Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

Healthy home's model for rural people with Analytical Hierarchy Process (AHP) in Kabupaten Ngawi, Indonesia

To cite this article: T S Rini *et al* 2020 *J. Phys.: Conf. Ser.* **1469** 012029

View the article online for updates and enhancements.

You may also like

- Corrosion potential of reinforced steel in reinforced concrete in Kabupaten Bireun: Analysis of groundwater content used as a concrete mixture
R D I Kurnia, Suhaimi, S Huzni et al.
- Strategy to increase Barangan Banana production in Kabupaten Deli Serdang
I Adhany, D Chalil and R Ginting
- Simulation and prediction the impact of climate change into water resources in Bengawan Solo watershed based on CCAM (Conformal Cubic Atmospheric Model) data
Sinta B Sipayung, Amalia Nurlatifah and Bambang Siswanto

This content was downloaded from IP address 103.53.76.113 on 26/11/2021 at 04:42

IOP Conf. Series: Journal of Physics: Conf. Series **1469** (2020) 012029 doi:10.1088/1742-6596/1469/1/012029

Healthy home's model for rural people with Analytical Hierarchy Process (AHP) in Kabupaten Ngawi, Indonesia

T S Rini[1,*], F S Rejeki[1], S W Purwaningrum[2], E Wahyuningtyas[3] and N Saurina[3]

[1] Department of Civil Engineering, Faculty of Technic, University of Wijaya Kusuma Surabaya, Surabaya, Indonesia
[2] Department of AgroIndustrial Technology, Faculty of Technic, University of Wijaya Kusuma Surabaya, Surabaya, Indonesia
[3] Department of Informatic Technology, Faculty of Technic, University of Wijaya Kusuma Surabaya, Surabaya, Indonesia

*titien.rini@gmail.com

Abstract. For many years, the housing environment has been acknowledged as one of the main settings that affect human health. Living and housing conditions are the basis of many factors influencing residential health. Risk and environmental factors in house building that can affect the incidence of diseases and accidents include ventilation, lighting, density, humidity, animal transmitting diseases, clean water, household waste, to the inhabitants of the house. This study is to measure criteria for rural people in Kabupaten Ngawi, Indonesia, whether including healthy home or not using AHP. Parameter measurement of healthy home in this research developed parameter which have been done by Ministry of health department, which use three parameters namely the components of the house; sanitation facilities; the behaviour of the residents in healthy living. This study adds three parameters the behaviour in processing household waste; drainage; and physical path. These additional parameters have been approved by the head of the health office in Kabupaten Ngawi. This method uses analytic hierarchy process (AHP) to measure healthy home's model result three values i.e. Lamda, Consistency Index, Consistency Ratio. The results show that healthy home for Kabupaten Ngawi with Global Priority value are 0.489792978, Medium Healthy Home with Global Priority value are 0.264061054 and last Unhealthy Home with Global Priority value are 0.246145969.

1. Introduction

For many years, the housing environment has been acknowledged as one of the main settings that affect human health. Living and housing conditions are the basis of many factors influencing residential health [1]. The quality of housing conditions plays a decisive role in the health status of the residents. Many health problems are either directly or indirectly related to the building itself, because of the construction materials that were used and the equipment installed, or the size or design of the individual dwellings. Representing the spatial point of reference for each individual, the home also has a broad influence on the psychosocial and mental well-being by providing the basis for place attachment and identity as well as a last refuge from daily life. However, especially, for this mental dimension of housing satisfaction and the meaning of home to the resident, not much data on the relation between health and well-being, and subjective satisfaction, and housing perception are available.

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

The past decade has brought an increasing amount of research and numerous publications on the influence of living conditions on the health of occupants, the evidence base for the complex effects of housing conditions on health is growing [2-14]. Healthy home requires the availability of facilities and infrastructure such as water supply, sanitation of garbage disposal, transportation and the provision of social services [15]. The condition of the house and the environment that do not meet the health requirements is a risk factor for the source of disease transmission. The source of transmission of this disease is closely related to the condition of housing sanitation which includes the provision of clean water and sewage treatment. Risk and environmental factors in house building that can affect the incidence of diseases and accidents include ventilation, lighting, density, humidity, animal transmitting diseases, clean water, household waste, to the inhabitants of the house [16,17]. The health conditions of the home environment have an indirect effect on the incidence of the disease, because the environment of less well-heeled homes will affect the amount or the density of germs in the home [18].

One of the most common methods used is the analytical hierarchy process, abbreviated as analytic hierarchy process (AHP). The AHP is a structured quantitative method that contributes to the selection of an option from the various solutions that exist to a problem [19]. This study is to measure criteria for rural people in Kabupaten Ngawi, Indonesia, whether including healthy home or not using AHP. Parameter measurement of healthy home in this research developed parameter which have been done by Ministry of health department, which use three parameters namely the components of the house; sanitation facilities; the behavior of the residents in healthy living. This study adds three parameters the behavior in processing household waste; drainage; and physical path. These additional parameters have been approved by the head of the health office in Kabupaten Ngawi.

2. Method and material

Interest in behaviors that have important impacts on our health and well-being is based upon two assumptions; (a) that a significant proportion of the mortality from the leading causes of death is caused by the behavior of individuals, and (b) that such behavior is modifiable [20]. Behavior is held to exert its influence on health in three basic ways: by producing direct biological changes, by conveying health risks or protecting against them, or by leading to the early detection or treatment of disease [21].

Healthy home according to the Decree of the Ministry of Health Republic Indonesia Number: 829 / Menkes / SK / VII / 1999 on Housing Health requirements, healthy home assessment has three assessment parameters which is component of the house; sanitation facilities; and occupant behavior [22]. Based on the Indonesia profile in 2010, it is known that the condition of healthy eligible houses for the national level is 24.9%. Households with access to 'good' quality drinking water reached 67.5%. Households according to the 'good' waste handling criterion reached 28.7% [23]. Healthy home appraisal conducted by Ministry of Health Republic Indonesia using three assessment parameters that is the components of the house with weight 31%; sanitation facilities with weight 25%; and the behavior of the residents in healthy living with weight 44%. This study developed the assessment parameters namely the components of the house with a weight of 12%; sanitation facilities with a weight of 14%; the behavior of the residents in healthy living with a weight of 23%; the behavior in processing household waste with weight 23%; Drainage with weight 18%; physical path with a weight of 10%, as can be seen in figure 1.

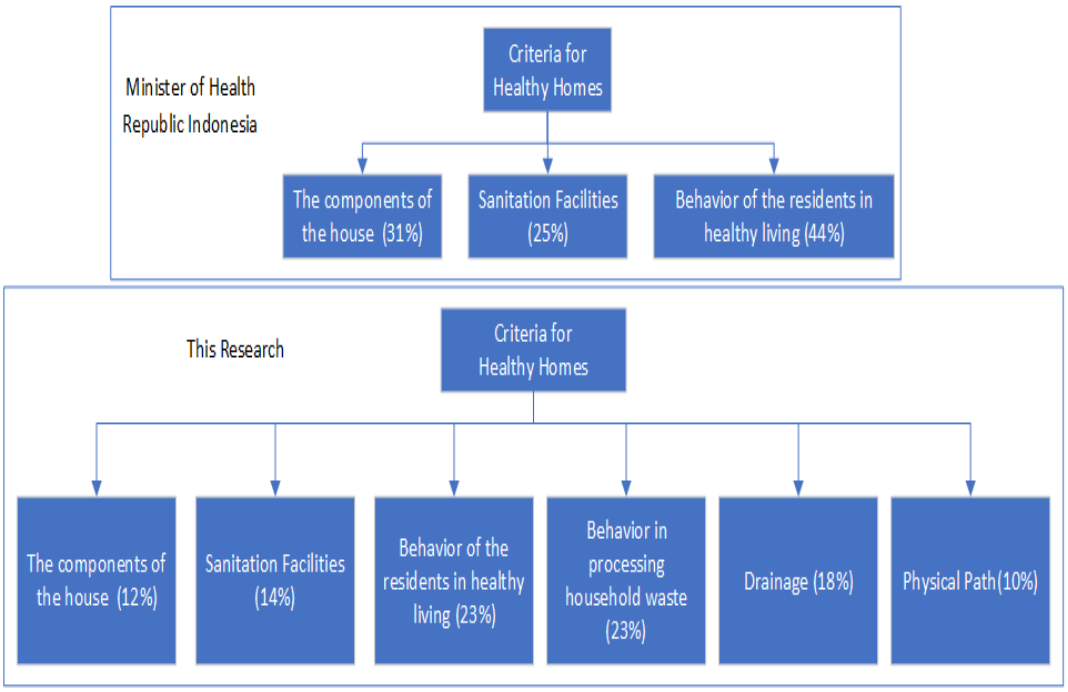

Figure 1. Development criteria for healthy home.

The AHP method was developed by Professor Saaty at the University of Pittsburgh in 1980 [24]. Usually, the complexity of a problem is decided by the interaction of many factors, and decision-makers must understand the significant criteria when they face such problems. They need to assess the relative importance of these factors to solve the problems. The AHP method applies an organization hierarchy structure to decompose and prioritize the influencing factors from high to low and top to bottom and determines the relative importance of factors as a single value, based on subjective judgments. Finally, it can decide which critical factors have greater influence by numerical analysis. Thus, the AHP method can help make decisions effectively and simplify decision-making [25]. Qualitative criteria and quantitative criteria can be compared in accordance with predetermined assessments to generate rank and priority. Each pairwise comparison evaluated in Saaty's scale 1 - 9 which can be seen in table 1.

Table 1. The fundamental scale for pairwise comparisons.

Intensity of Importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment slightly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation
Intensities of 2,4,6 and 8 can be used to express intermediate values. Intensities 1.1, 1.2, 1.3, etc., can be used for elements that are very close in importance		

As a case study, collecting data on the criteria of factors that influence the selection of healthy homes by questionnaire, as many as 30 respondents. Respondents were selected randomly from three villages in Kabupaten Ngawi, Majasem Village in Kendal Sub-Kabupaten; Karang Anyar Village in Karang

Anyar Sub-Kabupaten; and Kartoharjo Village in Ngawi Sub-Kabupaten. The research questionnaire was conducted in 2017. The collected data is processed by AHP method which processing using Microsoft Excel program. The data was previously tested of its inconsistency ratio (CR) i.e. data CR less than 10% which is considered consistent.

The steps of the AHP method are:

- Determine the types of criteria that are used as a requirement for the assessment of healthy homes
- Arrange the criteria in the form of matrix in pairs.
  Note: The way of filling the elements in a paired matrix is:
  a) Element a [i, i] = 1 where i = 1,2, 3,…n
  b) Elements of the upper triangular matrix as input
  c) The element of the lower triangular matrix has the formula

$$a\left[j,i\right]=\frac{1}{a\left[i,j\right]} \text{ for } i \neq j \quad (1)$$

- Sums up the column matrix.
- Calculate the value of the column element criteria with the formula of each column element divided by the number of column matrices.
- Calculate the priority value of the criteria by summing up the result of line matrix of step 4
- and the result 5 is divided by the number of criteria.
- Determine the alternatives that will be an option.
- Develop alternatives that have been determined in the form of matrix in pairs for each criterion. So, there will be as many as n pieces of matrix in pairs between alternatives.
- Each matrix paired between alternatives of n pieces of matrix, each matrix is summed per column.
- Calculate alternative priority values of each matrix in pairs between alternatives with formulas such as step 4 and step 5.
- Test the consistency of each matrix in pairs between alternatives with their respective formulas the matrix elements paired in step 2 multiplied by the priority value of the criterion. The result of each row is summed, then the result is divided by each criteria priority value of $\lambda_1, \lambda_2, \lambda_3, \ldots, \lambda_n$

$$\lambda \max = \frac{\sum \lambda}{n} \quad (2)$$

- Calculating Consistency Index (CI) with the formula:

$$CI = \frac{\lambda \max - n}{n - 1} \quad (3)$$

- Calculate Consistency Ratio (CR) by the formula:

$$CR = \frac{CI}{RI} \quad (4)$$

where RI is Random Consistency Index List RI which can be seen in table 2.

Table 2. Values of random consistency index.

Matrix's size	1.2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI Values	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

- If CR < 0.1 then the pairwise comparison value on the given criterion matrix is consistent. If CR > 01, then the pairwise comparison value on the given criterion matrix is inconsistent. So, if it is not consistent, then the filling of the values in the matrix paired on the criterion and alternate elements must be repeated. calculation process step 7, step 8 and step 9.
- The end result is a global priority as the value used by decision's maker based on the highest score.

3. Identification of criteria and hierarchy formation

In accordance with the steps of research, in this section discusses the actual data input, calculation and output process that calculates the percentage of healthy house component fulfillment by rural residents of Kabupaten Ngawi.

The analysis calculation of healthy home in Kabupaten Ngawi is modeled by AHP method. Each of the criteria is compared by AHP method, then each alternative is also analyzed by AHP method. Determination of criteria on the calculation of healthy homes has been validated by Head Office of Kabupaten Ngawi.

An alternative assessment to calculate the percentage of healthy homes is done by direct method, which is the method used to enter quantitative data. These values are derived from the experience and a detailed understanding of the fulfillment of healthy home components, so it can be straightforward to include the weighting of each alternative. Before starting the calculation with AHP method first made AHP hierarchy structure for the calculation of healthy home and its components, can be seen in figure 2.

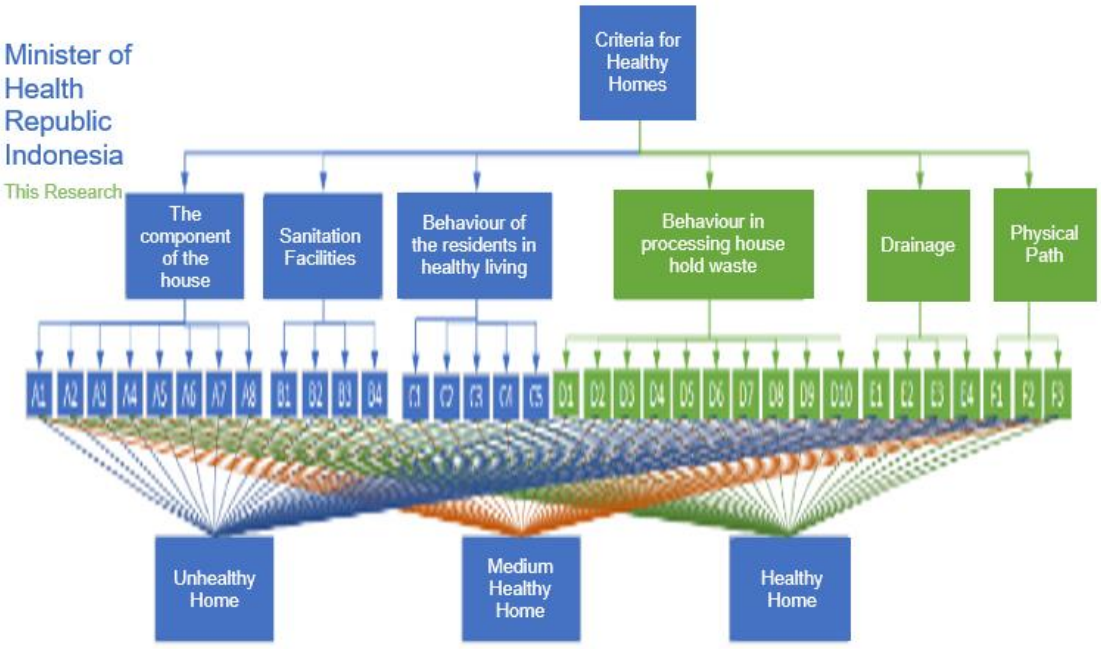

Figure 2. Criteria and sub criteria for healthy home.

Then with AHP steps we start to do the calculation as follows:

The first step is to determine the types of criteria commonly used to calculate the fulfillment of healthy home components that have been done by the Health Office Kabupaten Ngawi. Based on the survey conducted in this study obtained 6 (six) criteria used as a measure to see the fulfillment of healthy home components. The 6 (six) criteria are:

3.1. The components of the house

Components of the house used for to find out whether the homeowner has fulfilled the healthy components of the house or not. Table 3 shows the components of the house to be filled with the value.

Table 3. Criteria for the components of the house.

A	COMPONENT OF THE HOUSE		Point
1	Ceiling	None	0
		Fulfilled, difficult to clean it and accident prone	1
		Fulfilled, Clean and not accident prone	2
2	Wall	There are no walls (made of woven bamboo / weeds) semi-permanent / half wall / masonry brick or stone that is not plastered / board that is not water-resistant	1
		Semi-permanent / half wall / masonry brick or stone that is not plastered / board that is not water-resistant	2
		Permanent (wall / masonry brick or stone plastered / waterproof board)	3
3	Floor	Soil	0
		Board / woven bamboo close to the ground / cracked and dusty plaster	1
		Plastered / tiled / ceramic / board (house stage)	2
4	Window in Bedroom	None	0
		Fulfilled	1
5	Window in Living Room	None	0
		Fulfilled	1
6	Ventilation	None	0
		Fulfilled, Permanent ventilation area <10% of floor area	1
		Fulfilled, Permanent ventilation area > 10% of floor area	2
7	Hole for smoke from kitchen	None	0
		Fulfilled, ventilation area <10% from kitchen floor area	1
		Fulfilled, ventilation area > 10% from kitchen floor area (smoke from kitchen perfectly) or there is exhauster fan or there is other similar equipment	2
8	Lighting	Not bright, cannot be used to read	0
		Less light, so it can be used for normal reading	1
		Bright and not glare, so it can be used to read normally	2

3.2. Sanitation facilities

Components of the house used to determine whether the owner of the house has been fulfilling the components of the house in a healthy or not. Table 4 shows the components of the house to be fulfilled along with the value.

Table 4. Criteria for sanitation facilities.

B	SANITATION FACILITIES		Point
1	Facilities of clean water (SGL/SPT/PP/KU/PAH)	None	0
		Fulfilled, is not self-owned and does not meet health requirements	1
		Fulfilled, self-owned and unqualified	2
		Fulfilled, not self-owned and qualified	3
		Fulfilled, self-owned and qualified	4
2	Latrines (sewerage facilities)	None	0
		Fulfilled, not a swan's neck, no cap, channelled into a river / pond	1
		Fulfilled, not a goose neck and closed (swan neck), channelled into the river / pond	2
		Fulfilled, not a goose neck there is a cap, septic tank	3
		Fulfilled, swan neck, septic tank	4
3	Wastewater disposal facilities	None, so stagnant irregularly in the yard	0
		Fulfilled, impregnated but pollute water source (distance to water source <10 m)	1
		Fulfilled, flowed into an open sewer	2
		Fulfilled, flowed to a closed ditch (city sewer) for further processing	3
4	Disposal facilities (waste bin)	None	0
		Fulfilled, but not waterproof and no cover	1
		Fulfilled, watertight and not covered	2
		Fulfilled, watertight and covered	3

3.3. Behaviours of the residents in healthy living

For criteria behaviour homeowner's healthy culture is used to assess the occupants of the house whether they are doing healthy habits or not to support the realization of a healthy home. Table 5 shows the components of the behaviours of the residents in healthy living to be fulfilled along with the value.

Table 5. Criteria for behaviours of the residents in healthy living.

C	BEHAVIORS OF THE RESIDENTS IN HEALTHY LIVING		Point
1	Opening window in the room	Never opened	0
		Sometimes	1
		Every day opened	2
2	Opening window in Family room	Never opened	0
		Sometimes	1
		Every day opened	2
3	Cleaning the house and yard	Never opened	0
		Sometimes	1
		Every day opened	2
4	Dispose of baby feces from toddler to the trash	thrown into rivers / gardens / ponds carelessly	0
		Sometimes to the trash	1
		Every day thrown into the trash	2
5	Throw away garbage into the trash	Thrown into rivers / gardens / ponds carelessly	0
		Sometimes to the trash	1
		Every day thrown into the trash	2

3.4. Behaviours in processing household waste

This criterion is used to know habit of house dweller behaviour to household waste. Table 6 shows the behaviour in processing household waste to be fulfilled along with the value.

Table 6. Criteria for behaviours in processing household waste.

D	BEHAVIORS IN PROCESSING HOUSEHOLD WASTE		Point
1	Is your house swept every day?	No	0
		Yes	1
2	Do you have toilet?	No	0
		Yes	1
3	Where are your toilet placed?	Outside of the house	0
		Inside of the house	1
4	Do you have trash inside the house?	No	0
		Yes	1
5	How is the trash you have?	Opened	0
		Closed	1
6	Where do you put the trash?	Outdoors	0
		Indoors	1
7	When do you pull out a pile of garbage that's already packed from home?	4 times in a week	0
		3 times in a week	1
		2 times in a week	2
		Everyday	3
		Anytime when full	4
8	Where do you dispose of the garbage that is already full?	River	0
		The yard	1
		Dumpster outside the house	2
		Burned	3
		Buried in excavations	4
9	Where do you dispose of liquid waste water? (from kitchen, laundry, etc.)	Uncertain	0
		Streamed into the river	1
		Flowed into the gutter	2
		Flowed into fish ponds	3
10	Where do you dispose of dirty water (feces)?	Bathroom without septic tank	0
		Bathroom with septic tank	1
		Flowed directly to the toilet seat	2

3.5. Drainage

Drainage can be interpreted as an effort to control the quality of groundwater in relation to salinity, where drainage is one way of discharging excess water that is not desired in a region, as well as ways to overcome the effects caused by the excess water. From another point of view, drainage is one of the elements of public prerequisite that urban society needs in order to get a safe, comfortable, clean, and healthy city life. Table 7 shows the criteria for drainage to be fulfilled along with the value.

Table 7. Criteria for drainage.

E	DRAINAGE		Point
1	When the flood occurred, how long your house was flooded?	More than 4 hours	0
		3 hours	1
		2 hours	2
		1 hour	3
2	What is the height of the flood?	More than 100 cm	0
		50 - 100 cm	1
		0 - 50 cm	2
		Never flooded	3
3	What is the flood area?	More than 5 m^2	0
		3 - 5 m^2	1
		1 - 3 m^2	2
		Less than 1 m^2	3
4	How long period of flood?	more than 4 times a year	0
		Three time in a year	1
		Twice in a year	2
		Less than once a year	3

3.5.1. Physical Path

The criteria of physical condition of the road is used to find out how healthy the house and the environment the owner owns. Table 8 shows the criteria for physical path to be fulfilled along with the value.

Table 8. Physical path.

F	PHYSICAL PATH		Point
1	How wide is the road?	Less than 1 m	0
		More than 1 m	1
2	What kind of pavement around your house?	Soil	0
		Structural concrete construction	1
		Asphalt	2
3	Is there a side drain around your house?	No	0
		Yes	1

The second step is to arrange the criteria in the form of matrix in pairs. Then add the column matrix of each criterion. Matrix form pairs of these criteria as shown in table 9.

Table 9. Matrix of healthy house selection criteria.

	P1	P2	P3	P4	P5	P6
P1	1	3	3	1.5	2	0.5
P2	0.333333	1	1.5	2	2	3
P3	0.333333	0.666667	1	3	2	3
P4	0.666667	0.5	0.333333	1	3	2
P5	0.5	0.5	0.5	0.333333	1	0.5
P6	2	0.333333	0.333333	0.5	2	1
Sum	4.833333	6	6.666667	8.333333	12	10

The next step calculates the value of the column element criteria or the value of the column number division. i.e. by dividing each cell in table 4 by the number of columns respectively in table 4 and the results are shown in table 10.

Table 10. Table number distribution of columns.

	P1	P2	P3	P4	P5	P6	Number of rows
P1	0.206896552	0.5	0.45	0.18	0.166666667	0.05	1.553563219
P2	0.068965517	0.166666667	0.225	0.24	0.166666667	0.3	1.167298851
P3	0.068965517	0.111111111	0.15	0.36	0.166666667	0.3	1.156743295
P4	0.137931034	0.083333333	0.05	0.12	0.25	0.2	0.841264367
P5	0.103448276	0.083333333	0.075	0.04	0.083333333	0.05	0.435114942
P6	0.413793103	0.055555556	0.05	0.06	0.166666667	0.1	0.846015326
Sum	0.999999999	1	1	1	1.000000001	1	6

The next step is to calculate the Priority Criteria value used by the formula: Number of Rows in table 10 divided by number of criteria (in this study many criteria are 6 (six)). And the results are shown in table 11.

Table 11. Criteria priority value.

Priority Criteria	
P1	0.258927203
P2	0.194549808
P3	0.192790549
P4	0.140210728
P5	0.072519157
P6	0.141002554

Then determine the alternative criteria of healthy home that meet the criteria in Table 11. In this case the type of healthy home has 3 (three) result that is unhealthy home, medium healthy home and healthy home. Furthermore, the three alternative types of houses that have been determined arranged in the form of matrix in pairs for each criterion. So, there are 6 (six) matrix pairs between alternatives. Then each matrix paired between alternatives of 6 (six) matrices summed per column. The next step calculates the alternative priority value of each matrix in pairs between alternatives such as when searching for Priority Criteria value. The result is the priority score of each type of house for each criterion. And the results are shown in the following 12, 13, 14, 15, 16 and 17 table:

Table 12. Alternative priorities components of the house.

	Healthy Home	Medium Healthy Home	Unhealthy Home
Healthy Home	1	3	2.5
Medium Healthy Home	0.33333333	1	0.5
Unhealthy Home	0.4	2	1
Sum	1.73333333	6	4

	Healthy Home	Medium Healthy Home	Unhealthy Home	Number of Row
Healthy Home	0.576923077	0.5	0.625	1.701923077
Medium Healthy Home	0.192307692	0.16666667	0.125	0.483974359
Unhealthy Home	0.230769231	0.33333333	0.25	0.81402564
Sum	1	1	1	3

Alternative Priority	
Healthy Home	0.56730769
Medium Healthy Home	0.16132479
Unhealthy Home	0.27136752

Table 13. Alternative priorities sanitation facilities.

	Healthy Home	Medium Healthy Home	Unhealthy Home
Healthy Home	1	1.5	0.5
Medium Healthy Home	0.666666667	1	4
Unhealthy Home	2	0.25	1
Sum	3.666666667	2.75	5.5

	Healthy Home	Medium Healthy Home	Unhealthy Home	Number of Row
Healthy Home	0.272727273	0.545454545	0.090909091	0.909090909
Medium Healthy Home	0.181818182	0.363636364	0.727272727	1.272727273
Unhealthy Home	0.545454545	0.090909091	0.181818182	0.818181818
Sum	1	1	1	3

Alternative Priority	
Healthy Home	0.3030303
Medium Healthy Home	0.42424242
Unhealthy Home	0.27272727

Table 14. Alternative priorities behaviors of the residents in healthy living.

	Healthy Home	Medium Healthy Home	Unhealthy Home
Healthy Home	1	3	2.5
Medium Healthy Home	0.333333333	1	0.5
Unhealthy Home	0.4	2	1
Sum	1.733333333	6	4

	Healthy Home	Medium Healthy Home	Unhealthy Home	Number of Row
Healthy Home	0.576923077	0.5	0.625	1.701923077
Medium Healthy Home	0.192307692	0.166666667	0.125	0.483974359
Unhealthy Home	0.230769231	0.333333333	0.25	0.814102564
Sum	1	1	1	3

Alternative Priority	
Healthy Home	0.56730769
Medium Healthy Home	0.16132479
Unhealthy Home	0.27136753

Table 15. Alternative priorities behaviors in processing household waste.

	Healthy Home	Medium Healthy Home	Unhealthy Home
Healthy Home	1	2	1.5
Medium Healthy Home	0.5	1	1.5
Unhealthy Home	0.66666667	0.66666667	1
Sum	2.16666667	3.66666667	4

	Healthy Home	Medium Healthy Home	Unhealthy Home	Number of Row
Healthy Home	0.461538462	0.545454545	0.375	1.381993007
Medium Healthy Home	0.230769231	0.272727273	0.375	0.878496504
Unhealthy Home	0.307692307	0.181818182	0.25	0.739510489
Sum	1	1	1	3

Alternative Priority	
Healthy Home	0.46066434
Medium Healthy Home	0.29283217
Unhealthy Home	0.2465035

Table 16. Alternative priorities drainage.

	Healthy Home	Medium Healthy Home	Unhealthy Home
Healthy Home	1	2	1.5
Medium Healthy Home	0.5	1	3
Unhealthy Home	0.66666667	0.33333333	1
Sum	2.16666667	3.33333333	5.5

	Healthy Home	Medium Healthy Home	Unhealthy Home	Number of Row
Healthy Home	0.461538462	0.6	0.272727273	1.334265735
Medium Healthy Home	0.230769231	0.3	0.545454545	1.076223776
Unhealthy Home	0.307692307	0.1	0.181818182	0.589510489
Sum	1	1	1	3

Alternative Priority	
Healthy Home	0.44475525
Medium Healthy Home	0.35874126
Unhealthy Home	0.1965035

Table 17. Alternative priorities physical path.

	Healthy Home	Medium Healthy Home	Unhealthy Home
Healthy Home	1	3	2.5
Medium Healthy Home	0.333333333	1	3
Unhealthy Home	0.4	0.33333333	1
Sum	1.733333333	4.33333333	6.5

	Healthy Home	Medium Healthy Home	Unhealthy Home	Number of Row
Healthy Home	0.576923077	0.692307692	0.384615385	1.653846154
Medium Healthy Home	0.192307692	0.230769231	0.461538462	0.884615385
Unhealthy Home	0.230769231	0.076923077	0.153846153	0.461538461
Sum	1	1	1	3

Alternative Priority	
Healthy Home	0.55128205
Medium Healthy Home	0.2948718
Unhealthy Home	0.15384615

Then the priority results of alternative scores on the type of house for each criterion can be presented in table 18.

Table 18. Scores each of the criteria for a healthy home.

	P1	P2	P3	P4	P5	P6
Healthy Home	0.567307692	0.3030303	0.567307692	0.460664336	0.444755246	0.55128205
Medium Healthy Home	0.161324786	0.4242424	0.161324786	0.292832168	0.358741259	0.29487179
Unhealthy Home	0.271367522	0.2727273	0.271367522	0.246503496	0.196503495	0.15384616
Sum	1	1	1	1	1	1

Next is to calculate the value of Lamda by the formula of the number of rows divided by the priority criteria which results in the lamda value shown in table 19.

Table 19. Lamda for each criterion.

	Number of Row	Priority	Lamda
P1	0.402259779	0.258927203	1.553563218
P2	0.227097768	0.194549808	1.167298851
P3	0.223009175	0.192790549	1.156743295
P4	0.117954289	0.140210728	0.841264368
P5	0.031554169	0.072519157	0.425114943
P6	0.119290322	0.141002554	0.846015325
Sum			6

From table 19 can be calculated the value of Lamda max, Consistency Index (CI), and Consistency Rate (CR) with the following formula:

$$\lambda \max = \frac{\sum \lambda}{n} = \frac{6}{6} = 1$$

$$CI = \frac{\lambda \max - n}{n-1} = \frac{1-6}{6-1} = \frac{-5}{5} = -1$$

$$CR = \frac{CI}{RC} = \frac{-1}{1,24} = -0.80645161$$

Because CR < 0.1 then the pairwise comparison value on the given criterion matrix is consistent. The next step is to calculate the global priority of each type of house for each criterion with the formula of matrix table 9 multiplied by the matrix in tables 12, 13, 14, 15, 16 and 17. The results are shown in table 20.

Table 20. Lamda value for each criterion.

	P1	P2	P3	P4	P5	P6
Healthy Home	0.146891394	0.058954487	0.109371562	0.064590082	0.32253275	0.07773218
Medium Healthy Home	0.041771376	0.082536282	0.031101894	0.2041058211	0.026015614	0.04157768
Unhealthy Home	0.0702664433	0.053059039	0.052317093	0.034562435	0.014250268	0.0216927

The final step is to calculate the Global Priority of each home type by summing all the criteria of each type of house, or summing the rows in table 19 and resulting in table 20.

Table 21. Global priority for each criterion of the house.

Global Priority	
Healthy Home	0.489792978
Medium Healthy Home	0.264061054
Unhealthy Home	0.246145969

From table 15 generated Healthy home for Kabupaten Ngawi resulted in the order of the highest is Healthy House with Global Priority value of 0.489792978, Medium Healthy Home with Global Priority value of 0.264061054 and last Unhealthy Home with Global Priority value of 0.246145969.

4. Conclusion

A healthy home assessment method based on the development of the Criteria for Healthy Home from Minister of Health Republic Indonesia is proposed in this paper. On the basis of lamda, CI and CR which resulted in consistency of scoring where CR < 0.1, in unity with AHP. The results of the identification of criteria with the modeling approach indicate that modeling a healthy home based on AHP can effectively measure whether a home can be categorized as healthy or not.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Acknowledgments

The authors would like to thank the Health Office Kabupaten Ngawi, Head of Majasem Village in Kendal Sub-Kabupaten; Head of Karang Anyar Village in Karang Anyar Sub-Kabupaten; and Head of Kartoharjo Village in Ngawi Sub-Kabupaten, Ristekdikti and LPPM University of Wijaya Kusuma Surabaya.

References

[1] Jackson R J 2003 The impact of the built environment on health: an emerging fieldaa *American Journal of Public Health* **93**(9) 1382–1384
[2] Lowry S 1991 Housing and Health *British Medical Journal London*
[3] Ranson R 1991 *Healthy Housing – A Practical Guide Published by E&FN Spon on behalf of the WHO Regional Office for Europe* (London: Chapman & Hall)
[4] Ineichen B 1993 *Homes and Health How Housing and Health Interact* (London: E&FN Spon)
[5] Burridge R and Ormandy D 1993 *Unhealthy Housing: Research, Remedies and Reform* (London: E&FN Spon)
[6] Raw G J and Hamilton R M 1995 *Building Regulation and Health* (Watford: Building Research Establishment Report 289, BRE)
[7] Dunn J R and Hayes M V 2000 Social inequality, population health, and housing: a study of two Vancouver neighborhoods *Social Science and Medicine* **51** 563–587
[8] Fuller-Thomson E, Hulchanski J D and Hwang S 2000 The housing/health relationship: what do we know? *Reviews on Environmental Health* **15**(1–2) 109–133
[9] Mackenbach J P and Howden-Chapman P 2002 Houses, neighbourhoods and health *European Journal of Public Health* **12** 161-162
[10] Bonnefoy X, Braubach M, Krapavickaite D, Ormand D and Zurlyte I 2003 Housing conditions and self-reported health status: a study in panel block buildings in three cities of Eastern Europe *Journal of Housing and the Built Environment* **18** 329–352
[11] Evans G W 2003 The built environment and mental health *Journal of Urban Health* **80**(4) 536–555

[12] Thomson H, Petticrew M and Morrison D 2001 Health effects of housing improvement: systematic review of intervention studies *British Medical Journal* **323** 187–190
[13] Shaw M 2004 Housing and public health *Annual Reviews of Public Health* **25** 08.1–08.22
[14] WHO Regional Office for Europe, 2004 *Housing and Health, Health and environment briefing pamphlet series 41* (Copenhagen: WHO Regional Office for Europe)
[15] Krieger J and Higgins L 2002 Housing and Health: Time Again for Public Health Action *American Journal of Public Health*
[16] Ministry of Health Republic Indonesia 2005 *Guidelines for Sanitary Engineering Techniques* (Jakarta : Ministry of Health Republic Indonesia – Direktorat Jendral PPM&PL)
[17] Notoatmojo S 2007 *Public Health Sciences Basic Principles* (Jakarta. Publisher: PT Rineka Cipta)
[18] Entjang I 2003 *Microbiology and Parasitology for Nursing Academy and School of Equal Health Personnel* (Bandung: Citra Aditya Bakti)
[19] Saaty T L 2008 Decision making with the analytic hierarchy process *International Journal Service & Science* **1**(1) 83-98
[20] Conner M and Norman P 1996 *Predicting Health Behaviour* (Buckingham, UK: Open University Press)
[21] Baum A and Posluszny D M 1999 Health psychology: mapping biobehavioral contributions to health and illness *Annual Review of Psychology* **50** 137–163
[22] Ministry of Health Republic Indonesia 1999 *Housing Health Requirement. Decree of Ministry of Health Republic Indonesia Number: 829/Menkes/SK/VII/1999* (Jakarta, Indonesia)
[23] Ministry of Health Republic Indonesia 2012 *Health Map of the Republic of Indonesia. Indonesia Health Profile Report Year 2010* (Jakarta, Indonesia)
[24] Saaty T L 1980 *The Analytic Hierarchy Process* (New York, NY, USA: McGraw-Hill)
[25] Saaty T L 2006 Rank from comparisons and from ratings in the analytic hierarchy/network processes *European Journal of Operational Research* **168**(2) 557–570