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The Contributions of Trees in Public Park

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Abstract

Trees, as one of the principal components of landscape has some functions, roles and benefits that contribute in controlling and increasing the sphere quality in urban areas. Generally, cultivation of trees will be able to eliminate the environmental problem such as air pollution and can reduce the adverse effect on the microclimate. Trees also provides many environmental benefits where it reduces the urban heat island effect, microclimate protection, reducing environmental pollutants, cleans urban air, absorbs carbon dioxide from the atmosphere and improve the quality of urban ecology and encourages wildlife. Trees offer a lot of ways to reduce environmental impact in the city. This paper focuses on the Ahmad Yani Park in the city of Medan which is one of a biggest city in Indonesia with a total inhabitants of 2 million people or a density of 2.328 people per hectare. On the other hand, the total area of urban space, which function, as 'urban green space' is about 2, 8% of the total area of the town centres. Ahmad Yani Park is a public park in the downtown and has a various types of ornamental trees. The objective of this paper is to identify the trees and its characteristic at the Ahmad Yani Park, which contributes to reduce the microclimate change and environmental impact in the city. Some trees have grown to 50 meter in height such as: *Delonix regia, Macrophylla Swietenia, Alstonia Scholaris, Artocarpus Heteophyllus, Mimvsa elengi, Phyllanthus acidus Skeels, Plumeria spp, Lagerstomia speciosa, Adenanthera spp, Cocus nicifera, and Cassia Multijuga rich.* These conditions gave a most complete dust interception and signicant reductions in gaseous pollutant concentrations in the city. Consequently, it attracts birds, butterflies and other wildlife which can be a scenic sight of the urban areas.

Keywords: tree, environmental impact, microclimate change, urban green space, public park, Ahmad Yani Park

1. INTRODUCTION

In the urban neighbourhood, the concentrations of people and their activities create an intensified demand on the environment. However, the concentration of people offers opportunities, through design and actions at an urban scale, to minimise the various environmental impacts - ideally to the point where they can be assimilated with the ecosystems of the region without lasting damage. It can then be said that a level of sustainable existence has been reached at which the community can live in symbiotic harmony with its environment. During the industrial revolution in the mid-1800s, the design of buildings came to depend less on ambient energy and more on the abundant supply of fossil fuels for their thermal comfort. Current trends in architecture and urbanism often continue to ignore the potential of passive measures to achieve thermal comfort. The resulting impacts can be measured in several aspects, especially in environmental terms. There is an increasing acceptance among planners, urban designers and government officials that the current modes of human existence are unsustainable in the environmental terms. Some of the factors supporting this view are indications of global climate change, resource depletion, droughts, floods, local pollution and damage to the ecosystems (Brophy et, al. 2000).

2. URBAN IMPACTS

a. Ecological Footprint

The 'ecological footprint' is a measure of sustainable development by which categories of human consumption are translated into areas of productive land needed to provide resources and assimilate waste products. Included in the calculations of the ecological footprint of the community, are the volumes of 'imported' raw materials, food and fuel, taking into account of the land, water or air used for the production or waste disposal. Cities in developed countries generally have a much larger ecological footprint than those in developing countries. For example, the average

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ecological footprint in Italy is 4ha/person, representating 320% of the land available in Italy, while Switzerland and Germany have an ecological footprints that is greater than 5 ha/person. London's ecological footprint is almost equivalent to the entire area of Britain's farmland. By comparison, the world's average ecological footprint is 2.4 ha/person (www.progress.org).

b. Urban Heat Islands

A heat island is an area of land whose ambient temperature is higher than the land surrounding it. Many studies show that there is a direct correlation between the density and population of a city and the intensity of the heat island effect. Higher urban temperatures increase the demand for electricity for cooling and air conditioning in warm conditions which leads to an increase in the production of carbon dioxide and other pollutants. These pollutants in turn contribute to increase the global temperatures due to the 'greenhouse effect'. Some of the main factors contributing to the increased temperatures in urban areas are, air pollution and heat production from buildings and traffic as well as the buildings and other hard surfaces which absorb solar radiation and reflected heat. These actions will contribute to the reduction of airflow and an increased in humidity which is caused by the sheltering effect of the buildings.

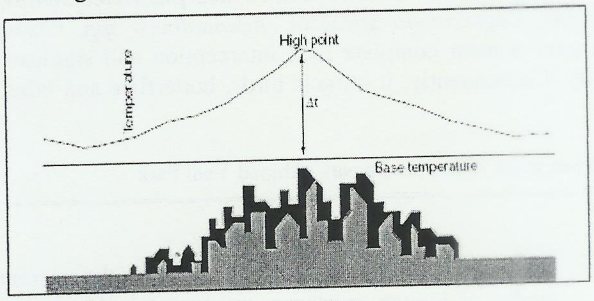

Figure 1: Urban Heat Island Effect.

c. Buildings and Land Use

In the city buildings are required for almost every activites and are the principal elements of the urban fabric. There are environmental impacts associated with their construction, usage and disposal. Land use for buildings and other purposes is scarce, where as finite resource that has hitherto often been used wastefully, especially in the cities and towns and suburban areas. Future sustainable development needs to address land use and planning guidelines according to the functions to ensure optimal usage is made on the available land resources to serve the needs of the society as a whole.

d. Traffic

Traffic congestion reduces the quality of life in the cities. It wastes time and energy, and increases environmental degradation and frustration among road users. The design, placement and density of buildings in an urban environment have a great influence on the immediate transportation patterns. The prolific use of the private car is both a cause and result of inadequate public transport facilities.

e. Wastes (Solid, Liquid, Gaseous)

The domestic, commercial and industrial wastes generated by urban living are of grave concern to the local authorities and inhabitants and a major source of environmental pollution. The odour and other emissions associated with sewage treatment plants and landfill sites, traffic and industrial processes are a regular source of irritation, particularly when a large numbers of people are living close to such source of pollution.

f. Water Quality

The quality of our water is influenced greatly by human development. Acid rain is a common problem in the urban communities due to continuous industrial activities. The expanse of hard impermeable surfaces in the cities results in a large body of rain water accumulating in one area and requiring to be discharge elsewhere. Dust, dirt and other solid pollutants are washed with rain water into the drains; the water sometimes discharged untreated into local waterways. Drinking water from local waterways often requires treatment with chemicals to combat bacteria and other micro-organisms from such pollution.

g. Air Quality, Ozone Depeltion, Greenhouse Gases, Solar Radiation

Many cities have succeeded in reducing the high levels of pollution traditionally caused by large-scale fossil fuel combustion. In London prior to the 1956 Clean Act, air pollution had reduced midwinter solar radiation in the city by 50% compared with the surrounding countryside (Yanas, 1998). The sun's capacity to contribute to thermal comfort in winter was thus halved. Today, vehicle usage is one of the main contributors to air pollution in the cities. Despite reductions in individual vehicular emissions, the increasing number of vehicles on the roads in cities ensures the continuing rise of urban air pollution levels.

h. Aerodynamic Impact

Wind velocities in the cities are generally lower than those in the surrounding countryside due to the obstructions of airflow caused by the siting of the buildings. Wind affects the temperature, rates of evaporative cooling and plant transpiration and is thus an important factor at a micro-climatic level. Built-up areas within the tall buildings may lead to a complex movement through a combination of wind channelling and resistance. This is often results in the wind turbulence in some areas and may create a concentrated pollution wherever there are wind shadows.

i. Urban Dust

Urban dust is a particulate matter released into the air as a by-product of building works, exhaust fumes from buildings and vehicular traffic, manufacturing and other processes. It clings to the porous surfaces such as stone, brick or concrete. The streaking effect under windows and architectural mouldings is a result of this dust being washed off while non-porous surfaces such as glass, and lodging itself on the porous material below. Extensive sealed surfaces and insufficient planted areas intensify this problem. Apart from the aesthetic effects of urban dust, studies have shown that excessive exposure to this dust may aggravate pulmonary disorders.

3. THE EFFECT OF TREES ON THE URBAN ENVIRONMENT

Trees provide contrasts of colour, texture and form in the built environment, introducing the shapes and colours of nature into the man-made geometric patterns of road and buildings. Changing colours with the passing of seasons, trees provide endless variety and delight. Trees have more than simply a visual appeal; the wind ruslting through leaves is a sound evocative of the countryside, and a welcome diversion from cities noises. The smell of blossoms, ripening fruit or drying leaves all has their associations with nature, and temper the artificiality of urban surroundings.

There is another aspect of considerable importance, and partly psychological in its effect. Trees contribute to the well-being and comfort to the town dwellers in replacing oxygen, recycling water and improve the soil. They are capable of absorbing large quantities of dust from the atmosphere. Some benefit is claimed both from the cooling effect of trees on their surroundings by the shade they afford and by the temperature reduction produced as the result of evapo-transpiration. This is of particular importance in hot climates. There can also be no doubt that in general terms the surrounding soil is improved. This benefit can be gained more especially where the ground is open and the recycling process provided by leaf fall is completed. It is, however, likely to prove unimportant in most fully urban conditions, where it is usually necessary to provide a good soil at the outset (Patterson, 1977). To a limited extent, depending upon the amount of planting relative to built areas; trees can provide a valuable habitat for wildlife, linking open spaces and parks within the urban framework.

Tree, as one of the principal components of landscape and environmental configuration, whether the natural or man made landscape, as well as a road corridor landscaping in the city, has some function, roles, and benefits in controlling and increasing the sphere quality in urban area. These things are tightly concerned with physiologic features of a tree such as the ability to absorb many kinds of gas, to turn CO_2 to O_2, and to catch particles (Bidwell, 1974). Besides, a tree also has some physical features that concerned with aesthetic functions such as the shape of its crown, the color and texture of its leaves, the scent it produces, and also the conformity with its sourronding (Zimmerman, 1971).

Open spaces are planted with trees, shrubs and herbaceous species, especially grass, where it alters the local climate, an increasing in the dispersion of pollutants. Simple grass swards absorb twice as much pollution as does the bare soil. This scavenging effect increases with the inclusion of shrubs and trees. Thus the average concentration of a pollutant in the atmosphere declines with increasing proportions of well planted open space in urban areas (Saunders & Wood, 1977).

The air beneath a tree canopy contains only a fraction of the pollution found above and around the wooded area. The vegetation acts as a filter, the rate of pollutant removal being controlled by its physico-chemical nature, the species and the height of the vegetation, and the prevailing weather conditions (especially wind velocity and air humadity). Dusts and aerosols are filtered out most rapidly with sulphur dioxide, hydrogen fluoride and nitrogen dioxide being removed less efficiently but more quickly than nitric oxide and carbon monoxide. Tree barriers in urban areas can reduce air pollution considerably for example a plantation of 30 m in depth can give almost a complete dust interception and signicant reductions in gaseous pollutant concentrations. Even one row of trees can reduce air pollution levels markedly if planted on green verges with or without an underlying of shrubs (e.g. 25% reduction in dust concentrations observed in tree-lined streets). Free circulation of air within the canopy of a tree barrier helps to promote the filtering of pollutants (Saunders & Wood, 1977).

Careful selection of plants is essential to ensure good establishment in severely polluted areas. Obviously, insensitive plants must be used close to the source of pollution (Saunders & Wood, 1977). Deciduous trees are particularly effective seasonal shading devices, providing protection in the summer months while allowing daylight and solar penetration in winter. Where sunlight reaches ground surfaces directly, such as plazas or wide streets, vegetation can used effectively as a means of solar shading (trees and shrubs) and absorption (grass). The main considerations in the design of planting are species type, growth rate and location. Different species of vegetation have different capacities to absorb solar radiation. Local species generally have a stronger resistance to local pest and climatic conditions, requiring less maintenance than exotic species. The characteristics of plants that can significantly affect their contribution to solar shading are:

- Growth patterns, the time taken for sufficient growth to provide shade/cooling benefits.
- Diameter and height, implications for tree-spacing, distance from buildings, extent of shadows at maturity
- Duration of leaf season, timing relative to the heating/cooling season, implications for solar access and the appearance of the trees in winter

- Pollution resistance, durable species are needed in urban areas to avoid premature plant death (Brophy et, al. 2000).

In cool climates and locations subject to high winds, vegetation can be used as a windbreaker, reducing excessive wind speeds, yet allowing enough air flow through external spaces. Dense planting around narrow openings in the urban fabric will mitigate wind-tunnel effects, impede the movement of dust and improve the thermal comfort within surrounding buildings by reducing fabric heat transfer and infiltration.

4. CASE STUDY: AHMAD YANI PARK

The latest census indicates that the city of Medan has total inhabitants of 2 million people, with a density of 2.328 people per hectare. However the total area of the urban space which functions as 'urban green space' is about 744, 67 hectare, with only about 2.8% from the total area of town centre. The proportion of the green space with respect to the total area of the city is rather small as compared to WHO standard. According to WHO, the production of oxygen in the urban area requires about 20 - 30% of green space from the total urban area about 10 square meters per people.

Medan downtown was formed and developed by the Dutch government at the end of 19th century, which is almost an ending period of the colonial era in Indonesia. Medan was designed as *new colonial urban settlement*. Although the European population was small but they dominate the Polonia area. The Dutch laid down their government district in the downtown, with *Lapangan Merdeka* Park as a square. During the colonial era the European assumed to have the highest social status because they dominated the government departments. Polonia area was designed with garden city concept. The green space of the inner city comprises of the Ahmad Yani Park and serves as an urban amenity which huddles up all requirements of their needs according to their life style. The area of Ahmad Yani Park is about 19,110.20 square meters. The Dutch government designed this park as a central park in order to serve the housing estate at the *Polonia* area. This park has various types of ornamental trees. During the colonial era the park served the function of the inhabitants for the recreational purposes. Ahmad Yani Park is located in the center of various urban activities such as: commercial, institutional, and residential. There are about 193 trees with 20 different types of species (Table 1) found in the area. An average tree has a diameter of the crown of up to 50 meters. The various types of trees came from topical zone that suits the geographiy and climate of Medan. This appropriate condition results in a minimal maintenance, i.e. with no usage of fertilizer and watering of trees. However the existences of trees can reduce the environmental impact and gives positive contributions in urban area, such as:

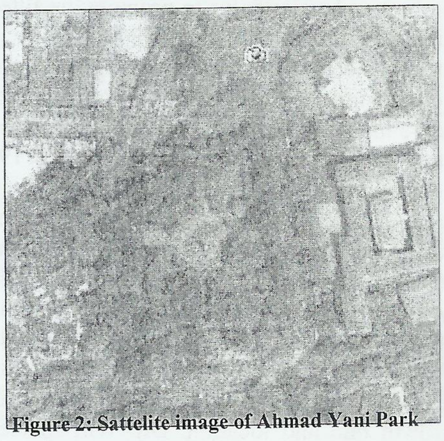

Figure 2: Sattelite image of Ahmad Yani Park

a. *Turning CO_2 to O_2.*

b. *Reduce gaseous and dust concentrations.*

c. Reduce air pollution.
d. Reduce micro-climate temperature as a result of evapo-transpiration.
e. Cooling the trees surroundings by their shade.
f. Providing a valuable habitat for wildlife, a santuary for birds and butterflies.
g. Mitigate wind-tunnel effects.

5. CONCLUSIONS

The Ahmad Yani Park in the city of Medan is mainly dominated by matured trees. It fulfilled the requirements of an open space according to the Dutch. Hence, it is quite a common feature of public parks at that time comparing to its cousin in Europe such as the Hyde Park or Marseilles or the like. The parks do not only serve as an open space or the "lung" in the city centre but it became a recreational and cheap family entertainment area since then.

The geographical advantage of the city of Medan which is bestowed with abundant rainfall and sunshine all year round encourages the sustenance of the park with minimal maintenance. The tropical trees require abundant rainfall and sunshine minus the fertilizer where the thick undergrowth helps to sustain water and provide natural compost for the tree to live healthily.

Some trees have grown to 50 meters in height such as: Delonix regia, Macrophylla Swietenia, Alstonia Scholaris, Artocarpus Heteophyllus, Mimvsa elengi, Phyllanthus acidus Skeels, Plumeria spp, Lagerstomia speciosa, Adenanthera spp, Cocus nicifera, and Cassia Multijuga rich. These conditions gave the most complete dust interception and signicant reductions in gaseous pollutant concentrations, turning CO_2 to O_2, reducing micro-climate temperature due to evapo-transpiration, besides; it can attract birds, butterflies and other wildlife which can be a scenic sight of the urban areas. Thus the existences of trees have fulfilled the criterion for sustainable urban green space and give the positive contribution for the urban environment and ecology.

No	Name of Trees	Volume	Origin		Maintenance			Characteristic		
			Tropical tree	Non-Tropical tree	Requires a lot of water	Prefers full sun	Requires a lot of fertilizer .	Attracts Birds	Attracts Butterfly	Way side tree/palm
1.	*Cocus nicifera (Kelapa)*	14	*		*	*		*		
2.	*Adenanthera spp (Saga)*	4	*		*	*			*	
3.	*Oreodoxa regia (Palem raja)*	107	*		*	*				*
4.	*Ficus Benyamina L (Beringin)*	2	*		*	*				*
5.	*Delonix regia (Flamboyan)*	3	*		*	*		*		*
6.	*Macrophylla Swetenia (Mahoni)*	28	*		*	*		*		*
7.	*Alstonia scholaris (Pulai)*	4	*		*	*		*		*
8.	*Acasiaauriculiformis (Akasia)*	4	*		*	*				*
9.	*Filicium decipiens (Kere Payung)*	2	*		*	*				*
10.	*Phyllanthus acidus Skeels (Cermai)*	1	*		*	*		*		
11.	*Mimvsa elengi (Pohon Tanjung)*	6	*		*	*		*		*
12.	*Cassia fistula (Trengguli)*	5	*		*	*				*
13.	*Pterocarpus indicus (Angsana)*	5	*		*	*				
14.	*Lagerstomia speciosa (Bungur/Ketangi)*	1	*		*	*		*	*	
15.	*Plumeria spp (Semboja)*	1	*		*	*		*		
16.	*Artocarpus Heteophyllus (Nangka)*	1	*		*	*		*	*	
17.	*Artocarpus Comunis L (Sukun)*	2	*		*	*				
18.	*Cassia Multijuga rich (Kasia Multijuga)*	1	*		*	*			*	
19.	*Erythrina subumbrands L (Dadap Serep)*	1	*		*	*				
20.	*Nyctantes arbor-tristis Linn (Sri Gading)*	1	*		*	*				

Table 1: Trees identification at *Ahmad Yani* Park

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