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Strategically Designed of Landscaping around Houses Produce an Extensive Cooling Effect

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Abstract

Every garden design is different and has its identity and style, dictated by site, size, microclimate and the preferences of their creators. All of the houses in Shah Alam and Putrajaya study area were surrounded by tropical landscaping, which included different combinations and amounts of plants. The recorded data and analysis conducted for this research included the general landscape design, garden size, and data about the five main categories of soft landscaping, includes trees, shrubs, vines, groundcover and turf. In tropical regions, trees are the most important plant structure in a garden. Foliage-canopy structures and vertical woody species distribution are important factors, as they can influence shading, evapotranspiration and the channeling of the wind.

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Keywords: Landscaping; shade; the wind; evapotranspiration

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1. Introduction

Vegetation is the general term for the plant life of a region. Plants do not exist by themselves in isolation; groups of plants living in the same area of a plant community. The vegetation structure relates to the number of vertical height layers of plants. Tropical gardens have significant elements, including bold foliage, dramatic colors, and flair, which create formal and informal style of design. In tropical regions, trees are the most important plant structure in a garden. In landscape design, the plant type's configuration and species that are chosen can be similar to the natural plant structure of the rain forest. The use of trees, shrubs and groundcovers in the production of shade, evapotranspiration, and channeling the wind depends on their size, species and location. The shrubs, vines, and groundcover situated on the east and west sides can provide shade from the direct sunlight on walls and glass windows. Turf adequately covered all earth surfaces completely around the garden to help evapotranspiration cooling. Evapotranspiration cooling from greater numbers of trees, shrubs and other small sized soft landscape elements around the house would also help to provide a cool, comfortable, and pleasant environment in the surrounding garden.

2. Literature review

The tropical and subtropical zones contain the greatest variety of plants in the world, with an estimated minimum of 200,000 species (Sparrow & Hanly, 2002). According to Casper (2007), besides having several canopies, the favorable conditions of the tropics encourages diverse plant life, which include trees, palms, shrubs, climbers, grasses, groundcover, and lawn. In tropical regions, trees are the most important plant structure in a garden. They often grow, particularly fast and can be the most satisfying plants in the garden (Sparrow & Hanly, 2002). However, while large trees with spreading branches help to keep the houses cool, there should not be so many of them to exclude breezes. The length and patterns of shade provided by trees vary with the seasons. Foliage-canopy structures and vertical woody species distribution are also important factors, as they can influence shading, evapotranspiration and the channeling of wind. Herbs and spices are synonymous with tropical gardens. As well as contributing their wonderful flavors and aromas to a wide variety of dishes, they provide fragrant garden areas.

The "cool effect" is defined as a change in the climatological micro conditions in a vegetated (green) area (Saaroni, Bitan, Dor, & Feller, 2004). The change is manifested at lower temperatures and higher relative humidity (Oke, 1988). Oke states that green areas are more humid and, therefore, cooler than their surroundings due to evapotranspiration processes. The shade of vegetation also prevents direct radiation from reaching the ground surface and warming it, thereby resulting in lower air temperatures above these surfaces. The air near the ground in green areas is cooler as a result of the evapotranspiration process. According to Santamouris (2001) and Misni & Allan (2010), evapotranspiration contributes to creating lower temperature spaces in the urban environment. This is known as "the cool phenomenon". In this process, the plant draws moisture from the ground and uses what it needs for growth and moderates its temperature as it transpires the excess water. This then cools the surrounding air. Evaporation of water from the leaves that are exposed to the sun consumes most of the absorbed solar radiation. The evaporation cools the leaves and the surrounding air in contact with them, and at the same time increases the humidity of the air (Givoni, 1991). Givoni stresses that the importance of this effect depends on the local humidity and temperature conditions.

Numerous studies simulating the effect of additional vegetation on urban temperatures have been performed by various researchers and provide very useful information. The computer simulation by Huang et al. (1987) predicted that increasing tree cover by 25% in Sacramento and Phoenix, USA, would decrease air temperature at 2.00 p.m. in July of 3.3 to 5.6°C. Taha (1997) reported that the factors that affect temperature reduction are evaporative cooling and shading of the ground, whereas a temperature increase during the night is the result of the reduced sky factor within the canopy. He concluded that the results of the simulations he carried out show that vegetation cover of 30% could produce a noontime cool of up to 6°C cooler in favorable conditions and night time heat island of 2°C. Evapotranspiration and shading play a role in creating the cooling effect (Saaroni et al., 2004). Oke states that it can be modified by the wind. According to Bernatzky (1982) and Misni (2013), they reduce the local temperature by 2–4°C. In hot-humid tropical climates, landscape design plays a significant role in determining the extent of the cool