PROCEEDING

Faculty of Landscape Architecture
and Environmental Technology
Jakarta, Indonesia

IDRC CRDI

MercyCorps

INTERNATIONAL SEMINAR on

SUSTAINABLE URBAN DEVELOPMENT

20-21 August 2008

at Campus A of Trisakti University,
Building D, 8th Floor,
Jl. Kyai Tapa No. 1, Grogol, Jakarta, Indonesia

No. ISBN 978 - 979 - 99119 - 3 - 3

ISBN 978-979-99119-3-3

ISBN 978-979-99119-3-3

PP.UM-09

STUDY OF CORRELATIONS SPATIAL INDEKS HOUSING AND PHYSICAL ENVIRONMENTAL QUALITY OF RESIDENTIAL

Dwi Nowo Martono *)
Ninin Gusdini **)

*) Researcher of National Institute of Aeronautics and Space, Remote Sensing affairs
**) Lecturer of Sahid University Jakarta

Abstract

The research focused on studying spatial index of housing and their correlations with the physical environmental quality of residential. The aim of the research were to recognize spatial characteristics of types of residential areas based on high resolution remote sensing data and to obtain an estimating correlations of physical environmental quality. The result of the research by linear regression model show, that a building density as a spatial variable which significance to effluence of the quality physical environment in the formal housing with coefficient correlation (r) level of 0,735. While, the road networking conectivities indeks (indeks β) and distance housing to the road are spatial variables which significance to effluence of the quality physical environment in the informal housing with coefficient correlation (r) level of 0,765.

I. Introduction

Population growth and urbanization are main factors in development of housing in urban areas. This development results in a number of spatial changes, some of which are density and organized arrangement of building construction, percentage of vegetation as well as area accessibility. So far there has hardly been any spatial study on the level of Housing Environmental Health Quality of residential areas, and some that have been conducted tend to be partial, in which statistical data are mostly used. Spatial aspects as a basic instrument in designing, deciding, and implementing principles of Housing Environmental Health Quality of residential areas have not been prioritized either by the government or in business. This situation is reflected in the formal standard technical procedures issued by the government bodies such as Department of Health and Department of Public Works who have not fully implemented spatial aspects as an important indicator in assessing the level of Housing Environmental Health Quality in residential areas. There has been a dichotomy between variables of the level of Housing Environmental Health Quality and those of spatial characteristics of residential areas. Moreover, the formulation of technical procedures for assessing/evaluating the level of Housing Environmental Health Quality has not been standardized, despite the established measuring variables, which are too qualitative still.

The research focused on studying spatial aspects formulated in the forms of spatial indexes and their correlations with the level of Housing Environmental Health

ISBN 978-979-99119-3-3

Quality of residential areas evaluated based on standard guidelines by Department of Health. The objectives of the research were : (1) to identify the level of Housing Environmental Health Quality of residential areas based on six main variables on the level of Housing Environmental Health Quality of residential areas by referring it to guidelines by Minister of Health no:829/VII/1999, (2) to recognize spatial characteristics of types of residential areas based on remote sensing data of Ikonos high resolution., (3) to obtain a model for estimating level of Housing Environmental Health Quality of residential areas based on spatial variables and thus identifying those that are influential.

II. Methodologies

The theoritical base applied was that the Housing Environmental Health Quality of residential areas was determined based on criterias of spatial and non spatial components. A change in one component would affect others. Spatial components include scattering pattern of the buildings, building density, vegetation percentage, lay out of the buildings, and accessibility. The non spatial components based on guidelines by Minister of Health including (1)furnerability of location against natural disasters; (2)quality of fresh water resource; (3)quality of air and noise pollution; (4)greening/penghijauan; and (6)facilities and infrastructure consisting of sanitation, waste management, drainage/sewerage system, condition of roads, transportation, education and worshipping facilities.

In the research methodology, types of residential areas were considered as mapping units. The types of residential areas were classified into four categories: luxurious, middle, simple, and informal housing types. Spatial variable of road network, buildings and vegetation were identified and interpreted from the Ikonos remote sensing data. Identification of spatial characteristics of residential types was based on the layout of the buildings, building density, percentage of vegetation and level of accessibility cluster analysis was used to categorize residential types based on the value of spatial variables. Identification of Housing Environmental Health Quality level of each type of residential areas was evaluted based on basic standard of Minister of Health Republic of Indonesia no:829/Menkes/VII/1999 regarding criteria of Housing Environmental Health Quality covering six aspects: critical areas, quality of air and noise pollution, reforestation/greening, disease vectors, and environmental facilities, and infrastructure. The Housing Environmental Health Quality is classified into five classes consisting of those very healthy, healthy, rather healthy, less healthy, and unhealthy. The correlation between spatial variables and the level of Housing Environmental Health Quality was estimated by using a discriminant analysis.

III. Data Analysis

ISBN 978-979-99119-3-3

The result of the research indicates that of the 89 samples for residential areas in the research location, five areas have a bad Housing Environmental Health Quality (6%), 47 areas have medium quality (53%) and 37 has good quality (41%). All the formal housing areas including those of luxurious, middle and simple have good Housing Environmental Health Quality. Meanwhile, the informal housing types comprising informal types of 1, 2 and 3 have varied quality ranging from bad, medium, and good. The influential environmental variables cover locations prone to flood, reforestation/greening, sanitation, waste management, road condition, education and warshipping facilities.

Formal housing types based on spatial variable analysis using Ikonos remote sensing data have more homogenous spatial characteristics compared to those of informal housing. The distance between houses, corners between houses, the distance between the house and the road indicate smaller standard deviation with regard to formal housing types. This is closely related to the layout of the buildings, which is more structured/organized/regular than those of informal. Regularity of the buildings is also closely related to the level of density and connectivity of road network. This is indicated by the better value of alpha and betha indexes of formal housing types than those of informal. The two indexes reflect the density and road network connectivity levels. The sizes of the roads informal housing types are more uniform and have wider dimension compared to informal types. However, the building density is higher informal housing type, but the vegetation percentage informal housing is smaller compared with those of informal. This is supposed to be related to the aspect of land efficiency, which is an economical factor in informal housing types as they are constructed for a commercial purpose by a developer. This spatial characteristic as a differentiating indicator between formal and informal housing types are shown in Table 1. and Table 2.

Table 1. Spatial Characteristics of Formal Housing Types

Housing Types	Average Distance Between Houses	Average Distance Between the House and the Road	Building Density	Residential Road	Road Size of Main Area	Environmental Health Level Score	Note
Luxurious	14.54 18.73 17.07	17.19 18.76 17.95	24.22 30.93 27.69	9.00 9.00 9.00	25.00 25.00 25.00	52.00 52.00 52.00	Healthy environment
Middle	6.66 9.60 8.38	10.00 14.25 12.06	37.63 46.48 43.48	4.00 6.00 5.30	6.00 10.00 7.90	47.00 51.00 50.70	Healthy environment
Simple	7.112 10.42 8.516	10.16 10.94 10.48	47.52 61.35 52.85	4.00 6.00 4.27	6.00 12.00 7.09	46.00 47.00 46.81	Healthy environment

ISBN 978-979-99119-3-3

Table 2. Spatial Characteristic of Informal Housing Types

Housing Types	T Indexs	Vegetation Percentage	Average Distance	Building Density	Density of Road Network	Road Network connectivity	DevS of Average Distance-Houses	DevS ofAverage Houses-Road	Environmental health Level Score	Note
Informal 1	0.623 1.140 0.963	7.733 43.801 23.452	33.04 77.54 46.39	10.323 44.305 20.219	0.000 7.692 0.852	0.750 1.150 0.852	2.688 6.285 3.982	8.240 34.33 22.94	31 38 37	*Less Healthy *Rather healthy *Rather Healthy
Informal 2	0.780 1.616 1.071	5.443 35.525 20.041	10.90 33.49 19.71	9.567 27.148 16.213	0.000 23.457 11.486	0.833 1.439 1.156	2.872 4.951 3.706	3.509 21.62 11.88	39 49 45	*Rather Healthy *Healty *Healthy
Informal 3	0.445 1.169 0.822	40.207 78.008 55.458	15.06 50.32 36.18	3.150 16.001 9.423	0.000 16.883 1.786	0.750 1.293 0.878	2.942 11.89 5.580	7.543 37.24 22.04	33 42 41	*Less Healthy *Rather Healthy *Rather Healthy

The growing of spatial characteristics for the identification of a spatial pattern of each type of housing was done by using a cluster analysis. Based on the analysis, there are 6 clusters, 3 of which are those of informal. The formal types include those of luxurious, middle, and simple, which have regular/structured pattern and layout medium building density, low percentage of vegetation and the road network forming a closed polygon having a uniform pattern where each road line is interconnected with another and with other main areas. The spatial characteristic that differentiate luxurious, middle, and simple house types is the distance between houses, the size of the residental road and the road of main area, which is much wider in the luxurious type than that in medium and simple ones. The simple housing type has the highest density building. Figures 1, 2, and 3 shows spatially the three types of formal housing.

ISBN 978-979-99119-3-3

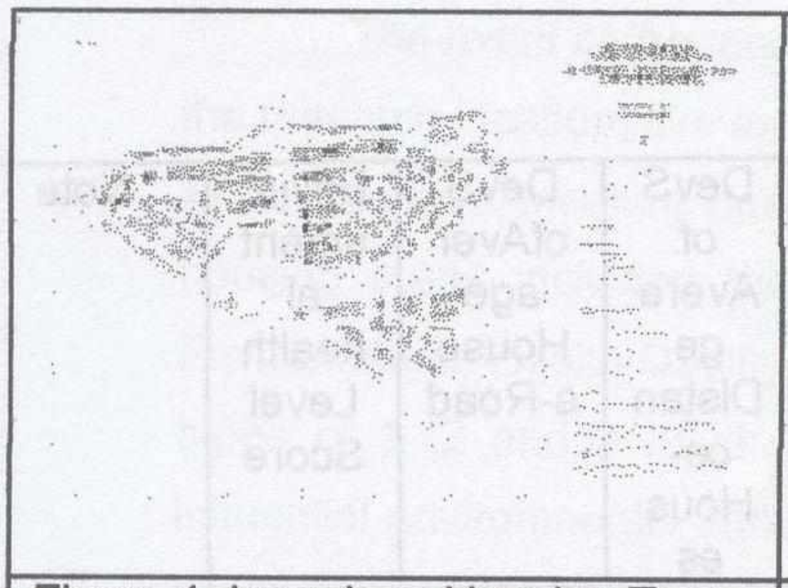

Figure 1. Luxurious Housing Type

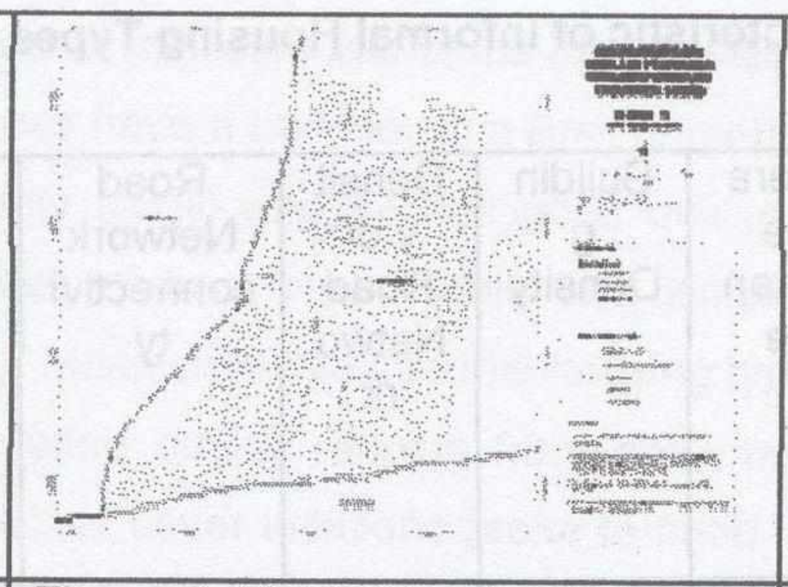

Figure 2. Middle Housing Type

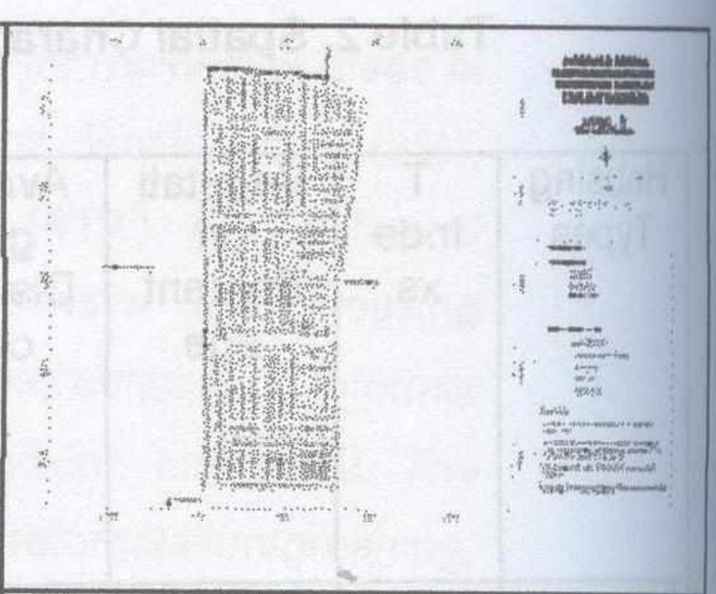

Figure 3. Simple Housing Type

The simple housing types include those of 1, 2, and 3. The type 3 informal housing have a spatial characteristic of more regular pattern and layout of buildings and is characterized by a residential road network which mostly form a closed polygon, and the road lines are mostly connected with each other. The type 2 and 3 informal housing have almost similar spatial characteristics in which the pattern and the layout of the buildings are irregular, the building density, the connectivity of road network are low, not forming a closed polygon. A significant spatial variable differentiating between type 1 and type 2 informal housing is vegetation percentage, which is higher in type 2. Spatially, the three types of informal housing are illustrated in Figures 4, 5, and 6.

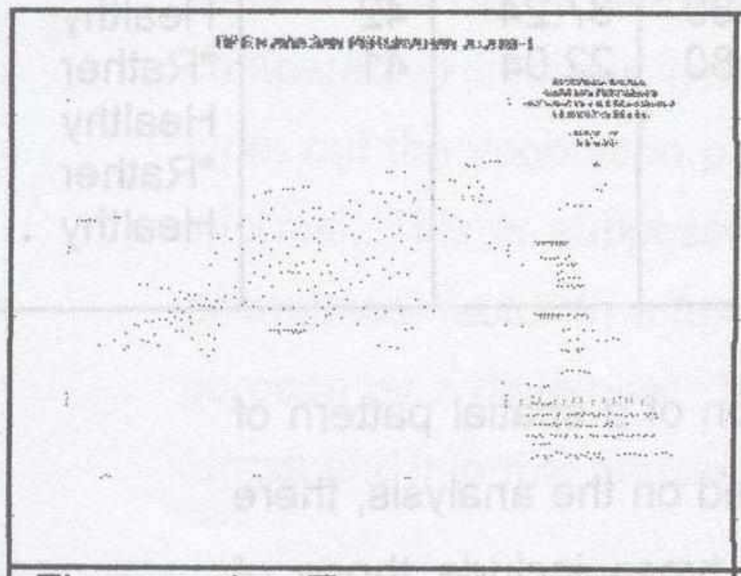

Figure 4. Type 1 Informal Housing

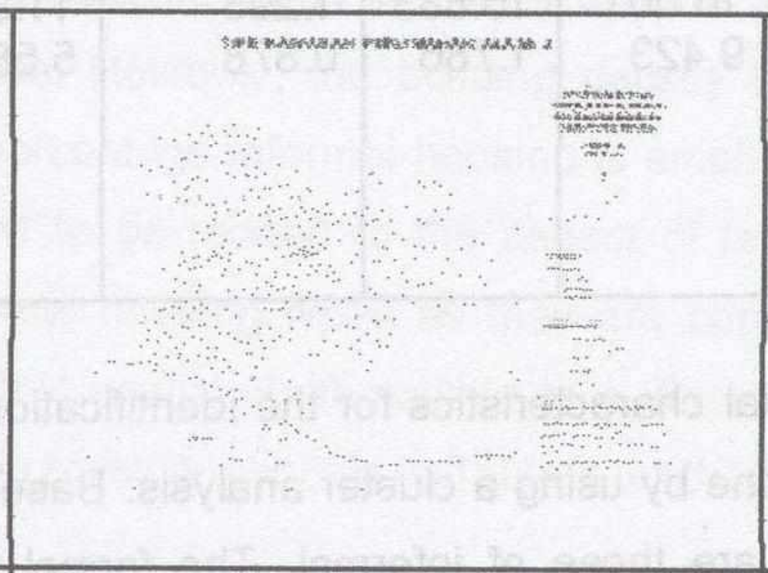

Figure 5. Type 2 Informal Housing

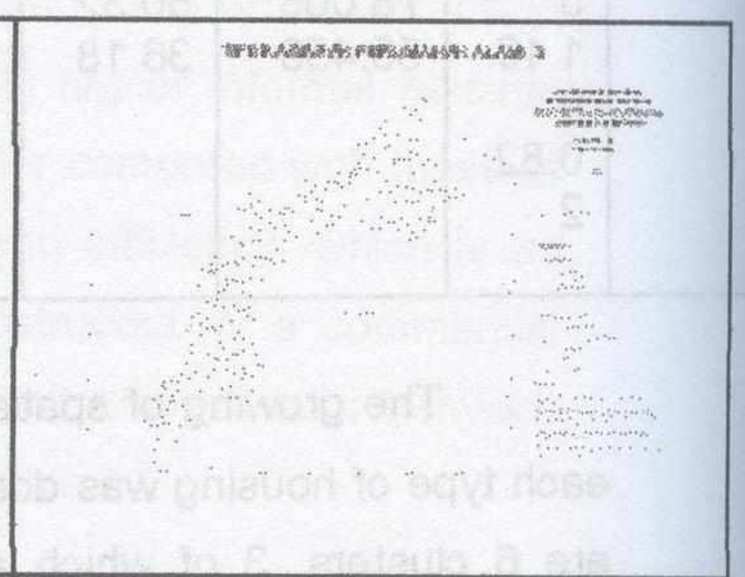

Figure 6. Type 3 Informal Housing

IV. Spatial Modelling

The model for the estimation of the level of Housing Environmental Health Quality can be predicted based on five spatial variables covering index-α, size of residential road, average distance between the closest houses, deviation standard of average distance between the closest houses and vegetation percentage. Mathematically, interactional relation between the level of Housing Environmental Health Quality and spatial variable are indicated by two discriminant equation Y: 0.444 + 0.037(vegetation percentage) + 0.506(width of residential road) + 0.064(index- α) – 0.160(average distance between the closest houses) – 0.211(deviation standard of average distance between houses) and Y: 2.323 – 0.19(vegetation percentage) + 0.757(the width of residential road) – 0.064(index- α) – 0.591(average distance between the closest houses) + 0.842(standard deviation of

ISBN 978-979-99119-3-3

average distance between houses). The cutoff point for discriminant equation of function 1 is that if it is less than one or equals 1.215, the level of Housing Environmental Health Quality is considered less healthy, while -1.215 <cutoff =< 0.337 means that the housing environment is rather healthy and when it is bigger than 0.337, the housing environment is healthy. The cutoff point for discriminant equation of function 2 is when it is bigger or the same as 1.424, the level of the quality indicates less healthy condition, while -0.068 =< cutoff <1.424 means the environment is rather healthy and if the value is bigger than 0.068, the environment is considered healthy. The accuracy of the estimation model of discriminant equation in relation/toward the level of Housing Environmental Health Quality indicates an accuracy number of 77.5% after cross validation. This means that the determinant equation can be applied in predicting the quality of housing environment as well as in proving that spatial components consisting scattering pattern and building layout, building density, vegetation percentage and accessibility are associated/corrrelated with the level of Housing Environmental Health Quality

V. Conclusion

The conclusions of the research are (1) all types of formal housing have healthy housing environment while the quality of informal housing types varies from less healthy, rather healthy, and healthy. The housing of environmental quality in the research location is generally considered good enough. The level of Housing Environmental Health Quality obtained in this research tend to be healthy mainly in terms of "physical and building environment". Other sides of social and esthetical aspects associated with "settled feeling" and individual freedom were not studied in this research; (2) the types of formal housing and those of informal form unique spatial, characteristics and correlate to the level of Housing Environmental Health Quality; (3) accuracy in the estimation of the health quality level of housing environment as big as 77.5%, indicates that interaction between spatial aspects and the level of housing environmental healthy quality is quite significant, and thus the indicator of the level can be detected and predicted based on "agihan" value characteristic of each spatial variable of housing types. Therefore, standard guidelines for the evaluation of the Housing Environmental Health Quality should be revised by including spatial variables as one of indicators of housing environmental health. The implementation can be conducted separately in which early/initial indicator of the health level of the housing environmental can be evaluated from spatial variable indicator and the verification can be then conducted by using the existing basic/standard methode either that in Department of Health or Department of Public Works.

ISBN 978-979-99119-3-3

References

Badan Pusat Statistik. 2004. Statistik Perumahan dan Perumahan. Jakarta

Badan Pusat Statistik Kabupaten Bekasi. 2002. Kabupaten Bekasi Dalam Angka. Kerjasama Badan Perencanaan Pembangunan Daerah dan Badan Pusat Statistik Kabupaten Bekasi

Bhide. A.V.. 1984. Cheris : Study of Slums through Aerial Photographs Coimbatore City. Human Settlement Analysis Group. Indian Institute of Remote Sensing. Dehra Dun.

Bintarto. Surastopo. 1993. Metode Analisis Geografi. LP3ES. Jakarta.

Bintarto. 1978. A Quantitative Expression Of The Pattern Of Urban Settlements In The Province Of Yogyakarta. The Indonesian Journal of Geography. Gadjah Mada University. Indonesia.

Dangnga. 2002. Pengaruh Interaksi Antara Pertumbuhan Penduduk. Perumahan. dan Kualitas Lingkungan Terhadap Sarana dan Prasarana Perumahan dan Faktor Faktor Kualitas Lingkungan. Desertasi. Pascasarjana. Institut Pertanian Bogor.

Departemen Kesehatan Republik Indonesia. 2002. Persyaratan Kesehatan Perumahan. Jakarta.

Gallego, F.J. 1995. Sampling Frames Of Square Segments. Joint Research Centre. *European Commission. Luxembourg. Brussels*

Haggett. P.. 1983. Geography. A Modern Synthesis. Harper and Row. Publisher. New York.

K.J.Tinker. 1978. An Introduction To Graph Theoretical Methods In Geography. Brock University. Ontario. Canada.

Mukerji. C.. 1974. Road Transportation Network Structure and Levels Of Urbanisation In Rajasthan. *The National Geographical journal Of India.*

Santosa. 1993. Kajian Kualitas Lingkungan Perumahan dan Perubahan Penggunaan Lahan Pertanian Kota Yogyakarta dengan Bantuan Foto Udara. Desertasi. Pascasarjana. Institut Pertanian Bogor