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Policy on the Bicycle Lanes Provision in East Java

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ABSTRACT

Traffic patterns in East Java most generally are mixed traffic, composed of motorized and non-motorized vehicles mix in together (no separation). This situation has enabled different speed operation and pattern which lead to potential accidents. Understanding on the cyclists' characteristics and the availability of bicycle lanes is the first step towards supporting sustainable transport. The location of study are Malang and Jember city, where interview has been held with bicycle and non-bicycle user. The result has been shown that Structural Equation Modeling (SEM) model on the provision of bicycle lanes is influenced by socio-economic characteristics, bicycle ownership and trips characteristics, where variation around the variable of perceptions on the provision of bicycle lanes for cyclists is 63.4 percent. Thus, it required a review on the existing provision of bicycle lanes by using Analytical Hierarchy Process (AHP). The AHP survey has been held with 55 respondents consist of 25 officer each in Malang and Jember plus 5 academic faculties. The analysis shows that the best policy for cyclists are taking consideration, these are the socio economic characteristics with the safety aspect of 48.78 percent, along with the comfort aspect of 14.1 percent, and travel time aspect of 6.4 percent.

INTRODUCTION

Cyclists are generally low-income communities because not everyone can own or enjoy cars or other motorized vehicles. According to Raad Tamin (2003) a lot of people who have low incomes in developing countries go through more than half of their journeys by walking and carry out the other half of it by using public transport or non-motorized transport such as bicycles. According to Arifin, *et al*. (2013), the provision of bicycle lanes for cyclists was influenced by socio-economic characteristics (SEC), bicycle ownership (BO) and movement characteristics (MC) for explaining the variation around the variables of perceptions on the provision of bicycle lanes (PBL) for cyclists at 0.634 or 63.4 percent.

Based on initial observations that had been made, in the morning peak hour (Peak) many cyclists from the border area go to the city center, either for their work activity as laborers, farmers, and artisans or for their study activity as students to go to school. These cyclists also require mobility, that should not be marginalized or lose the right to move on the road. Therefore, adequate infrastructure that can provide security and does not conflict with motorized vehicles is needed by the cyclists. Several studies on bicycle lane had been conducted in Bandung, Jogjakarta and Semarang. However, almost all of these results have not touched the requirement (Demand) and provision (Supply) of bicycle lane.

The Constitution of the Republic of Indonesia No. 22, 2009 regulates the non-motorized vehicles. In the regulation, the government must provide convenience for cyclists on the road. Cyclists are entitled to facility supporting security, safety, order, and fluency on the road. It is also stated that the local government can determine the type of motorized vehicle used in its own region based on the characteristics and the needs of the region.

Understanding on the characteristics of the cyclists and the availability of transport infrastructure, such as bicycle lanes, is the first step towards supported transport (sustainable transport). Support from the government in providing the bicycle lanes gives opportunity to increase the number of cyclists, to reduce noise and air pollution and to ensure safety, orderliness and smooth traffic. Thus, a review of how policies providing bicycle lanes viewed from the perceptions of cyclists and non- cyclists in East Java is required.

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MATERIALS AND METHODS

The data analyzed in this study were primary data taken directly by giving the questionnaire questions through questionnaires. Respondents whose information was extracted were stakeholders as respondents for AHP modeling. The sampling method used was probability sampling using simple random sampling with proportional approach. Hierarchical model of the provision of lane cyclists was constructed according to the criteria for sustainable transport policies which were taken from various literatures. The criteria were then developed based on the following priorities:

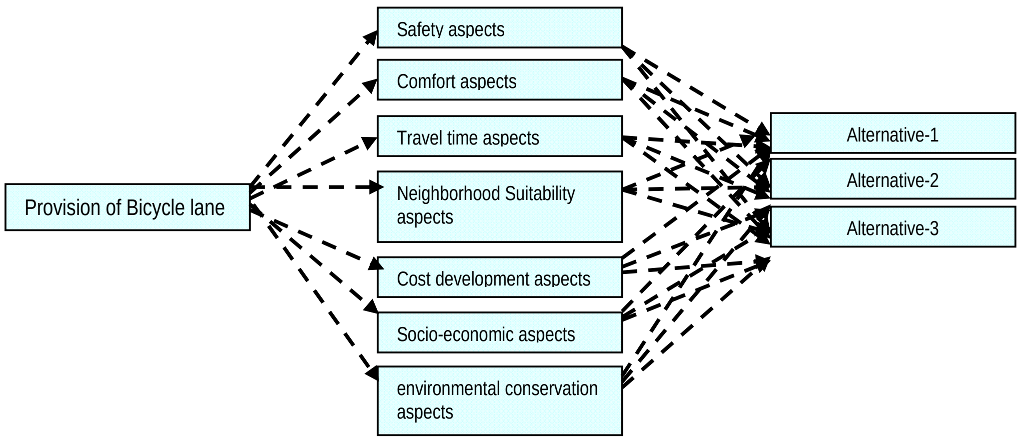

Fig. 1: Hierarchical model of provision of Bicycle Lanes in AHP.

AHP modeling in Figure 1, the weight values of each criterion, consistency ratio of respondents' answer, and priority were combined to get the best solution that can be taken for sustainability.

RESULTS AND DISCUSSION

Results of model testing completed with SmartPLS program of all latent variables that were valid and reliable, and on the testing of B = 500 bootstrap samples gave significant results. An R-Square value of 0.634 explained that the donation or the proportion from socio-economic characteristic (SEC), Bicycle Ownership (BO) and movement characteristics (MC) in describing the variation around the variable of perceptions on the provision of bicycle lanes (PBL) for cyclists was at 0.634 or 63.4 percent (Arifin, *et al*., 2013).

Socio economic characteristics (SEC) affected positively and significantly on perceptions of the provision of bicycle lanes (PPB). This is evident from the path coefficient that has a positive score of 0.731 with a T statistic value of 13.252, which was bigger than T - table = 1.96. Thus, socio-economic characteristics (SEC) directly affected perceptions of the provision of bicycle lanes (PPB) by 0.731, which means that whenever there is increase in socio-economic characteristics (SEC) it will cause raise in the perceptions of the provision of bicycle lanes (PPB) by 0.731. Bicycle ownership (BO) affected positively and significantly on perceptions of the provision of bicycle lanes (PPB). This is evident from the path coefficient that has positive score of 0.099 with a T statistics value of 4,877, which was bigger than T - table = 1.96. Thus, bicycle ownership (BO) directly affected perceptions of the provision of bicycle lanes (PPB) by 0.099, which means that whenever there is an increase on bicycle ownership (BO), it will raise perceptions of the provision of bicycle lanes (PPS) by 0.099. Movement characteristic (MC) affected positively and significantly on perceptions of the provision of bicycle lanes (PPB). This is evident from the marked positive path coefficient of 0.039 with a value of 3,001 statistics T bigger than T - table = 1.96. Thus, the movement characteristics (MC) directly affected perceptions of the provision of bicycle lanes (PPB) by 0.039, which means that whenever there is increase in the movement characteristics (MC) it will increase perceptions of the provision of bicycle lanes (PPB) by 0.039 (Arifin, *et al*. 2013).

Further policy studies using AHP modeling technique consists of several stages, which include performing hierarchical modeling, weighing criteria on the model, determining the inconsistency ratio of each pairwise comparison matrix, and determining the priority of criteria and solutions to be taken . Weighing criteria in AHP hierarchy model was carried out using pairwise comparison matrix. The values in the matrix of pairwise comparisons were directly obtained from questionnaires that were given to stakeholders. Scoring system on AHP questionnaires used the Saaty scale. AHP requires only one answer for one pairwise comparison matrix, so that all the results of the respondents' responses were averaged using the geometric mean as follows:

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$$r_{ij} = (a_1 a_2 ... a_n)^{\frac{1}{n}} \qquad (1)$$

wherein

a_i = Comparison value on the questionnaire with $i = 1, 2, \cdots, n$ (n=number of participants)

r_{ij} = Average value of the comparison between criterion i with j to n participants

Pairwise comparison matrix that had been averaged using the geometric mean on the sustainability criteria of the hierarchy model. Consistency is a very important component in AHP method. Responses from respondents would only be meaningful if and only if the value of the inconsistency ratio of respondents' responses (which is already converted to a pairwise comparison matrix) is less than or equal to 0.1. Any inconsistency ratio that is outside of the range is considered inconsistent and will not be used in the calculation.

Table 1: Local Priority and Inconsistency Alternative Aspects of Provision of Bicycle Lane.

	Safety aspects	Comfort aspects	Travel time aspects	Neighborhood Suitability aspects	Cost development aspects	Socio-economic aspects	environmental conservation aspects	Local Priority
Safety aspects	-	3.2	3.6	2.7	3.3	3.3	2.5	0,333
Comfort aspects		-	2.2	2.0	2.6	2.3	1.3	0,179
Travel time aspects			-	1.5	1.8	1.5	1.5	0,121
Neighborhood Suitability aspects				-	1.9	1.4	1.2	0,109
Cost development aspects					-	1.4	0.9	0,080
Socio-economic aspects						-	1.3	0,083
environmental conservation aspects							-	0,095
INKONSISTENSI = 0,03								

From Table 1, which is also the statement of all informants and gained local priorities and inconsistency value, it can be referred that the statement of all informants in our study was consistent as its inconsistency value fell at 0.03, which is smaller than 0.1. Furthermore, it can be interpreted that the aspects in influencing the supply of alternative bicycle lane are the safety aspect by 33.3 percent, comfort aspect by 17.9 percent, travel time aspect by 12.1 percent, neighborhood Suitability (RT/RW) compliance aspect by 10.9 percent, environmental conservation aspect by 9.5 percent, socio-economic aspect by 8.3 percent and development cost aspect by 8.0 percent, respectively.

The end result of the use of AHP method is finding a global priority (a criterion considered as the most important one) for the achievement of the objectives. The most important criteria in the selection of policy can be seen from the order of priority indicated by the output of the following Expert Choice program:

According to Arifin, *et al*. (2013), using SEM approach, it showed that the socio-economic characteristics, bicycle ownership and movement characteristics affected the provision of cyclists' lane. Whereas, using the AHP the criterion weight of each variable is the safety aspect of 33.3 percent, comfort aspect of 17.9 percent, travel time aspect of 12.1 percent, neighborhood Suitability (RT/RW) compliance aspect of 10.9 percent, environmental conservation aspect of 9.5 percent, socio-economic aspect of 8.3 percent and development cost aspect of 8.0 percent, respectively. The combination of SEM and AHP is multiplication between the coefficient on SEM and the weight criteria on AHP, and the results are presented in the following table.

SEM and AHP combination approach was prioritized on the socio-economic characteristics with the safety aspect criteria of 48.78 percent, comfort aspect of 14.1 percent, travel time aspect of 6.4 percent, neighborhood Suitability (RT/RW) compliance aspect of 5.2 percent, development cost aspect of 2.8 percent, the socio-economic aspect of 3.0 percent, and environmental conservation aspect of 4.0 percent, respectively. The next was bike ownership factor with safety aspects criteria of 6.66 percent, comfort aspect of 1.9 percent, travel time of 0.9 percent, neighborhood Suitability (RT/RW) compliance aspect by 0.7 percent, development cost aspect by 0.4 percent, socio-economic aspect of 0.4 percent, and environmental conservation aspects of 0.5 percent, respectively. Movement characteristic factor with the safety aspect criteria of 2.6 percent, comfort aspect of 0.8 percent, travel time aspect 0.3 percent, neighborhood Suitability (RT/RW) responses compliance aspect of 0.3 percent, development cost aspect of 0.1 percent, socio-economic aspect of 0.2 percent, and the environmental conservation aspect of 0.2 percent. The best solution to be taken for cyclists was therefore the provision of bicycle lanes with alternative I, by taking into the account socio-economic characteristic factor with the criteria of safety aspect of 48.78 percent, comfort aspect of 14.1, and travel time aspect of 6.4 percent, respectively.

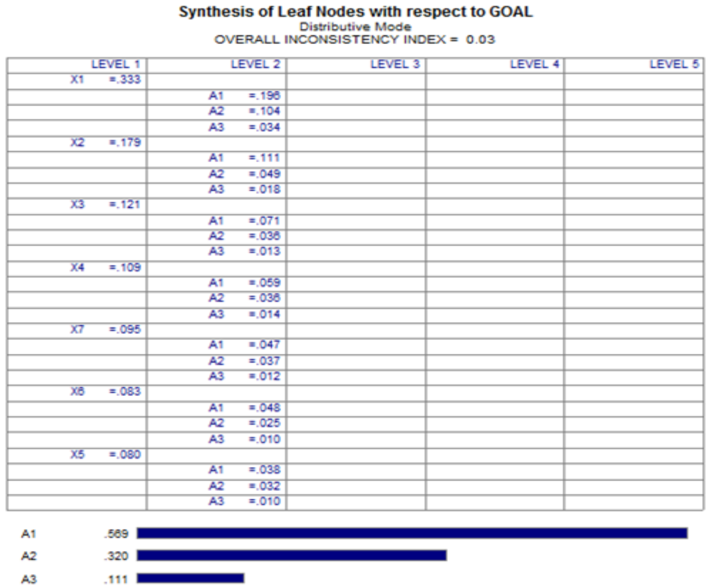

Fig. 2: Prioritized Output on the Selection of Alternative Provision of Bicycle Lanes.

Table 2: The combination strategy of SEM and AHP.

Factors	coefisien	Criteria	Weight	Combination Coefisien* Weight	Combination Percentage
Socio-Economic Characteristics	0.731	Safety aspects	0.333	0.243	0.487
		Comfort aspects	0.179	0.131	0.141
		Travel time aspects	0.121	0.088	0.064
		Neighborhood Suitability aspects	0.109	0.080	0.052
		Cost development aspects	0.080	0.058	0.028
		Socio-economic aspects	0.083	0.061	0.030
		environmental conservation aspects	0.095	0.069	0.040
Bicycle Ownership	0.099	Safety aspects	0.333	0.033	0.066
		Comfort aspects	0.179	0.018	0.019
		Travel time aspects	0.121	0.012	0.009
		Neighborhood Suitability aspects	0.109	0.011	0.007
		Cost development aspects	0.080	0.008	0.004
		Socio-economic aspects	0.083	0.008	0.004
		environmental conservation aspects	0.095	0.009	0.005
Movement Characteristics	0.039	Safety aspects	0.333	0.013	0.026
		Comfort aspects	0.179	0.007	0.008
		Travel time aspects	0.121	0.005	0.003
		Neighborhood Suitability aspects	0.109	0.004	0.003
		Cost development aspects	0.080	0.003	0.001
		Socio-economic aspects	0.083	0.003	0.002
		environmental conservation aspects	0.095	0.004	0.002

Conclusion:

Our results showed that the socio-economic characteristics are the dominant factor in determining the provision of cyclists' lane. The best solution for cyclists should be taking heed to the socio-economic characteristics with the criteria of the safety aspect of 48.78 percent, comfort aspect of 14.1 percent and travel time aspect of 6.4 percent.

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