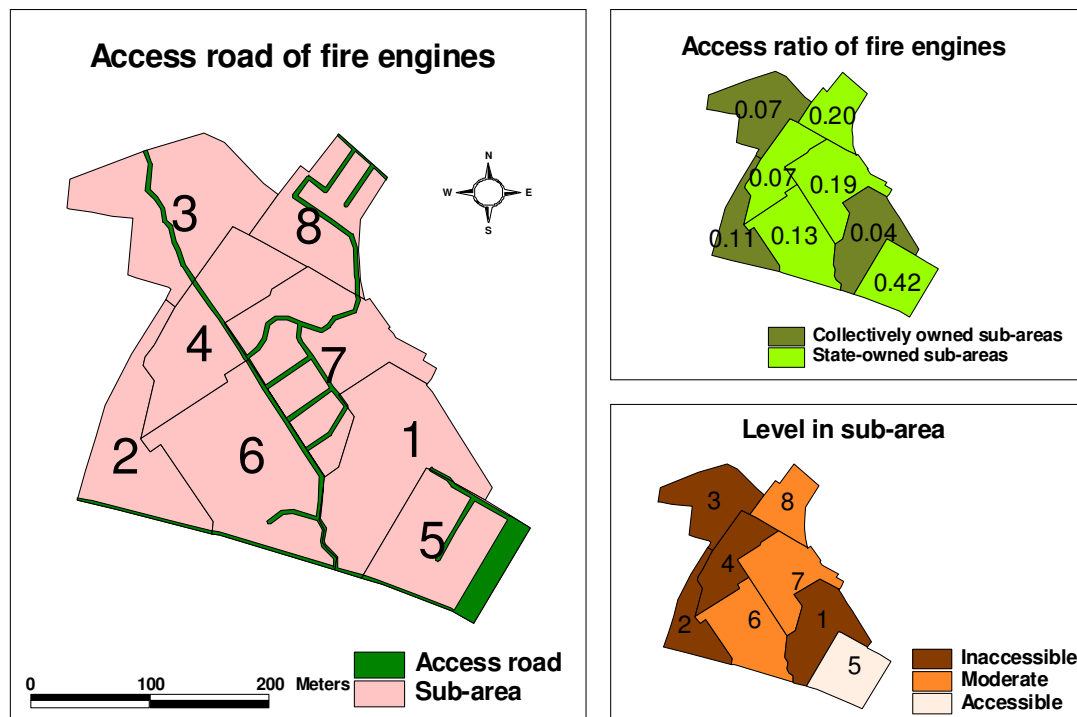
Map 4.7   Access ratio of fire engines in different sub-areas

Then, Comparing access ratio of fire engines in case study area (see **Map 4.7**) and the classified indicators (see Table III.2 in Appendix III), the accessible level of fire engines can be got and three characters can be found as following:

First, the access ratios of fire engines in most sub-areas are below 0.20 except for that in state-owned sub-area 5, which reflects the low accessibility of road from the viewpoint of fire engines in the Huangjiadun neighborhood.

Second, most of the state-owned sub-areas (sub-area 5, 6, 7 and 8) have a relatively higher ratio than the collectively owned sub-areas (sub-area 1, 2 and 3).

Third, one of the state-owned sub-area (sub-area 4) has a low access ratio of fire engines, because many old narrow-space and low-rise buildings in this area make the roads too narrow for fire engines to pass.

In a conclusion, the road accessibility from the viewpoint of fire engines in most sub-areas is low, especially in the collectively owned sub-areas 1, 2 and 3.

Pavement ratio (scale: sub-area)

In order to make the situation about pavement ratio clearer, the pavement condition is showed in **Map 4.8** at first, to give a visual impression that most of the roads in the neighborhood have pavement except for some in collectively owned sub-area 1 and 2, and state-owned sub-area 5 and 6. Especially in collectively owned sub-area 1, nearly no paved roads cross this region.
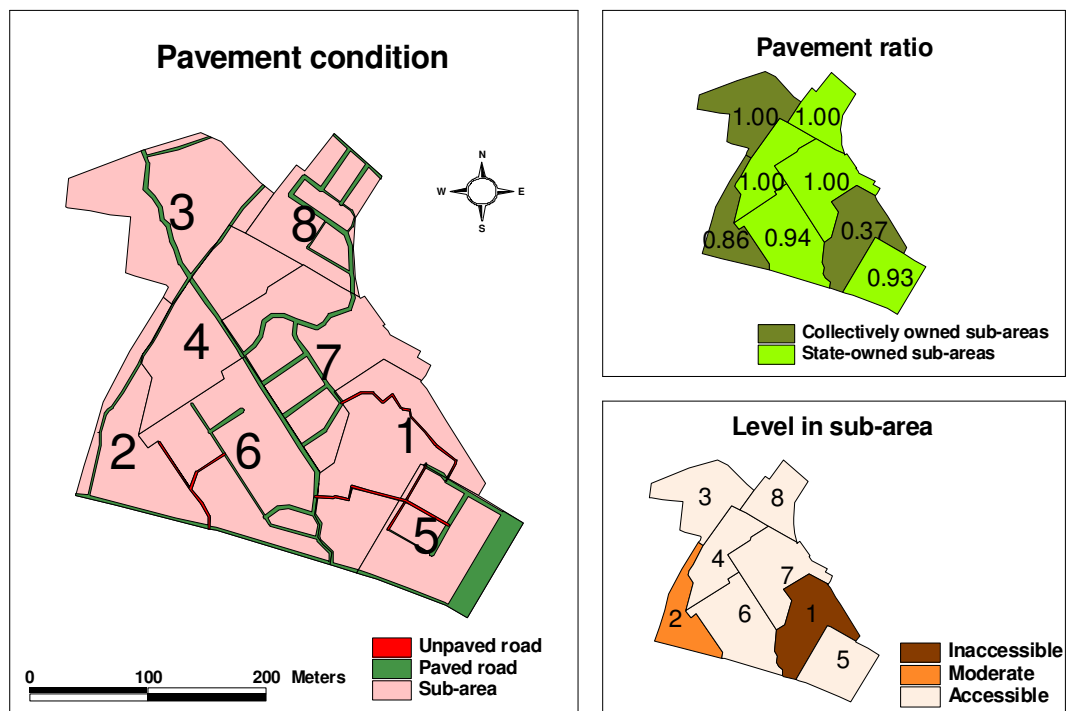
Map 4.8   Pavement ratio in different sub-areas

Then, Comparing pavement ratio in case study area (see **Map 4.8**) and the classified indicators (see Table III.2 in Appendix III), the accessible level of people can be got and two characters can be found:

First, the pavement ratios in most sub-areas are above 0.86, except for that in collectively owned sub-area 1.

Second, all the pavement ratios in the state-owned sub-areas are above 0.93, which means the accessibility level of road in the state-owned sub-areas is quite high from the viewpoint of people.

In a conclusion, the road accessibility from the viewpoint of people in most is high, except for that in collectively owned sub-area 1.

Conclusion about road problem

After analyzing the condition of road from the viewpoint of access ratio of fire engines and pavement ratio, the conclusions about road problem are following:

First, the road accessibility from the viewpoint of fire engines in most sub-areas is low, especially in the collectively owned sub-areas.

Second, the pavement ratios in most sub-areas are high, except for that in collectively owned sub-area 1.

Third, the composite scores about the serious level of road problem in different sub-areas can be got (see **Table 4.6**), from the viewpoint of access ratio of fire engines and pavement ratio.

Table 4.6   Composite scores about serious level of road problem

Sub-area	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4	Sub-area 5	Sub-area 6	Sub-area 7	Sub-area 8
Access ratio of fire engines	1	1	1	1	3	2	2	2
Pavement ratio	1	2	3	3	3	3	3	3
1-serious, 2-moderate, 3-unserious								

4.5.4.   Analysis on Building

There are two variables can be used to evaluate building condition, which are building condition (that reflects the intensity of use and the condition of maintenance activities carried by the owner or the occupant) and building age. Using these two variables, two questions can be answered: what buildings are in a relatively worse condition, and what buildings have relatively older age. In a common sense, worse quality means worse condition and older age.

Because of the shortage of data, the variable of building condition cannot be used in this study for evaluating serious level of building problem in different sub-areas. Therefore, the serious level of building problem on the scale of sub-areas will be evaluated only from the viewpoint of building age.

Building Age (scale: sub-area)

In order to make the situation about building age clearer, the age of each building is showed in **Map 4.9** at first, to give a visual impression that most of the oldest buildings that have an age between 33 and 53 year are concentrated in sub-area 4, which tends to mean a lower quality of building.
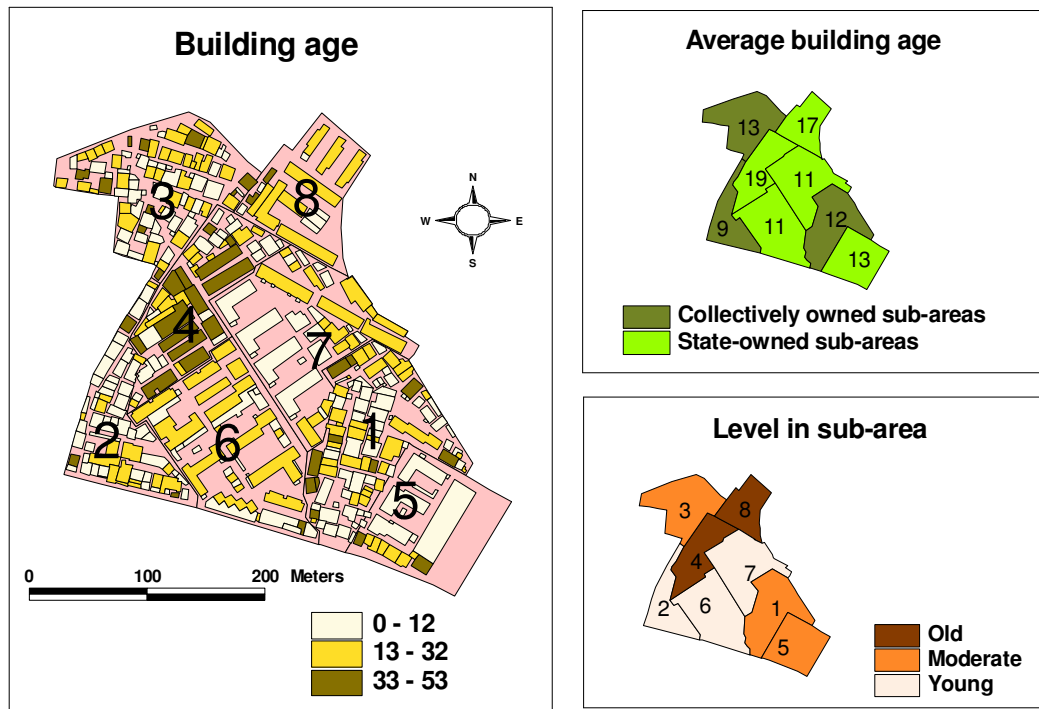
Map 4.9   Average building age in different sub-areas

Then, Comparing average building age in case study area (see **Map 4.9**) and the classified indicators (see Table III.3 in Appendix III), the level of building age can be got and three characters can be found:

First, the building age in most sub-areas is not more than 13 years with the oldest one of 19 years, which means that the building age in the Huangjiadun neighborhood is quite young.

Second, the relatively younger building age in the state-owned sub-area 5, 6 and 7 is mainly relevant to the three large-scale redevelopments around 1990; while in the collectively owned sub-areas, it is contributed by the self-help rebuilding activities from local inhabitants in these areas.

Third, the relatively older building age is in state-owned sub-area 4 and 8, since most of the buildings in these areas have been completed before 1980.

In a conclusion, the building age in most sub-areas is young, except for that in state-owned sub-area 4 and 8.

Serious level of building problem

After analyzing the condition of building, the score about the serious level of building problem in each sub-area can be got (see **Table 4.7**), from the viewpoint of building age.

Table 4.7   Score about serious level of building problem

Sub-area	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4	Sub-area 5	Sub-area 6	Sub-area 7	Sub-area 8
Average building age	2	3	2	1	2	3	2	1
1-serious, 2-moderate, 3-unserious								

4.5.5.   Analysis on Infrastructure

The basic infrastructure relevant to inhabitants' daily life includes sanitation, water pipe, electric net and telephone network; and the sufficiency of infrastructure can be evaluated by sanitation ratio, water pipe ratio, electric net ratio, and telephone network ratio.

Since the percentage of population with access to tap water and electricity are both 100% in the Huangjiadun neighborhood, the variables of water pipe ratio and electric net ratio will not be used for evaluating the serious level of infrastructure problem in different sub-areas. At the same time, because of the limit of data, the variable of telephone network ratio cannot be used too. Therefore, the serious level of infrastructure problem on the scale of sub-areas will be analyzed from the viewpoint of sanitation ratio.

Sanitation ratio (scale: sub-area)

In order to make the situation about sanitation ratio clearer, the sanitation condition is showed in **Map 4.10** at first, to give a visual impression that the buildings in the collectively owned sub-area 1, 2 and 3, and the state-owned sub-area 4 are lack of sanitation.
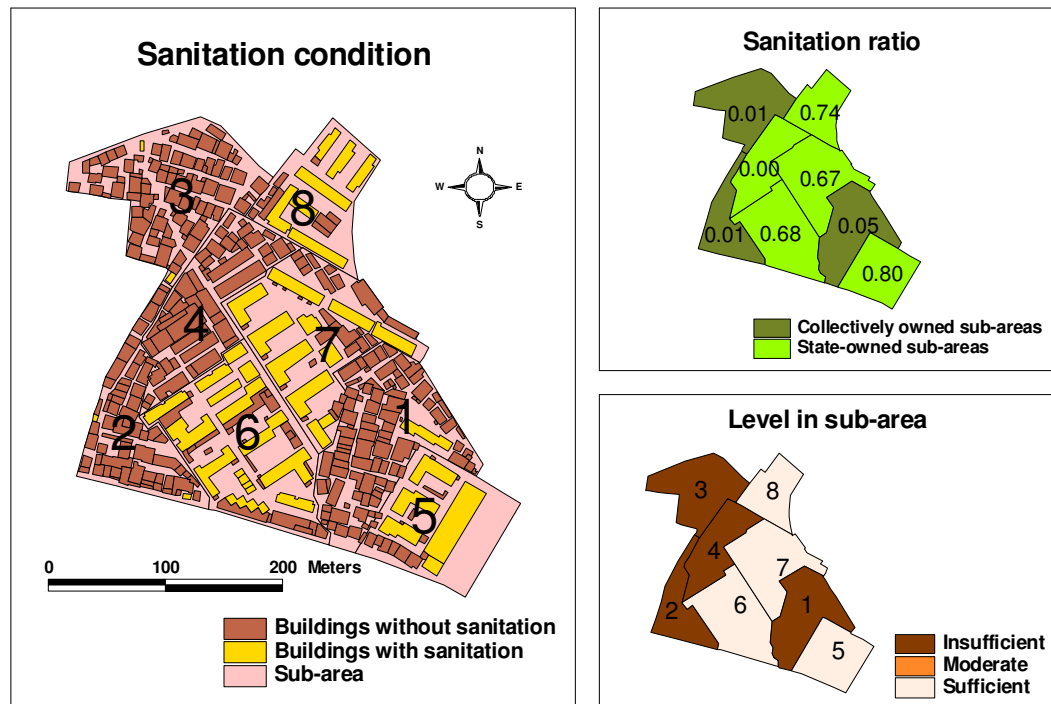
Map 4.10   Sanitation ratio in different sub-areas

Then, comparing sanitation ratio in case study area (see **Map 4.10**) and the classified indicators (see Table III.4 in Appendix III), the level of sanitation ratio can be got and two characters can be found:

First, generally speaking, there is an obvious difference between the sanitation ratio in the collectively owned sub-areas and that in the state-owned sub-areas. The ratios are very low in the collectively owned sub-areas (sub-area 1, 2 and 3), which are all below 0.05. However, relatively far higher ratios are in the most of state-owned sub-areas (sub-area 5, 6, 7 and 8), which are above 0.67.

Second, no sanitation exists in the state-owned sub-area 4, since most of the buildings were built between the 1950s and the 1970s without sanitation. Moreover, no redevelopment happened in this area like the other state-owned sub-areas. Both of these reasons make the buildings in state-owned sub-area 4 lack of sanitation so far.

In a conclusion, the shortage of sanitation is serious in the Huangjiadun neighborhood, especially in collectively owned sub-area 1, 2 and 3, and state-owned sub-area 4.

Serious level of infrastructure problem

After analyzing the infrastructure condition, the score about the serious level of infrastructure problem in each sub-area can be got (see **Table 4.8**), from the viewpoint of sanitation ratio.

Table 4.8   Score about serious level of infrastructure problem

Sub-area	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4	Sub-area 5	Sub-area 6	Sub-area 7	Sub-area 8
Sanitation ratio	1	1	1	1	3	3	3	3
1-serious, 2-moderate, 3-unserious								

4.5.6.   Analysis on Environment

This criterion includes four variables that are noise, pollution zone, safe place and good sights. Since the whole neighborhood is located in safe place (which means it is not in the flood-prone area, landslide-prone area or the area with poor geographic quality), the variable of safe place will not be used in this study.

After processing data, the area influenced by noise, pollution zone and good sights can be got (see **Map 4.11**). As regulated in methodology, it means the situation of uncomfortable (or comfortable) environment exists in the sub-area that even one building is influenced by noise, pollution zone (or good sights). Therefore, conclusions about environment condition can be got as following:
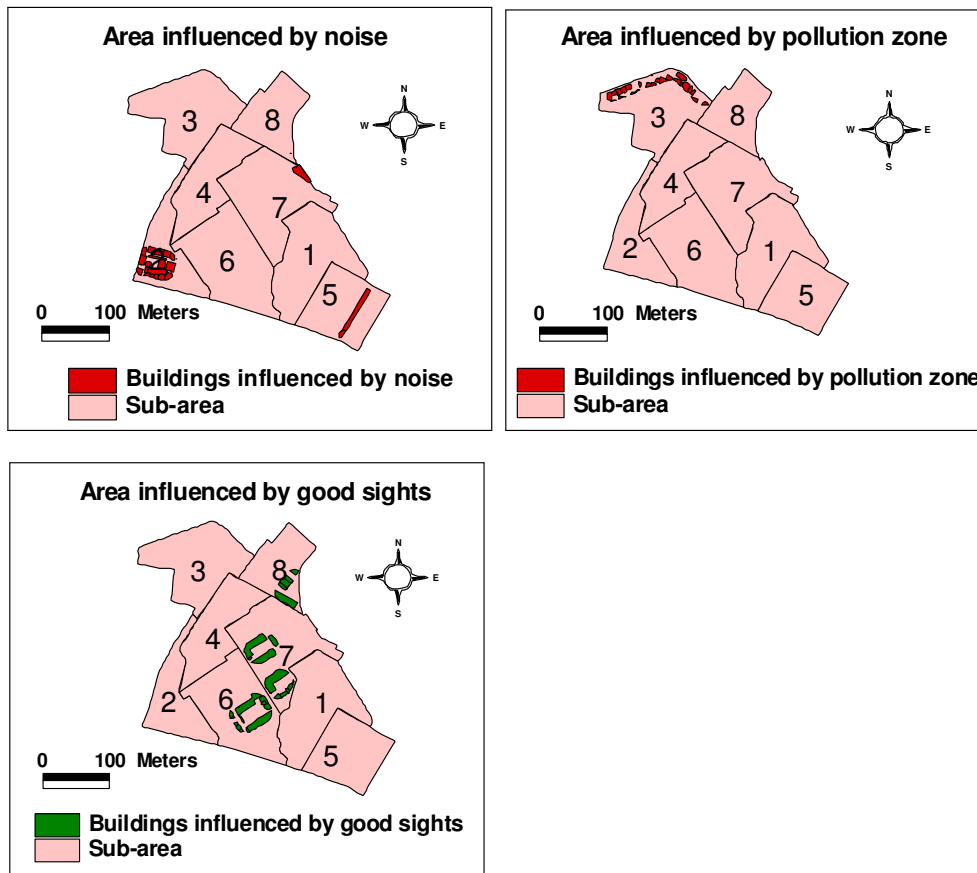
Map 4.11   Area influenced by noise, pollution zone and good sights

First, several buildings in collectively owned sub-area 2 are influenced by the noise from the primary school in this area without any green belt, one building in state-owned sub-area 7 is influenced by noise from the primary school near this area without any green belt, and two buildings in state-owned sub-area 5 are influenced by the noise from the main road near this area without any green belt.

Second, several buildings in collectively owned sub-area 3 are influenced by the polluted lake in this area without any green belt.

Third, part of buildings in state-owned sub-area 6, 7 and 8 get a good influence from the green area in these areas, which means the environment in the state-owned sub-areas is more comfortable than that in the collectively owned sub-areas, from the viewpoint of good sights.

Serious level of environment problem

After analyzing the condition of environment, the composite scores about serious level of environment problem in different sub-areas can be got, from the viewpoint of noise, pollution zone and good sights (see **Table 4.9**).

Table 4.9   Composite scores about serious level of environment problem

Sub-area	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4	Sub-area 5	Sub-area 6	Sub-area 7	Sub-area 8
Noise	3	1	3	3	1	3	1	3
Pollution zone	3	3	1	3	3	3	3	3
Good sights	2	2	2	2	2	3	3	3
1-serious, 2-moderate, 3-unserious								

4.5.7.   Overall scoring of physical problems using all variables

According to the evaluation rule described in section 3.7 and the weights assigned in section 3.6, the scores about serious level of physical problems in different sub-areas can be got (see **Map 4.12**).
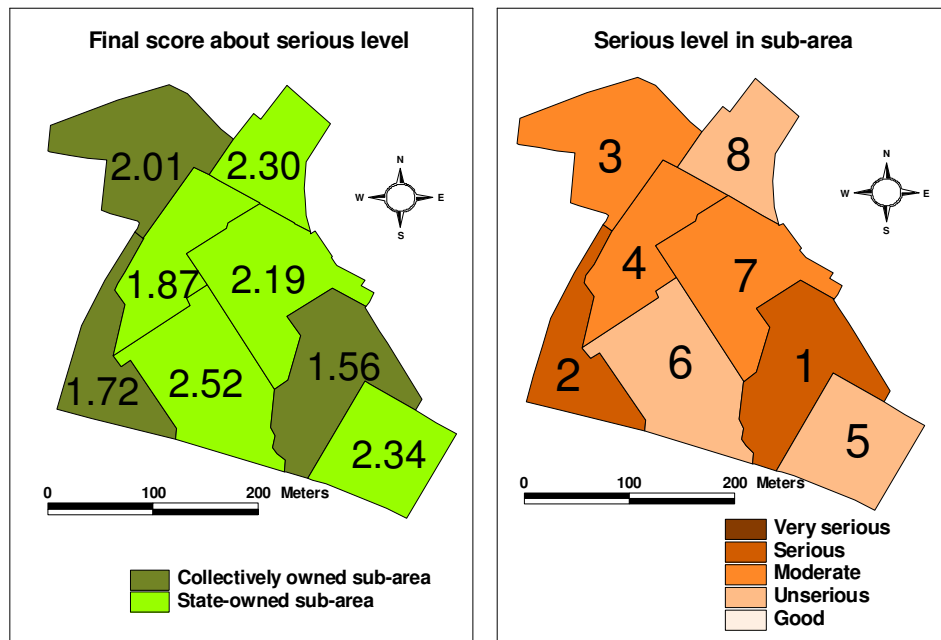
Map 4.12   Final score about serious level of total physical problems

From this map, two characters about serious level of physical problems in the Huangjiadun neighborhood can be found as following:

First, generally speaking, the physical problems in the collectively owned sub-areas are more serious than those in the state-owned sub-areas.

Second, according to the classification of five serious levels (see Table 3.15 in section 3.7), it can be found that two collectively owned sub-area 1 and 2 belong to the serious level, another collectively owned sub-area 3 and two state-owned sub-area 4 and 7 belong to the moderate level, the other three state-owned sub-area 5, 6 and 8 belong to the unserious level; while no sub-areas belong to very serious and good level.

Moreover, in order to help planners and politicians to formulate the strategies about urban renewal, the physical problems in each sub-area are listed in **Table 4.10**.

Table 4.10   Physical problems in different sub-areas

Land ownership	Sub-area	Physical problems
Collectively owned	1	Low open area ratio, High floor area ratio, Beyond service of post office, public toilet and residents' committee, Low access ratio of fire engines, Low pavement ratio, Low sanitation ratio
	2	Low open area ratio, High floor area ratio, Beyond service of post office and parking space for bicycle, Low access ratio of fire engines, Low sanitation ratio, Influenced by noise

	3	Beyond service of post office and parking space for bicycle, Low access ratio of fire engines, Low sanitation ratio, Influenced by polluted lake
State-owned	4	Low open area ratio, Beyond service of post office and parking space for bicycle, Low access ratio of fire engines, Old building age, Low sanitation ratio
	5	High floor area ratio, Beyond service of post office, public toilet and residents' committee, Influenced by noise
	6	High floor area ratio, Beyond service of post office and parking space for bicycle
	7	High floor area ratio, Beyond service of post office and public toilet, Influenced by noise
	8	High floor area ratio, Beyond service of post office, Old building age

From this table, the physical problems in different sub-areas can be concluded from the viewpoint of the two kinds sub-areas as following:

First, the problems of low open area ratio, low access ratio of fire engines, and low sanitation ratio mainly exist in collectively owned sub-areas.

Second, the problem of old building age only exists in state-owned sub-areas.

Finally, the problems of high floor area ratio and lack of post office, and the environment problems exist in both area types.

4.6.   Legal, Social, and Economic problems

Since urban renewal is not only relevant to physical factor, it encompasses different aspects of intervention namely physical, social, economic, politic, culture, health, and environmental; the legal, social and economic problems in case study area will be shortly analyzed in this section, which in turn contribute to the physical problems more or less.

4.6.1.   Legal problem

In this study, the legal problem will be analyzed, from the viewpoint of Chinese land policy that leads to the problem of unclear land ownership in the distressed neighborhood directly.

As mentioned before, still some areas in the distressed neighborhoods which belonged to collectively owned land past and have become state-owned land now, are still called as collectively owned land, and ignored by governments. Therefore, the analysis about how this problem appeared from the viewpoint of Chinese land policy is important in this study, which is described as following:

After the establishment of China in 1949, land reform (Tu Gai) was launched in a bid to reduce social inequality by confiscating land from the rich (landlords) and then redistributing it to the poor, which ended the private land ownership gradually. By 1958, all land was either state-owned or collec-

tively owned. It is regulated that urban land is state-owned, whereas farmland is collectively owned (Ding, 2003 p.110).

Then, the state owned all urban land and allocated it to some state-owned enterprises (Dan Wei) free of charge for an indefinite period and the constitution banned land transaction. Under the planned economy, land value and land income were hidden in the overall profits of the state-owned enterprises. Focusing on economic development plans, the state and municipal governments had the right to decide where projects should be made and allocate land to them. Since land did not have value and did not affect the equation of total project costs, many projects (particularly industrial establishments) occupied more land than they needed consequently, fencing it off by building walls (Ding, 2003 p.111). Without careful governance from the enterprises, this part unused land was occupied gradually by lots of local peasants later on, and is beyond the administration of the enterprises now.

At the same time, with the urbanization and city expansion, the nearby land to the distressed neighborhoods that belonged to the collectively owned land at the edge of city in the past has become and been bounded as part of urban area. The conversion of these areas from collectively owned land to state-owned land were realized through land acquisition by paying a compensation package to the peasants for the land, such as job opportunities, housing compensation, compensation for the loss of crops, and the granting of urban residency licenses. By 1978, nearly all the local peasants have been evolved to the inhabitants with urban residency licenses through this way. However, these areas are still called as collectively owned land now without governance of municipal governments.

Therefore, it can be found that two kinds of areas contribute to the land without clear land ownership. One kind is the unused state-owned areas invaded by local peasants. The other kind is the areas converted from collectively owned land at the edge of city in the past but still called as collectively owned land now. As mentioned before, there is a legal gap of no governance from municipal governments and other organizations in these areas.

Even when this legal problem has been noticed in recent years, still some bottlenecks exist: First, the lack of good cadastral, registration, and tenure records is a serious constraint on efficient city growth, especially on the development of the distressed neighborhoods (Dowall, 1991 P.ii). Second, the overcrowded buildings in these areas make the cost of reconstruction or redevelopment high, which leads to the reluctance of governance from governments and other organizations that in turn exaggerates the other physical, social and economic problems in these areas.

4.6.2. Social problem

The population components in the Huangjiadun neighborhood are three: employees in railway departments (concentrating in state-owned land), inhabitants evolved from peasants before 1978 (concentrating in collectively owned land), and immigrants (in collectively owned land). All the data about these people are collected by questionnaires, filled based on face-to-face interviews. The total sample are 65, occupying 2.8% of the whole families in the neighborhood. Among the total sample, 27 of them are employees in railway departments, 23 of them are inhabitants evolved from local peasants, and 15 of them are immigrants.

The method to analyze social problems in this study is described as following:

First is to analyze how the different socioeconomic statuses of people influence their views and attitudes. Then is to analyze how their different views and attitudes influence the physical condition in the neighborhood.

In this method, there are two important criteria needed be analyzed, which are the socioeconomic status of people, and the view and attitude of people.

- **Socioeconomic status of people**

This criterion can be analyzed through three variables: socioeconomic position of people, income of people, and usable space of people.

Socioeconomic position of people:

This variable mainly focuses on personal position of householder but not a whole family, since different people in a family have different positions.

Table 4.11   Socioeconomic position of people

Population compo-nents	"Hukou[10]"		Character of job			Main occupation
	Urban	Rural	Regular	Irregular	No	
Employees in railway departments (%)	100	0	33.3	3.7	63	Workers in Railway departments
Inhabitants evolved from peasants (%)	82.6	17.4	0	21.7	78.3	Landlord; Shopkeeper; Server
Immigrants (%)	20	80	6.7	80	13.3	Seller for vegetable, food-stuff, fruit, or commodity

From the statistics of questionnaire data showed in **Table 4.11**, it can be found as following:

With regard to the employees in railway departments, all of them are citizens in Wuhan. Most of these people are or were employees in Railway departments, and the rest are relatives of these employees. With regard to job character, only 33.3% of them have regular job, while 63% have no job now. Among the people who have no job, 76% of them are retirees, which means that they still can get retirement pension to make a living.

With regard to the inhabitants evolved from peasants, most of them are citizens in Wuhan. However, with regard to their job, most of them have no job and the rest have irregular job, which means the income of these part residents are mostly unfixed. It is interesting that although most of these people have no job, they still can earn a little money to make a living by renting their houses or leaving

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[10] China's *hukou* means a kind of residency license in China. (Household or residential registration) system has been used as a means of social control, especially in regulating domestic migration. It has survived two decades of rapid economic growth and market-oriented institutional and cultural changes, playing a critical role in maintaining sociopolitical stability. Under the *hukou* system, Chinese citizens are divided into urban and rural residents. All leaders and cadres, college graduates, and military officers (active duty or retired) are urban *hukou* holders.

part of the houses as shops. Therefore, landlord and shopkeeper are listed in the table as two main oc-cupations in this study.

With regard to the immigrants, only 20% have urban "hukou", which means the most of them will not obtain the same pay and welfare as those of citizens. The occupations of them are mainly seller for vegetable, foodstuff, fruit, and commodity. Although most of these people have job, their incomes are still unfixed because of their irregular jobs.

In sum, most of the people in the Huangjiadun neighborhood have little income or unfixed in-come, which reflects the relatively lower socioeconomic position of people in this neighborhood com-pared with those in Wuhan. It is interesting to find that although most of the inhabitants evolved from peasants are citizens of Wuhan, the job character of them is on the lowest level among these three population components.

<u>Income of people:</u>

Different from the variable of people's socioeconomic position, this variable is used to evaluate the average income level in a whole family. In order to evaluate the people's income level in the Huangjiadun neighborhood, it is important to quote the statistics of different income level in Wuhan showed in **Table 4.12**.

Table 4.12   Different income level and proportion in Wuhan

Income level	Lowest	Low	Lower Middle	Middle	Upper Middle	High	Highest
Proportion of population (%)	10	10	20	20	20	10	10
Per capita yearly disposable income (yuan)	2508	3562	4194	6158	8143	10888	15539

After processing the data about people's income in the Huangjiadun neighborhood, the income level in the Huangjiadun neighborhood can be found and showed in **Table 4.13**.

Table 4.13   Proportion of different income level in the Huangjiadun neighborhood

Income level / Population	Lowest	Low	Lower Middle	Middle	Upper Middle	High	Highest
Employees in railway departments (%)	22.2	7.4	40.8	7.4	18.5	3.7	0
Inhabitants evolved from peasants (%)	60.9	17.4	21.7	0	0	0	0
Immigrants (%)	46.7	26.6	13.3	6.7	0	6.7	0

From this table, it can be found as following:

With regard to the employees in railway departments, 56.6% of them are around the low middle-income level. The people in the lowest-income level also account for a large proportion by 22.2%.

With regard to the inhabitants evolved from peasants, 60.9% of them are in the lowest-income level, and all of them are below the middle-income level.

With regard to the immigrants, 86.6% of them are below the middle-income level, with 46.7% in the lowest-income level.

In sum, most of the people in the Huangjiadun neighborhood are below the middle-income level, with a large quantity on the lowest-income level, which reflects the relatively lower income level of people in this neighborhood compared with those in Wuhan. It is still interesting to find that among these three population components, the income level of the inhabitants evolved from peasants is lowest, from the viewpoint of their income level.

Usable space of people (sq. m per capita):

This variable is used to evaluate the average living level of a whole family. In order to evaluate the people's living level in the Huangjiadun neighborhood, it is important to quote the statistics of per capita usable space of residents of Wuhan in 2000 that is 12.6 sq. m per capita.

After processing the data about people's usable space in the Huangjiadun neighborhood and comparing the result (see **Table 4.14**) with the average level of those in Wuhan (12.6 sq. m per capita), the living level in the Huangjiadun neighborhood can be found as following:

Table 4.14   Average usable space of people in the Huangjiadun neighborhood

Population	Average usable space (sq. m per capita)
Employees in railway departments	13.2
Inhabitants evolved from peasants	19.2
Immigrants	5.5

With regard to the employees in railway departments, the average usable space of them has reached the average level in Wuhan.

With regard to the inhabitants evolved from peasants, the average usable space of these people is far above the average level in Wuhan, which is consistent with their character of occupations. As mentioned above, the main occupations of these people are landlord and shopkeeper, which caused some of them to extend their houses for business.

With regard to the immigrants, the average usable space of these people is only 5.5 sq. m per capita, which reflect their quite low living level, compared with the average level in Wuhan. This phenomenon can be explained according to their background. Since their goal of immigration is to earn money for their family in country, they tend to select cheapest living condition and to save money as much as possible.

In sum, expect for the immigrants, people in the Huangjiadun neighborhood have a relatively higher level of usable space compared with that in Wuhan.

● **View and attitude of people**

This factor includes the willingness of people's caring about physical situation of this neighborhood, and the willingness of people's living in this neighborhood. In this study, these two variables mainly focus on householder's view and attitude but not a whole family, since different people in a family have different views.

Willingness of people's caring about physical situation of this neighborhood:

After processing the questionnaire data, the different attitudes to physical condition in the Huangjiadun neighborhood can be got and showed in **Table 4.15**, from the viewpoint of different population components.

Table 4.15   Different attitudes to physical condition in the Huangjiadun neighborhood

Population	Willingness of caring			Reason of not caring		
	Very much	Little	No	No responsibility	No time or spirit	No opportunity
Employees in railway departments (%)	51.9	40.7	7.4	27.3	9.1	63.6
Inhabitants evolved from peasants (%)	7.7	61.5	30.8	62.5	25	12.5
Immigrants (%)	0	40	60	36.4	45.4	18.2

From this table, it can be found as following:

With regard to the employees in railway departments, more than half of them care about the physical condition in the Huangjiadun neighborhood very much. At the same time, among the people who care a little or not care about the physical condition, 63.6% want to care about it but do not know how to do for it, which can be understood as having no opportunity to do something for the physical condition.

With regard to the inhabitants evolved from peasants, majority of them care little or do not care about the physical condition in the Huangjiadun neighborhood, of whom 62.5% think they have no responsibility for physical condition and 25% have no time or spirit to care about it.

With regard to the immigrants, no people care the physical condition very much, among whom 45.4% have no time or spirit to care about it, and 36.4% think they have no responsibility.

In sum, among the three population components, the employees in railway departments care about physical condition most and immigrants care least.

<u>Willingness of people's living in this neighborhood:</u>

After processing the questionnaire data, we can get the different attitudes to living in the Huang-jiadun neighborhood showed in **Table 4.16**, from the viewpoint of different population components.

Table 4.16   Different attitudes to living in the Huangjiadun neighborhood

Reason of living here / Population	Birthplace	Low expense	Supply from work place	Convenient traffic
Employees in railway departments (%)	22.2	14.8	70.4	3.7
Inhabitants evolved from peasants (%)	86.4	50	11.1	0
Immigrants (%)	0	73.3	0	53.3

Population	Willingness of changing		Reason of not changing			Where people want to leave for	
	Yes	No	Famili-arity	No money	Convenient traffic	Around	Away
Employees in railway departments (%)	55.6	44.4	41.7	23.1	66.7	46.2	53.8
Inhabitants evolved from peasants (%)	27.3	72.7	57.1	62.5	7.1	66.7	33.3
Immigrants (%)	53.3	46.7					

From this table, it can be found as following:

With regard to the employees in railway departments, most of them live in the Huangjiadun neighborhood because of the houses supplied by work place. When asked about changing residence, more than half of them have this intent. Even among the people who do not want to change, the main reason is the convenient traffic but not economic reason.

With regard to the inhabitants evolved from peasants, most of them live in the Huangjiadun neighborhood as a birthplace. When asked about changing residence, most of them do not want to change with two important reasons that are familiarity with the neighborhood and the economic rea-son. Even among the people who have intent to change, most of them still want to leave for the place around the neighborhood.

With regard to the immigrants, only two reasons important for living in the Huangjiadun neighborhood, which are the low expense and the convenient traffic. When asked about changing residence, more than half of them have this intent.

In sum, among the three population components, the employees in railway departments and im-migrants have a relatively more tendency to change residence than the inhabitants evolved from peas-ants.

● **Conclusion of social problem**

After analyzing the social characters of different population components, the conclusions about social problem can be got as following:

First, generally speaking, the attitude about physical condition is influenceed by the socioeconomic status. The people who have a relatively lower socioeconomic status care less about the physical condition in the neighborhood.

Second, the biggest social problem comes from the inhabitants evolved from peasants. These people are on the lower level of socioeconomic status in the neighborhood and care less about the physical condition. Since their main income comes from renting houses or leaving part of their houses as shops, they will not change their residence without much better compensation.

4.6.3. Economic problem

In this study, the economic problem will be analyzed from the viewpoint of finance assistance from governments or other organizations, which is still the main financial source for the maintenance of the constructions in the distressed neighborhoods. Three contents are included in this aspect, which are the source of finance assistance, the amount of finance assistance, and the contribution of the finance assistance.

After field survey, interviews with local inhabitants, and visitation with local governments, it can be found that very little finance assistance is got from local governments every year. In the Huangjiadun neighborhood, only the state-owned land under control of the railway departments still can get a small quantity of finance assistance in recent years, while the collectively owned land has no such assistance at all. This phenomenon is corresponding with the legal gap existing in the latter areas, which has been analyzed in section 4.5.1.

With regard to the state-owned land in the Huangjiadun neighborhood, its main finance assistance comes from the Jiangan Construction Bureau in Wuhan Railway Department, with the amount of about 250 thousand Yuan per year. It is a very small assistance for the physical maintenance in a 55073 square meters area.

From their records, the contributions of these finance assistances in recent years are following: In 1999, near 200 thousand Yuan is used for the repairing of drainage in building. In 2001 and 2002, near 440 thousand Yuan is used for road pavement.

Overall, the finance assistance in the Huangjiadun neighborhood is very limited, which reflects the poor maintenance of physical condition in this neighborhood on certain degree.

4.7.　　　Conclusion

This chapter mainly deals with the applying of the GIS-based methodology to the case study area, for analyzing physical problems in the Huangjiadun neighborhood.

For each physical variable, the general description about physical problems is given at first. Then the serious level about physical problems in different sub-areas is evaluated, attached with different scores. At the end of the section of analysis on physical problems, two conclusions about serious level of physical problems are got. One is that generally speaking, the physical problems in the collectively owned sub-areas are more serious than those in the state-owned sub-areas. The other one is that from the viewpoint of the two kinds of sub-areas, the problems of low open area ratio, low access ratio of fire engines, low sanitation ratio mainly exist in collectively owned sub-areas; the problem of old building age only exists in state-owned sub-areas; and the problems of high floor area ratio and lack of post office, and the environment problems exist in both area types.

Considering that urban renewal is not only relevant to physical factor, the legal, social and economic problems are shortly analyzed at the end of this chapter.

With regard to the legal problem, it is found that two kinds of areas contribute to the land without clear land ownership from the viewpoint of Chinese land policy. One kind is the unused state-owned areas invaded by local peasants. The other kind is the areas converted from collectively owned land at the edge of city in the past but still called as collectively owned land now.

With regard to the social problem, two conclusions are got. One is that generally speaking, the attitude about physical condition is influenced by the socioeconomic status. The people who have a relatively lower socioeconomic status care less about the physical condition in the neighborhood. The other is that the biggest social problem comes from the inhabitants who have evolved from local peasants before 1978. These people are on the lower level of socioeconomic status in the neighborhood, care less about the physical condition and will not change their residence without much better compensation.

With regard to the economic problem, it can be found that the finance assistance in the Huangjiadun neighborhood is very limited, which reflects the poor maintenance of physical condition in this neighborhood on certain degree.

From the above results, it can be said that the legal problem has contributed a lot to the imbalance of physical characters between the state-owned sub-areas and collectively owned sub-areas, and social and economic problems have contributed a lot to the poor maintenance of physical condition in the neighborhood.

5. Conclusions and Recommendations about methodology

This chapter mainly focuses on the conclusion and recommendations about the methodology developed in Chapter 3 and applied in Chapter 4, since the main objective of this study is to develop a GIS-based methodology. Moreover, in order to give a more comprehensive conclusion about this research, the findings of this research and conclusion about data collection are mentioned too.

5.1.　　Findings of this research

Findings of this research are made of four aspects, physical, legal, social, economic problems, among which the analysis of physical problems is the emphasis.

With regard to physical problems, it can be found that the physical problems in the collectively owned sub-areas are more serious than those in the state-owned sub-areas. From the viewpoint of the two kinds of sub-areas, it can be found as following: First, the problems of low open area ratio, low access ratio of fire engines and low sanitation ratio mainly exist in collectively owned sub-areas; second, the problem of old building age only exists in state-owned sub-areas; and finally the problems of high floor area ratio and lack of post office, and the environment problems exist in both area types.

With regard to the legal problem, it is found that two kinds of areas contribute to the land without clear land ownership from the viewpoint of Chinese land policy. One kind is the unused state-owned areas invaded by local peasants. The other kind is the areas converted from collectively owned land at the edge of city in the past with the city expansion.

With regard to the social problem, it is found that the attitude about physical condition is influenced by the socioeconomic status; and the biggest social problem comes from the inhabitants who have evolved from local peasants before 1978, since these people are on the lower level of socioeconomic status in the neighborhood, care less about the physical condition and will not change their residence without much better compensation.

With regard to the economic problem, it can be found that the finance assistance in the case study area is very limited, which reflects the poor maintenance of physical condition in this neighborhood on certain degree.

5.2.　　Conclusion about methodology

●**Difference between the variables defined in this methodology and used in case study area**

In this study, it can be found that some variables defined in Methodology Chapter are not used in the Huangjiadun neighborhood. There are two reasons showed as following:

The first reason is the limit of collected data. Since the data about drainage system ratio, building condition and telephone network ratio are not collected; these three sub-variables are not used in this study.

The second reason is the limitation of specific condition in case study area. Since the percentage of population with access to tap water and electricity are both 100% in the Huangjiadun neighborhood, these two variables are not used in this study. The variable of safe place is not used too, since the whole Huangjiadun neighborhood is located in a safe place.

In this case, it means that although all the variables defined in this methodology aim at the distressed neighborhoods and can be referred to by other people, different ones of them should be selected, according to the different collected data and specific condition of neighborhoods in others' researches.

●**Applicability of the indicators defined in this methodology**

Generally speaking, the indicators got from the *Norm of neighborhood design* in China can be used for all kinds of neighborhoods in China, the indicators got from the regulations about neighborhood design in Wuhan or the *Wuhan Statistical Yearbook* can be used for neighborhoods in Wuhan or some similar cities, while the indicators defined according specific condition in case study area only can be used in the Huangjiadun neighborhood.

However, the indicators about service kinds and needed area are two exceptions compared with other indicators from the *Norm of neighborhood design* in China. The indicators about these two variables defined in this study are limited by the size of case study area, which means they only can be used in the Huangjiadun neighborhood or the neighborhoods with similar population, but not all kinds of neighborhoods in China.
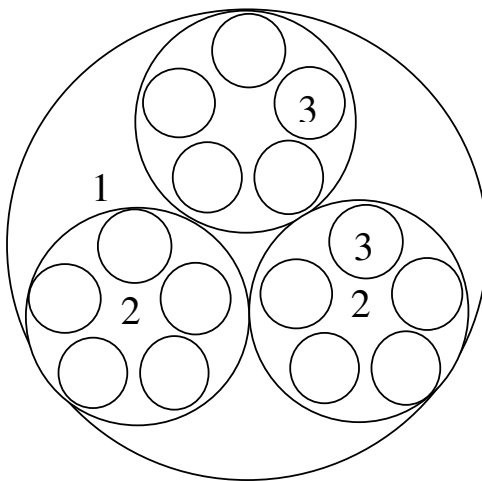
In the *Norm of Neighborhood Design*, there are three kinds of neighborhoods in Chinese cities from the viewpoint of their size, which are named as "residential district", "residential quarter" and "housing cluster". A "residential district" tends to mean a neighborhood with a population from 30000 to 50000, a "residential quarter" tends to mean a neighborhood with a population from 7000 to 30000, and a "housing cluster" tends to mean a neighborhood with a population from 1000 to 3000. From **Figure 5.1**, it can be seen that a "residential district" (1) is made of several "residential quarters" (2), and a "residential quarter" (2) is made of several "housing clusters" (3).

Figure 5.1   Relationship among three kind neighborhoods

According to the three kinds of neighborhoods, different service kinds and area are regulated and listed in the *Norm of Neighborhood Design*. Generally speaking, relatively more service kinds and area are needed in "residential district", less of those are needed in "residential quarter", while least of those are needed in "housing cluster".

Since the Huangjiadun neighborhood belongs to the "residential quarter", the indicators about service kinds and needed area corresponding to a "residential quarter" are selected in this study. In this case, the indicators about service kinds and needed area in this study only can be used for the neighborhoods with similar population; while with regard to other two kind neighborhoods, the indicators should be selected again, according to the specific size of case study area.

●**Limitation of using the statistics of questionnaires method to assign weights**

Although the method of assigning weights of variables according the statistics of questionnaires answered by local inhabitants is the most objective one for urban renewal at neighborhood scale, it still has a limitation that inhabitants only can choose the designed alternatives, which can be easily influenced by the designer's subjectivity. This means that if the designer has not a relatively more understanding about the physical condition in the case study area, the questionnaires will be useless.

●**Limitation of evaluating physical problems on sub-area scale**

Generally speaking, the data of most variables are processed at sub-area scale, such as open area ratio, floor area ratio, access ratio of fire engines, average building age, sanitation ratio and so on.

However, for some variables, the result is more relevant to unit of buildings, such as service radius, noise, pollution zone and good sights. For these variables, the serious level is evaluated by finding in which sub-area the buildings have service or environment problem, which means the problems exist in this sub-area.

In this study, it is regulated that even one building having physical problem means the problem exists in the sub-area. This regulation is easily questioned that the result will be distorted if many sub-areas are evaluated to have physical problems just because few buildings cannot reach the standard. Therefore, it should be considered firstly how many sub-areas have this situation and on what degree the result will be distorted, and then decide if this regulation suitable or not. Since this situation was met only when analyzing variables of service radius and noise, it can be said that this regulation is tolerably suitable in this study.

5.3.   Conclusion about data collection

Generally speaking, it is difficult to collect the needed data at neighborhood scale, or some more microcosmic data with the unit of family or building. Since this kind of data are too specific, no institutions, governments or organizations can provide them detailedly. Moreover, it is a common phenomenon in China that few official data are open to the public in most institutions and

nomenon in China that few official data are open to the public in most institutions and governments. All these contribute to the difficulty of collecting data for urban renewal at neighborhood scale.

However, still many such data have been collected in this study. The methods are as following:

First, with regard to the basic map, the scale of a neighborhood is too microcosmic to use any aerial photos or satellite images, which can help to reduce the difficulty of getting or cut down a large expense for buying this kind of maps. Instead, a kind of CAD measured maps at a scale of 1: 2000 about any urban area in Wuhan city can be got from the urban planning departments, or their blueprint maps can be bought from institutions with a far lower payment, compared with that of aerial photos or satellite images.

Second, with regard to the spatial data with the unit of building in a neighborhood, the simplest and most effective method is to collect them by field survey (observing, measuring and recording).

Third, with regard to the demographic and social-economic data, they can be got by interviewing the governors in local governments such as residents' committee, and by interviewing local inhabitants to fill the questionnaires.

In a word, all these above methods make it feasible to collect the data for urban renewal at neighborhood scale.

5.4.   Recommendations about methodology

●**About using the statistics of questionnaires method to assign weights**

As discussed before, the limitation of assigning weights according to the statistics of questionnaires is that inhabitants' choices are confined in the designed alternatives, which is easily influenced by the designer's subjectivity. Therefore, in order to reduce this passive influence, the designer should spend some time in surveying and interviewing local people for getting a more comprehensive understanding about the physical condition in case study area before designing the questionnaires.

●**About the way to fill questionnaires**

When investigating, the way to fill the questionnaires should be noticed. Aiming at different population components, the ways should be different. Generally, the simplest way is handing out the questionnaires, being filled by people, and finally taking them back. However, with regard to the low-income people and immigrants, most of them do so reluctantly. Therefore, the best way is to fill the questionnaires by face-to-face interviews with some little gifts.

Appendix: I

This questionnaire is part of the Questionnaire of social, economic and physical survey in the Huangjiadun Neighborhood. This part is emphasized on physical survey, in order to weigh the different importance of different physical aspects (land use, public and commercial service, house, road, infrastructure, and environment).

The guideline is that the aspect on which the problems are reflected by relatively more residents, can be considered to have more influences on residents' life and relatively more important. According to the variables of each aspect mentioned in section 3.6, the alternatives of each aspect have been designed. Selecting any alternative of them means that the aspect has been reflected. After statistics, we can find the frequency of reflecting on each aspect. Finally, according to the proportion of frequency, the different weightings of importance on each aspect can be calculated.

Questionnaire on Physical factor in Huangjiadun Neighborhood

1. Problem on Land use

□Narrow space between buildings
□Lack of green space

2. Problem on Public and Commercial Service
(This aspect includes nursery school, primary school, hospital, center of activity, shop,
 food market, bank, post office, dump, committee, parking lot, bus station and so on)

□Some services are far from houses, such as _____
□Lack of some kinds of services, such as _____
□The scale of some services need be expended, such as _____
□The level of some services need be promoted, such as _____

3. Problem on Road

□Having narrow nodes for traffic
□Material of road is in low level
□Lack of draining
□Serious occupation
□Lack of legibility with too many turns

4. Problem on Building

□Overcrowded   □Lack of ventilation   □Lack of sunlight   □Bad quality

5. Problem on Infrastructure

□Lack of Sanitation   □Lack of Water pipe
□Lack of Electric net   □Lack of Telephone network

6. Problem on Environment

□Filthy water /Fume /Garbage   □Noise   □Lack of good sights
□In flood-prone areas /landslide-prone areas /areas with poor geographic quality

Appendix II

This questionnaire is the other part of the Questionnaire of social, economic and physical survey in the Huangjiadun Neighborhood. This part is emphasized on social survey, in order to analyze the socioeconomic status of people in the neighborhood and the view and attitude of them, which can help me to find the social problems in the Huangjiadun neighborhood finally.

Questionnaire about People in Huangjiadun Neighborhood

Doorplate: _____
Time: _____

SCHOOL OF URBAN STUDIES, WUHAN UNIVERSITY

Hello! With the admission of Committee, I will represent School of Urban Studies in Wuhan University to make a research about people in this neighborhood. Please feel at ease. This is an anonymous investigation and the result will not be used as any official information. But the result is very important for us. This interview may cost your 30 minutes. I hope the little gift after interview will make up part of your expense. Would you mind to accept my interview?

1. Basic Situation of Family

A1. Sex: □Male □Female
A2. Age: _____   Living years in this neighborhood: _____
A3. Population of family: _____
A4. Relationship: □Owner □Spouse □Father or Mother □Grandpa or Grandma
          □Son or Daughter □Son-in-law or Daughter-in-law
          □Grandson or Granddaughter □Brother or Sister □Others
A5. Connubiality: □Single □Married □Divorced □Losing spouse
A6. Domicile: □Country □Other city   □This city □Others
A7. Culture: □Illiterate □Primary school □Junior school □Senior school
□Male Vestibule school □Bachelor and above □Others
A8. If you have a job now: □Regular work □Closing down □Illness
Stop doing business and retain the post □Return to work after retired
A9. If you have no job now: □Student □Unemployed □Retired □Deformity □House-wife or House-husband □Others

2. Income of Family

B1. Income of a person per year: _____Yuan
B2. Source: □Salary □Welfare □Sale □Others _____

3. House Condition

C1. Patter of house: □Unit □House □Dormitory
C2. Ownership: □Public □Private
C3. Space area: _____m^2
C4. Amount of rooms: _____bedrooms _____living rooms _____toilets
C5. Age of house: _____ The year of rebuilding: _____

4. People's View and Attitude to Neighborhood

H1. Do you care about the development of this neighborhood?
  □No □Just a little □Very much
H2. Why do not you care much about it? (multi-choice)
□This is the duty of Committee and I have no responsibility on it.
□Work has occupied most of my time and I have no time or spirit to care about it.
□I have thought to care about it, but I do not know how to do for it.

□If needed, I am willing to do something for it.

H3. Why do you live here? (multi-choice)

□It is a legacy.

□The expense of living here is low.

□For work.

□The traffic is convenient here.

H4. Do you want to change your residence?

□No □Not certain □Very much

H5.Why don't you want to change your residence?

□I have been used to living here.

□I have no money to change residence.

□It is convenient to live here.

H6. If you want to change your residence, where do you want to go?

□Around here

□Far away

Thanks very much for participating in this survey!

Appendix III   Indices defined accroding to specific condition

Score	Variable / Class	Open area ratio
3	Reasonable	>=0.548
2	Moderate	<0.548 and >0.362
1	Unreasonable	<=0.362

Table III.1.   Index of open area ratio

Score on each variable	Variable / Class	Access Ratio of fire engines	Pavement Ratio
3	High Accessibility	>=0.344	>=0.874
2	Moderate Accessibility	<0.344 and >0.116	<0.874 and >0.496
1	Low Accessibility	<=0.116	<=0.496

Table III.2.   Composite index of access ratio of fire engines and pavement ratio

Score	Variable / Class	Building age
3	Young	<=11
2	Moderate	>11 and <17
1	Old	>=17

Table III.3.   Index of building age

Score	Variable / Class	Sanitation ratio
3	Sufficiency	>=0.64
2	Moderate	<0.64 and >0.16
1	Insufficiency	<=0.16

Table III.4.   Index of sanitation ratio

Appendix IV   **Photos in the Huangjiadun neighborhood**

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