

THE ESTIMATION OF  
EVAPOTRANSPIRATION IN KUANTAN USING  
DIFFERENT METHODS

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### **SUPERVISOR's DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of the Bachelor Degree of Civil Engineering with Hons.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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**Exclusively dedicated to my beloved family, friends, and lecturers for their endless support and encouragement throughout my years as a student at University Malaysia Pahang**

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## LIST OF SYMBOLS

$\Delta$	slope vapor curve (kPa°C <sup>-1</sup> )
$R_n$	net radiation of the crop surface (MJm <sup>-2</sup> day <sup>-1</sup> )
$G$	soil heat flux density (MJm <sup>-2</sup> day <sup>-1</sup> )
$T$	air temperature at 2m height (°C)
$u_2$	wind speed at 2m height (ms <sup>-1</sup> )
$e_s$	saturation vapor (kPa)
$e_a$	actual vapor pressure (kPa)
$\gamma$	psychrometric constant (kPa°C <sup>-1</sup> )
$p$	mean daily percentage of annual daytime hours
$T_{\text{mean}}$	mean daily temperature (°C)
$K_C$	Specific Coefficient
$H$	Energy Budget
$n$	Radiation
$R_a$	Extra-Terrestrial Radiation (MMJ·m <sup>-2</sup> day <sup>-1</sup> )
$R$	Correlative Coefficient
$r_s$	Stomata-Resistance
$ET_{\text{osc}}$	the gross evapotranspiration
$N$	the maximum number of sunny hours in function of the month latitude
$d_m$	the number of day per month
$T_{\text{med}}$	mean temperature (°C)

I                    the monthly heat index

## LIST OF ABBREVIATIONS

BC	Blaney Criddle
ET	Evapotranspiration
ET <sub>c</sub>	Crop Evapotranspiration
ET <sub>o</sub>	Reference Crop Evapotranspiration
MMD	Malaysian Meteorological Department
PET	Potential Evapotranspiration
PM	Penman Monteith
RH	Relative Humidity

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## ABSTRACT

Evapotranspiration (ET) is a term represents the combination of two processes water cycle whereby water is lost to the atmosphere from the soil and water bodies' meanwhile transpiration from vegetation or plant. The importance of ET due to the climate change which mainly expected to affect the air temperature, precipitation intensity and distribution. The objective of the study is to estimate and analyse the value of evapotranspiration by using Penman-Monteith (PM), Blaney-Criddle (BC) and Turc method in Kuantan, Pahang. In this study, the evapotranspiration value can obtain based on a program that we develop for the period 15 years from 2001 until 2015. Evapotranspiration can be effect the water level whether high or low, soil moisture, water supply, irrigation and agricultural. However, there are various types of method can be used for the calculation of ET. All ET methods present different structural complexity and data requirements. The methods was compared the values of appropriate methods with the exact ET values by develop a calculation program for ET calculation. Based on the ET value for the smallest value during month December to February. The most suitable method for ET value based on this study is Turc method and followed by Penman-Monteith due to the radiation-based parameter.



## ABSTRAK

Penyejatpeluhan (ET) adalah istilah yang mewakili gabungan dua proses kitaran air di mana air akan diserap ke atmosfera daripada tanah dan air dari transpirasi iaitu dari tumbuh-tumbuhan atau tanaman. Kepentingan ET amat penting disebabkan oleh perubahan iklim yang sebahagian besarnya dijangka memberi kesan kepada suhu udara, hujan dan pengedaran. Objektif kajian ini adalah untuk menganggar dan menganalisis nilai penyejatpeluhan dengan menggunakan Penman-Monteith (PM), Blaney-Criddle (BC) dan kaedah Turc di Kuantan, Pahang. Dalam kajian ini, nilai penyejatpeluhan yang akan diperolehi berdasarkan program yang membentuk bagi tempoh 15 tahun dari 2001 sehingga 2015. Penyejatpeluhan boleh menjadi kesan paras air sama ada tinggi atau rendah, kelembapan tanah, bekalan air, pengairan dan pertanian. Walaubagaimanapun, terdapat pelbagai jenis kaedah boleh digunakan untuk pengiraan ET. Semua kaedah ET dapat diperolehi dengan berbeza keadaan struktur dan data yang diperlukan. Kaedah tersebut dibandingkan dengan nilai kaedah yang sesuai dengan nilai-nilai ET yang tepat dengan program yang di bangunkan dalam pengiraan ET. Berdasarkan nilai ET bagi nilai yang paling kecil pada bulan Disember hingga Februari. Kaedah yang paling sesuai untuk nilai ET berdasarkan kajian ini adalah kaedah Turc dan diikuti oleh Penman-Monteith kerana parameter berdasarkan radiasi tersebut.

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

Hydrology is a physical science that is closely related to the water cycle or hydrological cycle of the water on the earth where it can be identified by the movement, the existence of the water itself and reactions to the environment and life on earth. Hydrology refers to water that is moving continuously stream of water like rivers, rainfall, pond, reservoir and catchment area either above or below the earth surface. Water that flows naturally also called as hydrological study in which this cycle can be used as a source of water supply. The occurrence of this cycle, people can understand and comprehend the existence of the water management systems (Patra, 2008).

Rivers and its environment will get the water source continuously through this hydrological cycle or rainfall cycle. The process that happens in hydrologic cycle is evaporation and transpiration. The process begins with the sea water under the sun vapor then fall to earth as precipitation. Evapotranspiration (ET) is a term describing the combination of evaporation and plant transpiration from the earth's land surface to atmosphere where it is including soil (soil evaporation), and from vegetation (transpiration). The most important contribution to evapotranspiration is these two processes (Kutchment, 2004).

Evaporation takes place of movement of water to the air from sources, canopy interception, and water bodies. Meanwhile transpiration is for the movement of water within a plant and the subsequent loss of water as vapor through stomata in its leaves. Other contributors to evapotranspiration may include evaporation from wet canopy

surface (wet-canopy evaporation), and evaporation from vegetation-covered water surface in wetlands (Burba, 2010).

## **1.2 PROBLEM STATEMENT**

The environment is important where it includes all living things and non-living which occurs naturally in the earth or in part which consist of several major components in the environment. It is also include the landscape that serves as the system naturally without human interruption where including flora and fauna, as well as natural phenomena such as earthquakes, eruptions of volcanoes, floods and others. There are also have the natural resources and physical phenomena that not have certain limitations which is climate, water, air, radiation, electric charge, and energy who was not involved as a result of human activity.

In this study, the environment plays a very important role to the process of ET which will give effect in the daily routine of life in which humans and the environment are interdependent with each other. Unpolluted environment can maintain a safe and comfortable atmosphere. Apart from the convenience of the people, it will also affect the activities of some of the country's development if the environment in our country are not properly maintained or systematic. In any damage occur to the environment, it will give a serious impact on people's lives. This shows the importance of the environment so as to maintain the fresh air, a stable ecosystem, wildlife habitat, whether land or sea can be maintained and can guarantee human health. It is said that because of environmental supply air to humans where human health will be affected if living in a less clean or polluted.

Besides the environment, the main consumer of solar energy in the Earth surface is included one of the process of ET. ET also is one of the most significant components in the water cycle beside the precipitation. ET represents the combination of two processes water cycle whereby water is lost to the atmosphere from the soil and water bodies' meanwhile transpiration from vegetation or plant. Based on this combination, the estimation of the evapotranspiration was found as the important issue of this study. The

value of ET is needed due to the change of the climate which mainly expected to affect the air temperature, precipitation intensity and distribution.

The expected climate change might evoke changes in the areas of the water resources, agriculture and forest and public health (Remrova et al, 2010). Evapotranspiration can be effect the water level whether high or low, soil moisture, water supply, irrigation and agricultural. However, there are various types of method can be used for the calculation of ET. All ET methods present different structural complexity and data requirements. It is difficult to select the appropriate ET method due to wide available ET estimation methods. Selecting an appropriate method is important depending on the area and meteorology data.

### **1.3 OBJECTIVE**

The objectives of this study are:

- i. To estimate and analyse the value of evapotranspiration by using Penman-Monteith, Blaney-Criddle and Turc method in Kuantan area.
- ii. To develop a calculation program for ET calculation.
- iii. To compare the values of ET estimation methods and determine the more reliable value between the method.

### **1.4 SCOPE OF STUDY**

This study has mainly investigated about the potential ET in Kuantan area exact value of evaporation with the meteorology data. In this study it was necessary to calculate the value of evapotranspiration in the Kuantan area. The value of evapotranspiration was estimated based on meteorology data from Malaysian Meteorological Department (MMD). The data consist of solar radiation, temperature (min/max) air humidity and wind speed. The evapotranspiration was estimated by three methods where Penman-Monteith, Blaney-Criddle and Turc method. This method was being selected due to the

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