

SYSTEMATIC TECHNOLOGY FOR REMOTE SENSING AND INFORMATION PRACTISING  
IN THE METHODIC RESEARCH ON PLANNING BUSINESS OF MODERN URBAN AND RURAL

Liu Bin-yi Li Wei-qian

Ph.D. and Associate Professor

College of Architecture and Urban Planning Dept. of Surveying  
Tongji University, Shanghai 200092, P.R. of China  
ISPRS Commission VII

Abstract

Integration of two tasks on subsidize subjects of state natural scientific fund and the practical examples on engineering of greening planning of environment in PUDON new area, SHANGHAI, this paper investigates the theory method and technology about how to take remote sensing and informational system using in planning business of modern urban and rural. The image data is collected from LANDSAT 5 TM/SPOT image tape, then the basic information for planning of urban and rural is extracted and proceeding with research for classificational pattern. The thematic data base and application of informational system are based on architecture, traffic, greening of environment pollution and so on with urban as core hard are put them using in analogy of urban planning and model setting up of analytical evaluation.

Keywords: Remote Sensing, Informational System, Greening Planning

1. Introduction

Exploiting PUDON, vitalizing SHANGHAI, enabling PUDON to set up a international city of extroversion, multi-function and modernization, which is a engineering of striding across centuries and has to pioneer progressively towards to depth in a planned way, on a stress and in a sequence. The other basic facilities and greening system are appropriate developed. "Greening Systemic Planning in Shanghai" has been jointly drawn up by Greening Commission of Shanghai, Gardens Administration Shanghai and our Tongji university. We want to take the novel modern ecology-theory of landscape as train of thought, according to objective reality of Shanghai, the systemic greening planning of regional environmental eco-system and modern city system is put forward by stages. The eco-environment of whole the Changjiang (Yangtze river) delta is taken as background using satellitic remote sensing and geographic informational system GIS technology. All sorts of information on environmental greening aspects in Shanghai area are collected on a large scale and the greening informational system is established. The image Processing of remote sensing is practised to planning business of modern urban and rural.

"The informational data extraction of environmental greening Shanghai" is a sub-project of "Greening Systemic Planning of Shanghai", the first part of which is collection of information on remote sensing and integration of GIS with investigation for landuse status quo, atmospheric floating dust, draining pollution away for body of water, landuse of afforestation etc. of Pudon new area.

2. Testing Regional Summary

The exploiting extent in Pudon means the east of the Huang -Pu river, the north of the Chuan Yang river. It draws near by a triangular area of the urban district in Shanghai. The total area is about 350 square kilometres. According to the strategic thinking for oriented toward world, the 21 centuries and the modernistic with the help of successful experience of civic exploitation for new area at home and abroad, we want to construct Pudon into a complete sets of equipment and modernistic and extrinsic industrial

base and become into a new window of further expanding and opening to foreign trade.

3. Acquiring informational data

In this test, we selected the computer compatible tapes (CCT) of autumnal two scenes, Shanghai acquired by American landsat-5 Thematic Mapper(TM). The time of satellitic crossing boundary is a.m. Oct.30,1989, the orbital numbers are 118/38 and 118/39. The testing area covers a range of Pudon, Puxi of whole Shanghai and including ten suburban counties. The geographic location is northern latitude  $30^{\circ}35'--31^{\circ}55'$  and east longitude  $120^{\circ}50'--122^{\circ}15'$ . Its tole area is 6,144.75 square KM. First of all, proceeded to the first work is environmental greening remote sensing of 350 square KM, including PUDON new area. This is a important foundational work.

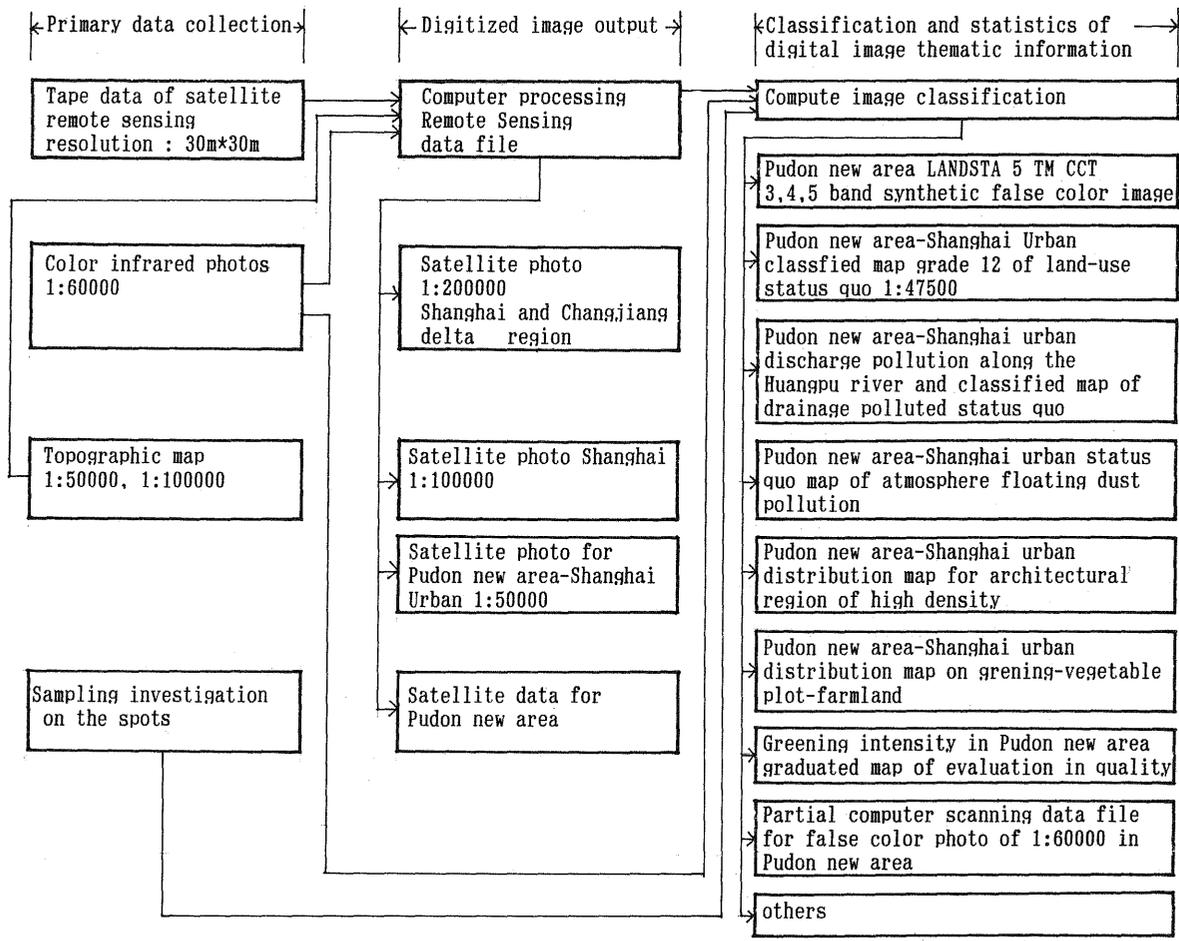
In order to cooperate for analytic necessity of larger scale, we purchased 10 color infrared aerial photoes of 1:60000 in PUDON new area at same time, its taken time is Oct.28,1989 and corresponds basically to the tape time of CCT. Two sets of topographic maps of 1:50000 in PUDON area and 1:100000 in Shanghai were collected for the necessity of geometric registration between image and real position on ground.

4. Technical route and methodic steps

The technical route about the environmental greening remote sensing in Pudon new area Shanghai see the block-diagram 1 as below.

Owing to considering the large investigative area, the high requirement for existing situation, widespread applied aspect and a large amount of basic information provided in a short time. So this research for greening remote sensing adopted the computer processing of digital image by remot sensing and performed varied image processing technology of composite selection for bands, image histogram equalization, geometric correction, radiometric correction, digital image mosaic, computer-based automatic classification and statistics for classificatory area etc. All the processing works are performed by EARTHVIEW/S140/COMTAL system.

4.1 Bands composition



Blockdiagram 1: Remote sensing technical route on environmental greening in Shanghai-Pudon new area

The orbital altitude of landsat-5 is 705 KM, the covered period is 18 days, the resolution of carried thematic Mapper is 30 M. The data of seven spectral bands contained by TM possess different properties each other and their data also differ from reflected ground cases. The composition selected bands should enable the information of researched object as more as possible and different classes on image all having distinct reflection. So the correlativity should be small among the selected bands. The different bands all need more unique information. The data must decrease the interfering with other factors and can reflect the real situation on ground. Considering that the bands of TM1,2,3 and TM5,7 are respectively closely related but the data of TM1,6 are great under the influence of atmosphere. The band of TM6 is small information volume and low resolution but the TM4 on near infrared band has higher reflectivity to greening vegetation than other bands of type. The combined testing among all bands is performed and the analytic result shows: The well image classifying effectiveness is the bands combination of TM2,3,4, TM3,4,5 and TM2,4,7. The combined bands of TM4,5,3, in which, reflect differ greatly from distinct type of land-use, rich information, abundant classification clear boundary and optimum interpretative effect. It is fine to append the band of TM7 for drainage analysis.

#### 4.2 Image histogram equalization

In order to enhance image contrast, abundant colour and ease in recognition of classification, so the linear stretch is performed and according to histogram

equalization so as to mix the gray ratio well and improve the relation of brightness ratio. After equalization, the information of image vegetation is protruded and make the image clear.

#### 4.3 Gray correction and band registration

In this step, the digital processing of spatial transformation, geometric correction, filtering processing, remove streak, eliminate cloud shadow and band registration etc. are performed. The purpose is using ground control points to search for the corresponding relation between image geometric distortional with standard geographic space by mathematical model, to revise geometric distortion and to perform geometric registration.

On the topographic map of 1:50000 and the color infrared photo of 1:60000, in contrast with the image range by screen output and selecting the control points of even distribution and covered whole area, the spatial transformation is performed for image under the principle of least squares adjustment so as to eliminate geometric distortion. At same time, the digital filtering is also performed for this and eliminate distortion of gray. The image after this processing can overlay with corresponding geographic information, thus all sorts of thematic informational map can be yielded, then various planning is performed to draw the blueprints of greening systematic planning Shanghai--Pudon.

The extraction for all sorts of thematic information mainly depends on the results of supervised classification for computer image.

#### 4.4 Computer image classification

Passing all sorts of transformation, after processing of enhancement, the unsupervised classification for image is performed and taking as subsequent carrying out the basis of supervised classification.

The investigation on the spot is performed before research work and the reconnaissance for various overlay of vegetation, status quo of landuse, soil erosion, atmospheric pollution, vision scenery etc. aspect of researching area also are proceeded with. For the greening status quo e.g. Pudon park, Sancha port forestry farm, nursery, sand beach, Chuansha county town etc. has been implemented the priority sampling. The related picture, photograph writing material are collected and interpretative marks are established.

On the drafting classified system, the training has been carried on for the sample area and the statistic numerics of spectral feature for each spectral classes are calculated. The decision pattern combined maximum likelihood and minimum distance with neuron network is selected at carrying on classified decision. The logical filtering has been performed for the spreading sprig phenomena in classical results, the isolated pixels differing from peripheral marks are eliminated and for classified image is smoothed.

#### 4.5 Statistics for classified area

All kinds of pixel number, area (conforming to total area) and accuracy are counted up mainly according to classified pixel number and achieved each kinds of spectral feature data containing parameters of mean value and standard error etc.

#### 4.6 Primary result and picture

Following data file and picture photograph stored at computer are obtained by computer image processing of remote sensing.

4.6.1 The false color satellitic photographes of LANDSAT 5 TMCCT 1:200000 Shanghai and Changjiang delta region, the covered area on the spot on these photoes is 68450 KM<sup>2</sup>.

4.6.2 The false color satellitic photographes of LANDSAT 5 TMCCT 1:100000 Shanghai, the covered area on the spot on these photoes is 6340 KM<sup>2</sup>.

4.6.3 The false color satellitic photographes of LANDSAT 5 TM CCT 1:50000 Pudon new area--Shanghai urban district, the covered area on the spot on these photoes is 1935 KM<sup>2</sup>.

4.6.4 The false color image by composition of LANDSAT 5 bands of TM CCT3,4,5 Pudon new area, the covered area on the spot on these photoes is 430 KM<sup>2</sup>.

4.6.5 The classification map of level 12 (1:47500) on landuse status quo, Pudon new--Shanghai urban district, in which, the information of the distribution of new and old architectural using-land, farmland, vegetable plot, afforestation using-land, water body and network of waterways etc. are contained, cf. photo 1. where, pink green shows greening information, pale white shows vegetable plot, tangerine color shows farmland, purplish blue is general cluster of building, black purple is constructed district of high density and cobalt blue shows water domain.

4.6.6 The classification map on pollution drainage and the status quo for pollution of water body along Huangpu river, Pudon new area--Shanghai urban district.

4.6.7 Status quo map on atmosphere floating dust pollution, Pudon new area Shanghai urban district.

4.6.8 Distribution map on architectural region of high density, Pudon new area--Shanghai urban district, distribution on architectural density, Pudon new area.

4.6.9 Distribution map on afforestation --vegetable plot--farmland, Pudon new area--Shanghai urban district.

4.6.10 Greening intensity on graduated map of evaluation in quality, Pudon new area (cf. photo 2).

4.6.11 Partial computer scanning data file for false color photograph of 1:60000, Pudon new area (spatial resolution is 2.5 m \*2.5 m).

#### 5. Computer analogy on field domain landscape information

5.1 The establishment of computer analogic system on multi layers information of field domain landscape

Initial data based remote sensing data is added to expand for already possessing informational system. The computer analogic system on multi layers information of field domain landscape is set up in this paper (block diagram 2), where including six parts of collection of primary data, digitized image output, analogy for field domain landscape information, analogy on impressional information for field domain landscape, informational synthetic evaluation and Application for planning design engineering.

5.2 The mathematical model on all layer of field domain landscape information.

As showing in block diagram 2, the mathematic model on all layer of field domain landscape information including environmental informational model of each landscape for field domain, the model of impressional information for each field domain landscape and the synthetic evaluated model of each field domain landscape information, where some models have been shared together e.g. topographic slope, sloping direction, sun shine and shadow etc. Some models are set up based on a specialized necessity e.g. index mark to each civic planning, some are emphasized on the model of aesthetic sensing for spetial physical vision e.g. the model of scenic fine forecastness and the model of scenic vastness. Besides the mathematic representation, the key builded these models has to comprehend fully the theory and its specialized necessity of architectural environmental subject and also needs to make the model clear and complete gradually by checking of real engineering.

5.3 Programing design by computer and working out to software

This software is worked out from popularization, spreading and ease to work out and debugging on the microcomputer series of IBM PS/2 and series IBM PC and taken the language of True Basic as chief to work out.

#### 6. Conclusion

This part of work is smoothly fulfilled, so that the afforestation planning of Pudon area can be performed systemly cf. photo 3. The information of detailed environmental background is provided, so that the planning possed reliable scientific basis. The practical result shows, the method and technology

constructed frame put forward in this paper possess such advantages.

- The informational material needed for planning design is obtained speedily and exactly.

- The analysis and evaluation are systematically and quantitatively performed for the status quo of architecture, city and scenic garden.

- A series of theory and method of modern planning design is enabled to come true.

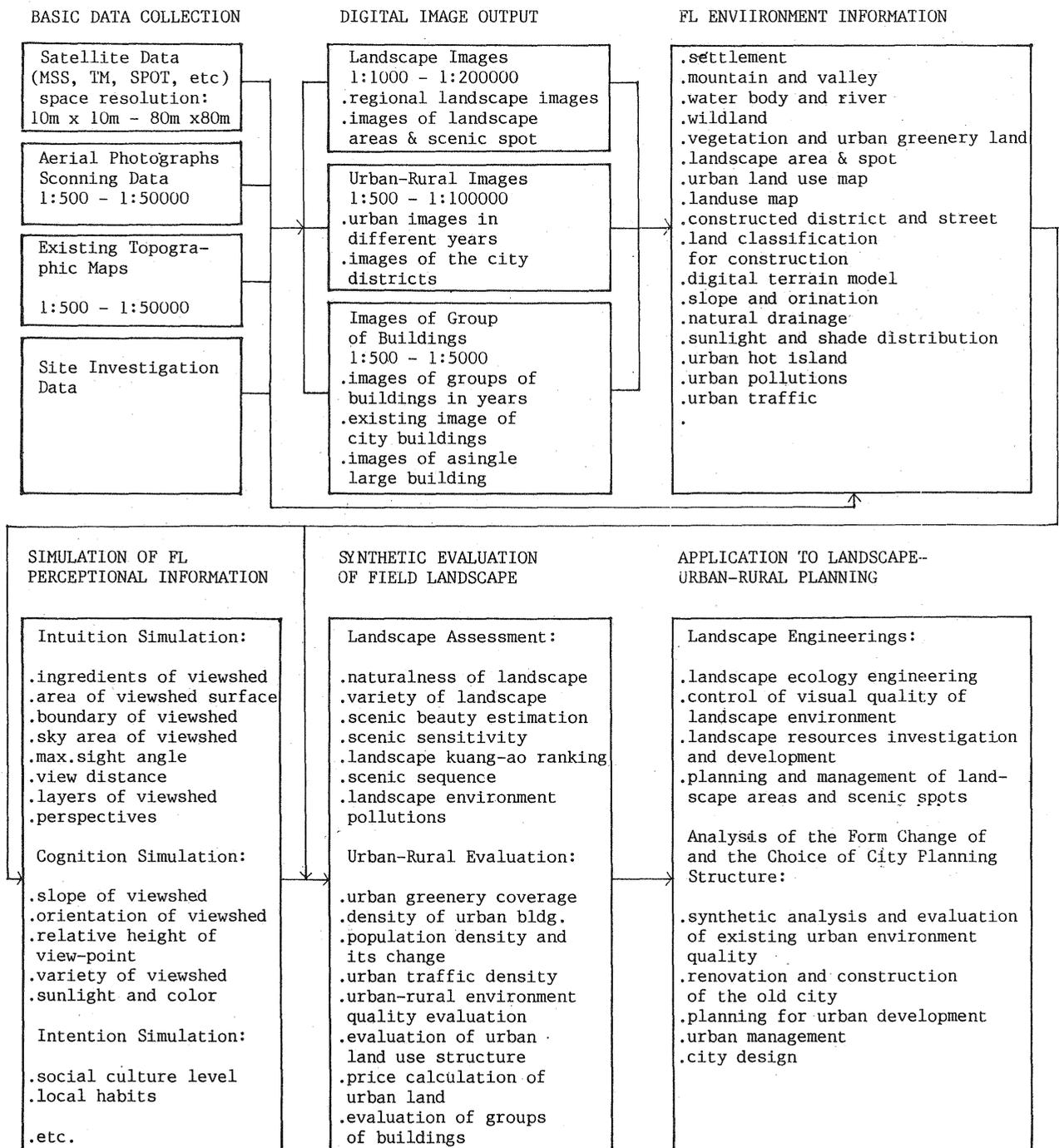
- The yield of new specialized theory, method and medium are promoted.

- Promoted the professional alternation and permeation.

- Open vast vistas for applications

### 7. References

[1] Liu Binyi The establishment for the information system on scenic landscape by electronic computer Journal of Tongji University, Vol.19(1):91-101.  
 [2] Liu Binyi, Digitize the sense of Beauty, Internation society for photogrammetry and Remote sensing, commission III, proceeding of the symposium progress in Data Analysis, Vol.28, part 3/2:474-482. May, 1990



Block Diagram 2. Simulation System of Field Landscape Multi-layers Information

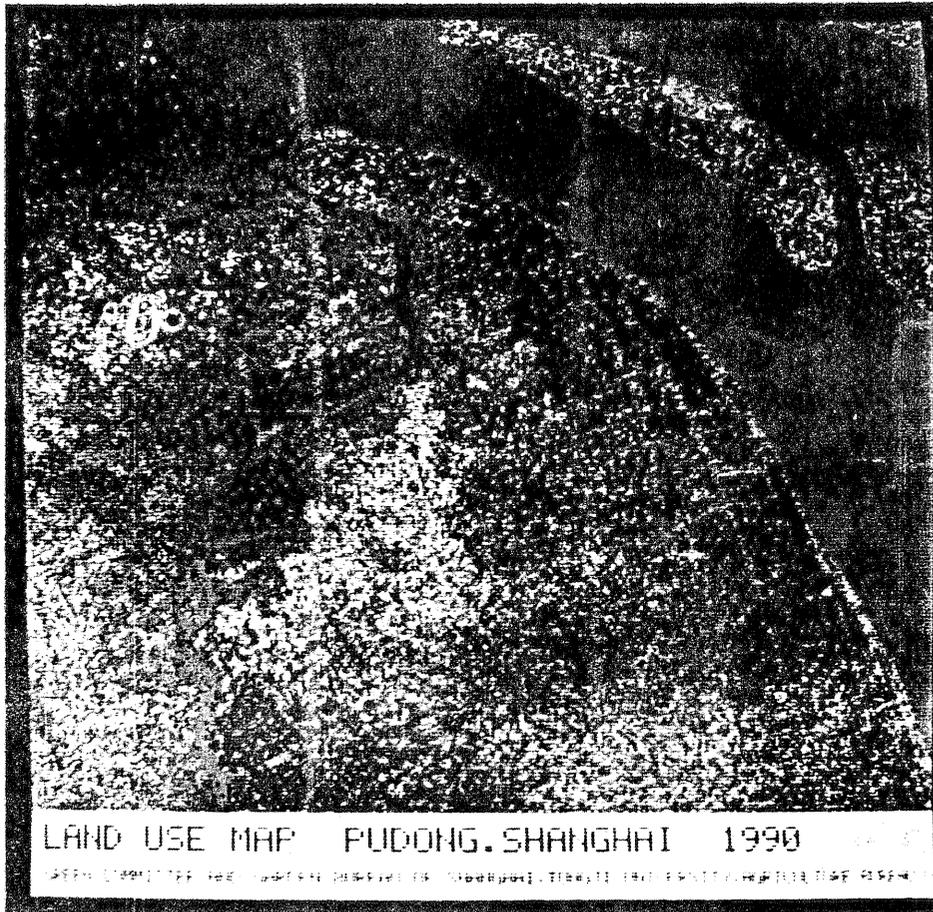


Photo 1: Classification map levels 12 on land use status quo

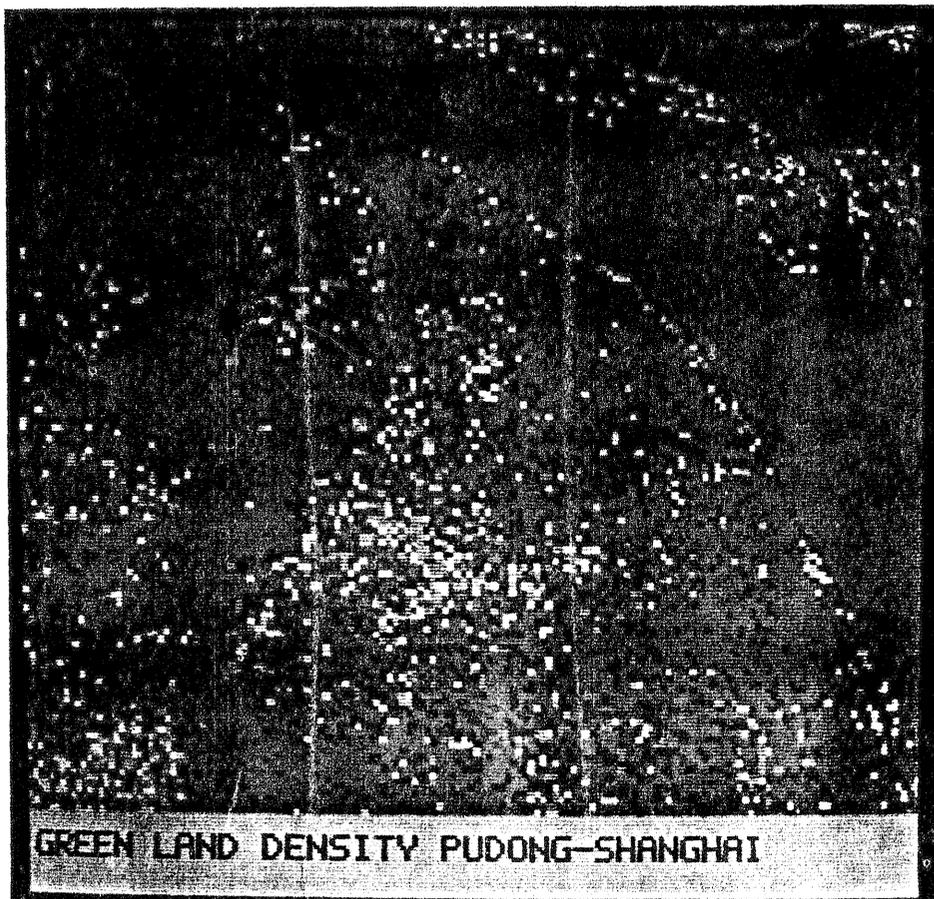


Photo 2: Greening intensity for graduated map of evaluation in quality, Pudon new area

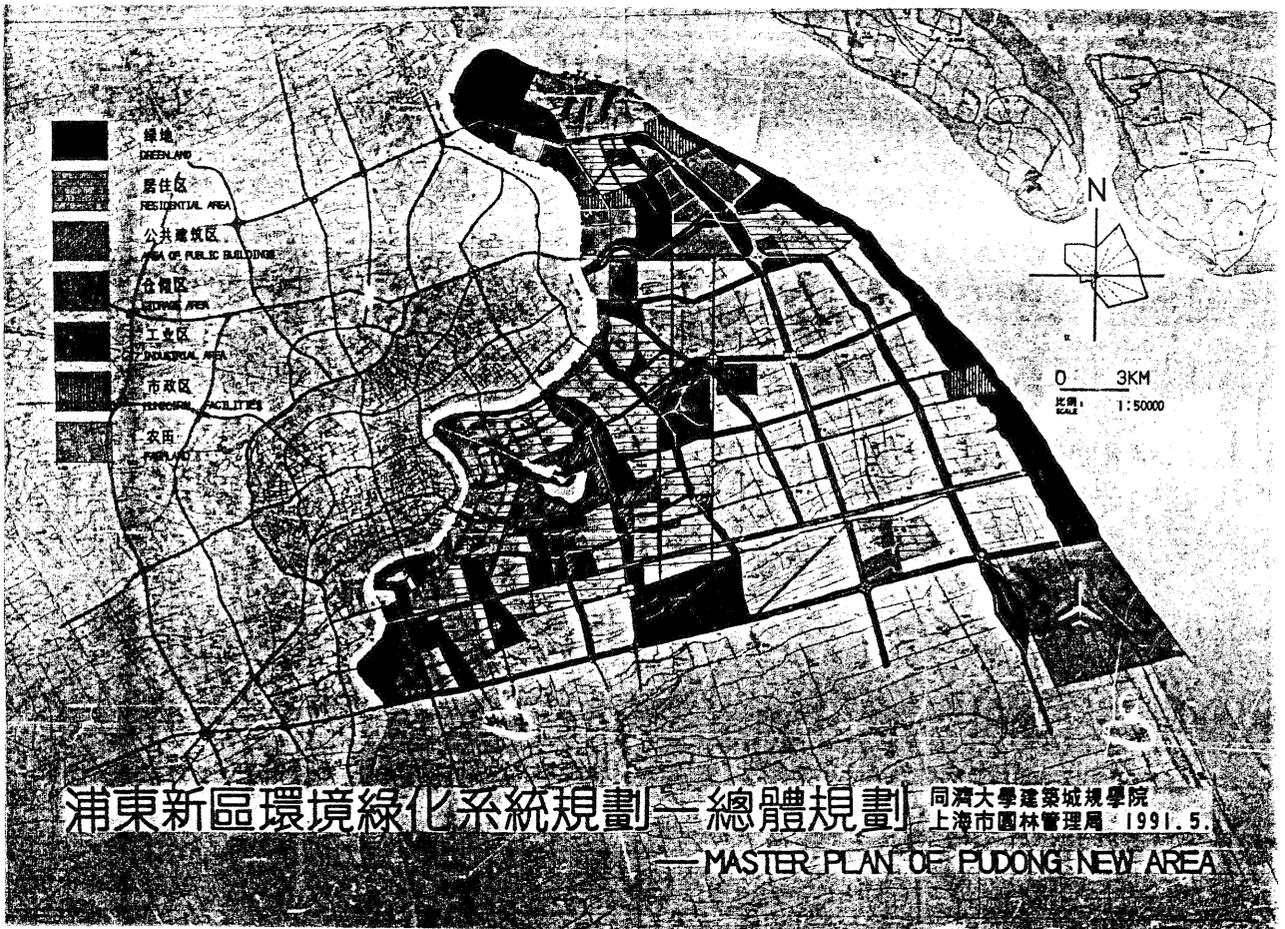


Photo 3: Afforestation planning of Pudon new area