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Research paper

Life satisfaction index and physical sustainability aspects of kampung settlement in Malang, Indonesia

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Abstract

Kampungs, common places in Indonesia-Malaysia-Singapore -Brunei, are widely considered as slump areas. In Indonesia, kampungs are urban settlements that cover large part of urban areas [1]. Therefore, as a part of efforts to achieve Sustainable Development Goals (SDGs), it is significant to develop and improve the living environment of urban kampung based on sustainable development criteria. Many efforts to upgrade urban kampung should result in increasing life satisfaction on the inhabitants. This paper investigate the link between physical aspects and life satisfaction in urban kampungs, using the case in Malang City, Indonesia. This research focused on social-economic aspects of sustainable development. Selected social-economic aspects of life satisfaction were assessed and were aggregated into life satisfaction index based on the formula used by the National Central Body of Statistic and the physical sustainability of kampung was measured into an aggregate index using fuzzy logic approach. The research found that the most significant aspect which contributed to life satisfaction was the harmony within the family, while the lowest scores were related to income and occupation. The outputs also prove that life satisfaction of the community correlates with sustainability aspects of kampung's physical entities.

Keywords: *Urban Settlement; Aggregate Index; Physical Entity; Fuzzy-Logic.*

1. Introduction

This paper correspons to two goals in the SDGs. Firstly is Goal 3 which guarantee the well being for all. People's well being is also stated in most of national constitutions world wide as the outcome of their national development. It is very common to measure someone's well being from their income, however income was not an exclusive indicator to measure the outcome of development. At macro level, previous study shows that well-being, happiness and Human Development Index (HDI) correspond to Gross Domestic Product (GDP) [2]. At household level, income is a stronger predictor of life evaluation but a weaker predictor of subjective well being since subjective well being considers of feelings [3]. To have a better indicator of well being, income indicators must be combined with health and happiness [4] where social connectedness is a key factor in happiness. Related to happiness, the Organisation for Economic Co-operation and Development (OECD) countries, in 2011, had promoted to use Happiness Index to measure prosperity in social aspect.

The term happiness is often used interchangeably with life satisfaction. However, the concept is different. We can measure someone's current level of happiness, but if we want to evaluate someone's life as a whole, then, we evaluate life satisfaction. Life satisfaction shows how much a person likes overall quality of his/her life as a whole [5]. Life satisfaction is long term and more stable. Life satisfaction is based on someone's own cognitive judgement where external influence is less. Life satisfaction indicates subjective well being, determined by his/her personal meaningful factors.

The Indonesia's Central Body of Statistics published happiness index every 2 years. Indonesia had released its first happiness index report in 2013 and the last publication was in 2017. The Indonesian Happiness Index is supported by indicators of monetary and non-monetary factors which are the components of the economics of happiness [6]. It also corresponds Goal 3 of SDGs which guarantee well being for all. Unfortunately, limited data related to studies and reports which explore the determinants of subjective well being at local level, is the big constraint in Indonesia and other developing countries [7]. Therefore it is important to continuously explore the determinants of life satisfaction as parts of well being, where different culture may result in different determinants. Rural and urban culture may also need different perspective in the formulation of development indicators. Gender equality and social capital are important for rural development [8] while urban development (in Indonesia) may have different priorities of developement indicators.

Second SDGs's goal addressed in this paper is Goal 11 which promotes inclusive, safe, resilient and sustainable cities. The quest is wether there is a correlation between sustanabilty and life satisfaction. Cloutier, Larson, & Jambeck [9] proves that there is positive correlation between sustainable city and happiness in US. It supports previous research where happiness and sustainability are connected [10]. Condition in less developed countries, such as Indonesia, may show different character with developed countries since majority of urban population live in kampung (similar to favelas in South America), which is often considered as unsustainable living environment.

This paper also raises issues of major urban settlement in Indonesian cities, i.e., kampung, which covers large part of Indonesia's urban areas. Kampung in Indonesia covers about 70% of urban area. Kampung is a term for particular settelement that are found in Indonesia, Malaysia, Singapore and Brunei.

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Kampung is a place that associated with rural village [11], informal settlement [12], or a (birth) place with social cohesiveness and nearness of extended family [13]. Sustainable city program in Indonesia must therefore address kampung. The question is whether or not urban kampung physically sustainable. Physical aspects are important factors to evaluate because most of urban upgradings are related to improvement of physical aspects.
Communities in most of urban kampung in Indonesia still maintain village culture, which is characterized by bonding relationship, sense of community, and problem solving skill [14], even though their areas has transformed into urban areas. It is important to maintain positive culture which influents behaviour of the community and this will contribute to their well being [15]. Since the majority of urban dwellers are living in kampungs then the focus of urban development should be given to urban kampungs by improving the well being of kampung's communities and promote sustainable development aspects found in the kampungs. If people living in kampung are happy then there should be more interpretation and parameters of sustainability particularly for kampung, as also questioned by Shaharir & Alinor [16].
National Mid Term Development Plan 2015-2019 states that acceleration of poverty reduction and equitable development must be achieved by promoting sustainable development and improvement of well being. Local authorities respond the SDGs and Mid-Long Term Development Plan by promoting particular characters of each kampung in order to improve the quality of kampungs for both their physical aspects and living. Certain kampungs promotes their local potential such as hand craft, agricultural products, or tourism potential. 'Rainbow-painted' kampungs, '3D painted' kampungs are recently popular in Indonesia to improve physical appearance of kampungs to support local tourism, coexisted with the growing attitude of the young generation to do selfie and wefie. This type of kampung development is also exemplified in Malang City (fig. 1).



Fig. 1: 'Rainbow/Colourfu-Painted' Kampung, A New Trend in Improving Kampung's Appearance in Indonesia.

The sustainability of this trend for kampung development is questionable since most of the fundings are from company's corporate social responsibilities (CSRs). The more important kampung development to address is actually to improve its sustainability and provide happiness of the population with its typical location and physical characters.
Based on those issues, this paper aims to investigate the correlation between tangible indicators of happiness, i.e. life satisfaction indicators that are employed by the Indonesia's Central Body of Statistics, and urban kampung physical sustainability indicators. The life satisfaction indicators comprise of health, job, income, family harmony, time availability, social connectedness, housing and assets condition, environment, and security [6], while physical sustainability indicators of urban kampung employed in this research are: compactness, accessibility, density, and entropy as proposed by Jabareen [17].

2. Methods

This research was a causal comparative study, which aimed at finding the effects of independent variables (life satisfaction indicators) to dependent variables (level of life satisfaction index and physical sustainability of the community's habitat (kampung) indicators). This research was based on survey and interview to selected samples of population as respondents. The selected urban kampung were Arab Kampung and Kebalen Kampung. These two kampungs were then compared to Terapi Kampung, one of the best practices of kampung development in Malang City.
Population of the three kampungs were 774 households. Samples were taken from Slovin's formula:
$n = \frac{N}{1+Ne^2}$ Where n = samples; N = population; e = error standard. The number of samples were 111 households.
By using those samples, the analysis were subsequently conducted as follows :

2.1. Exploratory factor analysis (EFA)

Based on the questionares and their responses, statistical analysis (EFA) was conducted using SPSS software to generate the weight of each variable. Two gro ups of variables were employed in the analysis: personal life satisfaction variables (X1, X2, X3, X4, X5) and social life satisfaction variables (X6, X7, X8, X9,X10) (table 1). Ten variables considerred in the Life Satisfaction were: health (X1), education and skill (X2), occupation (X3), housing and assets (X4), household's income (X5), security (X6), social connectedness (X7), availability of leisure time (X8), environmment (X9), and family harmony (X10). Each variable may consist of several sub variables. Each sub-variables were assessed using scoring system, see table 1. These variables were assessed from the perception's of the respondents and ordinally scored. The variables and the criteria of score that were inputed for EFA of SPSS are:

Table 1: Variables of Life Satisfaction and Their Score Criteria

Variables	criteria	score	Variables	criteria	score
X1 Health:			X5 Household's income:		
Health problem in the last month?	Yes	0		Higer income	4
	No	1	From economic activities	High	3
Covered by Health insurance?	Yes	1		Medium	2
	No	0		Low	1
X2 Education and skill:			X6 Security:		
Highest level of education	Higher education	3	Crime accidents in the last year	Never	3
	High school	2		Once	2
	Primary school	1		Twice or more	1
Effort to improve knowledge	Always	3	X7 Social connectedness:		
	Often	2	Number of organization joined	7-9	3
	Seldom	1		4-6	2
X3 Occupation:				2-4	1
Type of occupation	High	3	Frequency of activities	3-4	3
	Medium	2		Twice	2
	Low	1		Once	1
X4 Housing and assets:			X8 Leisure time:		
Land status	Certificate	3	Availability of free time/week	17.2-34.2 hrs	3
	State's land	2		10.1-17.1	2
	Rent	1		3-10	1
Sanitation	Private	3	X9		

Variables	criteria	score	Variables	criteria	score
facilities			Environment:		
	Share	2	Ground water quality	Good	2
	Public	1		Bad	1
	Mineral	3	Air quality	Good	2
Drinking water	Piped	2		Bad	1
	River, rain water	1	Disaster intensity in the last year	Never	2
				Yes	1
			X10 Family harmony:		
			Intensity to meet	Everyday	3
				Once a week	2
				Once a month	1
			Intensity of activity together	3-4 times/ week	3
				Twice a week	2
				Once a month	1

The loading factors of each variables obtained from EFA (in SPSS) were used as the weight values of variables in the subsequent analysis.

2.2 Analysis of life satisfaction index.

The analysis was based on the National Central Body of Statistic's formula:
HI=Life satisfaction of Happiness Index
$HI= W_1.I_{\text{social life satisfaction}} + W_2.I_{\text{personal life satisfaction}}$
W_1= weight of social life satisfaction
W_2= weight of personal life satisfaction
$I= \sum_j \sum_i \frac{bi.Xij}{n}$, where
bi= weight values for the variable i, obtained from loading factors of factor analysis method;
$bi= \frac{\text{standardised weight}}{\text{Sum of weight of all variables}} = \frac{B}{SB}$
n= number of population (samples)
Xij= value of variable i of household j
The weight of variable i (bi) is obtained from standardised weight (B) divided by the sum of weight of all variables (SB), The value of Xij was the satisfaction of individual to each happiness aspect that was converted to scale 1-100, divided into 4 ranges, using following formula: (i-1) x 100 /range, where
I = life satisfaction at scale 1-10; range = highest scale – lowest scale
The four ranges are: scale 0-25 (not satisfied), scale >25 – 50 (less satisfied), scale >50 – 75 (satisfied), and scale >75 – 100 (very satisfied).

2.3. Fuzzy logic analysis

Based on data resulted from the analysis of life satisfaction, fuzzy logic analysis, using fuzzy logic toolbox of Matlab software, was used to test and decide the linguisic level of life satisfaction of the households in three kampungs. Prior to fuzzy logic analysis, validity test of variables was conducted. Initial samples were tested to check the validity of variables. The selected variables were then analysed by fuzzy logic method Mamdani's model to chategorized composite life satisfaction indicator into four categories: not satisfied; less satisfied; satisfied; very satisfied. Delphi analysis was utilized to chategorized the level of satisfaction (fuzzy rules) used in fuzzy logic analysis. Since there are 3 conditions of life satisfaction in each indicator and 4 levels of life satisfaction in composite indicator, then there will be 3^4 rule base combinations. The valid variables were then analysed which resulted in scores of composite indicator of life satistaction. The following figure shows the process of fuzzy logic analysis (fig. 2).

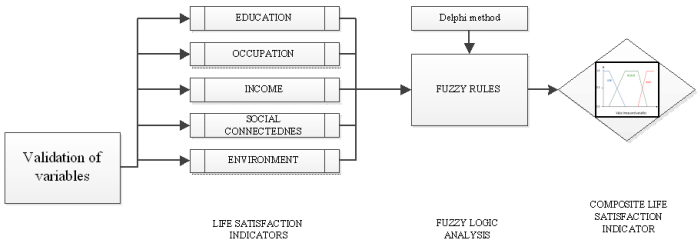


Fig. 2: Fuzzy Logic Rules Process.

2.4. Comparation

The last step was to compare the results with the physical quality of kampung based on their physical entities of sustainable urban form. The evaluated physical entities were compactness, access, diversity of uses and density of the kampungs.

a) Compactness index was measured using the following formula:

$C=\frac{D_i}{D_{i'}}$ and $D_i=2\sqrt{\frac{A_i}{\pi}}$, where
C= compactness index
Di= diameter of such circle which has the same area as the i area
$D_{i'}$= the longest straight line that connects two points on the i-boundary area
Ai= the area of i

b) Connectivity index was measured using alpha index formula:
$\text{Alpha} =\frac{e-v+p}{2v-5}$, where
e = number of roads
v = number of intersections
p = area

c) Diversity of uses. Entropy index was used to measure diversity of uses:

$EI=\sum_{i=1}^{N} K_i.\log\left(\frac{1}{Kl}\right) / \log(N)$, where
EI = Entropy Index
K = Area of land use
N = Amount of land use

3. Results and discussion

3.1. Life satisfaction indices of households in the three kampungs

Factor analysis is the first part of the process in calculating life satisfaction index. This analysis is required to obtain the weight of each variables of life satisfaction index. The weight is taken from the loading factor of factor analysis [18]. The loading factor values of ten life satisfaction index variables are shown in table 2. The loading factor is the sum of values for 4 components selected from eigen values.

Table 2: Loading Factors of Life Satisfaction Variables

Variables	Loading factors Terapi Kampung	Arab Kampung	Kebalen Kampung
Health	1.379	1.480	1.165
Education and skill	1.161	1.147	1.152
Occupation	1.060	1.174	1.061
Household's income	1.555	1.261	1.204
Security	1.582	1.189	1.607
Social connectedness	1.572	1.445	1.188
Availability of leisure time	1.005	1.380	1.398
Housing and assets	1.499	1.211	1.099
Environment	1.352	1.124	1.378
Family harmony	1.305	1.553	1.487

Table 2 shows that among three kampungs, there were differences in the weight of variables. Security matters most in Terapi Kampung and Kebalen Kampung, while in Arab Kampung family harmony is the most important. The least weight among variables in Terapi Kampung, Arab Kampung and Kebalen Kampung are availability of leisure time, the condition of environment, and occupation respectively.

Life satisfaction index is an index measured proportionally from all indicators of individual satisfaction upon ten variables based on The National Central Body of Statistic's formula $HI=\sum_j \sum_i \frac{bi.Xij}{n}$. The result of HI calculation is presented in table 3.

Table 3: Life Satisfaction of Three Samples of Kampung in Malang

Variables	Life Satisfaction Index scores		
	Terapi Kampung	Arab Kampung	Kebalen Kampung
Health	92%	98.71%	74.68%
Education and skill	83.65%	72.55%	65.98%
Occupation	65.33%	75.57%	65.57%
Household's income	93.19%	65.50%	80.23%
Security	93.06%	69.35%	85.81%
Social connectedness	98.68%	91.36%	66.15%
Availability of leisure time	77.79%	91.65%	92.28%
Housing and assets	91.14%	80.44%	75.06%
Environment	96.27%	65.86%	86.06%
Family harmony	96.63%	99.54%	97.25%

Life satisfaction indicators in three kampungs indicate that people in Terapi Kampung were significantly happy, if we look at the index over 95%, with their social connectedness, harmony in their family, and the condition of their environment. People in Arab Kampung are happy with their harmony in family and condition of health, while in Kebalen Kampung the harmony in the family is the highest score of life satisfaction variable.

3.2. Composite indicator of life satisfaction using fuzzy logic

There were 4 steps in the fuzzy logic analysis process. Firstly, using the same data, life satisfaction index data, validity and reliability test was conducted to select valid variables. Based on data of the initial sample, with significance level at 5%, the r table of was 0.514. There were 5 variables with r calculation higher than r table. Those variables were: education, occupation, household's income, social connectedness, and environment condition. The composite indicator calculation using fuzzy logic was therefore based on these 5 variables.

Secondly, scores of life satisfaction in each variable were grouped into three memberships: low, medium, and high with the range from 0% to 33.3%; 33.4% to 66.7%; and 66.8% to 100 % respectively. The equations of happiness membership variables are as follows:

$$\mu[\text{Low}] = \begin{cases} 0 \le x \\ (0.5 - x)/(0.5 - 0) \text{ using decline linear curve} \\ x \le 0.5 \end{cases}$$

$$\mu[\text{Medium}] = \begin{cases} 0 \le x \text{ or } x \le 1 \\ (x - 0)/(0.5 - 0) \text{ using triangle curve equation} \\ (0.5 - x)/(1 - 0.5) \end{cases}$$

$$\mu[\text{High}] = \begin{cases} 0.5 \le x \\ (x - 0.5)/(1 - 0.5) \text{ using incline linear curve} \\ x \le 1 \end{cases}$$

Thirdly, inference process using fuzzy logic analysis. This process was inferencing the stage of happiness in the 5 variables which were in 3 memberships, into a composite indicator in four categories of life satisfaction: not satisfied; less satisfied; satisfied; very satisfied. Pre-requirements of the categories, obtained from Delphi analysis, were:

Not satisfied, if there was no variable belongs to high and medium category;

Less satisfied, if there were 2 variable maximum belonged to high category and 2 variable maximum belonged to low category;

Satisfied, if at least 3 variables belonged to high category and no variable belonged to low category;

Very satusfied, if there was no variable belonged to low category and at least 4 variables belonged to high category.

Since there were three memberships of life satisfaction for discrete indicators (variable) and five membership for composite indicator than there were 3^5 combination for inference process.

Fourthly, defuzzifying of life satisfaction. Defuzzification used centroid rule which describes the distribution of overall fuzzy composition from their factors thoroughly through their centroid. The result of defuzzifying life satisfaction shows that Terapi Kampung was the highest (the happiest), the second and the third were Arab Kampung and Kebalen Kampung with the value of 0.674, 0.51, and 0.48 respectively (table 4).

Table 4: Defuzzifying Life Satisfaction Level

Kampung	Defuzzy score	Life satisfaction level
Terapi	0.67	Satisfied
Arab	0.51	Satisfied
Kebalen	0.48	Less satisfied

3.3. Relationship between life satisfaction index and physical entity of kampung sustainability index

Physical entities that were observed are: compactness, access, diversity of uses and density. Based on these 4 indicators, assessment was conducted for Arab dan Kebalen Kampung. Terapi kampung is used as benchmark and is considered to have high physical sustainability index since it was selected as a model of sustainable kampung in the City of Malang. The following figure (fig. 3) examplifies the assessment of Arab Kampung. Based on its physical characteristics, the analysis of compactness, access, diversity, and density can be conducted using formulas explained in sub section 2.4.

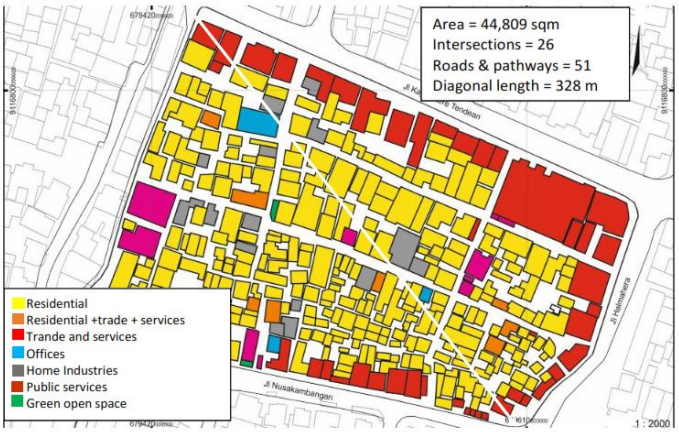


Fig. 2: Physical Characteristics of Arab Kampung.

Physical entitiy indices of Arab and Kebalen Kampung were 0.62 and 0.45 repectively. Comparison of the results between life satisfaction indices and physical sustainabiliy of kampung indices proved that physical sustainability of kampung positively correlates to life satisfaction of the residents (table 5).

Table 5: Life Satisfaction Index and Kampung Sustainability

Kampung	Life satisfaction level	Sustainability level	Sustainability category
Terapi	0.67	Not assessed*	High sustainability
Arab	0.51	0.62	Medium high sustainability
Kebalen	0.48	0.45	Medium sustainability

Source: [18].

* the Kampung was declared by the Municipality as the best practice of Kampung in Malang City.

4. Conclusion

Assessment of life satisfaction of the three kampungs shows that the harmony within family was considered the first priority that determines the life satisfaction of all households in the three kampungs. Other variables which contribute to life satisfaction varied among three kampungs. In common, social connectedness, health, environment, and availability of leisure time were considered important variables of life satisfaction. The results of life satisfaction scores of each variables can be used as tools to recommend kampung's improvement programs, e.g. in Terapi and Kebalen Kampung, the most important aspect (based on the lowest score) is creating job opportunities while in Arab Kampung is to increase income. Composite indicators, obtained from fuzzy logic analysis indicate the sustainability level of the kampungs. Arab Kampung (medium high sustainability) was higher than Kebalen Kampung (medium sustainability). This means community in Arab Kampung are happier than Kebalen community and it corresponds to the level of sustainability of their kampungs.

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