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IMPLEMENTATION OF *THE WASPAS METHOD* FOR DETERMINING THE QUALITY OF WOOD TYPES OF FURNITURE MATERIALS

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Abstract
After Brazil, Indonesia have forest Rain tropical biggest second, and have diversity rich life, incl wood quality tall. Component the main thing really influence caliber furniture or craft wood other is wood. So from that is, create an election program quality wood best For material Furniture with use Draft System Supporter decision. The method that will be used in study This adalan WASPAS method. In collecting data using method literature study, observation, interviews with gather a number of criteria and alternatives. There are five criteria used that is texture strong materials, minimal maintenance, no easy burn, hold on to pest, no Lots absorb water. For alternative taken there are five types wood, that is wood teak, albizia, medang, cempaka, and mahogany. Alternative Test Results obtained, the wood is considered worthy and possessing quality best for material standard Mebelar is Cempaka with calculation results with a value of 92.25.

I. INTRODUCTION

Indonesia has forest Rain tropical biggest second after Brazil, and has diversity rich life, incl wood quality tall. Component the main thing really influence caliber furniture or craft wood other is wood. Carving wood at first Lots used for make furniture, emphasize quality artistic from object so (engraving). By overall, industry or business furniture produce things you can used daily from component wood raw half So until So, that's showing off beauty in engraving and production the product. Characteristics physique wood, diameter, and grain used as metric for evaluate quality wood. Instead, wood teak, albasiah, wood albizia, wood cempaka, and wood Waru is substitute used. For help furniture owners, we want build System Decision Support (DSS). System supporter decision This works as tools and resources information for choose wood best for used in construction furniture, no as taker decision[1], [2].

The Weight Aggregated Sum Product Assessment (WASPAS) technique can maximizing estimation or minimize error moment choose mark highest and lowest. Ideal performance values for every criterias must determined moreover formerly For count results with use WASPAS approach[3], [4]. Next, the matrix normalized decisions must created, and finally mark from normalized matrix must calculated. Highest and lowest values can lowereds from findings calculation for determine which managers are performing peak.

Based on research conducted by [5] Research methods This is the technique used called SAW, and it works for take decision from developing issues in a way No structured Where No clear How decision will made.

Physical properties, toughness, properties mechanics, wood grade, and texture is a number of factors that become consideration in election type wood For material furniture. Whereas the alternative including wood mindi, mahogany, teak, sungkai, and trembes. Based on research conducted by [6] Approach Weighted Product is selected Because can choose choice best from various choice. Based on criteria established by the approach Product Straightforward, easy weight understandable, effective, and efficient, alternatives in situation This is quality the best rambutan fruit. When using technique decreasing, value every attributes first must lifteds to position characteristics required (order mark from the largest). Based on research conducted by [7] Total normalized matrices with specified weight for every criterias, which describe sorting alternative, is results end calculation. election type wood based on distance from criteria, from closest with him. From there, it is obtained option different based on type owned wood agent.

Lack of understanding about type the best wood for used as furniture material become obstacles encountered producer furniture, so product they fragile, weak, and easy weathered. Selection value type wood best will increase strength and age long manufactured furniture. In an attempt sharpen focus they in choose wood quality tall for production furniture, entrepreneurs furniture can utilise information from study This For help they choose type the best wood. So from that is, create an election program quality katu best For furniture materials with use System Supporter decision. The method that will be used in study This adalan WASPAS method.

II. RESEARCH METHODS

2.1. *Multi Criteria Decision Making* (MCDM)

According to [8][9], [10] Fuzzy Multi-Attribute Decision Making (FMADM) is a technique used to identify the best answer from several choices that meet certain criteria. For choose suggested solutions, moreover formerly must ranking process is carried out for determine mark weight every characteristic. By general, yes three methods for determine mark weight attribute: method subjective, method objective, and method combined subjective-objective. There are advantages and disadvantages from every strategy. In approach subjective, taker decision-subjectivity used for produce mark weighting, which is possible for determination independent Lots element in the ranking process alternative. Whereas technique objective ignores subjectivity maker decision with count mark weighting in a way mathematical.

2.2. Stages Study

To outline the stages in the research, a problem-solving structure was created as seen in the following image

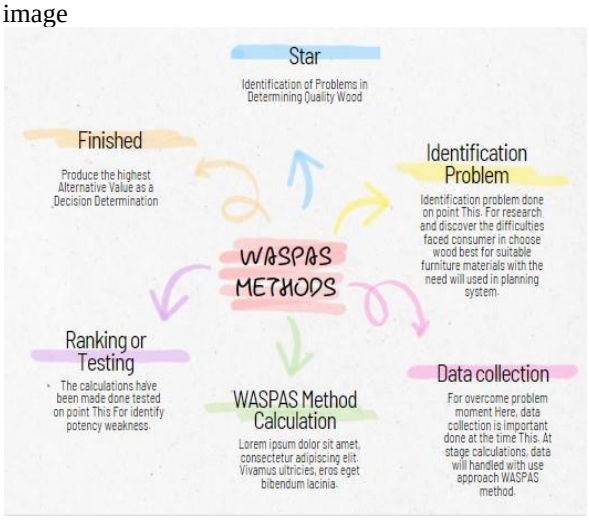

Figure 1. Stages Study

Stages of research outlined as following:

1. Start
   Identification of Problems in Determining Quality Wood
2. Identification Problem
   Identification problem done on point This. For research and discover the difficulties faced consumer in choose wood best for suitable furniture materials with the need will used in planning system.
3. Data collection
   For overcome problem moment Here, data collection is important done at the time This. At stage calculations, data will handleds with use approach WASPAS method.
4. WASPAS Method Calculation
   On point in this case, the WASPAS algorithm is used for count all alternative data and criteria have been set. Rating alternative varieties available wood used as material building furniture will generateds with calculation use WASPAS.
5. Ranking or testing
   The calculations have been made done tested on point This For identify potency weakness.
6. Finished
   Produce the highest Alternative Value as a Decision Determination

2.3. WASPAS Method

Summation model weighted (WSM) and product models weighted (WPM), the WASPAS method involves combination new of two well known MCDM approaches initially need linear normalization of element matrix decision using two equations. the This choosed optimal answers, and alternatives assessed in accordance with all established criteria. When the maker decision No can make decision moment system

currently designed, Waspas Method to be very useful[11], [12][13]. Following details calculation WASPAS based WASPAS method:

1. Make matrix decision.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{11} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m1} & \cdots & x_{mn} \end{bmatrix} \ldots\ldots\ldots\ldots (1)$$

Where xij is effectiveness connection alternative with criteria j and m are amount candidate alternatively, n is amount criterias evaluation.

2. Normalize matrix X
Criteria profit *(benefits)*

$$x_{ij} = \frac{x_{ij}}{maxi\ xi_j} \ldots\ldots\ldots\ldots (2)$$

Cost Criteria *(cost)*

$$x_{ij} = \frac{mini\ x_{ij}}{x_{ij}} \ldots\ldots\ldots\ldots (3)$$

3. Make Calculation Preference (Q_1)

$$Q_1 = 0{,}5 \sum_{j=1}^{n} x_{ij}\ w_j + 0{,}5 \prod_{j=1}^{n} (x_{ij})\ w_j \ldots\ldots\ldots\ldots (4)$$

Choice with highest Qi value is ideal choice

2.4. Determination Criteria and Weights

Table 1 shows criteria used based on assessment norms quality wood best for material furniture:

Table 1. Wood Criteria

Criteria	Information
C1	Tecture strong material
C2	Minimal maintenance
C3	Not easy burnt
C4	Resistant to pest
C5	Not many absorb water

From each criterion the will determineds every its weight. Will be more clear weight made in table 2

Table 2. Weighting

Information	Weight
Very less	1
Not enough	2
Enough	3
Good	4
Very good	5

2.5. Application Multi-Criteria Decision Making (MCDM)

The selection of online English courses involves several criteria and alternatives, so this problem can be solved by using Multi-Criteria Decision Making (MCDM). The MCDM approach is a decision-making solution that aims to get the best alternative froma number of criteria. One of the MCDM models is the Weighted Aggregated Sum Product Assessment (WASPAS) method[13]. WASPAS is known as a method that combines the Weighted Product (WP) approach and the Simple Adaptive Weighting (SAW) approach[14], [15]. The WASPAS method is a popular method for solving multi-criteria and evaluating several alternatives with a number of criteria. WASPAS is an approach that can reduce errors or optimize the assessment in choosing the best alternative through weighting With WASPAS method of the many type wood, 5 samples were taken wood as example application WASPAS method in evaluation quality wood best For material Furniture.

Table 3. Criteria

Alternative	Criteria				
	Tekture strong material	Minimal maintenance	Not easy burnt	Resistant to pest	Not many absorb water
Albasia	5	4	4	4	5
Mahogany	5	3	3	4	5
Medan	5	5	3	3	4
Cempaka	4	4	4	3	4
Teak	4	4	3	5	4

Table 4. Suitability Ratings for Each Alternatives to Criteria

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	5	4	4	4	5
A2	5	3	3	4	5
A3	5	5	3	3	4
A4	4	4	4	3	4
A5	4	4	3	5	4

And referring to table 8 then obtained matrix decision X with data as following :

$$\begin{bmatrix} 5 & 4 & 4 & 4 & 5 \\ 5 & 3 & 3 & 4 & 5 \\ 5 & 5 & 3 & 3 & 4 \\ 4 & 4 & 4 & 3 & 4 \\ 4 & 4 & 3 & 5 & 4 \end{bmatrix}$$

Giving mark weight **W** Retrieval decision set weight based on significance from every required criterias. _ **W = (40 20 20 10 10)**

III. DISCUSSION

WASPAS method

Make matrix decision

$$\begin{bmatrix} 5 & 4 & 4 & 4 & 5 \\ 5 & 3 & 3 & 4 & 5 \\ 5 & 5 & 3 & 3 & 4 \\ 4 & 4 & 4 & 3 & 4 \\ 4 & 4 & 3 & 5 & 4 \end{bmatrix}$$

Max: 5, 5, 4, 5, 5

Matrix decision updated during the normalization process depending on whether every criterias is criteria cost or benefit. Use equality second If the criteria is profit equality third If That is cost one.

$C_1 = Max\ \{5,5,5,4,4\} = 5$

$X_{11} = \frac{5}{5} = 1$

$X_{21} = \frac{5}{5} = 1$

$X_{31} = \frac{5}{5} = 1$

$X_{41} = \frac{4}{5} = 0{,}8$

$X_{51} = \frac{4}{5} = 0{,}8$

$C_2 = Max\ \{4,3,5,3,4\} = 5$

$X_{12} = \frac{4}{5} = 0{,}8$

$X_{22} = \frac{3}{5} = 0{,}6$

$X_{32} = \frac{5}{5} = 1$

$X_{42} = \frac{4}{5} = 0{,}8$

$X_{52} = \frac{4}{5} = 0{,}8$

$C_3 = Max\ \{4,3,3,4,3\} = 4$

$X_{13} = \frac{4}{4} = 1$

$X_{23} = \frac{3}{4} = 0{,}75$

$X_{33} = \frac{3}{4} = 0{,}75$

$X_{43} = \frac{4}{4} = 1$

$X_{53} = \frac{3}{4} = 0{,}75$

$C_4 = Max\ \{4,4,3,3,5\} = 5$

$X_{14} = \frac{4}{5} = 0{,}8$

$X_{24} = \frac{4}{5} = 0{,}8$

$X_{34} = \frac{3}{5} = 0{,}6$

$X_{44} = \frac{3}{4} = 0{,}6$

$X_{54} = \frac{5}{5} = 1$

$C_5 = Max\ \{4,4,3,3,5\} = 5$

$X_{15} = \frac{5}{5} = 1$

$X_{25} = \frac{5}{5} = 1$

$X_{35} = \frac{4}{5} = 0{,}8$

$X_{45} = \frac{4}{5} = 0{,}8$

$X_{55} = \frac{4}{5} = 0{,}8$

Result of Normalization matrix X is obtained matrix xij

$$X_{ij} = \begin{bmatrix} 1 & 0{,}8 & 1 & 0{,}8 & 1 \\ 1 & 0{,}6 & 0{,}75 & 0{,}8 & 1 \\ 1 & 1 & 0{,}75 & 0{,}6 & 0{,}8 \\ 0{,}8 & 0{,}8 & 1 & 0{,}6 & 0{,}8 \\ 0{,}8 & 0{,}8 & 0{,}75 & 1 & 0{,}8 \end{bmatrix}$$

Attribute Then optimized with double weight of each criterion.

$$\begin{aligned} Q_1 = 0{,}5 \sum & \big((1 * 40) + (0{,}8 * 20) + (1 * 20) \\ & + (0{,}8 * 10) + (1 * 10)\big) \\ & + 0{,}5 \prod ((1)^{40} + (0{,}8)^{20} + (1)^{20} \\ & + (0{,}8)^{10} + (1)^{10}) \\ & = 0{,}5\ (\ 97{,}11\ )\ = \mathbf{48{,}55} \end{aligned}$$

$$Q_2 = 0{,}5 \sum((1 * 40) + (0{,}6 * 20) + (0{,}75 * 20) + (0{,}8 * 10) + (1 * 10)) + 0{,}5 \prod((1)^{40} + (0{,}8)^{20} + (0{,}75)^{20} + (0{,}8)^{10} + (1)^{10}) = 0{,}5\ (\ 87{,}11\ ) = \mathbf{43{,}55}$$

$$Q_3 = 0{,}5 \sum((1 * 40) + (1 * 20) + (0{,}75 * 20) + (0{,}6 * 10) + (8 * 10)) + 0{,}5 \prod((1)^{40} + (1)^{20} + (0{,}75)^{20} + (0{,}6)^{10} + (0{,}8)^{10}) = 0{,}5\ (\ 91{,}11\ ) = \mathbf{45{,}55}$$

$$Q_4 = 0{,}5 \sum((0{,}8 * 40) + (0{,}6 * 20) + (1 * 20) + (0{,}6 * 10) + (0{,}8 * 10)) + 0{,}5 \prod((0{,}8)^{40} + (0{,}6)^{20} + (1)^{20} + (0{,}6)^{10} + (0.8)^{10}) = 0{,}5\ (\ 83{,}12\ ) = \mathbf{92{,}25}$$

$$Q_5 = 0{,}5 \sum((0{,}8 * 40) + (0{,}8 * 20) + (0{,}75 * 20) + (1 * 10) + (0{,}8 * 10)) + 0{,}5 \prod((0{,}8)^{40} + (0{,}8)^{20} + (0{,}75)^{20} + (1)^{10} + (0{,}8)^{10}) = 0{,}5\ (\ 82{,}12\ ) = \mathbf{90{,}89}$$

Ranking can dones with using the data above. Table 7 below This show calculation ranking in a way whole.

Table 7. WASPAS Ranking

Alternative	Mark	Rank
Q1	4 8.55	*3*
Q2	4 3.55	4
Q3	45, 55	3
Q4	92.25	1
Q5	90.89	2

From the analysis above, it can be seen that A 4 get highest value. Existing manual test data calculated and implemented use WASPAS method, yes seen For The results of the alternative tested using the WASPAS Alternative 4 method have the highest value with a score of 92.25, namely Cempaka wood.

IV. CONCLUSION

From calculations mark alternative following obtained highest value namely Q4 = 92.25. Of the five alternatives tested with 5 criteria obtained, the wood is considered worthy and possessing quality best for material standard Mebelar is Cempaka Wood. By utilizing the WASPAS weighting method, a decision support variable system is now available to process data for assessing the best quality of wood for furniture materials more effectively so that the public and appraisers can more quickly obtain information on the best wood assessment. As for suggestions that would like I convey to researchers who will come for can develop study his use other and additional methods the system can do it too used on the Android system.

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