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Developing a Model for Planting Trees Along the Walkway

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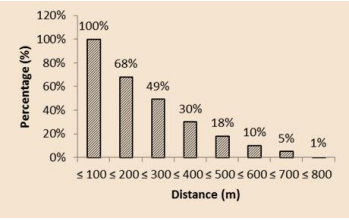
Graphical abstract



Abstract

Non-motorized transport (NMT), also called active transport and human power transportation denotes to walking, cycling and many other variants of transportation such as scooters. Walking is the foundation of other modes of transport and is also the main mode of transportation. Strategies for upgrading footpaths offer a range of benefits to society, which can increase the safety and comfort of pedestrians and cyclists, expand travel options for non-rivers, reduce conflicts between motorists and other road users, reduce automobile traffic and enhance recreational experiences and improve health. Based on these priorities, this study was conducted specifically to study the needs of planting trees along the walkway that will influence road users' willingness to use it. The primary objective of this study is to develop a transport model for the willingness to walk if there is sufficient foliage cover along a walkway. The linear regression method was used to produce transport model. This model can be used to determine the suitability of planting the trees. Results showed that the highest number of pedestrians are willing to walk a maximum distance of 400m if there is inadequate trees along the pathway. Planting trees result in a willingness of pedestrians in UKM to walk between 400 to 800 m, double the distance compared to the normal state.

Keywords: Non-motorized transport; walking; active transportation; pedestrian walkway

■1.0 INTRODUCTION

Non-Motorized Transport (NMT), also called active transport and human powered transportation denotes walking, biking, and several other options such as scooters [1]. NMT strategy is able to offer a range of benefits to society, which can increase the safety and comfort of pedestrians and cyclists, expand travel options for non-drivers, assuage the conflict between motorists and other road users, reducing automobile traffic and increases the activity of recreation and health [2-8].

Additionally, it also promotes tourism activities, gives ease to the disabled people, and helps creating a more comfortable place to live [9, 10]. One of the main components of NMT and the basis for all modes of transportation is walking. Therefore, the main purpose of this study is to investigate and analyse the UKM citizens' willingness to walk greater distances if more trees are planted along the walkways. Trees in this study refer to trees that will provide shade to pedestrians from the sun.

1.1 Tree Planting Programs

Trees or plants provide beauty and numerous benefits to the population, especially the urban population. Trees that are on the streets, parks, residential areas and natural forests will provide better air and water quality to humans. Planting trees play a very important role in the greening of cities. In Malaysia this began in the 18th century until the establishment of the National Park (Taman Negara) today. The earliest planting of trees in urban areas in Malaysia was recorded more than a century ago. Angsana tree or its botanical name as *pterocarsindus* was reportedly planted in 1778 in the planting of trees on the roadsides. While other local species such as *syzygiumgrande, millettiaatropurpera* and *mesuaferream* were widely planted in urban areas in 1920 and 1930.

In 1973, the first greening program in Malaysia was held in Kuala Lumpur with the setting-up of the Beauty Unit. The first agenda carried out in this program was "No Road Without Trees". The program was successfully carried out in accordance with the plan designated. Based on the success of the program, Kuala Lumpur City Hall took serious steps in conducting tree planting program in the city by organising other programs such as "Instant Tree Planting". This program was implemented using the concept: cut off large tree branch used for replanting. It has made Kuala Lumpur a green city.

■2.0 WALKING

2.1 Why Walking

We are all pedestrians. Any kind of travel in any manner, at the least, we need to walk in the beginning and at the end of our

journey. Walking is the basis for human transportation and also a major form of urban transportation. In addition, the benefits of walking could be related to economy, health, elevation and weather [11].

2.1.1 Economy

Walking involves very little expense. Pavements are usually constructed along with regular road building and if it involves certain expenses it is still quite minimal. Minimum cost is due to the fact that construction of the route is more concise than other modes of transportation, because it does not factor carrying and supporting heavy loads into the equation. However, it should be strong enough to support vehicle maintenance.

2.1.2 Health

Walking is an effective and simple exercise. It is also an inexpensive and safe workout. It is a method of exercise that is appropriate for people of all ages. These exercises can be done at anytime and anywhere whether be it at home, at the office, shopping malls and other places. Practicing walking as exercise is beneficial to our cardiovascular health, reducing the risk of heart disease by lowering cholesterol levels. In addition, it also aids the control of blood pressure and prevents the risk of high blood pressure and stroke. Furthermore, walking can reduce the risk of diabetes. Walking increases the body's ability to process sugar better and helps blood flow.

2.1.3 Availability

No need to wait for transit or to start the engine; modes are always present and ready to use. Nowadays most major cities around the world have been providing pedestrian networks. Fact, some pedestrian networks have been separated from the traffic with curbs to provide safety for pedestrians.

2.1.4 Eco-friendly

Walking is a significant and eco-friendly transportation mode.

2.2 Why People Choose Not To Walk

Even walking is a pleasant experience and recommended, as it offers numerous advantages, walking is not the mode of transport for all purposes as there are many other functional limitations. The following points present limitations for walking [11]:

2.2.1 Distance

Humans become easily and quickly exhausted. People will always try to find the path of least resistance or shortcut to conserve energy.

2.2.2 Speed

The speed of a human is slow. Typically, the human walking pace is 15 minutes to 20 minutes per mile. This translates into a 4 or 3 mph (6.4 or 4.8 miles per hour). For short distances, because walking does not involve the loss of the initial, the slow speed of pedestrians is not important, but it becomes a significant factor in a longer trip.

2.2.3 Elevation

Normally, humans who walk refuse to change the height level (elevation) because they know that it involves the use of energy as opposed to walking at the same level. Therefore special consideration is required by planners who want to design the walkway that involve gradients or elevations. Among the alternatives to overcome the variation of this case is to provide elevators and escalators service.

2.2.4 Weather

Weather whether it is rain, snow, wind or the hot will significantly reduce any tendency to walk. This is one of the main reasons why indoor pedestrian environment has been so successful. Planting trees that will provide shade from the scorching heat of the sun along the walkway is also one of the advantages to pedestrians.

3.0 METHODOLOGY

This study was conducted at the main campus of Universiti Kebangsaan Malaysia (UKM) Bangi, Selangor. Respondents were students who settled in colleges in the main campus of UKM, Bangi, comprising of graduates and undergraduates, who are mostly pedestrians. In this study, a stated preference survey (SPS) was used to obtain the data. Through this method, the questions in the questionnaire asked the respondents to consider whether the respondent is the particular distance they were willing to walk, based on different conditions. The first condition, the respondent should consider the distance they were willing to walk without shading trees or any weather protection system. Then the second question, the respondent were asked to consider the distance they were willing to walk with the existence of trees along the walkway. The differences of the distance, for these different circumstances, was studied. A total of 150 respondents were randomly selected and interviewed.

4.0 RESULT AND DISCUSSION

Figure 1 shows the percentage of respondents' walking based on the walking distance. Based on this figures 100% of respondents are willing to walk less than or equal to 100 m, 68% of respondents prefer less or equal to 200, 49% choose less or equal to 300m, 18% to less than or equal to 500 m, while only 1% chose to walk at a distance of 800m or less. Percentage difference between the optimum and minimum distance is 99%. In total, respondents tend to choose short distances to walk.

Meanwhile Table 1 and Figure 2 shows the number and percentage based on the walking distance if there are trees along the walkway. Figure shows that the percentage of 100% of respondents walk at a distance of less than or equal to 100m, 84% have chosen to walk less or equal to 200, 69% to less than or equal to 300 m and 56% to less than or equal to 400 m. Additionally, at the distance less or equal to 700 m, 14% chose to walk if there are trees on the sidewalk. The difference in percentage between the farthest distance from the nearest distance recorded readings of 95%. Overall the respondents' willingness to walk long distances increase if there are trees along the walkway.

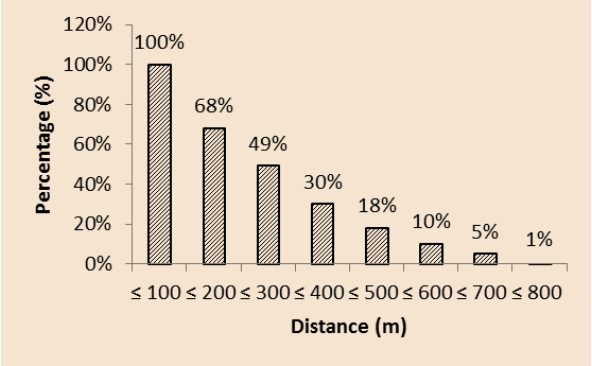


Figure 1 Percentage of respondents walking based on the distance

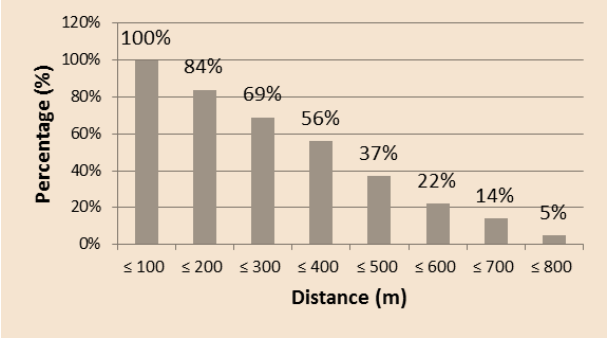


Figure 2 Percentage of respondents walking based on the trees along the walkway

Table 1 Percentage based on the trip walking distance if there are trees along walkway

Max. distance (m)	100	200	300	400	500	600	700	800
Number	24	22	20	28	23	12	14	7
Percentage (%)	16	15	13	19	15	8	9	5

Distance (m)	≤100	≤200	≤300	≤400	≤500	≤600	≤700	≤800
Number	150	126	104	84	56	33	21	7
Percentage (%)	100	84	69	56	37	22	14	5

The data was then analysed using the logistic model analysis and linear regression analysis to develop the logistic model. Logistics functions that are commonly used in transport modeling is shown in Equation (1):

$$P = 1/(1 + De^{(\alpha x + \beta y)}) \quad (1)$$

Where, P is the probability,
x and y are independent variables,
α and β are the coefficients to be calibrated
D is a constant

Based on the analysis, the results of the logistic model for the walkway with and without trees are shown in Table 2. Meanwhile a graphical comparison of the two conditions is shown in Figure 3. It is revealed that for the distance 300m to 700m percentage of willingness to walk doubled if there are trees along the walkway. This indicates that walking as a part of NMT activities can be increased if there are trees along the walkway that provide shade to pedestrians.

Table 2 Comparison of logistic models based on distance travelled

Distance (m)	**P Model (without trees)**	**P Model (with trees)**
100	0.72809	0.7910
200	0.57365	0.6954
300	0.40340	0.5794
400	0.25361	0.4539
500	0.14585	0.3340
600	0.07903	0.2323
700	0.04134	0.1544
800	0.02121	0.0992

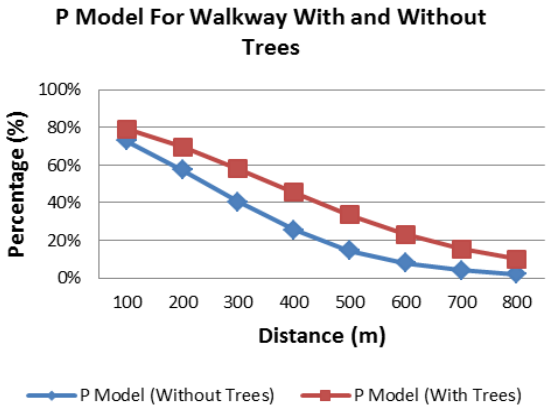


Figure 3 Comparison between P Model for walkway with and without trees

5.0 CONCLUSION

As a conclusion, two models of willingness to walk was developed in two different conditions. First, the situation in which the respondent walks in normal conditions (walkway without trees or any weather protection system). Second in the condition where there are trees that provide shade to pedestrians along the walkway. The first model can be used to design the distance between two buildings or facilities. For example, the distance between the centre of students activity and the residential college. If the student is willing to walk within 400 m, then the distance between the two central facilities are 800 m. Logistic model based on the willingness of walking travel distance is constructed as Equation (2) below:

$$P = 1/(1 + 0.187689e^{0.006881x}) \quad (2)$$

The second model can be used to determine whether planting trees along the walkway is needed or not. In this study, trees that can give the shade as the factors is studied. Model obtained for the willingness to walk away based on distance travelled if there are trees is developed as Equation (3) the following:

$$P = 1/(1 + 0.145308e^{0.003778x}) \quad (3)$$

This model can provide guidance to engineers in transportation planning. If trees that act as the weather protection system to provide the shade are able to attract motorists to walk then the engineers can save the cost of providing covered walkway

that requires higher construction costs and additional costs for maintenance. In addition, trees also can beautify and invigorate the natural environment.

Moreover, based on Table 1, it also shows that the distance of 400m is the perfect distance for planting trees because most of the respondents choose to walk at that distance. This study successfully achieved the overall goals and objectives. Meanwhile, the study significantly demonstrates the relationship between the walking distance with the planting of trees to provide shade along the walkway. In conclusion, the planting of trees along the walkway will encourage users to walk farther distances.

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