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# Mapping of Sabah Islands using Airborne Hyperspectrometer

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**Abstract**

Human recreational activities and tourism are concentrated on the islands and in coastal waters, often depending on the maintenance of high water quality. The managing of impacts of urbanization and industrialization on the coastal zone ecology has become a high priority for many nations such as Malaysia and, hence, the need to develop better methods for monitoring and predicting change in islands and their coastal systems. Many of the dynamics of the open ocean, islands and changes in their coastal areas can be mapped and monitored using remote sensing techniques. Hyperspectral imaging is a tool that can provide an increasing number of marine and coastal properties over a spatial and temporal range. The remote-sensing measurements of some selected Sabah islands and their coastal waters were collected using a 4 kg "bread-box" sized UPM-APSB's AISA (Airborne Imaging Spectroradiometer for different Applications) airborne spectrographic imager where it was flown over the islands of Bohey, Mabul, Pom-Pom, Kulapuan, Omadal and Larapan study areas as part of the 2004 Sabah's "Ops Pasir" inaugural flight experiment in Sabah on July 13, 2004. The purpose of the study was to determine the current capabilities of a locally developed UPM-APSB's AISA airborne hyperspectral remote sensing applications to operationally map and monitor the islands in Sabah and observe the status of their coastal waters and reef environment. The airborne data were pre-processed on-board a fixed wing aircraft and later processed using spectral end member during the advance digital processing techniques. AISA AeroMAP$^{TM}$ research products showed that the current technology did a good job of conveying spatial variability of the parameters being tested such as human activities and impact, presence of fishing boats, coral reef, near shore shallow bathymetry, shoreline features and coastal vegetation.

## 1. Introduction

The monitoring and maintenance of water quality and ecological quality of islands, coastal zones and inland waters is a growing national concern. Over 20% of the Malaysian human population, especially in Sabah lives in the shallow waters zone surrounding the islands. Coastal development can lead to modification of foreshores, loss of key habitats, changes to flushing rates, re-suspension of sediments, and direct inputs of nutrients and toxicants. Coastal waters are of particular significance in terms of the national fishery. Human recreational activities and tourism are concentrated on the island and her coastal waters and often depend on the maintenance of high water quality. The managing of impacts of urbanization and industrialization on the

coastal zone ecology has become a high priority for many states in Malaysia and, hence, the need to develop better methods for monitoring and predicting change on the islands and her coastal systems.

Recently, UPM-Aeroscan Precision (M) Sdn Bhd has begun utilizing this approach with airborne hyperspectral data of the near-shore marine environment. While ocean data are generally more complex, and some work has been done in applying hyperspectral sensing data to near-shore-marine problems (Holden and LeDrew, 1999; Holden et al., 1999; Hochberg and Atkinson, 2000), many of the concepts developed for forestry and agricultural analysis are applicable to analysis of near-shore airborne hyperspectral data. The UPM-APSB's AISA airborne hypespectral imaging case study described here for some selected Sabah Islands, utilizes the unique capabilities of airborne hyperspectral data to locate, map, and identify components of the beautiful coral reef ecosystem, assessing airborne hyperspectral data's capability with respect to little established ground truth. The overall aim of this paper is the development of a monitoring system for island and coral reef database ecosystems based on hyperspectral remote sensing information. This monitoring system should enable not only the efficient mapping of the coral reefs surrounding the beautiful islands, but also the identification of the reefs that are most endangered. This information will significantly contribute to the progress of protecting and restoring the coral reef and island environments and will in this way add to the sustainable development of these valuable natural resources.

## 2. Methods

### *2.1 Description of study site*

A mission was undertaken over the waters of some selected Sabah Islands to examine the effort required to examine and map the coral reef habitat conditions around the Islands (Figures 1a and 1b). The majority of the effort took place over the Islands of Bohey, Mabul, Pom-Pom, Kulapuan, Omadal and Larapan, during the months of July 2004. These selected islands are excellent test case areas due to their distribution of both fringing and platform reef morphologies and the existence of protected reef habitat.

**<<Fig. 1a. A map of the selected islands in Sabah>>**

**<<Fig. 1b. A map of Sabah with selected islands in dotted circle>>**

### *2.2 The test data and sensor system*

A UPM-APSB's AISA sensor deployed on a Sabah Air's GAF N22B aircraft was acquired over the selected Sabah Islands on 13$^{th}$. July 2004. The UPM-APSB's AISA instrument was programmed in its mode 2 setting, which has a 20 band spectral resolution and a full spatial resolution of 1 m at nadir in the visible and near-infrared part of the spectrum.

### *2.3 Data processing and image analysis*

UPM-APSB has evolved a "standardized" airborne hyperspectral data analysis methodology that has been tested for a variety of data. within the "Environment for Visualizing Images" (ENVI) software system. This is not the only way to analyze these data, but it has been found that it provides a consistent way to extract spectral information from airborne hyperspectral data without *a priori* knowledge or requiring ground observations. The analysis approach consists of (a) correction for atmospheric effects, (b) spectral compression, noise suppression, and dimensionality reduction using the Minimum Noise Fraction (MNF) transformation, (c) determination of end-members using geometric methods (Pixel Purity Index – "PPI"), (d) extraction of end-member spectra using n-dimensional scatter plotting, (e) identification of end-member spectra using visual inspection, automated identification, and spectral library comparisons, and (f) production of some selected Sabah Islands maps using a variety of mapping methods.

## 3. Results and discussion

The airborne hyperspectral technology may provide accurate base maps distribution of the reef communities, coastline features, mainland activities and allows for change detection in near real time. It is quite evident that the detected shoreline features are differentially but consistently offset from one another indicates that a range of physical characteristics in the vicinity of the land–water interface are being detected. It is reasonable to speculate that a number of factors could potentially influence the position of shoreline indicator or features obtained by digital image analysis. The land-water-coral discrimination can be clearly extracted from the image where water is shown in blue, mainland in orange and green, human activities in purple and bright patches while the corals are in darker blue-green and dark purple colors, surrounding Mabul and Omadal Islands, respectively (Figs.2 and 3).

**<< Fig. 2. The corals around Mabul Island >>**

**<< Fig. 3. Coconut plantations on Omadal Island>>**

The islands are also characterized by shallow and gentle sloping sea bottom, and seem to be protected by any monsoon during the image acquisition time. The existence of healthy coral reefs in the area proves that those islands under study provide favorable conditions for coral reefs to develop. At Kulapuan and Pom-Pom Islands survey sites for instance, the reefs are in good shape with high live coral cover ranging from 40-60% (Figs. 4 and 5). The same benthic type, for example sandy bottom in both islands, can be interpreted as shallow, moderately deep and deep sand. At a similar water depth, the reflectance of reefs and seagrass beds recorded in visible bands (400-700 nm) is generally lower than from a sandy bottom. Reefs and seagrass beds behave as darker blue features in contrast to the brighter white sandy coastlines (Figs. 6and 7). At the land/seascape ecological scale, there are interconnections between coral reef, seagrass ecosystems, and the upland land use/land cover. Coral reef communities are highly adapted to nutrient-deficient, oligotrophic and clear water conditions. They often depend upon other ecosystems such as coastal forest, mangrove wetlands and sea-grass beds, which normally act as filters for sediment run-off from land. The suspended silt decreases light penetration, thus reducing photosynthesis and diminishing the principle nutritional source for the corals.

**<<Fig. 4. The "untouched" Kulapuan Island>>**

**<<Fig. 5. Pom-pom Island rich with benthic cover>>**

The development in some of the islands especially Larapan and Bohey Dulang Islands coupled with an increasing population means more land clearance for construction and agricultural land use (Figs. 7 and 8). This will potentially lead to increased runoff and excessive sedimentation and subsequently end up on coastal water where fringing coral reefs scattered along the coastlines. The knowledge of the areas more vulnerable to erosion could be of use to resource managers in proper land use planning for the sake of the nearby coral reef viability.

**<<Fig. 6. Larapan Island rich with coral habitat>>**

**<<Fig.7. Bohey Dulang Island with human activities>>**

## 4. Conclusions

These analyses show that the near real time UPM-APSB's AISA airborne hyperspectral separation and mapping of distinct land/water, near-shore bottom characteristics and human activities surrounding and on the islands are possible. UPM-APSB data were used to demonstrate the capability of airborne hyperspectral remote sensing for a quick and effective monitoring of remote coral reef regions, such as those surrounding the selected islands in Sabah's coastal waters. While there is some potentials of these basic UPM-APSB results to publish benthic habitat maps, coral reef distribution, coastline features, near-shore bathymetry and human activities, depth dependencies are apparent. Spectral "ground truth" at UPM-APSB's AISA scales is required for verification of similarities/differences.

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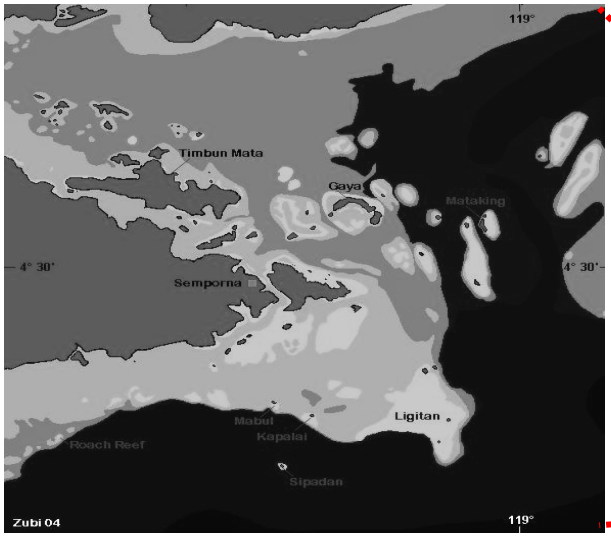


Figure 1a. A map of the selected islands in Sabah

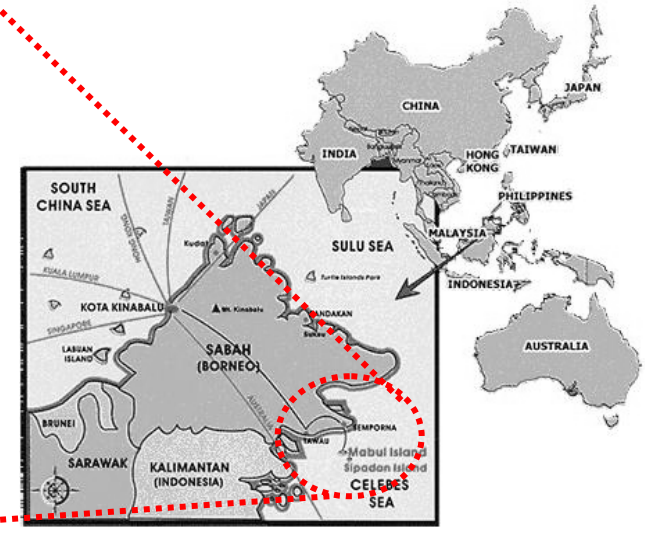


Figure 1b. A map of Sabah with selected islands in dotted circle

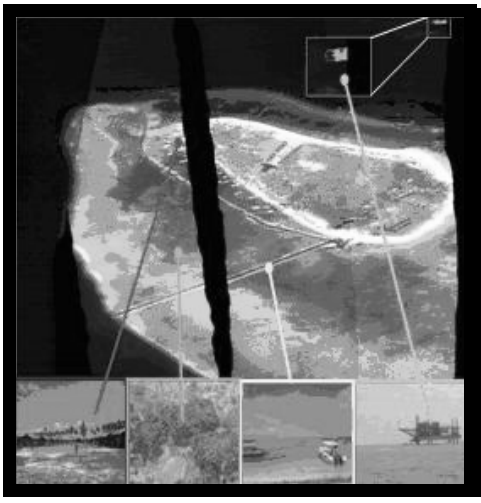

Figure 2. The corals around Mabul Island


Figure 3. Coconut plantations on Omadal Island

Figure 4. The "untouched" Kulapuan Island

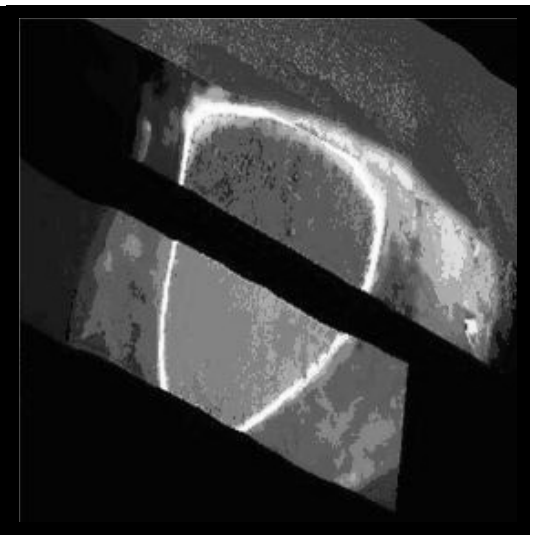

Figure 5. Pom-pom Island rich with benthic cover

Figure 6. Larapan Island rich with coral habitat

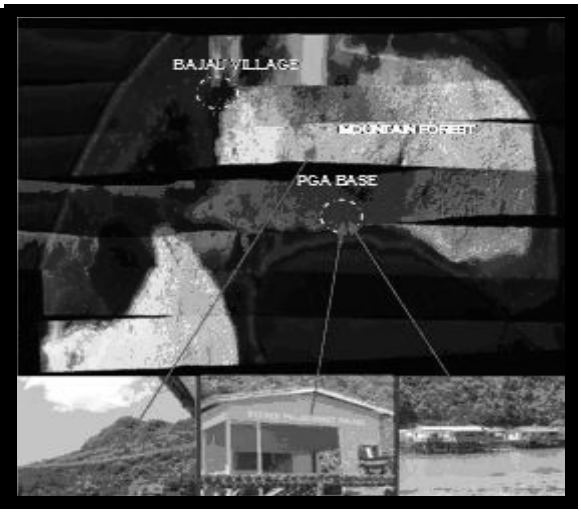


Figure 7. Bohey Dulang Island with human activities

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# On the Characteristics of Housing Spatial Structure and Location Selection of Residential Communities: A Case Study of Wuhan City

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**Abstract**

With the deepening of the housing system reform in China, the residential spatial structure has gradually assumed a complex shape along with its tremendous changes in Wuhan city. It is very crucial and necessary to show the city's housing spatial structure in order to guide the city's housing development and administration. Based on current statistic data and field survey, this paper tries to open up the spatial law of residential communities of Wuhan city, by means of GIS, from the quantitative and empirical points of view.

As far as housing spatial structure is concerned, the three characteristics on the spatial development of residential communities are identified: (1) the housing is stretching towards surroundings with ring and wedged structure; (2) residential communities distribution in urban district is concentrating; (3) on the other hand, the amount distribution of residential communities in the suburbs are examined, mainly along main traffic lines.

Meanwhile, based on the above analysis of the housing spatial structure, the characteristics on residential

location selection of residential communities are also put forward: (1) residential communities development and distribution are mainly concentrated along main traffic lines to obtain more convenient location; (2) moreover, a great many of residential communities have distributed around some lakes and along Yangtze or Hanjiang River. So, it is thought much of gradually for the whole city's residents to obtain the better accessibility and surroundings.

**Keywords:** Residential communities, Housing spatial structure, Residential location selection, GIS, Wuhan city

## 1. Introduction

With the rapid development of urban economy and the alarming increase of urban population since 1990s, housing reform has been deeper and deeper and the contradiction between housing demand and real estate supply has become fiercer and fiercer. At the same time, the spatial structure of urban internal housing market has also experienced tremendous changes, which draw researchers' and relevant authorities' attentions to some relevant issues such as the development and management of real estate industry, especially for housing space and investment location decision. Foreign researchers had systematically investigated housing space from various aspects such as economy, geography, social science and political science and so on, and formed a multi-aspect, multi-hierarchy, multi-dimension (spatial-temporal) and multi-scale (microscopic and microcosmic) research system where both quantitative and qualitative approaches, theoretical and practical methodologies are used. In general, their researches are respectively concentrated on the spatial structure of residential landscape (from the view of ecology) (Caster, 1981), tenements' housing selection and decision behavior (from of the view of behavior science) (Alonso, 1964; Forrest, 1991), the characteristics and social spatial structure of residential community (from the view of social science) (Johnston, 1966). While domestic researchers investigate the spatial structure of residential market from the aspect of urban internal spatial structure, thus their studies focused on various aspects including the spatial distribution of real estate (or residence) and its influence on regional structure (Zhang, 1997; Yan, et al., 2001), the spatial structure evolution of residential space(Wu and Cui, 1999; Zhang and Liu, 2002), housing price and land price(Du, 1997), housing type and its social spatial structure(Xu, et al., 1989; Wang, 1995; Gu, 1997), residential suburbanization and population distribution(Zhou, 1996; Cai and Zhou, 2000), the location of residential community and traffic expansion(Xu, 2002; Zhou and Xu, 2002) and so on. However, there is a lack or weakness in the quantitative and practical study on the spatial distribution of residential community.

In Wuhan city, its residential market is rapidly commercial and humanization environment has gotten more and more attention. Furthermore, in order to uncover the rule of residence spatial extension, guide community commercial service planning and realize sustainable development of humanization environment of residential community, we need to deep investigate the development and complexity of real estate. Based on existing statistical data and on-the-spot investigation and with the aid of GIS, this paper investigates the location selection characteristics of residential community development through the spatial distribution analysis of residential community development. This study can give out some suggestions to residential community management and commerce network planning.

## 2. Research area and methods

### *2.1 Research area*

Considering the internal deep-mining centralization and edge expansion suburbanization, we set the 9 city zones as the main research area and part analysis are only pointed to 4 outskirts due to data accessibility.

*2.2 Framework of study*

Based on statistical data and on-the-spot investigation, we build a GIS spatial data set which includes tenement number, average housing price, construction scale, housing type and floor location etc. With the help of some spatial analysis functionalities of GIS (e.g. buffer and overlay), we then investigate the spatial distribution characteristics of tenement number, price, combination type and construction scale of residential community. Finally we can uncover the properties of spatial structure and location selection for residential community. The frame of this study is listed as shown in Figure 1 below.

*2.3 Research Methodology (see Figure 1 below)*

Step 1: data collection. Using some maps of Wuhan city such as traffic map, land use planning map (from 1996 to 2020), on-selling building distribution map (http://www.zdxx.net/houses/index.htm), (the ChuTian Metropolis Daily, Chutian Golden newspaper and some other newspapers, the almanac of Wuhan real estate (year 2005), Wuhan Soufang website(http://wuhan.soufun.com) and Yifang website(http://www.fdc.com.cn), we can get some basic attributes of residence sample including the name, address(house number), house type, floor location, area and average price, tenement number etc.

Step 2: Extraction of the spatial feature of the data. Firstly, we build a housing sample spatial data based on the selected on-selling house distribution map and housing number geographical code, then we carry out overlay analysis, i.e., combine these maps with Wuhan traffic map, land-use map. Finally, we build the spatial and attribute dataset of these housing samples.

Step 3: Data processing and data analysis. (1) Cell classification. We carry out 1 kilometer buffer analysis of the inner-ring, the main lakes, rivers and traffic arteries of Wuhan city. Use the inner-ring as a border we can divide the whole research area into 40 annular belts, and use the four radicalized traffic arteries as the axes, we can carve up the whole research area into four sector extension belts(see Figure 2 below). (2) Spatial clustering analysis. Respectively use type of residence, housing scale (area of structure, land area), the total floor number, housing price and land load (rate of green, capacity rate) as standards to classify the annular or sector structure of research area. Finally, we can find out the residential group according to the density of housing sample data.

**3. Characteristics of spatial distribution**

*3.1 Ring-shape distribution difference of buffering-belts*

After comparing the number and density of sample data, tenement size and land scale of each residential community of the whole research area, we find out that it demonstrate a significant hierarchical diversity and forms a circle region distribution. We set the sample density, sample ratio, average price, tenement size (means average number of tenement), land scale (means the ratio of construction area), land load (means capacity rate) of 266 randomly chosen new-built buildings in the year of 2005 in Wuhan city as the vertical ordinate while the distance from each annular belt to the area center as the horizontal ordinate. Obviously, the 40 annular belts can be divided into 4 big circle regions: i.e. inner-circle, mid-circle, outer-circle and out-edge circle region respectively comprises of the area between annular belt 1 to annular belt 12, annular belt 13 to annular belt 24, annular belt 25 to annular 33 and outside annular belt 34 (see Figure 3 below). More importantly, the inner-circle buildings are characterized by high density, big construction area, small land area, high capacity and price and fewer tenements, the main housing style are mainly residential/commercial houses and economy houses. Differentiated from it, the mid-circle building are of mezzo density, big land scale and less higher price and more tenements, the main housing style of this region are common houses and economy houses. House located in the outer-circle region can be identified by their big land scale, less developing density, lower price but a large number of tenements, together with a form of housing suburbanization. The main house types in this region are villas and common houses. Houses located in the outer-edge circle region are with a quite low

density, higher price and less tenements. Most of the houses there are villas. See Table 1 below.

*3.2 Sector extension*

Recently, the development of residential communities in Wuhan city tends to be extended along the line of several main traffic arteries, such as Jinyin Lake residential community sector region(RCSR), '318' national highway residential community sector region(RCSR), Miao Mountain residential community sector region(RCSR) and Wuhuang Road residential community sector region(RCSR) (see Figure 4 below). This sector extension is consistent with former studies (Zhang et al. 2004). To illustrate it clearer, we describe the 4 sectors as follows: (1) Jinyin Lake RCSR refers to the northwest extension region located between Jinsan Avenue and Hanfei Avenue, most of them are around-lake low-rise villas and along-river low-rise common house, and they always have convenient traffic, wonderful living environment, low tenement density, low capacity rate, high quality and price. A large number of tenements here are wage earners of Wuhan East Lake high-tech development zone (EDZ). This region is at the stage of rapid development and house price here is more than 3000 RMB per square meters and its capacity rate is lower than 1.5. (2) '318' national highway RCSR, it covers Wuhan East Lake high-tech development zone (EDZ), regions around Houguan Lake, south Taizi Lake and Sanjiao Lake etc. it extends southeast along the '318' national highway. Similar to Jinyin Lake RCSR, this area also have convenient traffic and good living environment, and most of the houses here are low-rise villas and multi-level common houses. House price here is relatively low (2500-3000 RMB per square meters). (3) Miaoshan RCSR. It mainly includes the east part of around-Tangxun Lake area and extends south along Lianghu Avenue. This region is quite closed to Wuhan East Lake high-tech development zone (EDZ); also have good traffic and very wonderful living environment. Many houses here are multi-level common houses, some low-level villas and economy house are located around Tangxun Lake. As this residential community is developed for teachers in university, it formed a university town. Some of the around-lake apartment has become the first choice of peoples who works in Wuhan East Lake high-tech development zone (EDZ). Moreover, house price here is relatively low (2000-2500 RMB per square meters). (4) Wuhuang Road RCSR. It locates between Wuhuang Highway and Wuhuang Road and extends east. Houses here are mainly high-level economy house and common houses, which serves for mid and low-income families. The capacity rate of this region is relatively high (2.1). Besides, both traffic and natural environment here is preferably. House price here is around 1500-200 RMB per square meters.

*3.3 Synchronous concentrations and distribution*

As mentioned above, from the relevant data of the almanac of Wuhan real estate (in 2005), we can obviously see that influenced by the housing policies and system (e.g. urban function, land construction planning, housing reform) and interaction between urban land price, location, population density and purchasing scale, the spatial distribution of the development intensity and construction density of residential community in Wuhan city is complex and uneven.

3.3.1 Centralization of internal deep-mining

In recent years, the urban land use planning of Wuhan city paid a lot of attention to the intensive development of urban function. Due to the remove of unfinished buildings and low-level short old buildings in urban field and growing immigration of companies, there are a large number of left lands. Moreover, infrastructure of traffic, medical treatment and education is relatively perfect in Wuhan city. All of these made the real estate development "making use of every bit of time and space" and concentrated in the internal city. Or more detailed, the real estate development of Wuhan city is: (1) intensive, dense and with a large scale. The number of developed buildings in the central city has accounted for 80% of the whole city, while total construction area, total tenement number, average density, sum of high-rise and semi high-rise houses and the sum of

multi-level houses in central city has respectively account for 90%, 60%, 80%, 90% and 65%. In this regions, land load are always high, the capacity rate had been up to 3.6. (2) circle region distribution of the combination pattern of residential community, in general these communities are resident, official and commercial buildings. Conventional central district is characterized as frequent commercial activities and population migration and large-scale development of official & residential buildings. These buildings are mainly super high-rise with large construction area and are always concentrated in beneficial location such as along the traffic artery. While economy house, multi-level common house are served for low and middle income family, they are always rebuilt from old communities and concentrated in sub-central district. Medium size villas with a low density are also popular in common strict where suitable traffic and living environment is equipped, such as around a lake or river. (3) High price. Comparing with outskirts, urban district residential communities have a higher price. For instance, in year 2005, the rock-bottom price of major building in all urban districts of Wuhan city is 2350 RMB per square meters which is 1.5 times as high as housing price of urban outskirts. Additionally, the average house price of central district of Wuhan is 3000 RMB per square meters.

3.3.2 Suburbanization of edge expansion

With the extension of urban suburbanization, many companies migrate from city center to urban outskirts. Economic development zone also concentrated in these outskirts. Such “company-residence separation” and “company-residence closely adjacent” have become two main trends of residential community development, which greatly promotes the development of housing community in urban outskirts. And with the tide of population suburbanization, the residential community also became suburbanization (Cai and Zhou 2000). Comparing with residences in urban area, residence in urban outskirts is always with a moderate even low price, and its development intensity and scale are small. The spatial distribution of residences in outskirts has demonstrated some specific characteristics: (1) on the support of external traffic arteries, the extension of low density multi-level residential communities is radicalized and formed four sector regions. (2) Most of the around-lake houses are low-level, low-density but high-price villas. Such as villas group of Houguan Lake, villas group of Tangxun Lake, South Lake and Hou Lake etc. (3) with the support of economic development zone, many mediate density multi-level common houses had been built which mainly serves for wage earners. This type of houses can been found in Wujiashan development zone, Zhuan kou and East Lake economic development zone.

3.3.3 Relatively concentrated big group

It is well known that influenced by some factors such as urban planning, population distribution, location and regional infrastructures (traffic, water and power supply, hospital, school etc.), and natural environment, urban residence tend to favor certain places and form a big group structure. It is because such big group structure can provide a better location advantage and can better meet the complex housing demand of urban citizens (e.g. convenient traffic, perfect environment, good auxiliary facilities). There are some big residential community groups in Wuhan city: (1) Xudong residential community group (RCG). Xudong has obvious location advantage. For instance, it is the intersection of Youyi Avenue and Heping Avenue, near Sha Lake and have the support of Xudong Avenue, besides, convenient traffic and developed commerce makes it more attractive. Many super-level commercial residence concentrated here such as Xudong europe garden, Kaixuanmen plaza, Hengqin garden etc. such residences are with a high density and high price (3000 RMB per square meters), also large scale. (2) Sha Lake RCG. This group locates in the inner ring of Wuhan and is adjacent to the central-south-central-north commercial belt, besides, it has very beautiful scenes around the lake. Residences here are mainly high-rise or semi high-rise common houses whose price are relatively high (average price is 2500 RMB per square meters). Huiyu garden, Xin’an garden and Jiahe sunshine cost all belongs to this group. (3) South Lake RCG. This group extends along South Lake and South Lake Airport. Also have good traffic

and environment. Most of the residences here are multi-level semi high-rise commercial and residential houses. It is with high density and price (2000 RMB per square meters). It is needed to mention that South Lake new town is developed along the South Lake, in this new town, not only multi-level common houses can be found for university teachers including teachers who work in south-central university, Huazhong normal university, Huazhong agriculture university and Zhangnan university of economics & law, but also super high-rise common and commercial residences designed for abroad market (e.g. 'Shi long ming ju', 'li shang ren jia' etc.). Besides that, low-rise and low density villas are also built here. The house prices here are nearly 2500 RMB per square meters. (4) Guan shan RCG. This group is near Guanggu and Huazhong university of science and technology, has good traffic. Most residences here are low density multi-level commercial and common houses. House price here is between 1800-2800 RMB per square meters. This group is mainly built for wedge earners who work in university and high technological industries. (5) Tangxun RCG. This group is around Tangxun Lake and closely adjacent to university town. Most houses are mainly low-rise and low density villas. Some are multilevel and high-rise common houses. This region has cheaper land price and better environment, which endows it with a great potential of development. (6) Changqing RCG. It is located in the intersection of Hanfei Avenue, Jinsan Avenue and Changqing Road and adjacent to Jianghan economic development zone and industry industrial parks of mainland and Taiwan. Residential real estate developed very fast. Most of the houses here are large-scale and high density common houses (see Figure 4 below). (7) Qing shan RCG. This group extends along Yejing Avenue and Heping Avenue. Since year 1954, Party central community has located Wuhan iron & steel group in Qingshan district, those areas along the Yangtze River from Jiangjiadun to Renjia Road is used mainly for worker's residences of Wuhan iron & steel group. In recent years, many low-rise but high density common houses are built for mid-income workers of both Wuhan iron & steel group and Cailin group.

## 4. Characteristics of location selection

From the above spatial analysis of residential communities of Wuhan city, it can be easily found out that the development of residential community was greatly influenced by the location condition, the level of regional infrastructure (e.g. traffic, water and power supply, hospital, school etc.), environment condition (natural, social and humanistic environment) and so on. Among all of these influence factors, convenient traffic and perfect environment play the most import role in peoples' house purchasing decision. Thus, the spatial location selection illustrates an obvious characteristic of "contiguity to the street or water".

### *4.1 Traffic orientation*

In this section, we take the inner ring of Wuhan city, Fazhan Avenue, Yanjiang Avenue, Hanyang Avenue, Wuluo-Luoyu-Wuhuan Road as an example to investigate the traffic orientation of the location of residential community. We draw 1 kilometer buffering for each object with the aid of ArcGIS 8.3(see Figure 5 below), and respectively calculate the sum of residence sample located in each buffer. See Table 2 below.

Obviously, there are 147 residential communities in the 1 km buffers of inner-ring road and five major traffic arteries, which account for 55.26 of the total number of sample data (266). Moreover, the average density of residence sample is 2.85/km2), which is 5.5 times as many as the density value of research area (middle-ring). Thus there is a significant traffic orientation in the development of residential community. Or in other words, most of the real estate projects are concentrated along the side of traffic arteries.

Most of the buildings are dense (more than 3/km2) and located in inner-ring of Wuhan city or along Heping Avenue. Such buildings are always super high-rise common houses or commercial buildings with a large scale and high capacity ratio. The proportion and density of those buildings located along the middle-ring road such as Jianshe Avenue, Hanyang Avenue and Fazhan Avenue are lower than the inner-ring buildings. Houses in

this region are mainly large scale multi-level common houses and economy houses with a high capacity ratio. Although the buildings along the Wuluo-Luoyu-Wuhuang Road have a low average density and proportion, comparing with the average residence density of outskirts, the residence development intensity of outskirts is greatly higher than city skirts. For instance, the density of residence sample along Wuhuang Road is 2.17/km2, which is 24 times higher than the density of residence sample of outskirts (0.09/km2). Furthermore, the concentration degree of outskirt residence along traffic artery is quite higher than city residence sample. So we can speculate that in the city, residential communities concentrated along traffic artery and usually have a large scale while the development of residential communities along the radical arteries of outskirt are always not so intensified and always have a not so large scale. However, in general, the development of residential communities of outskirts depend more on traffic artery than city residential community.

*4.2 Water orientation*

For explaining the water orientation of residential communities, we take Yangtze River, Hanjiang River, Sha Lake, Jinyin Lake, South Lake and Tangxun Lake as an example. We use the same approaches as part 4.1 to calculate the proportion and density of every sample residential community located in the buffer of each lake (see Table 3 and Figure 5 below).

From Table 3, we find out that: (1) On the whole, the distribution of residential community around water is disperser than those residential communities along streets. The proportion and density of residential community around the water are both low. Besides, the development intensity, capacity ratio and green rate of such communities are relatively low. Residences around water are always multi-level common house or low-rise villas which have good environment but high prices. (2) Most of the around water residences located in the central city with a high density, and such residences are always multi-level, super high-rise common houses. For instance, Sha Lake sample residential community (located in central city) is lowly proportioned but concentrated with a large development scale, while the residential communities in the sub central city have relatively small development scale and very low density; as most of the land use in such residential communities are Greenland, large scale development of real estate are restricted to the regions located on the west of east and south of the bustling urban built-up area. Two residential community groups have been developed rapidly, namely South-Lake RCG and Along-River RCG. The former are dense buildings of multi-level common houses and villas, while the latter are crowed with more than 17% newly built-up residences of Wuhan city and houses there have low dense and small scale, the main house type are multi-level common houses and villas. (3) The suburb residential communities around lake are developed with a low density and small scale, and most of them are low-rise villas. The Jinyin Lake residential community and Tangxun Lake residential community only proportioned 4.5% of the whole residential communities around rivers, which is relatively lower than urban residential communities. This is because residential communities around Tangxun Lake are on its early development stage, most of residential buildings there are low-rise large-scale villas and multi-level common houses; while Jinyin Lake developed more rapidly than Tangxun Lake, the density of its residential community are relatively high and houses there are always low-rise large scale expensive villas.

**5. Conclusion**

Using the type of building and house, tenement number, selling price, construction scale and other statistical data of sample residential communities in Wuhan city, with the help of spatial analysis in GIS, we find out that:

(1) On the whole, the spatial distribution of residential community in Wuhan city is circle region-sector extension, it demonstrate a structural complexity of the co-existing circle differentiation and sector

differentiation (Wang 1995, Wang et al. 2001). The development intensity and construction scale of residential communities tends to decrease from central city to city outskirts. Moreover, the residential communities form several circle regions from center to edge, i.e. central city, sub central city, common urban areas. In the common urban areas, the residential communities extended radicalizedly along traffic arteries and large lake and finally formed several sector areas. The developing density rapidly decreases along the sector.

(2) Synchronous concentration and diffusion of building development in local which is greatly influenced by traffic, population and environment. The spatial distribution of residential communities is uneven. Locally, the circle region-sector extension has been changed by "perturbation deformation" to concentration-diffusion structure. On one hand, through remolding the old houses, residences for workers of immigration companies have "make use of every bit of time and space" and their distribution is diffused, on the other hand, with the development of artery and the group structure of economic development zones, population suburbanization has also developed rapidly, which promotes the emerging of "company-residence separation" and "company-residence closely adjacent" residential pattern or residential suburbanization. As this residential pattern is easily influenced by traffic and environmental condition, they are always concentrated along traffic arteries or around lakes. Regional differences can be found for their spatial combination ways. Besides, the uneven spatial distribution of residential communities is very significant from the aspect of several concentrated residential group.

(3) In recent years, with the deepening of the housing system reform in China, the residential communities of Wuhan have grown rapidly and influencing factors of them has become more and more complex. In general, among all the factors influencing the location selection of residential community, such as urban planning policy, population distribution and purchasing capacity, infrastructure level (traffic, medical, education etc.), location condition, land use structure and planning, land price, natural environment, social environment and so on, traffic and environmental plays the most important role. This point of view can also be found through our practical study in Wuhan city.

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Table 1. The ring-shape structure of residential communities with hierarchy in Wuhan city

| Circle region | Construction area rate (%) | Rate of tenement (%) | Rate of house type (%) | Ratio of sample gross (%) | Ratio of sample density (%) | Ratio of average price (%) | Ratio of type of building (%) | Main characteristics | Regional type |
|---|---|---|---|---|---|---|---|---|---|
| Inner-circle region | 59.83 | 13.83 | A-37; B-61; C- 29; D- 15 | 33.67 | 52.50 | 1.29 | High rise: 47 Semi high-rise: 60 Multi-level: 31 Low-rise: 10 | High density & capacity rate, most of them are high rise buildings, residential & commercial high price | High density, large scale, high-rise, residential & commercial Common houses |
| Mid-circle region | 29.34 | 40.14 | A-25; B- 23; C- 38; D- 22 | 45.12 | 24.24 | 1.19 | High rise: 30 Semi high-rise: 26 Multi-level: 34 Low-rise: 17 | Medium density Multi-level Common house Large development scale Large tenements number | Medium density & scale Multi-level Common house Economy residential house |
| Outer-circle region | 7.63 | 36.52 | A-28; B- 9; C-11; D-35 | 14.81 | 14.50 | 1.33 | High rise: 14 Semi high-rise: 9 Multi-level: 23 Low-rise: 39 | Low density Most of them are low-rise/villas Development of high-intensity large tenements number High price villas | Low density Medium scale High price Low-rise villas |
| Out-edge region | 3.20 | 9.51 | A-10; B- 5; C- 12; D- 28 | 6.40 | 8.76 | 0.77 | High rise: 9 Semi high-rise: 5 Multi-level: 12 Low-rise: 35 | Low density, most of them are low-rise & villas Lower price Fewer tenements | Low density Large scale Low-rise villas |

(Noted: A: common house, B: residential/commercial house, C: economy house, D: villas)

Table 2. Distribution of residential communities along main roads

| Sample residence distribution | Inner Ring | Fazhan Avenue | Jianshe Avenue | Heping Avenue | Hanyang Avenue | Wuluo-Luoyu -Wuhuang Road | Sum | Average |
|---|---|---|---|---|---|---|---|---|
| Proportion (%) | 16.54 | 7.89 | 6.02 | 11.65 | 6.77 | 6.39 | 55.26 | 100 |
| Density(number/km$^2$) | 3.12 | 2.56 | 2.76 | 3.16 | 2.81 | 2.36 | 2.85 | 0.52 |

Table 3. Distribution of residential communities around rivers and lakes

| Sample residence distribution | Centre city | | | | Urban fringes | | Sum | Average |
|---|---|---|---|---|---|---|---|---|
| | Along Yangtze River & Hanjiang River | Sha Lake | East Lake | South Lake | Jinyin Lake | Tangxun Lake | | |
| Proportion (%) | 17.29 | 3.76 | 5.26 | 7.89 | 2.26 | 2.26 | 38.72 | 100 |
| Density(number/km$^2$) | 1.95 | 3.25 | 0.71 | 2.56 | 1.38 | 0.52 | 1.46 | 0.52 |

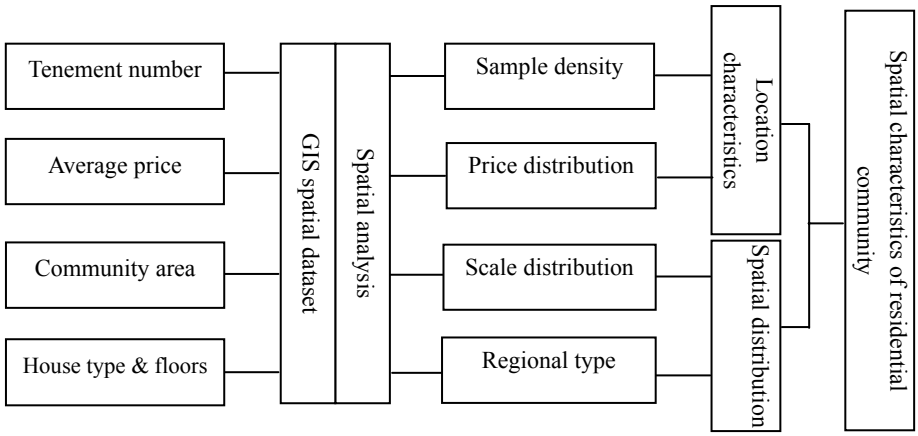


Figure 1. Framework of study

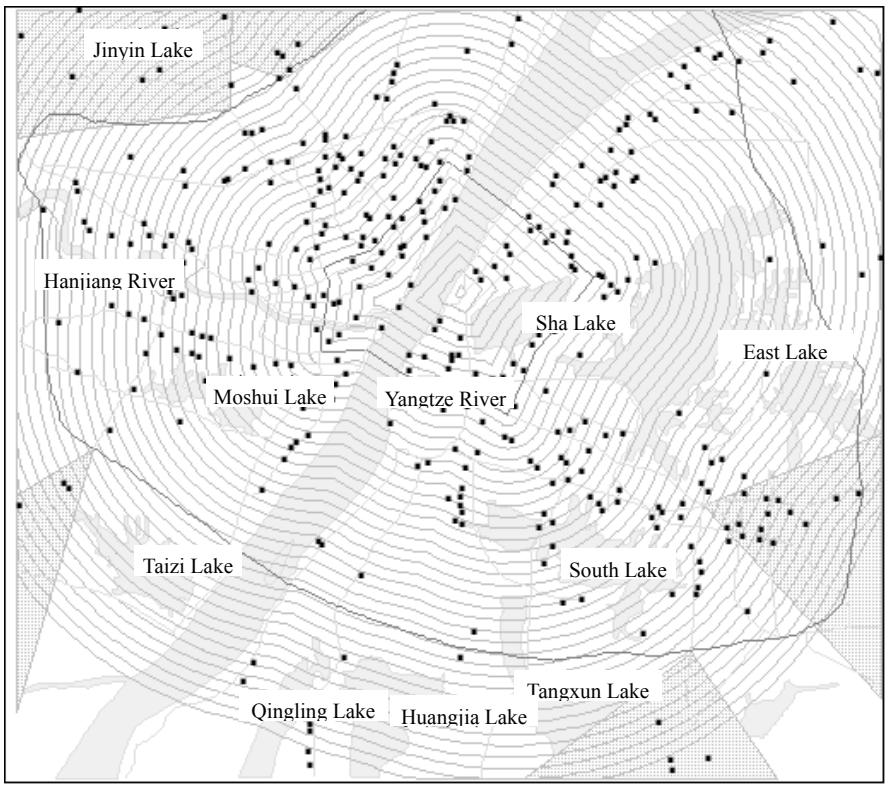


Figure 2. The spatial distribution difference of residential communities by buffering in Wuhan city

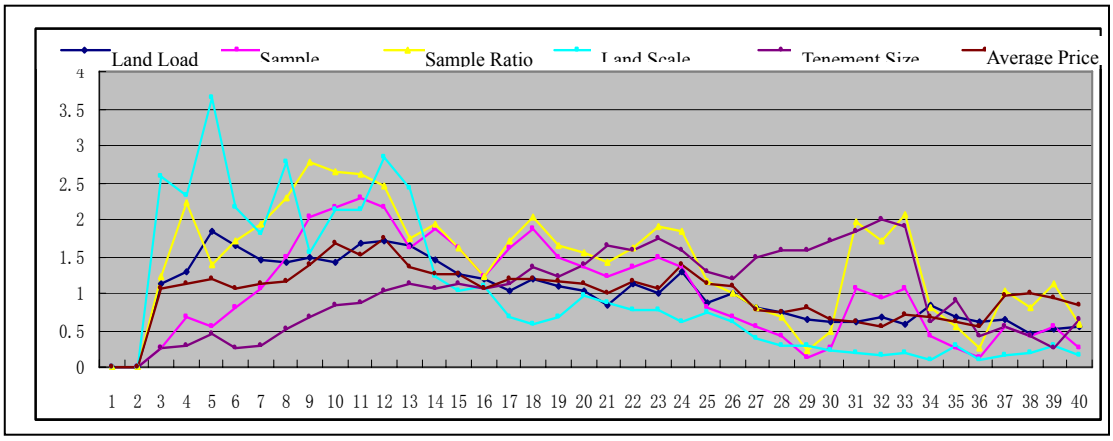


Figure 3. Distribution difference of residential communities by buffering in Wuhan city

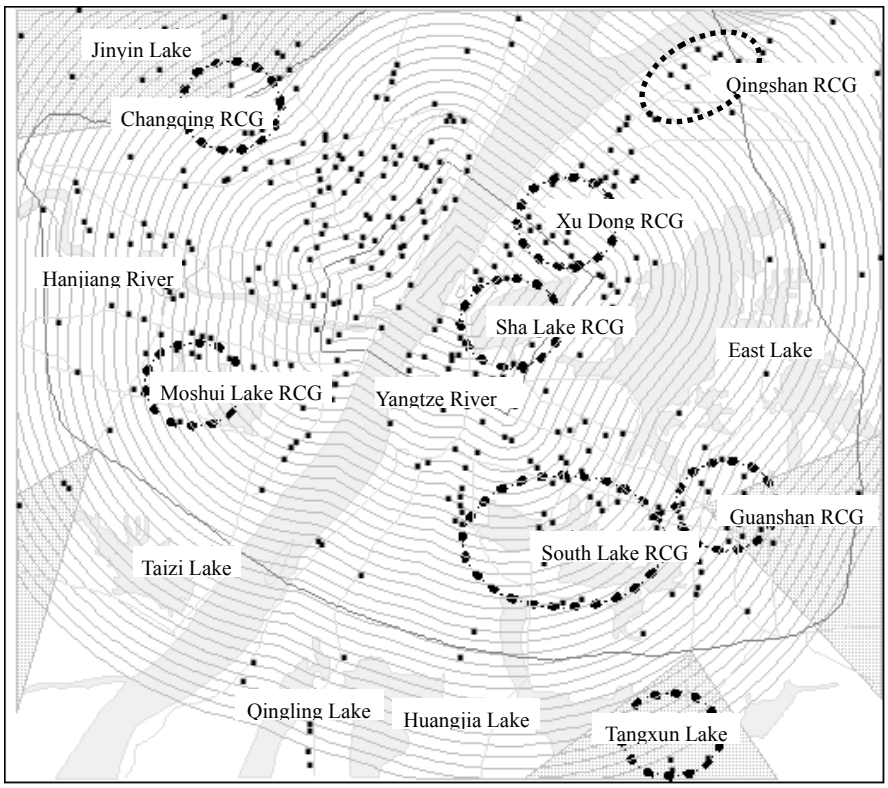


Figure 4. Aggregation distributions of residential communities in Wuhan city

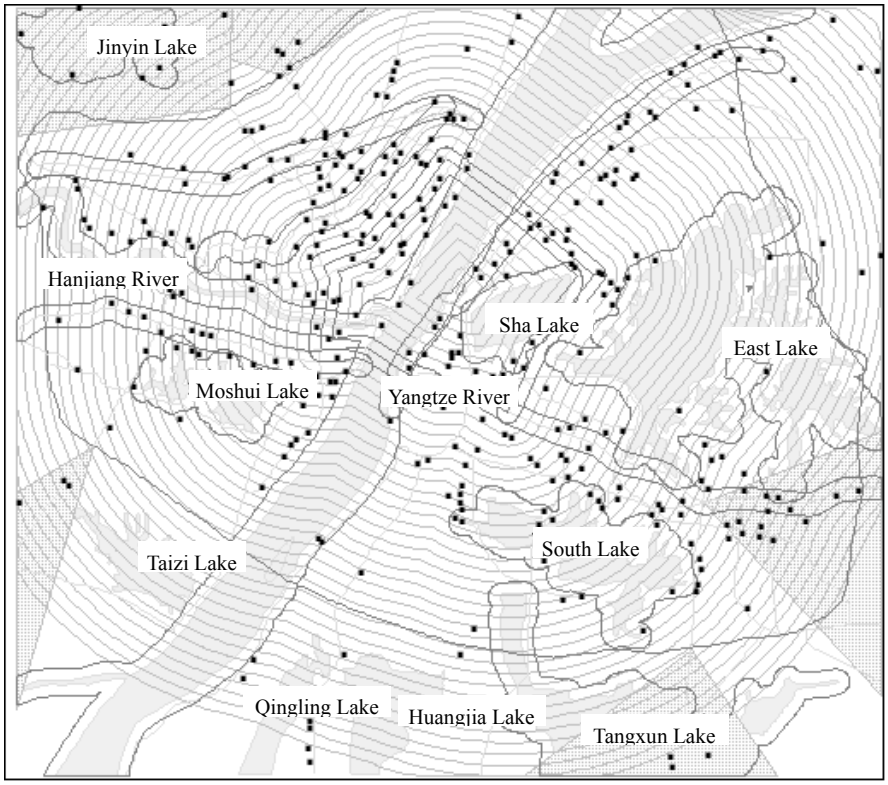


Figure 5. Spatial distribution of residential communities by buffering main roads, rivers and lakes

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# Remote Sensing Image Based Analysis on Present Land Utilization of Chongqing Area

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**Abstract**

Based on the remote sensing images taken by China-Brazil earth resource satellite during July 2006, the paper describes eight types of land utilization of 1,612 km2 city Chongqing area. As a result, the actual area and corresponding proportion of each type of land utilization is obtained. In addition, the paper has analyzed current land utilization status of the area.

**Keywords:** City Chongqing, Remote sensing interpretation, Present land utilization

## 1. Introduction

Remote sensing interpretation can be characterized as an inverse procedure of remote sensing imaging. It reconstructs a geographic landscape through target recognition and phenomenon identification, which is in turn achieved by analyzing a variety of characteristic information provided by the images acquired through remote sensing. Based on the remote sensing images, this paper analyzes plant coverage across major area of Chongqing. Chongqing is a well known city in mountainous area with complex terrain condition. The complexity of mountainous terrain makes it difficult to identify the information from remote sensing images, resulting in a relatively false conclusion from image interpretation. At present, there are mainly two types of interpretation methodologies: visual interpretation and computerized digital pattern recognition. Although visual interpretation is easy and feasible, it can not process large amount information in a quantitative way. Computerized digital pattern recognition generally takes an approach of interactive effort from both user and computer, is able to process in qualitative and quantitative analysis. However, process speed and quality of results are directly impacted by algorithm. In addition, the results are largely based on statistical modeling, are hardly precise in describing a specific and real geographic terrain.

## 2. Outline of the studied area and data source

The studied area includes Chongqing city and surrounding area, a total of 1,612 km2. The area also includes Jinyunshan, Geleshan and part of Nanshan. Chongqing city is located near to where Changjiang River meets Jialingjing River. Surrounded by mountains and embraced by rivers, the water front city is built on numerous hills and valleys, known by its water and famous by its picturesque view. Geographically, the terrain is mainly

complex and diversified mountainous area.

Basic data used for this study comes from the remote sensing images taken by China-Brazil earth resource satellite during July 2006. The images studied were taken by IRMSS (Infrared Multi-Spectral Scanner). The spatial resolution of the images is 20 m. Images have 4 bands of spectrum, namely 1, 2, 3, and 4. The study chose 2, 3, and 4 bands of spectrum designated with red, blue and green. The reference data are based on 1:50,000 topographic map and 1:200,000 present land utilization map of Chongqing.

## 3. Research methodology and pre-processing of the remote sensing images

### *3.1 Research methodology*

There are many different approaches to interpret remote sensing image, including frequency domain analysis with high resolution image, texture processing, high resolution SSMC, interactive method between researcher and computer, neural network, etc. (Zhang, Su, 2008; Yang, Bin, 2004; Huang, Xin, 2006; Zhang, Songling, 1999; Zhou, Tinggang, 2004). The most critical part of remote sensing interpretation is image processing and classification.

The primary study methodology includes comprehensive applications of unsupervised classification and supervised classification, cluster analysis, filtration analysis, depletion analysis and et al (Dang, Anrong, 2004, p. 186-237) on the selected remote sensing images to achieve the interpretation and classification of Chongqing city area. The preliminary process of the images includes geometric correction, boundary tracking, radiometric correction and et al. The remote sensing images were taken by China-Brazil earth resources satellite during July 2006. The image processing tool and software include Erdas Imagine 8.7, Arc GIS 9.0 and GTS.

### *3.2 Remote sensing data processing*

The remote sensing images inevitably have statistical and systematic deformation errors. Images may exhibit one-on-many object-spectrum or many-on-one object-spectrum mapping. In addition, seasonal change may affect the consistency of the images. Preliminary image process is necessary before image interpretation, which includes image projection and coordinate transformation, dissection of the studied area, topographic reconstruction, precision geometric correction, artificial color composition and et al. Figure 1 shows the processed remote sensing image.

<Figure 1>

#### 3.2.1 Data format conversion and coordinate transformation

The data, provided by the ground station for satellite remote sensing at the Chinese Academy of Sciences, is given in BSQ format. Data of each band is independently saved as a binary grayscale image file and a header file. The header file includes variety of information for interpreting the image. Using coordinate data at four corners in the header file, one can transfer the format of remote sensing data from matrix coordinate system into real space Gauss coordinate system.

#### 3.2.2 Precision geometric correction

Remote sensing data is processed with systematic correction. It has a high degree of geometric deviation. It is necessary to process the data with precision geometric correction. Taking the gully line and ridge line from a 1:50,000 topographic map as the precision geometric correction reference in the control layer. Sufficient correction control point can be obtained and the geometric error can be corrected to the limit of one pixel.

#### 3.2.3 Image extraction of the studied area

The studied area is extracted from 1:50,000 topographic map. With buffer analysis, the area is determined by

expanding the administrative boundary outward by 1.5 km in order to keep the data integrity of the studied area after precision geometric correction.

3.2.4 Elimination of orographic influence

Topographic variation and sun elevation angle often introduces aberrant spectrum. To keep the interpretation and analysis accurate, the same forest vegetation at different slope direction or different slope position are modeled with the same spectral parameters, therefore eliminates the orographic influence.

## 4. Interpretation and classification of remote sensing image

### *4.1 Classification of land utilization*

Since the study is based on the quality change of ecological environment, the type of land utilization of the city Chongqing is classified into dry land, paddy field, forest land, shrub land, unutilized land, river, lake and urban construction land according to relate ecological safety assessment standard (Xie, Hualin, 2004; Gong, Jianzhou, 2006; Zuo, Wei, 2003).

As for unsupervised classification, we classify the land utilization into 24 types, more accurate and more detailed than above-mentioned classification.

### *4.2 Comprehensive interpretation with data on geographical environment*

Complex topography and geomorphology will influence the interpretation of image. It is essential to investigate the data about geographic environment of the studied area comprehensively. Aberrant spectrum, occurred in interpreting forest vegetation, will lead to different vegetation types with identical spectral characteristics. It is the most basic interpretation procedure to use the data on habitat condition and environmental gradient as auxiliary data, such as altitude, slope direction, slope position, slope gradient, soil and et al. The study quantify the habitat data by spatial overlay analysis method; then directly calculate at each map spot of vector data; finally, interpret the image by man-machine interactive process with above-mentioned data. As a result, the interpretation accuracy and work efficiency are improved significantly.

### *4.3 Establishment of interpretation criteria*

Automatically interpret the remote sensing image by unsupervised classification to obtain the interpretation criteria; then revise and merge these interpretation criteria by visual interpretation with reference to previous investigations on forest, land utilization, present land-utilization graph and et al of Chongqing. A detailed and accurate interpretation criterion is finally established.

### *4.4 Classification*

First, get the interpretation criteria with unsupervised classification process; then process the treated remote sensing image by supervised classification process with the revised interpretation criteria. Land-utilization types are classified into 9 classes. Process these classes with cluster analysis, filter analysis and depletion analysis; Recode the obtained types (Table 1 shows the recoded types). After recoding, transfer the interpreted grid map into editable vectorgraph by Erdas software; establish the topological relation among elements of the map layers by cleaning and building vectorgraph; introduce the obtained data with Arcinfo format into Arcmap, eliminate or merge the map smaller than 5,000 m2 by Arcmap. As a result, data is reduced by about 30% so that the further operation is more convenient.

<Table 1>

### *4.5 Edit of interpretation data*

In Arcmap, open the automatically generated vector data and integrated environmental gradient data, establish the interpretation criteria. Data directly interpreted by Erdas is different from the actual conditions; therefore it

is essential to revise the obvious defects in the map by comparing the original remote sensing image to the present land-utilization map. Based on the remote sensing algorithm, color codes of ground objects and environmental gradient data in the attribute database of vectorgraph, interpret the attribute of terrestrial objects in batch and write them into the attribute database of vectorgraph. Verify the interpreted results combined with ecological distribution and revise the batch processing conditions. According to the interpreted land-utilization types in 2006, integrate the spatially connected land of the same category to get the map spot layers. With this approach, we obtain the data of the picture spots in city Chongqing in 2006 from above-mentioned map spot layer. Figure 2 is the interpretation graph of remote sensing image of Chongqing area.

<Figure 2>

**5. Interpretation and classification of remote sensing image**

Table 2 shows all 8 types of land-utilization types in city Chongqing. Vegetation coverage is about 50% (forest land accounts for 10.2% and shrub land accounts for 37.74%); urban construction land (the city and nearby suburban area) is 20.40%; dry land is 23.84%; paddy field is 2.60%; river is 3.36%; unutilized land is 0.97%. Among them, there is vast area of river because the center part of city is at the junction of Changjiang River and Jialingjiang River. In addition, forest land is also large, one reason is the strong protection for the original forest land; the other is increased conversion of cropland to forest and artificial afforestation. However, paddy field is small, this is because that Chongqing is a mountain city lack of paddy field; also, most paddy fields turn into dry land because of water shortage. Meanwhile, many paddy fields are occupied with the rapid development of city.

<Table 2>

**6. Conclusion**

Remote sensing interpretation method is an accurate and effective procedure to collect data on the land utilization. Based on the remote sensing images taken by China-Brazil earth resources satellite in July 2006, with preliminary correction and processing, then interpretation and classification to get vector data, finally introduction them into Arcmap to edit and revise, we acquired the present land-utilization data in city Chongqing. In the entire process, the more difficult parts are preliminary process of original data and revision of vector data. Both aspects need to refer relevant data. With repeated corrections, good results could be achieved. However, there are still room for improvement in the process and results. First of all, geographical environment has effects on the data since same object may have different spectrums and different objects may have same spectrum in the original images. Although many scholars have developed some effective methodologies, these methods still have their limitations, especially facing mountainous terrain, that effectiveness is limited. Secondly, the amount of vector data is large and difficult to process. Although they can be merged to certain degree, they are relying on manual process and efficiency is low. These two issues should be addressed in the future study.

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Table 1. Classification of remote sensing interpretation criteria of land-utilization types in city Chongqing

| Land-utilization types | Dry land | Paddy field | Forest land | Shrub land | Unutilized land | River | Lake | Urban Construction land |
|---|---|---|---|---|---|---|---|---|
| Serial number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Table 2. Present land utilization in city Chongqing

| Land-utilization types | Urban construction land | Dry land | Forest land | Shrub land | Reservoir | Paddy | River | Unutilized land |
|---|---|---|---|---|---|---|---|---|
| Area($km^2$) | 329.0695 | 384.5616 | 164.5483 | 608.7176 | 14.3714 | 41.9542 | 54.2093 | 15.3644 |
| Proportion(%) | 20.40 | 23.84 | 10.20 | 37.74 | 0.89 | 2.60 | 3.36 | 0.97 |

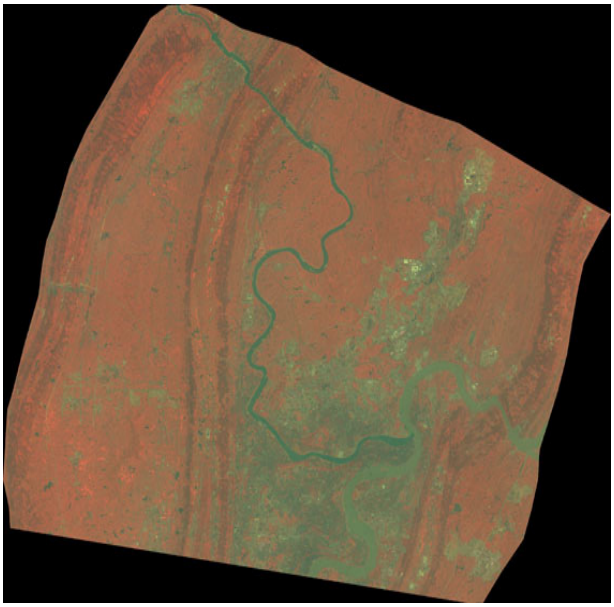

Figure 1. The Processed Remote Sensing Image

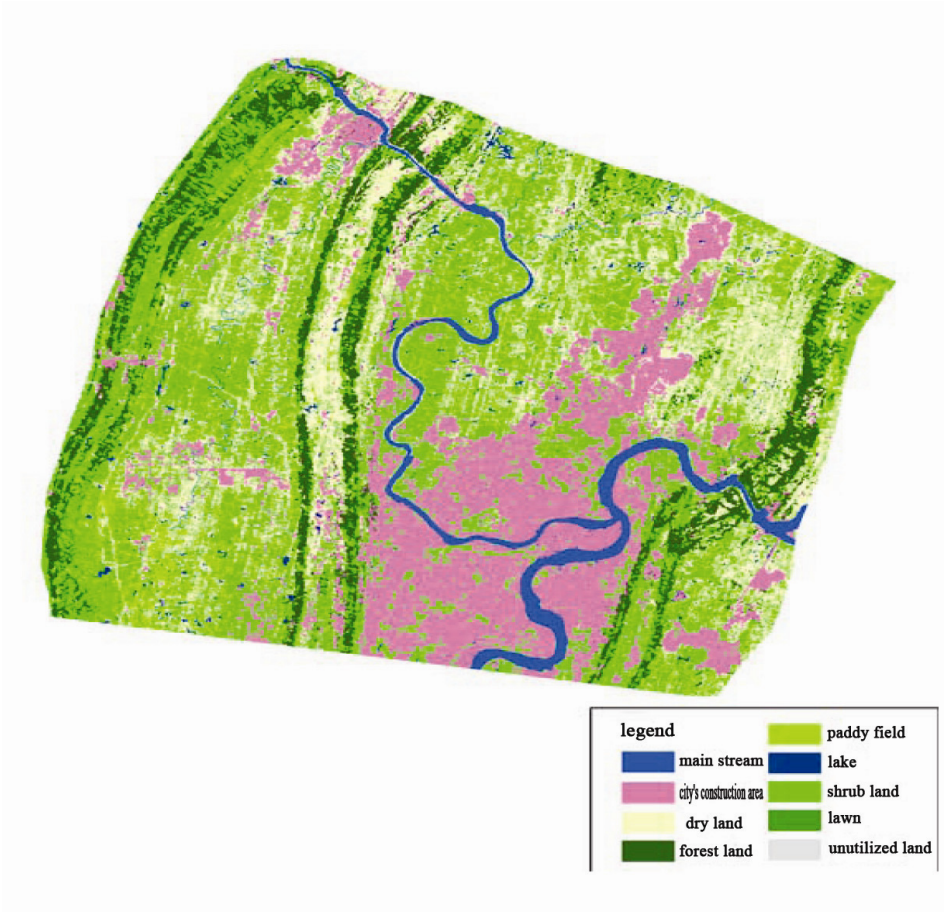


Figure 2. The Interpretation Graph of Remote Sensing Image of Chongqing

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# The Disaster of May 12th Wenchuan Earthquake and Its Influence on Debris Flows

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**Abstract**

On May 12th, 2008, a rare major earthquake with magnitude 8.0 occurred in Wenchuan, Sichuan province of China, which caused considerable damage. Considering mud-rock flows in the quake-hit areas caused and influenced by the major earthquake, the essay analyzes the formed conditions and the influential factors for mud-rock flows disaster in the quake-hit areas. Meanwhile, it presents preventive measures for the post-disaster mud-rock flows.

**Keywords:** Earthquake, Debris flow, Disaster, Influence

## 1. Introduction

On May 12th, 2008, a rare major earthquake occurred at noon in Wenchuan, Sichuan province of China, which is the second major earthquake since the foundation of the PRC. The seismic magnitude, influence scope and relevant loss are rare for the same period of the history. The mud-rock flow which belongs to a non-land area of earthquake debris burst ferociously and rushed violently with lots of silt. There are many kinds of direct and secondary disasters caused by the earthquake. The mud-rock flow is one of the serious secondary disasters and the damages can not be more.

## 2. The overview of the earthquake disaster

On May 12th, 2008, a rare major earthquake with magnitude 8.0 occurred in Wenchuan, Sichuan province of China, whose largest earthquake intensity reached 11 degrees. More than 100,000 square kms became the particularly serious quake-hit areas including Sichuan, Gansu, Shanxi, Chongqing, Yunnan and so on. Sichuan province, such as Beichuan, Shifang, Dujiangyan, Mianzhu, Wenchuan, Pengzhou, etc. is the most severely affected area. The quake-hit areas. The casualties of the earthquake were 87,000 people including 69,000 deaths and more than 18,000 disappearances . The direct economic loss amounted to 845.14 billion yuan, and indirect loss was numerous.

**<Figure 1>**

**3. Brief statement for the debris flows in the quake-hit areas**

Longmen Mountains were largely changed the crust because of the earthquake. An on-site survey showed in some places that the crust had gone up or down to a few meters vertically. Some rocks and soil were loose, broken and easy to cause a large number of debris flows, post-disaster debris, collapses and other geological disasters. The earthquake disaster was the most severe geological disaster of all China's one-time catastrophic events in the history. Preliminarily judging, about 1/3 of the whole Wenchuan earthquake losses were not by the direct result of the earthquake, but by the secondary geological disasters. Among these secondary disasters the debris flow hazards can not be ignored. The distribution of landslides that may occur is shown in Figure1. After the earthquake, many mountains' terrains have been damaged and the southwest part of China is mountainous, so the mountains are easy to seriously slide during the rainy season which is from May to September.

The following examples are mud-rock flows occurred in the disaster areas: On May 17$^{th}$, 2008, a heavy rainfall in WenXian accompanied by strong winds, lasting 40 minutes and reaching 12.7 mm, triggered a large mud-rock flow in Guanjiagou, Wen County with 15 cubic meters per second. The flow buried several cars parked on the roadsides. On May 12$^{th}$, 2008, a certain part of Baoji-Chengdu Railway was blocked. About 2.7 million ton mud-rock flew into the tunnel, destroyed over 4300 ton roadbeds. 11 trains were forced to stop or to change their lines. On September 25$^{th}$, 2008, torrents with a mud-rock flow happened in the old town of Beichuan. It damaged the town and the only road to the town was blocked. According to an on-site survey and relevant information, we learn that an earthquake can easily cause mud-rock flows. Such examples as mentioned above do exist in many other places.

**4. The impact of the debris flow after the earthquake disaster**

After the earthquake a debris flow is a common geological disaster. When a debris flow happens, the mixture of water, soil, rocks with a high speed will cause huge casualties and property losses.

Debris flows destroy transport facilities. It damages the buildings, silts lines, and disrupts traffic. After the earthquake, according to the survey from the transport sector, when the rainy season comes, debris flows often damage the railways and roads especially the roadbeds and buried buildings, causing traffic disruption.

Debris flows causes river courses to block. As the mud-rock flow carries a lot of solid substances, the frequency of the flow is far greater than that of the flow of water. What's more, it flows with the rapid erosion, transport and stacking. As a result, in a very short time, it can cause drastic changes of the original valleys. The debris accumulates a lot in the lower valley to form "Landslide Lake", Such as Tangjiashan "Landslide Lake". If it isn't well managed, huge potential hazards will exist in its lower reaches.

Mud-rock flows' damage to the regional environment is enormous. The flow carries large amounts of loose sand, which silts so widely that farmland can not be cultivated. The flow changes the original mountains' terrains, causes soil erosion and vegetation damage, and fails to regulate climate and conserve soil and water. Climate changes will exacerbate.

**5. The formed conditions and factors of mud-rock flows in the quake-hit areas**

Generally speaking, the following three conditions can form a mud-rock flow: the topography and geomorphology with steep catchments areas which are easy to accumulate water and other substances; there is a wealth of loose substances; a lot of water gets together in a short time. (Fei, Xiangjun, 2004) The mud-rock flow caused by Wenchuan earthquake equally satisfies these conditions, while it also has its own characteristics.

*5.1 The topography and geomorphology conditions of mud-rock flows formed in the quake-hit areas*

The earthquake occurred at the main fault of Longmen Mountains, located in the middle part of China's north-south seismic belt. There are many high mountains, deep valleys, steep terrains and steep gully beds where water can be easy to flow together. The slope of the broken soil surface affected by the earthquake infiltrated when a rainstorm hit. The soil was loose to slide down, mixed with water, and finally formed debris flows along the steep slope after erosion.

*5.2 The source of loose substances for mud-rock flows in the quake-hit area.*

Usually mud-rock flows happen in the areas with complicated topography, the folding faults, the active newly-formed terrains and high seismic intensity. Bad geological phenomena such as rock breaking, the surface splitting and collapsing after the earthquake provides many loose solid substances. In addition, the areas with a layer of soft and hard rocks are easily damaged by the earthquake, which provides rich debris. The debris from rock collapsing, the soil slipping in the rainstorms and the loose debris from valley beds form a mud-rock flow.

*5.3 Water conditions of mud-rock flows in the quake-hit areas*

The main earthquake zone this time is in Sichuan, and the rainfall is much more during the rainy season. A debris flow is closely related to the 10 mm rainfall. (Qi, Xiaojun, 2003) Water is not only an important component and condition of the mud-rock flows but also the media to carry debris. Usually the water sources of mud-rock flows are from heavy rains, and melt snow and water from reservoirs. (Pan, Mao, 2002) The main water sources of debris flows in the quake-hit areas are rainstorms, continuous rain for a long time and so on. The earth surface water caused by strong storms in the mid and upper valley erodes the broken mountains. With the increasing intensity of erosion, some rocks in the valleys begin to loose. Being heavily lift, swept, the rocks mix with water and form a mud-rock flow.

*5.4 The factors of debris flows caused by earthquake*

The factors of debris flows caused by earthquake are complicated, which include the crustal rock construct, topography, soil vegetation, hydrology, climate, rainfall and so on. Collapse and landslides because of the earthquake cause even more serious mud-rock flows. More other factors need seriously analyzing.

**6. Prevention measures for mud-rock flows after the quake**

The significant earthquake activated the potential disasters of mud-rock flows before the earthquake. In particular, mud-rock flows often occur in main flood seasons. Heavy rainfall and frequent aftershocks may cause more mud-rock flows at any time. Considering the characteristics of the debris flows in the mountain areas, I come up with the following prevention measures for the quake-hit areas.

*6.1 Administrative measures*

By post-disaster planning team's requirements, the quake-hit areas must establish the monitoring and forecasting systems, classify the districts in danger and teach relevant knowledge to local residents. Mud-rock flows' early warning system and emergency evacuation mechanism must be established necessarily. Before or when mud-rock flows occur, the affected units and individuals should take corresponding measures. By preventing and mitigating disasters, we should do lots of things such as rescuing the wounded, evacuating the residents, detecting disasters, organizing self-help, stabilizing social orders and so on.

*6.2 Engineering and biological measure*s

In order to prevent even greater damages caused by debris flows, it is necessary to build gravity dams, masonry dams, concrete stone arch dams, soil dams, grille dams, drainage troughs, silt basins and so on in

proper places. (Wang Shige, 2002) Reasonably planting trees and grass in the areas which are prone to occur mud-rock flows can conserve water and soil and reduce the volume of solid substance sources of debris flows.

*6.3 Measures on self-examination*

As for the characteristics of the main shock and the aftershock, with the influence of aftershocks, the mountain body is instable enough to cause mud-rock flows when rainstorms come. Therefore, we should investigate the geological environment and the distribution of the mud-rock flows in quake-hit areas and seriously do a good job about weather forecasting records.

**7. Conclusion**

As a member from quake-hit areas, I witnessed the earthquake and disasters, which touched my heart deeply. "5.12" earthquake has gradually been away from us. However, all kinds of disasters have impressed us at the bottom of our hearts. We should analyze and sum up the disasters caused by mud-rock flows and work out the characteristics of mud-rock flows caused by the quake-hit areas. In this case, we can better predict and prevent the geological disasters. I believe that by scientific means of management, we will overcome the natural disaster and reconstruct our beautiful homeland.

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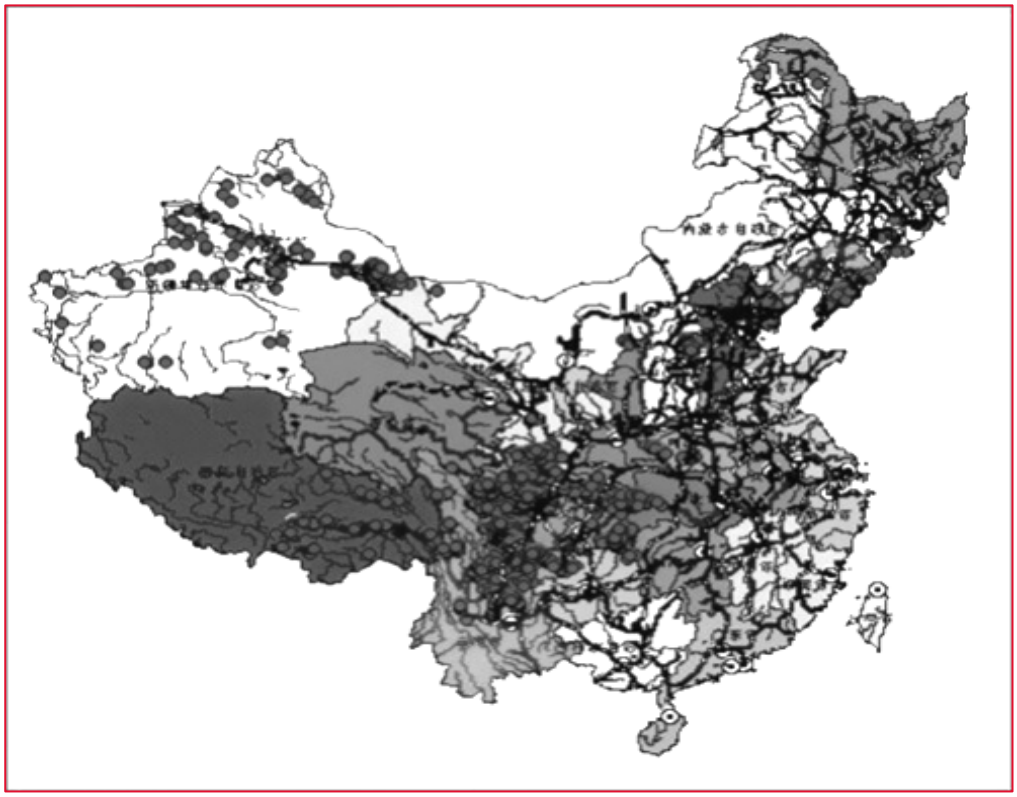

Figure 1. Distribution of post-disaster debris from MA Dongtao

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# A Pilot Study on the Development of the Experienced Rural Tourism in Shijiazhuang of China

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**Abstract**

Based on the feasibility analysis that China develops the experienced rural tourism, we analyzed the tourism resources around Shijiazhuang in this article, and divided the tourism sites around Shijiazhuang into five types. We pointed out the advantages and limited factors that Shijiazhuang developed the experienced rural tourism and respectively put forward different development advices combining with various types. We put forward the new opinion developing the experienced rural tourism to promote the new countryside building, and advised taking the development of rural tourism as the change to build the new socialist countryside.

**Keywords:** Shijiazhuang, Experienced rural tourism, Development

## 1. To develop the experienced rural tourism can promote the building of new countryside

The new socialist countryside should be built according to the total requirements that the production should be developed, the life should be wealthy, the rural mores should be civilized, the village appearance should be clean and the management should be democratic. That requires us to liberate our ideas, develop our thoughts, and change the concepts of growth such as letting the farmer become into a sort of vocation, not a sort of identity, letting the countryside become into a residence, not a sort of administrative district, letting the agriculture become into the industry which can be free “advance and retreat”, letting farmers liberated from the land develop and build the new socialist countryside.

The tourism is called as the "smokeless industry", and to actively develop the rural tourism can make the countryside develop only depending on its own strength, reduce national capital supports, promote the change of the rural even the national economic structure adjustment and economic growth mode, and push the "development of the production". To develop the rural tourism and emphasize the participation of the community can extend the employment of the countryside, increase farmers' incomes, enhance farmers' living level and achieve "wealthy living". To develop the rural tourism and contact exterior culture and advanced thoughts can enhance farmers' cultural level and moral quality, and promote "civilized rural mores". To develop the rural tourism can strengthen farmers' resource consciousness and environment consciousness, be propitious to protect the resources and environment and establish the society with "saving resources and friendly environment", and live up to "clean village appearance". To develop the rural tourism and quicken the exterior communication and standardize the management of tourism resource can help to realize the "democratic management". To develop the rural tourism is the important approach to promote the building of the new socialist countryside, the important means to increase incomes and become rich for farmers, the important content to implement the scientific outlook on development and establish the harmonious socialist society, and it accords with the goal and requirement of Chinese Party Central Committee to build the new socialist countryside (Zhou, 2007, P.25-28).

The development of the tourism market points out the way for the building of new countryside. As viewed from the economics, the ideal rural tourism is the combination of the tourism and the agriculture, and it is a sort of affixation under the situation that the third industry doesn't influence the first industry, and it is a sort of form that the agriculture changes to diversified operation. As viewed from the geography, the development of the rural tourism indicates that the region possesses not only the basic survival factors of the agricultural society, but the conditions developing the tourism (Wang, 1999, P.38-42). The circumjacent countryside of the big city can completely grasp the uncommon opportunity, fully dig local tourism resources and build the new socialist countryside combining with the development of the tourism.

## 2. The feasibility analysis to develop the experienced rural tourism

According to the research report of WTTC, up to 2010, the employers in Chinese tourism industry will achieve 0.19 billion, and the total income of Chinese tourism in 2020 will exceed 3300 billion Yuan which equals to 8% of Chinese GDP, and the tourism will be the mainstay industry of national economy (Hu, 2007, P.52-53).

At present, Chinese mass tourism is in the ascendant, especial for the big cities, with the quickening of the urban living, denizens' pressures are larger and larger, and along with day and night hurly in the city, denizens' desires to return the nature are more and more intensive, and with the enhancement of living level, denizens expect more and more improved living quality, and with the increase of urban population, denizen's average green area decrease sharply, and because of large work pressure, present holiday mode and economic endurance ability, most denizens select the destination of the tourism in the outskirts of the city. Mr. Wu Bihu called this tourism range as the "recreational belt around metropolis (ReBAM)" (Wu, 2001, P.354-359).

## 3. Analysis of the rural tourism belt of Shijiazhuang

There are 5 cities, 6 districts and 12 counties in Shijiazhuang which total area is 14161 square kilometers, and it has 9555 thousands permanent population, and the urban area is 453.6 square kilometers, and the urban population is 2377.3 thousands, and the population density is 5241 person per square kilometer. In 2007, the regional production gross was 239.3 billions Yuan, and the urban per capita disposable income was 13.205 thousands Yuan, and the urban per capita consumption payout was 9189 Yuan.

### *3.1 Definition of the rural tourism belt of Shijiazhuang*

Wu Bihua, Huang Zhuowei and Ma Xiaomeng (2004) researched and found that the distribution of rural

tourism area around the big and middle-sized cities presented the decreasing trend with the distance (except for the initiatory 30 kilometers), and 84% of tourism areas were centralized in the range which distanced the city in 100 kilometers (Wu, 2001, P.757-763). Considering that the modern traffic develops very quickly, and the public traffic advances rapidly, and various counties in Shijiazhuang can be arrived in 3 hours, and large amounts of private car largely promote the urban and rural association and reduce the time distance between the city and the village, in the article, we define the rural tourism belt of Shijiazhuang in the range which can be arrived by the public traffic in 3 hours, and the range includes the counties around Shijiazhuang, the Dingzhou City in the north of Shijiazhuang and the Lincheng County in the south of Shijiazhuang.

*3.2 Experienced tourism resources evaluation of Shijiazhuang rural tourism*

For the problem what is the "rural tourism", there are many definitions such as the rural tourism, the rural experienced tourism, the rural participated tourism, the agriculture of going sightseeing, the leisure agriculture and the agricultural tourism in the academe. Zheng Liaoji (Zheng, 2006, P.118-125), Zheng Qunming, Zhong Linsheng (Zheng, 2004, P.33-37), and He Xiaorong (He, 2004, P.90-94) had made relative researches. The "experienced rural tourism" in this article means to take the residents in the central city as the main passenger source based on special rural natural and human landscapes, take the keeping of rural scene and land flirtatious expressions as the characters, take hobnobbing with the nature and feeling the land as the core, feel the natural mountains and rivers, accept real farmhouses to fulfill tourists' goals relaxing emotion, reviving pressure, returning nature and feeling themselves. At the same time, the countryside should strengthen the construction of the basic establishment and develop the special commodities to fulfill tourists' integrated demands including food, house, travel, visit, amusement and purchase. The experienced rural tourism possesses many characters such as practice, experience, amusement, education and relatively destroying.

3.2.1 Experienced tourism resources division of the local rural tourism belt

The tourism resources of the rural tourism belt in Shijiazhuang are abundant, and they can be divided into following types according to the attributes and characters.

(1) The mountains and rivers type. The representative scenery spots include Mountain Cangyan, Wuyue Village National Forest Park, Zhangshiyan National Geopark, Baodu Village, Pingshan Tuoliang Mountain, Mountain Tiangui, Kongshan Baiyundong National Park.

(2) The historical cultural type. The representative scenery spots include the famous historical and cultural city of Zhengding, the famous historical and cultural city of Zhaoxian, the Tianchang ancient town in Jingxing County, Yujia Stone Village, the ancient village group of Daliang River, Zhongshan County in Pingshan County.

(3) The folk-custom and special local product type. The representative products include Jingxing Lahua, Zhengding Civil Flower Meet, Snowflake Pear of Zhao County and Chinese data of Zanhuang.

(4) The revolution sacred place type. The representative place is the Xibaipo in Pingshan County.

(5) The ecological civilization type. The representative spots are numerous ecological demonstration villages.

3.2.2 Advantage of comparison

The urban population of Shijiazhuang had exceeded 2300 thousands in 2007, and the population density had exceeded 5000 persons per square kilometers, and the urban per capita disposable income had broken 13 thousands Yuan, and people have the desires and financial ability for trip.

The citizens' recreational demands of Shiajiazhuang are very intensive, and most citizens have participated into the outing, and they could complete the trip in the present day or two-day holiday basically (Jia, 2002, P.84-89).

Comparing with the urban districts, the circumjacent scenery spot in the rural tourism belt possesses following obvious advantages.

(1) The rural regions without the hurly of the big city are closed to the nature.

Urbanites have been bored by the boisterous environment for a long time, and in the countryside, they can approach the land and the nature, "while picking asters neath the Eastern fence, my gaze upon the Southern mountain rests", and they can really taste the coziness of "being in the bird cage for a long time, returning to the nature again".

(2) The tourism resources in the rural regions are abundant, and the varieties are numerous and the area is wide.

The countryside possesses wide sky and land, and there are not only the natural scene, but also human sceneries, and people can not only enjoy the mountains and rivers, but also accept the patriotic education, and they can not only feel the uncanny workmanship of the nature, but also take the great pioneering work of the people, wander in the farms, appreciate the nature, feel themselves, learn knowledge, widen the view, forget the worry and feel the happiness, and benefit the life and health.

(3) The values of the tourism resources in the rural regions are very high.

Many scenery spots such as the Mountain Cangyan, Zhangshiyan National Geopark, Kongshan Baiyundong National Park and Mountain Tiangui are national class tourism scenery spots, and especially the Karst landform possesses obviously special characteristic and rarity characteristic. Xibaipo is the famous patriotic education base, one of six sacred places of the revolution, and it can make people really fell "the first sun rays in the morning of new China".

(4) The combination status of the rural tourism resources is better.

Many scenery spots are neighboring each other, and the combination of the sceneries is better, and the further organization can produce the effect of "1+1>2". For example, the scenery spot of Xibaipo is closed to the Gangnan Reservoir, and the distance between it with the famous scenery, Mountain Tiangui is only 40 kilometers, and the distance between it with the onetime capital site of Zhongshan County about 45 kilometers, and the distance between it with "First Village under Heaven", Baodu Village, is 90 kilometers, and the distance between it with the Buddhism scared place Wutai Mountain is 120 kilometers.

3.2.3 Limited factors

(1) The regions of the rural tourism lack in uniform layout, the sceneries are identical and the competition is graved.

The rural tourism regions lack in uniform layout. First, the sceneries in various tourism regions are identical, for example, when the picking rises, many villages will develop the "picking festival", and the blind imitation and competition destroy the good combination of the tourism resources, which make the scenery become humdrum, and visitors will be bored. Second, the interiors of many tourism regions lack in programming, and the living is sluttish and the village appearance is worm-eaten, which will induce the rural tourism lack in attractions.

(2) The rural infrastructure construction is deficient and the environment should be further improved.

First, the traffic is not convenient, and the roads toward various rural tourism spots are bad and the standard is very low. Second, the traffic connections among various neighboring rural tourism spots are bad. Third, the reception establishments in some rural tourism spots are much undeveloped. The bad environment and imperfect infrastructure largely influence the entrance of visitors, and strike visitors' desires to visit.

(3) The development deepness of the rural tourism resources is not enough, and the layer is not high, and the complete industrial chain has not been formed.

Wang Bing (Wang, 1999, P.79) pointed out that Chinese rural tourism presented large dependence for the tourism scenery spot, the harvest activity of the agricultural production and the traditional festival. Chinese rural tourism still stays in the layers of visiting, picking, chatting and wandering in the farms, and it lacks in the embodiment of the folk cultures, and the development deepness is not enough, and the layer is not high, and the independent tourism cultural industry chain has not been formed. The deficient innovation design, deep processing and cultural meanings can not make tourists experience the local folk custom, which will influence the attraction of the tourism products and the revisiting rate.

(4) The traditional scenes in the historical and cultural districts should be protected early, and the balance should be looked for in the relation between the protection and the development utilization.

Different problems exist in the historical and cultural districts, and the protective consciousness becomes indifferent, and the property of construction is largely destroyed, and many buildings lack in repairs for long. Most historical streets have not been programmed and protected. Historical buildings and environment has been destroyed to different extents. The thought of protecting the culture has not gone deep into human hearts, and common villagers have not completely known the resources what they have. The construction skills and technologies of the old buildings are disappearing, and they are urgent to be saved and protected, for example, the horizon contour line of the historical city, Zhengding, has been and will be destroyed to some extent.

(5) The production scale of the tourism products is small, and the sales can not form the system.

The commercial consciousness is lagged, and the tourism commodity with local characteristics can not be developed, and the sales of the commodities lack in independent network system.

## 4. Development advices for Shijiazhuang rural tourism belt

### *4.1 Increasing the power of environment protection, and further developing the beauty spot tourism resource with mountains and rivers*

For the scenery spots with mountains and rivers, people want to experience their natural characters, so we should not be adsorbed in the front benefits, but ignore the environment protection and make the beautiful mountains and rivers become bare mountains and dangerous rivers. The villages near the scenery spots should constantly emphasize the environment protection, and protect the environment that people depend on. Based on the environment protection, rebuild the new countryside, strengthen the infrastructure construction, increase the production of special commodities, and provide multiple services such as eating, housing, buying and traveling for visitors. Before the construction, the layout should be made better, and the construction can not destroy the environment of the scenery spot. We should strengthen the traffic association between the villages and scenery spots, and strengthen the traffic association between the villages and the visitor sources, and the villages should be the middle station between the visitor sources and the scenery spots to server for the recreational activities.

### *4.2 Reasonably designing the layout and instructing the protection of historical and cultural streets and districts*

For the resources in the historical and cultural conservation districts, we should scientifically make the layout, reasonably utilize them, and fully dig their social values such as history, culture, scientific technology, arts, education, nationality and tourism, and emphasize the survival environment of the historical and cultural conservation districts, and give prominence to the “historical reality, life reality and shape integrity”. Better grasp the renovation contents of the historical and cultural conservation districts, avoid dismantling and

building randomly by all means, live up to save the appearances and "repair as old", renovate the interior to fulfill citizens' living and inhabiting demands.

Using international modus for references, the better historical buildings in the historical and cultural conservation district should be reserved, the disrepair building can be repaired, and the ratty buildings can be dismantled and rebuilt by the original appearance. We should save the original parts of the historical buildings to the largest extents, and reflect the traceability and the identification of the historical buildings (Cui, 2005).

*4.3 Inheriting the folk-custom culture and promoting the spread of special rural culture*

The rural tourism can not stay in the layers of viewing, picking, chatting and wandering in the farms only, but should fully dig the meaning of the folk-custom culture, enhance the class, increase the development depth, find the abundant nourishments in the national culture, fully dig the profound connotations in many aspects such as cultural tradition, national custom, manners and customs, local folk art forms, civil craftworks, festival activity and industrial culture, embody the characteristic of Taihang Mountains and the flirtatious expressions of Yan Country and Zhao Country, and form the tourism cultural industry chain. The rural tourism should also fully dig the experienced contents, go on the road of commercial operation, pass the civilization, and benefit the local countryside.

*4.4 Carrying forward revolutionary spirit and promoting the development of red tourism areas*

In the development of the rural experienced tourism, combining with the patriotic education, advocate the green scenes, blue waters, historic sites, new appearance of villages and cultural meanings, and strengthen the comprehensive development degree of the tourism resources, and let tourists rememorize the red history and appreciate the village expressions and fulfill their multiple demands.

*4.5 Relying on the engineering of water diversion and driving the rural ecological construction along the line*

The midline and trunk line engineering of South-to-North water diversion passes Shijiazhuang. The villages along the water diversion engineering can take the opportunity of this engineering to rebuild the dwellings, deal with the dwelling houses exceeding the standard and the leisure house sites, make the second working, and enhance the infield quality under the premise that the gross of the infield doesn't decrease, build the dwellings with simple and unsophisticated appearance and modern interior establishment, and construct the beautiful human settlement.

In the rebuilding process of villages, the establishment of the civilized ecological village should be the goal, and according to the total requirement of "developing economy, healthy democracy, enriched spirit and better environment", strengthen the rural infrastructure construction and the building of the courtyard and environment. Start from rigidifying the road surface, cleansing the streets and courtyard and planting in the village, and strengthen the constructions of many suited establishments such as the drinking security, garbage disposal and street illumination, and achieve the goal of "improving a batch", and really profit people.

The places along the line which can develop the tourism industry should properly develop the construction of the tourism scenes. Pay attention to the combination of the landform with the water flow, adjust measures to local conditions, build the scenery spot by the water, and fully reasonably utilize the limited water resources under the deficient water environment. Define the programming construction region, advocate all citizens to take part in the construction, and offer saplings and grass seeds to plant for tourists.

*4.6 Strengthening the consciousness of commodity and fulfilling tourists' various demands*

Villagers leaded by the village committee and the branch committee of CPC should strengthen the degree of the commercial operation, produce special tourism commodities, let tourism consumers buy the tourism products in the usual farmer homes, and make the tourists' demands including food, house, travel, visit,

amusement and purchase fulfilled in the common farmers' homes.

*4.7 Strengthening the cooperation and digging the self characteristic to realize the mutual benefit and win-win*

The cut-throat competition among various scenery spots, especially among the scenery spots with close geographical positions should be avoided. Every scenery spot should preserve the whole benefits, and the consultation mechanism and the linkage mechanism should be established, and all scenery spots should be as a whole, and every scenery spot develops his project with the best advantage, which can realize the mutual benefit and win-win and achieve the profit maximization.

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# Thoughts on the Right Transfer Issues of Farming Land

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**Abstract**

Farming right transfer of land is an inevitable consequence of the economic development in agriculture. It is the nation's endeavor towards modernized and large scale agriculture production that drives the farming right transfer of land. This paper analyzes the causes that starts the trend of farming right transfer, identifies the issues in the present practice of the farming right transfer, the issues such as practice lack of formality, a system lack of proper mechanism and regulation. Based on the study, the paper also presents some suggestions and advices to how to manage the farming right transfer.

**Keywords**: Agricultural modernization, Farming right transfer, Land use right

## Introduction

The keys to ensure farmers' long term right on land, generate enthusiasm from farmers, guide and motivate farmers to focus on the effort towards modernization of agriculture, are to promote innovation in land regulation system, introduce market mechanism into land contraction between farmers and government, and establish the market-oriented contraction and right transfer system for land use. In recent years, with the shift of agricultural structure, growth of the second and the third rural industries, labor force migration from countryside to cities, the right transfer of land has showed a trend of accelerated speed.

## 1. Current issues in the right transfer of land

The right transfer of land is driven by the rural economic development and it reflects the objective demand from ever increasing productivity. It pushes the shift of agricultural structure and business-like operation, drives operation to a proper scale, increases agriculture investment and broadens the channels of income. However, problems exist which can not be ignored.

### *1.1 None-regulated practices.*

At present, the mechanism for transferring right has not been completely established. Many problems exist in completing the mechanism and standardizing the procedures. Instead of following law, regulation and procedure, many farmers rely on verbal agreement in private transfer. Such actions fail to enforce the rights and obligations between parties and potentially lead to serious problems.

### *1.2 Lack of fully functional intermediary organization*

So far, most areas do not have regulated market mechanism for transferring the right of land, severely lack of intermediary organizations of land transfer, and lack of channels for information flow. Although some local authorities established intermediary organizations, it is rare that these organizations facilitate transfers

following market principles and following law. Poorly developed market, lack of intermediary organization and lack of information flow often lead to the failure in which farmers intended to give the land right hardly find suitors to acquire the rights, while the farmers trying to get land right can not find anyone to acquire from. The situation in turn impacts the flow and optimal allocation of critical production elements.

*1.3 Improper government role in land transfer*

Some local authorities play dominant role in land transfer, showing no respect to farmers' intention, arbitrarily changing the lease contract and engaging in forced land transfer. Some take the land transfer as a way to increase local authorities' income; some take it as a way of showing off local political achievement at the cost of local farmers' interest. Some local authorities take policy of "back-leasing" and "sub-contract" (leasing back the land that is not properly farmed and sub-contracting to individuals who could use the land more efficiently, noted by translator). Due to different motivations and practices, some of these misinterpret or even violate laws and regulations related to land, such as forced "back-leasing", under compensation, "back-leasing" for under-the-table "sub-contracting". Income from land contractual activities and redistribution of the income are lack of transparency.

*1.4 Trend of detriment to farmers' interest from non-farming construction use of land*

At present, most non-farming construction land is from national acquisition without the consideration to the differences of public welfare and commercial use. Land expropriation and land offer are based on dual-track system, namely, land expropriation keeps the coercive tradition of the planned economy system; while land offer adopted the market economy system and is compensated. Local government profits from selling land. With ever increased real estate development, constructions such as university towns, development zones, small towns, have gradually grown to a white hot stage. Land expropriation gets out of control, "land siege" keeps escalating. Farmers can not be compensated fairly with the so called "one finalized deal". In addition, the compensation is often short when it comes to farmers due to multi-layered commission fees by middle men. Farmers are often compensated by a little relocation fee only. Land acquisition cost has reached RMB1,050,000-1,200,000 per hectare, while the farmers are only paid RMB150,000 per hectare. It is like a rubbery to farmers. Many farmers lost their lands, lost stable input from the land for living, eventually become drifters and threaten the social stability.

## 2. Principles for standardizing and regulating the right transfer of land

The land's right transfer matters not only to farmers' vital interests, but also to the agriculture development and the stability of rural area. It belongs to the domain of adjustment of production relation, has strong political implication and broad reach, and is with serious complications and conflicts. Therefore it is necessary to have a set of well defined principles and systematically develop the framework.

*2.1 Essential principles for transfer right of land in rural area*

The basic principles for improving fairness in land transfer are to correctly excise the policies and laws related to land, improve the utilization/allocation efficiency of rural land resource, ensure to protect farmers' legal rights, as well as correctly solve the intricate subtle issues among these issues. The major premise for warranting the fairness in transferring land is the following the Party's land policy in rural area. The essential task is improving allocation efficiency of land resource. The ultimate goal of facilitating land transfer is to protect farmers' legal rights and interests. All of these are consistent with the slogan "Regarding Peasants as Core".

2.1.1 Follow the principle of family-based land contractual right and maintain the principle for 30 years

This is the principle fundamentally protecting farmers' current interest and long term interest. It is the policy foundation for the stability of rural area. Under this principle, the land transfer is only the right of utilization. Farmers will not lose ownership due to the right transfer. The transfer of right is not compensated with one payment; neither is at a permanently fixed rate. Farmers should have a stable income permanently.

2.1.2 Follow the principle of farmers collectively owned land

30 years' contractual right grants farmers real property right. This is a quasi-property right, with which farmers enjoy the right of possessing, using, profiting from and dealing of land. It is only when farmers are granted full contractual right without any compromise that an effective land transfer system could be possibly established, become an essential element of market, and lead to improved allocation efficiency of land.

2.1.3 Follow the principle of "farmers as focal point" in the land transfer

Farmers' opinion has to be respected in the land transfer. The focal point of land transfer is farmers. Transfer should mainly among farmers. Income should be shared among farmers. The principle of farmers as the major practitioners is the natural consequence of following above two principles. It is also the realization of protecting farmers' land interest (Zhang, Aiyun, 2003, p. 12-15).

**3. Strengthen the standardized administration and regulation of the land transfer**

The land transfer involves the interests of land owner, land user, intermediary organization and others. Land transfer should be preceded according to standardized and regulated procedure. With the land transfer contractual concept established, parties should sign an authorized transfer contract qualifying the transfer form, the amount, the term, the condition of the transfer, the rights of relevant parties. The contract has to be notarized by relevant authorities. It is necessary to establish a broad registration system for land transfer, standardize and regulate the transfer administration.

*3.1 Promote leasing while allow diversified forms of land transfer*

Leasing is simple and easy to practice. It is easier for farmers to accept. It is also a form popular over the world. It is even more suitable to our country where land purchase/selling is not allowed and land right transfer is allowed. Leasing fee is also more understanding and easier to be regulated comparing to the "compensation of land right transfer". The term for land transfer should not be too long since the value of land in far horizon is difficult to estimate, especially with the expectation of rural economy development and growth of land market. Long term transfer makes it harder to protect farmers' long term interest.

*3.2 Grow aggressively the intermediary organization for the land transfer*

Establishing a market for transfer the right of using land is imperative in the shift of land transfer system. Perfecting intermediary organizations is the key in establishing the market of land right transfer. Intermediary organizations bridge the parties of land suppliers and the parties of land demanders. Counties may establish such intermediary organizations associated with agricultural economic centers. The intermediary organizations may be responsible for bridging and managing land right transfer, including planning and scheduling, collecting and broadcasting information of supply and demand, promoting specific contracts, regulating and standardizing transfer procedure, guiding through procedural process, coordinating among different parties and providing services.

*3.3 Accurately position the local authorities' roles*

The local authorities are the administrators for the rural land. They are responsible for supervising the proper utilization of land resource, the transfer of land-use right, and controlling the dynamic balance of land supply and demand. They should not adjust the flow of land resource transfer with authority power, interfere with and even take over the right of land from farmers. Therefore, local authorities should position themselves as enhancing management and providing service. Local authorities should do a good job in qualification examination, contract notification, archive management and dynamic supervision. Local authorities should provide information and provide services such as bridging, organizing, coordinating, etc. Local authorities should plan strategically the long term land utilization and transfer, land interconnection and converging, construction and improvement of agricultural land infrastructure, and create a better environment for facilitating land transfer (Gai, Guoqiang, 2001, p. 20-23).

*3.4 Protect farmers' legal interests in the non-farming land acquisition*

Land is a scarce resource that can not be regenerated. With the development of market economy, land processes not only the function of providing living income, but also the function of property with ever increasing value. To non-agriculture land transfer, we have to distinguish national public welfare construction and commercial construction. For national public welfare construction, it is proper to expropriate the farmers' land, but the compensation on rural land acquisition should benefit farmers instead of being exploited by middlemen. For commercial construction land, it is not proper to buy out the farmers' land, leasing of land or partial ownership should be adopted so that farmers may have long-term stable income.

*3.5 Accelerate the legislation of the land transfer*

Details should be established in the laws and regulations of land lease and contract in rural area as early as possible. It is imperative to establish the laws and regulations for rural area land transfer, which governs the definition of the rights of farmers over land, the qualification of the compensation standard and income sharing for the land right transfer, management of land transfer, solution to the confrontation and conflicts that local authorities have difficulties to address and solve. Rural land transfer process should be fitted under the legal framework of law through thoughtful study and investigation. Law should be used to protect long term stability of agricultural economy, and protect healthy and orderly growth of the interest of land contract and land right transfer.

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# Investigation of Relationship between Economy and Environment

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**Abstract**

The economic activity is based on the necessary of human development. The environment changes when the society develops. The relationship between society and environment is always an important topic which people pay much attention to. The period change of human social economy development will inevitable cause corresponding huge change of environment, which embodies the change of the relationship between economy and environment. It's very important of this topic for promoting sustainable development of society, economy and environment.

**Keywords:** Traditional economy, Global economy, Environment industry

The traditional industries set the high-speed economic growth as a goal, and never dreamed that we had paid a heavy environmental cost in the process of agriculture and industrialization development. In the fight for the realization of economic and social sustainable development, the relationship between economic and environmental issues is clearly on the table. It's very essential to have an in-depth research about these. Economic development and environmental protection are not the conflicting sides. We want to improve the situations that the traditional economic had damaged the environment and the subversive effects of the destroyed environment to the economic development. Then it is necessary to make economic, social and resources, environmental development in harmony to achieve that "Without prejudice to the needs of future generations, to meet the financial needs of contemporary people (Mao Hanying, 1995)." We know that the good economic situation should be built on the basis of the ecological sustainability, and also the environment industry may become a new economic growth point. The emerging knowledge economy and environment are closely related, as well as the recycling economy. Economic development is important, but environmental protection can not be ignored. Only to harmonize the two can the society develops steadily. In the face of the rapid development of the world's scientific and technological revolution, and the growing trend of economic globalization, overlooking the gratifying results of the China's reform, joining the WTO and Beijing Olympic Games, the Sustainable Development that China has chosen is the right choice. To achieve the double-harvest in both economic and ecological benefits is the key to the China's social development. I will discuss the relationship issues between economic and environmental issues in three aspects issues.

**1. The Destruct Effect that the Traditional Economic Development to the Environment**

Since the outbreak of the famous industrial revolution in Europe, the enginery-based manufacture has gradually replaced the agriculture-based natural economy. People thought that without the industrial revolution, without its enormous productivity, our society would not have the overstepping progress of society, and the social life would not become so rich and varied. However, would somebody think of that when thousands of machines grumbling, when factories were constructed more and more, when a certain period of the railway line be opened, when new city was developing one by one, which brought what serious consequences to the natural ecological environment. Agricultural pollution combined with industrial contamination's emissions made the four circle seriously damaged. The earth just likes a drowned mouse. Agricultural pollution is mainly from the chemical fertilizers, pesticides as well as the pollution caused by industrial pollution and other factors. The decline in the quality of cultivated land includes the land salinization, soil fertility decline and land desertification, which will also have a direct impact on the city's climate, population and economic development. Industrial pollution is the main factor of environmental pollution in nearly two centuries. The "three wastes" polluted the environment seriously, even do harm to the survival of mankind (Zhou Wenzong, 2005). In 1948, the Donora town in the United States occurred smog affair. The 43% of more than 10,000 had the symptoms such as severe headaches, breathing difficulties, vomiting and so on, 17 people were killed. That was because the town is located in the valley, the two sides are covered with factories, and constantly vehicles on the road with emissions lead to air pollution and then lead to serious consequences. In recent years, the person in Russia's Volga's River Basin is depressed for without water to drink because of the largest river in Russia received half of the industrial waste water. This sewage is not only waste water, compounds and oil substance, but also the heavy metals, radioactive substances and toxic organic quality. It showed that the water pollution situation is quite serious, Such pollution cases happened in every countries. And solid waste pollution you might see everywhere. Hill's garbage occupied the land resources, polluted the environment, and left a lot of hidden dangers. The garbage heaped for a long time will diffuse diseases, pollute water, air and soil, and thus endanger human health. The toxic substances in industrial wastes will break down and do harm to others. Industrial production and research especially heavy industry will bring invisible pollution to human, including noise pollution, electromagnetic pollution, nuclear radiation pollution and so on, which hang a layer of the terrible shadow over human health and survival. To this extent that the deterioration of environment human can feel, then they know that in the pursuit of rapid economic development, at the same time, we need a more beautiful living environment. Therefore, it is abnormal to damage the ecological environment in exchange for economic benefits, to the lack of green in exchange for economic prosperity in economic and social development. The right way to develop the economy has to achieve the unification of economic and ecological benefits.

**2. The Simultaneous Development of the Two New Global Economic Situation and Environment Industry**

Following the agricultural economy and industrial economy, the world's two emerging economic situation is knowledge economy and circular economy. only to follow closely the new pulse can make real economic and social sustainable development.

Knowledge economy refers to that knowledge or modern science and technology as a factor plays a leading role in the process of social reproduction, which is bridge and link of knowledge that syncretizes with economic integration gradually (Wang Lei, 2007, p180-182). It includes a variety of high-tech industries as well as the use of modern science to the transformation of agriculture, industry and tertiary industry, and these do with the environment. In the context of knowledge economy, environmental technology with biotechnology and communications technology develop side by side has become one of the most promising of the three major

technical. Environmental industry as a new category of the economy will become a new growth point of the national economy. Recalling of the early 1980s, the problem of acid rain caused widespread concern in Europe. Germany enacted stringent environmental laws and regulations to urge the development and utilization of desulfurization technology quickly. To promote a large number of flue gas desulphurization technology, so that desulfurization equipment with a total investment of 14,300,000,000 marks in five years from 1983 to 1988. The move not only solved the problem of environmental protection, but also led to the development of environmental industries, and promoted the whole economic development to a new level. Environmental industries offer the provision of environmental equipment and services. More than the industry environment to reduce the losses caused by pollution, but also promoted economic system to upgrade technology. Japanese name the environmental protection as the "springboard" of the technological upgrading, and also believe that Japan should be founded on the environment in the 21st century. China's industrialization process has not yet been completed. There are of poor quality, low capacity for sustainable development in China's industry, which problems are the major factors lead to the environmental pollution. As a result, to reduce the distance between China and developed countries, we have to follow the trend of international economic integration, actively develop high-tech industries, achieve the industrial growth change from extensive to intensive type, improve the resources and energy's utilization, push the introduction of Environmental protection, and improve the quality of China's economic development. Therefore, knowledge economy and the environment industry are synchronized. Environmental industries development characterized high-tech and knowledge-intensive in knowledge economy society. All of scientific and technological achievements of the creation, expansion and the application in the environmental protection and related disciplines fields will directly lead the development of environmental industries. Environmental industries prepare a good social environment for the development of knowledge economy. They are closely and harmonious.

Recycling economy the new concept has a relationship that cannot be divided with the environmental industries. The so-called circular economy is to change the material single way of the traditional economy — "resources - products - pollution discharges, establish the material flow of the economic cycle —"resources - products - renewable resources", which can compare with the ecosystem. The 16th CPC National Congress advanced: "the development of circular economy in China is effective means to resolve conflicts between environmental protection and economic development, implement the strategy of sustainable development, and achieve an important way for a new type of industrialization." One of the important principle of recycling economy is the recycling, reduction and the innocuity of the wastes. From the basic characteristics of the recycling economy can illuminate that the resources recycled at the core of recycling economy. (Zhang Kun, 2003).Circular economy is a required course for the environmental industry. Circular economy's waste recycling industry is the only solution to urban sewage and garbage piles. The biggest benefit of developing the circular economy is that it can fundamentally solve the conflict between economic development and environmental protection for a long time. Currently, the main developed countries' renewable resources total value of 250,000,000,000 U.S. dollars and grow rate of 15-20% annually.

To recycled paper, for example, 1 ton of waste paper can yield 0.85 ton of good product recycled paper, saving 3 cubic meters of wood, 100 ton of water, 1.2 ton of coal, 600 degree electricity, which also can reduce a lot of water pollution Circular economy and the environment industry are also simultaneous develop. The ethos of environmental protection creates a good atmosphere for the recycling economy development and scientific research, and the recycling economy makes a big contribution for environmental industry. In accordance with the laws of ecology, the recycling economy uses the natural resources and environment capacity to achieve the ecologization from the economic activities.

To sum up, the more the social economic development, the more harmonious we should achieve with the

environment development, which can make the social productive forces and elements achieve the sustainable development at high speed, and promote the real progress in human society.

**3. The Outlook of China's Economic and Environmental Harmonization**

In order to fully implement the spirit of "Three Represents and the concept of scientific development"put forward by the Party Central Committee, the National People's Congress passed "the National Economic and Social Development, the 11-year plan outline", which put resources and environmental protection at an important status, wish to achieve "persist in taking economic construction as the centre, achieve the double-win of environmental protection and economic development". In the face of the rapid trend of economic globalization, it's essential for China to make the principle that economy and environment coordinated development (Zhu Guohong, 1995, p18-24; Xia Huanlong, 2006, p8-9).

Since acceding to the WTO, non-tariff barriers of trade barriers especially the green trade barriers has became the constraint factors that China's products could not enter the international markets. The prominent contradiction of our economic development is the structural problem. so the nation alleviated the pressure on the resources and the environmental conditions by adjusting the industrial structure. China has also actively pursued the policy of "one-controlled double standard", that is, control the pollutant emissions, and achieve the emission standards of the industrial pollution and the urban environment domain. Some companies think that the cost and the power of pollution will reduce the economic efficiency of enterprises. This viewpoint will appears due to they went in the mental fallacies caused by analyzing the relationship between the environment and the economy without the long-term development and the dialectical unified views. The smart entrepreneurs think that "the good environment is also productivity". Through the pollution control standards, not only will it alleviate the pressure on the country, to create a good corporate image, but also bring continuing economic benefits for the company. Reduce pollution to enable the rapid economic development, and provide an effective environment of space for developing large-scale, high-quality and high-tech industry.

Acceding to the WTO, choosing the export-oriented economic development, no matter the introduction of the project, or in the area of investment, we should give priority to environmental protection requirements. in the fight for greater trade liberalization, at the same time, we have to prevent environmental degradation. It is not only necessary to actively promote trade and economic development, but also to safeguard the interests of national resources and the environment. To join the WTO, it is necessary to understand constraints effect between economy and environment. Only to ensure the economy and environment are harmonized so that China can catch up on the pace of economic globalization.

Beijing Olympic Games and Paralympics Games were organized which made national jubilation. Since then, it is bound to bring a series of the appropriate economic measures such as urban planning, layout, construction of large facilities, , including the tourism industry the tertiary industry will also bring considerable economic benefits. If China can take full advantage of this opportunity to go on reasonable development and utilization of resources it will be beneficial; but if unreasonable to develop and utilize resources it will do harm to environmental protection. A city state of the environment, including natural and human environment, can reflect a country's civilization and national conditions, may also reflect the quality of the people. A good social environment can attract more funds, personnel, technology, equipments so that economy will grow. Therefore, in the development of urban construction, we can not just pursuit short-term economic benefits at the expense of the environment, but should be in accordance with scientific principles and systems of long-term significance of the reform and construction, elements of the natural environment as well as the history culture site must be effective protection, for the building of economic prosperity in harmony with nature as a garden city. I believe this city in the international arena will be more competitive and to bring the economic value of eco-tourism, sight-seeing value of the great economic benefits. This is so-called unification of the economy and the environment.

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# Fuzzy C-means Clustering for 3D Seismic Parameters Processing

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**Abstract**

3D seismic parameters can reflect the features of petroleum reservoir from different profiles. By analizing the 3D seismic parameters, we can assess the parameters of the reservoir characterization, such as deposition, structure and growth history, fluid saturation and so on. The traditional clustering methods can't capture the degree of similarity between reservoir parameters very well, so we introduced in this paper the application of fuzzy C-means (FCM) clustering for the processing of 3D seismic parameters. It begins with the analizing the relationship between 3D seismic parameters and reservoir characterization parameters, and then we process the 3D seismic parameters with FCM and assess the parameters of reservoir characterization. The testing results show that FCM can classify the 3D parameters more accurately and provide a good evidence for the research of petroleum reservoir.

**Keywords:** 3D seismic parameters, Structure and growth history, Fuzzy C-means clustering

## 1. Introduction

Fuzzy C-means (FCM) clustering is one of the essential branches of non-supervisory pattern and it was widely used in pattern recognition, data mining, computer vision, as well as in areas such as fuzzy control. Now, FCM has become a relatively mature technology. In the field of petroleum engineering, it has been widely applied to the evaluation of reservoir quality (Chen, Liang, 1997), reservoir classification, Petroleum exploration and decision-making (Zhu, Kejun, 1999) and so on.

In this paper, we introduced FCM to deal with 3D seismic parameters so as to assess some of the parameters of reservoir characterization, such as structure and growth history, permeability, fluid saturation, and master their distribution. First, we introduced the principle of FCM; then we use FCM to deal with three-dimensional seismic parameters; lastly, we make a summary.

## 2. The Principle of Fuzzy C-Means Clustering

Fuzzy C-Means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method is frequently used in pattern recognition. It is based on minimization of the following objective function:

$$J_m = \sum_{i=1}^{N} \sum_{j=1}^{C} u_{ij}^m \| x_i - c_j \|^2 \tag{1}$$

Where $m$ is any real number greater than 1, it was set to 2.00 by Bezdek; $u_{ij}$ is the degree of membership of $x_i$ in the cluster $j$; $x_i$ is the $i^{th}$ of d-dimensional measured data ; $c_j$ is the d-dimension center of the cluster and ||*|| is any norm expressing the similarity between any measured data and the center.

Fuzzy partitioning is carried out through an iterative optimization of the objective function shown above, with the update of membership $u_{ij}$ and the $c_j$ cluster centers by:

$$u_{ij} = \frac{1}{\sum_{k=1}^{c} \left( \frac{\| x_i - c_j \|}{\| x_i - c_k \|} \right)^{\frac{2}{m-1}}} \tag{2}$$

$$c = \frac{\sum_{i=1}^{N} u_{ij}^m x_i}{\sum_{i=1}^{N} u_{ij}^m} \tag{3}$$

This iteration will stop when

$$\max \left\{ | u_{ij}^{k+1} - u_{ij}^{k} | \right\} < \varepsilon \tag{4}$$

Where ε is a termination criterion between 0 and 1 and k are the iteration steps.

This procedure converges to a local minimum or a saddle point of $J_m$.

The algorithm is composed of the following steps:

1. Initialize $U = [u_{ij}]$ matrix, $U(0)$

2. At k-step: calculate the centers vectors $C(k)=[c_j]$ with $U(k)$

$$c = \frac{\sum_{i=1}^{N} u_{ij}^m x_i}{\sum_{i=1}^{N} u_{ij}^m} \tag{5}$$

3. Update U(k) , U(k+1)

$$u_{ij} = \frac{1}{\sum_{k=1}^{c} \left( \frac{\| x_i - c_j \|}{\| x_i - c_k \|} \right)^{\frac{2}{m-1}}} \tag{6}$$

*If* $\| U(k+1) - U(k) \| < \varepsilon$ then STOP; otherwise return to step 2.

**3. FCM for 3d Seismic Parameters Processing**

In the 3D Seismic Parameters Processing, we first import a potentially large number of independent data (such as seismic amplitude), and quickly assess which are most related to the dependent data (such as porosity-thickness) with FCM, then produce a cluster pattern map of those most-related independent data or

any user selected data contained in the imported file (correlation and ranking is provided as output). The FCM is very robust as it works well in cases where the dependent data (well control) population is small. In addition to producing a cluster map, an output file can be generated that contains grid location(x, y), cluster rank and cluster mean-value from the dependent data.

Here, we give you an example. The data in table 1 is a portion of input data used for testing. It was used as input data. In the table, the rows A and B are the coordinates, row C is numeric well identifier, the row D and E are well information, those are dependent data. Rows from F to L are independent data, those are seismic time information.

The figure 1 is the clustering results map with FCM, and it contains four parts: the coordinates of the independent data (x, y), the clustering map, the cluster groups and the clustering ranks. These cluster groups represent areas of similar structural growth history. The thinnest areas, with maximum growth, are ranked as 1, here is cluster 3 on the map, the quality of the reservoir is the best. The thickest areas, with minimum growth, are ranked as 3, here is cluster 2 on the map, the quality of the reservoir is the worst . The quality and the growth history of the reservoir ranked 2 are between cluster 2 and cluster 3.

## 4. Conclusion

The purpose of FCM is to find a reasonable classification system for a given sample with mathematical method, and solve the classification problem in the reservoir description. In this paper, we introduce fuzzy C-means clustering method to the study of dealing with three-dimensional seismic parameters. The experiment results show that, it can deal with the three-dimensional seismic parameters effectively, so we can analize some of the reservoir characterization parameters, master the distribution of the reservoir caracterization parameters, and improve the exploration and development effectiveness of the oil and gas reservoir.

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Table 1. Portion of Input Data Used for Testing

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1212821 | 149427 | 3.3E+09 | -6066.8 | -1747.3 | 652 | 991 | 1120 | 1554 | 1618 | 1713 | 1805 |
| 2 | 1212474 | 145067 | 3.3E+09 | -6059.4 | -1750.7 | 645 | 989 | 1118 | 1546 | 1612 | 1707 | 1799 |
| 3 | 1211646 | 144209 | 3.3E+09 | -6052 | -1752 | 642 | 993 | 1118 | 1548 | 1613 | 1708 | 1799 |
| 4 | 1212374 | 144767 | 3.3E+09 | -6052.4 | -1753 | 643 | 990 | 1117 | 1547 | 1612 | 1707 | 1798 |
| 5 | 1215767 | 142373 | 3.3E+09 | -6060.4 | -1757.3 | 652 | 997 | 1126 | 1553 | 1615 | 1713 | 1801 |
| 6 | 1214184 | 150850 | 3.3E+09 | | -1759.1 | 660 | 996 | 1125 | 1561 | 1623 | 1713 | 1807 |
| 7 | 1207014 | 152537 | 3.3E+09 | -6119.93 | -1762.45 | 643 | 984 | 1117 | 1551 | 1614 | 1703 | 1803 |
| 8 | 1216262 | 152792 | 95 | -6184.9 | -1831 | 666 | 1005 | 1129 | 1568 | 1635 | 1783 | 1831 |
| 9 | 1207727 | 148819 | 1555 | | | 635 | 984 | 1112 | 1545 | 1612 | 1708 | 1803 |
| 10 | 1206414 | 148488 | 1554 | | | 636 | 983 | 1115 | 1541 | 1610 | 1710 | 1803 |
| 11 | 1209040 | 148488 | 1553 | | | 636 | 982 | 1108 | 1554 | 1613 | 1708 | 1801 |
| 12 | 1206414 | 148819 | 1552 | | | 636 | 984 | 1116 | 1544 | 1613 | 1712 | 1804 |
| 13 | 1704742 | 148488 | 1551 | | | 636 | 982 | 1114 | 1593 | 1609 | 1709 | 1803 |
| 14 | 1207070 | 149482 | 1550 | | | 637 | 987 | 1118 | 1551 | 1617 | 1715 | 1805 |
| 15 | 1208055 | 148819 | 1549 | | | 637 | 983 | 1113 | 1548 | 1614 | 1710 | 1802 |
| 16 | 1210025 | 144847 | 1548 | | | 637 | 988 | 1119 | 1552 | 1613 | 1706 | 1800 |

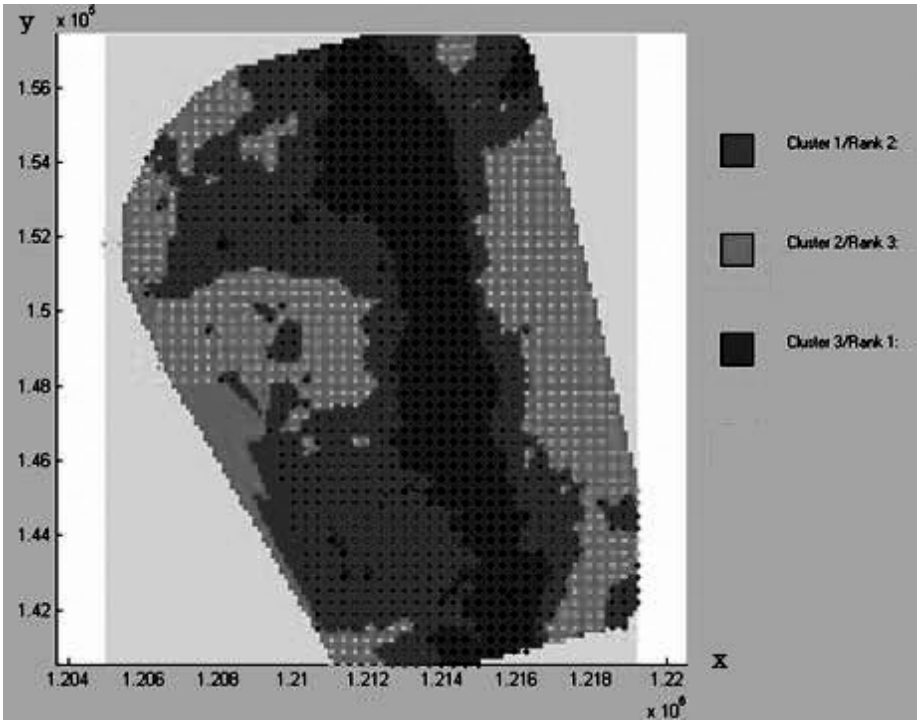


Figure 1. The Clustering Results

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