EVALUATION MODEL ON RESIDENTIAL ENVIRONMENT QUALITY OF LOCAL CITY CONSIDERING PERSONAL RESIDENTIAL PREFERENCE*
- A CASE STUDY OF SAGA

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1. Background and purpose

With the development of economy and society, as well as the growing demands on quality of life, the improvement of residential environment quality has become the key targets of city policy and urban planning, where the research on residential environment evaluation is the important first step.

The study on Environment Quality Index (EQI) for residential area is one of the main fields of the research of residential environment, and many studies have been performed to provide methods to evaluate the quality of residential environments[1]. However, most of these researches are carried out in the large central cities, such as in Tokyo, Kitakyushyu and so on[2], while in small local cities, such kinds of researches are not enough by far. Owing to the apparently different properties in political, economy, culture, geography and natural, as well as the variance in life style and residential preference, the assessment methodology and evaluation index system are sure to be distinct from big central cities. Therefore it is of great importance to improve the research on residential environment evaluation and to establish evaluation system suitable for small local cities instead of applying the big city model directly. On the other hand, most of the researches have been focusing on environment index and evaluation method. However, the residential environment evaluation is related to both objective factors and subjective factors, and the subjective factors are quite complicated because of individual subjective characteristics, such as life style, personal preference and so on. Thus, not only the index and method, but also the personal residential preference type, and its influence on evaluation are worth being studied.

In this paper, through the case-study of Saga, the assessment index system and evaluation model for small local city considering personal preference for residential environment quality is studied, which may help to the improvement of residential environment design and construction efficiently and effectively.

2. Establish of assessment index system and evaluation model

(1) Questionnaire survey

During the summer of 2001, a questionnaire survey was carried out within all of the 19 residential areas (elementary school areas) of Saga. The questionnaire form contains four parts (85 questions), concerning information of personal and household, personal residential preference, evaluation on residential environment quality and intimate sense to present residential area. Altogether 3802 residents were randomly selected and sent a questionnaire, and the overall response percentage is 49.5%.

(2) Hierarchical multi-attribute model for residential environment evaluation

The hierarchical multi-attribute assessment index system and evaluation model were established in four levels, described in Fig. 1. The attributes of each level were designed on the basis of the principle analysis finished by the rudimentary research of our laboratory two years ago[3], where regional characteristics of local city were considered through the aspects of efficiency, comfort, safety, health and community.

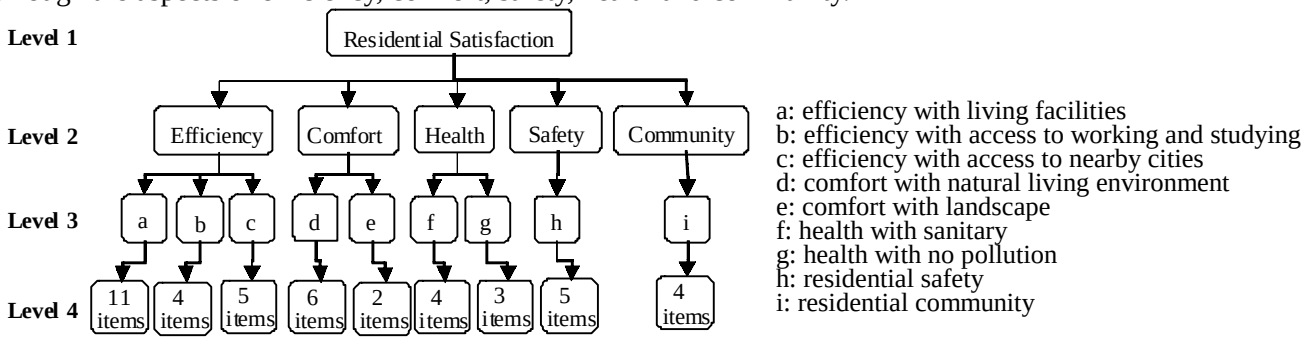

Figure 1 Hierarchical multi-attribute model for residential environment assessment

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According to this model, environmental quality in terms of "residential satisfaction" (level-1) depends on satisfaction with "efficiency", "comfort", "safety", "health" and "community" (level-2). Attributes of level 2 are assumed to depend on satisfaction with nine level 3 attributes. Furthermore, each of the nine attributes of level-3 is decomposed into some specific lower level attributes in level-4.

(3) Analysis on residential environment quality

On-site residents were asked to evaluate their present residential situation with respect to residential satisfaction on multi-attributes. Evaluations were given in terms of satisfaction degree elicited from "very much" (1 point) to "not at all" (5 points). Through the survey, residential environment situation all over Saga in each region can be grasped. From the survey results, it is revealed that residents were fairly satisfied with their residential environment quality, with the average score (standard deviation) of 2.34(0.81), which is close to the midpoint of the scale. The quality of efficiency, comfort, healthy, safety and community are 2.83(1.02), 3.03(0.82), 2.91(0.92), 3.19(0.81) and 3.01(0.66) respectively.

(4) Hierarchical regression analyses

The relative importance of the residential attributes is assessed by means of multiple regression analysis. Residents' evaluations of higher-level attributes will be regressed on the evaluations of the lower-level attributes. The relative importance of various residential attributes can be revealed in terms of coefficient β, shown in Table 1.

Table 1 Results of hierarchical regression analyses

Level 1	Level 2	Level 3	Level 4
Residential Satisfaction r^2=0.804	Efficiency r^2=0.925 β =0.558	a r^2=0.997 β =0.241	11 items
		b r^2=0.984 β =0.293	4 items
		c r^2=0.983 β =0.500	5 items
	Comfort r^2=0.619 β =0.248	d r^2=0.905 β =-0.022	6 items
		e r^2=0.923 β =0.803	2 items
	Healthy r^2=0.870 β =0.137	f r^2=0.914 β =0.296	4 items
		g r^2=0.836 β =0.857	3 items
	Safety β =0.308	h r^2=0.612	5 items
	Community β =0.02	i r^2=0.904	4 items

It shows that 80.4% of the variance in the assessment of "residential satisfaction" (level-1) can be explained by the five level-2 attributes. Satisfaction with efficiency appeared to be the most important attribute (β =0.558), then come the attributes of satisfaction with "safety", "comfort" and "healthy" (β =0.308, β =0.248, β =0.137, respectively). The fifth attribute of satisfaction with "community" (β =0.02) does not appear to affect residential satisfaction to an important extent.

Three attributes a, b and c (level-3) can explain 92.5% of the variance in satisfaction with efficiency. Efficiency with "access to nearby cities" (β =0.500) appears more important than that of "living facilities" (β =0.241) and "access to working and studying" (β =0.293).

The two level-3 attributes d and e appears to explain 61.9% of the variance in satisfaction with "comfort" (level-2), in which "landscape" (β =0.803) seems to be much more important than "living natural environment" (β =-0.022), and the later one seems not so significant.

As to the satisfaction with health (level-2), the two attributes f and g (level-3) can explain about 87.0% of the variance, in which "no pollution"(β =0.857) seems more important than "sanitary" (β =0.296).

From analysis above, it may also be noted that the model fitness (r^2) is quite high, indicating that the hierarchical multi-attributes model used in this study can offer a promising and valuable theoretical framework for modeling residential environment quality. Our questionnaire ended with the question "Is there any other items not mentioned in the questionnaire that will affect the residential environment quality?" Almost all of the answers consider no such items, which shows that the present model has captured most attributes of residential environment quality.

3. Influence of Personal Residential Preference on Evaluation of Residential Environment Quality

(1) Types of personal residential preference

In order to identify the personal residential preference from various viewpoints, there are 12 choices present for the residents about their preference when choosing the present dwelling, including residential environment factors

①～⑧, economic factor ⑨, social factor ⑩, historical factor ⑪, and others ⑫ (①convenience of shopping; ② convenience to school and job; ③natural landscape; ④streetscape; ⑤safety against disaster; ⑥safety against crimes; ⑦health and welfare service; ⑧access in the city and to the around cities; ⑨low cost; ⑩near with parents or children; ⑪without special consideration for long time living; ⑫others). Among these choices, we does not consider the community factors since the community condition is very difficult to be grasped and inspected when choosing dwelling. In addition, the factors of health are also not taken into consideration since they are the most fundamental requirement of human beings, and in local cities the residential health condition is quite well and does not differ a lot around the whole city.

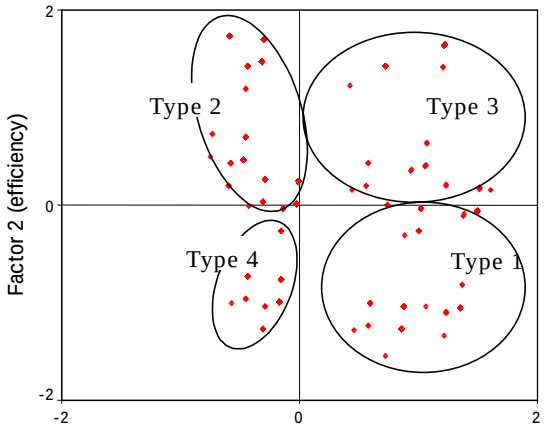
Firstly, in order to focus on residential environment itself, the factor analysis was performed considering only residential environment factors, while removing other factors and the answers without environment factors. Analysis was performed by the software SPSS 11.0, by extraction method of principle component analysis, and rotation of Varimax with Kaiser Normalization. From the results shown in Table 2, 5 principle components have been extracted: 1st - comfort + safety; 2nd - efficient; 3rd - safety; 4th - efficient of access in and around cities; 5th – health and welfare service. According to this results, the main preferences of selecting dwellings are in the order of comfort + safety, efficient, safety, efficient of access, health and welfare service. The total variance shows that the above five principle components can explain the residential preference quite well, with the cumulative 81.9%, and the first and second factors served as the 47.0%.

Table 2 Results of factor analysis

Variance	Component				
	1	2	3	4	5
convenience of shopping	-0.106	0.875	-0.049	0.031	0.087
convenience to school and work	0.335	0.730	0.076	0.140	-0.075
natural landscape	0.765	-0.036	0.121	-0.060	-0.016
streetscape	0.856	0.109	0.056	0.042	0.074
safety against disaster	0.862	0.102	0.050	0.012	0.043
safety against crimes	0.083	0.092	0.993	0.014	-0.012
health and welfare service	0.067	0.070	-0.012	0.055	0.993
access in the city and to the around cities	-0.013	0.122	0.086	0.989	-0.055
percentage of variance of component(%)	29.504	17.545	12.688	11.871	10.271
Cumulative percentage (%)	29.504	47.049	59.737	71.608	81.879
Eigenvalue	2.360	1.404	1.015	0.950	0.822

Factor analysis was performed once again to analyze the influence of economic factor on residential environment, and the principle factors changed in the sequence to be: 1st: comfort + safety; 2nd: efficient (including daily and access efficient); 3rd: efficient of health and welfare service; 4th: economy and 5th: safety. Herein, the economic factor turns out to be the 4th main component influencing the residential environment quality evaluated by residents.

In order to analyze the personal preference residential type, the scatter plot of the distribution of component value of 1st and 2nd factors (which can explain about half contribution of the total factors) of each resident is plotted in Fig.2. The X-axis is the 1st factor (comfort + safety); Y-axis is the 2nd factor (comfort), and 4 types can be identified.



Type	Type characteristics	Number	Percentage
type1	comfort+safety type	171	14.40%
type2	efficiency type	820	69.30%
type3	comprehensive type (comfort+safety+effciency)	66	5.60%
type4	other type	127	10.70%

Figure 2 Scatter plot of component value of factor 1 and factor 2

(2) Influence of personal preference on residential environment evaluation

In order to analyze the characteristics of each preference types, we calculated the satisfaction scores and importance scores of 4 types, shown in Table 3.

Type 1 (comfort and safety type): The evaluation on satisfaction and importance of the comfort attribute are both quite high among all types, much higher than the average score of total samples. The same tendency can be noted in the case of the safety attribute, where importance evaluation is above average, and the satisfaction evaluation is the highest among the 4 types. On the other hand, the evaluation on efficiency is the lowest among all types, which may illustrate the difficulty in pursuing the satisfaction with comfort, safety and efficient at the same time. Type 1 considers comfort and safety as their first preference, and this seems to be realized, while the aspect of efficiency is compromised.

Type 2 (efficiency type): This type is focused on efficiency, and the evaluation on efficiency importance is the highest. It is also shown that the satisfaction evaluation on efficiency is quite high, much higher than the average. The importance evaluation on comfort and safety are the lowest, and satisfaction with comfort and safety are also quite low among 4 types, much lower than the average. Similar to that of type 1, type 2 choose the efficiency as the most important factor on dwelling, in consequence their requirement on comfort and safety are given up to some extent. Among all the residents, the percentage of this type is largest (69.3%).

Type 3 (comprehensive type): The importance evaluation on comfort, heath, and safety are highest among all types, and importance evaluation on efficiency are on average, while their satisfaction with efficient, comfort, health, safety rank the first among all types, community ranks the second. It can be seen that their comprehensive wish on living condition are realized to the largest extent, which is also the target of residential environment plan and design. Although the number of this type is as the lowest as only 66 residents, the importance to analysis the residential environment property of this type is considerable. To grasp the main property can be useful to the improvement of residential environment of other areas.

Type 4 (other type): The preference is focused on other factors instead of comfort, safety and efficiency. As we see in Table 3, the evaluation on importance and satisfaction with 5 factors are all very low, while efficiency is the second worst, and other 4 factors are the worst. The totally satisfaction on residential environment is also the lowest. The reason may be related to their unclearness of residential preference. The residential environment condition of this type is also worth being studied, in order to improve their residential environment, as well as their residential awareness.

Table 3 Evaluation on residential satisfaction and importance of 4 types

	Evaluation on residential satisfaction with 4 types						Evaluation on residential importanc with 4 types				
	Efficiency	Comfort	Healthy	Safety	Community	Total	Efficiency	Comfort	Healthy	Safety	Community
Type1	2.99	2.87	2.83	3.07	3.09	2.27	2.75	2.37	1.95	1.69	2.77
Type2	2.65	3.05	2.89	3.15	2.95	2.28	2.62	2.43	2.01	1.73	2.92
Type3	2.57	2.66	2.73	3.07	3.06	2.27	2.73	2.02	1.78	1.63	3.06
Type4	2.87	3.18	3.01	3.29	3.12	2.43	2.74	2.43	2.09	1.64	3.01

4. CONCLUSIONS

The following results can be concluded from the above research:

(1) The present residential environment situation evaluated by on-site residents can be grasped in each residential area all over Saga, which can serve as the basic data for the urban design and decision-making for the improvement of residential environment quality.

(2) The environment assessment index system and hierarchical multi-attribute model are established considering local city characteristics. Research on model fitness shows that the present model captures most attributes and can offer a promising and valuable theoretical framework for modeling residential environment quality.

(3) Four personal residential preference types are identified and their influences on residential environment evaluation are also studied, which can be referred to in the development, management and decision-making of urban residential environment.

References

1) Naito, M. and Morita, T.: Environmental index and their application to environment design, Tokyo, Japan, 1995.
2) Asami, Y.: Residential environment: methods and theory for the evaluation, University of Tokyo Press, Japan, 2001.
3) Yoshimoto, Y.: Assessment Method on residential environment considering personal expect and regional characteristic, graduation thesis, 96T747, Saga University, Japan, 2000.