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WATER FOOTPRINT ASSESSMENT OF WATER SUPPLY TREATMENT PROCESS: A CASE STUDY OF SEMAMBU WATER TREATMENT PLANT

NURUL ASYIKIN BINTI MOHD ROFI

Thesis submitted in fulfilment of the requirements for the award of the Bachelor of Engineering (Hons.) in Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITY MALAYSIA PAHANG

JUNE 2016

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LIST OF ABBREVIATIONS

CO_2	Carbon dioxide
FOA	Food and Agriculture Organization
H_2S	Hydrogen sulfide
NEM	Northeast monsoon
NH_3	Ammonia
NWRC	National Water Resources Council
PAIP	Pengurusan Air Pahang Berhad
SWM	Southwest monsoon
WF	Water footprint
WFA	Water footprint assessment
WFN	Water Footprint Network
WHO	World Health Organization
WSTP	Water supply treatment process
WWF	World Wide Fund

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ABSTRACT

In many parts of the world, freshwater is already a scarce and overexploited, raising the concern about global water scarcity. Previously, the Life Cycle Assessment (LCA) has been used to assess the impact of pollution to the environment. In 2002, Water Footprint Assessment (WFA) has been introduced. However, WFA has been only conducted to assess the product. In this study, the sustainability assessment by using WFA approach was conducted to assess the water supply treatment process (WSTP) of Semambu Water Treatment Plant. The study identified the type of water footprint (WF) at each stage of WSTP and calculated its water footprint for the period 2010 to 2015. Two factors that influenced the accounting of WF such as population and monsoonal changes were also evaluated. From the results obtained, the increasing water due to the increases population and land use factors affected the total water footprint per year; however the pattern of rainfall intensity due to monsoonal changes did not directly influenced the total amount of water footprint however it has slightly affected the total water intake. Thus, if the pattern keeps increasing due to the unregulated development and occurrences of climate changing, the water intake river is afraid to be insufficient and this may lead to water scarcity. The findings suggest interventions to reduce the water footprint will likely have as great impact on freshwater resources availability by regulating the placement area of development.

ABSTRAK

Di dalam banyak bahagian dunia, air tawar mulai sukar didapati dan pengekstrakan berlebihan, telah meningkatkan kebimbangan mengenai kekurangan air global. Sebelum ini, Penilaian Kitar Hayat (LCA) telah digunakan untuk menilai kesan pencemaran kepada alam sekitar. Pada tahun 2002, Penilaian Jejak Air (WFA) telah diperkenalkan. Walaubagaimanapun, WFA hanya dijalankan untuk menilai produk. Dalam kajian ini, penilaian dengan menggunakan pendekatan WFA telah dijalankan untuk menilai proses di Proses Rawatan Bekalan Air (WSTP) di Loji Rawatan Air Semambu. Kajian ini mengenalpasti jenis jejak air (WF) di setiap peringkat di WSTP dan mengira jumlah jejak air bagi tempoh 2010 hingga 2015. Dua faktor yang mempengaruhi pengiraan WF seperti penduduk dan perubahan monsun juga dinilai. Dari keputusan yang diperoleh, peningkatan air disebabkan oleh faktor peningkatan populasi dan guna tanah memberi kesan jumlah jejak air setahun, bagaimanapun corak kehadiran hujan yang disebabkan oleh perubahan monsun langsung tidak mempengaruhi jumlah jejak air sepenuhnya, tetapi sedikit menjejaskan jumlah pengambilah air keseluruhannya. Oleh sebab itu, jika corak ini semakin bertambah disebabkan pembangunan yang tidak terkawal dan fenomena perubahan iklim, tidak mustahil air sungai menjadi tidak mencukupi dan menyumbang kepada masalah kekurangan air. Hasil kajian menunjukkan campur tangan untuk mengurangkan kesan jejak air akan memberikan kesan kepada ketersediaan sumber air tawar.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Water is one of the most important mechanics to health and essential day life. Two parts of hydrogen and one parts of oxygen is combined to form H_2O elements. The body either humans, animals and plants cannot work without water, just similar to the analogy of the vehicle cannot run without oil and gas. In fact, all the organs and cells functions that makes up the whole anatomy and physiology rest on water for their functioning. The water can be gained from different sources such surface water, rivers or lakes, rock catchment areas and rock holes, excavated dams, rainwater tanks, bores and well and groundwater (Natural Resources Management and Environment Department).

Nowadays, the main problem faced by many societies is water scarcity. Water scarcity is a relative notion and can be come about at any level of demand or supply. Water scarcity can be defined as the lack of adequate water supplies and resources to fulfill the demands of water usage within a region. Water use has been increasing at more than twice the rate of population growing whereby, people put ever increasing demands on limited supplies of water. The monsoonal changes also one of the factors that lead to the water

scarcity, since the amount of uses water during wet and dry season is differenced (eSchoolToday, 2010).

For Kuantan city, the main sources of clean water are Kuantan River and groundwater. Unfortunately, the domestic water is usually discharged directly into the drains and rivers, which contribute to increasing risk of river pollution and a threat to marine life. Basically, Kuantan was supplied by 11 different water treatment plants placed at Bukit Ubi, Pasir Kemudi, Bukit Goh, Kampung Pandan, Paya Bungor, Kuala Kenau, Kampung Kolek, Bukit Kunin, Kampung Penor, Alur Batu and Semambu.

Before clean water arriving at home tap, water is treated at the water treatment plant in order to remove sediment, bacteria and other impurities. The water treatment process may slightly different depends on the locations, technology of the plant and uses of water, but the principles to produce clean and safe water still the same (Abdollah, 1985). Water treatment is a method of making water suitable for its application or returning its natural state. It is needed to eliminate the impurities that are contained in water as found in nature. Water treatment is functioned to produce clean and safe water for public demand. There are several stages that involved in water treatment process; aeration, coagulation and flocculation, sedimentation, filtration, and disinfection.

Man usually use a lots of water for daily activities such drinking, cooking and washing, but more uses of growing food, producing of clothing, and electronic products. Water footprint can be defined as the amount of water that use in or around home, office and school throughout the day. It also includes the measurement of water took to produce the products, goods and service. The Water Footprint (WF) consists of three elements which are green, blue and grey water footprint. These three elements serve a comprehensive image about uses of water by showing the source of water consumed, either rainfall or groundwater, and the amount of fresh water needed for consumption of pollutants (Network, 2013)

1.2 PROBLEM STATEMENT

The main function of water treatment process (WTP) is to produce clean and safe water to be used. However, the demand for clean water is increased from year to year due to the increase in the population of users, whether human, animal and plant life, other than a request from the industry for the production of products that require water supply besides the demand during the wet and dry season. Therefore, the water treatment process management needs to provide sufficient water supply in order to fulfill the requirements of it. Sufficiently of water supply is dependent to the river water availability. The El Nino phenomenal has put Malaysia at the risk of water scarcity. Due to unregulated placement of population, agriculture and industrial area, more and more development will be placed at one area where the water intake will be at similar point. At the same time, the sustainability of national water treatment methods has also raised a great concern.

The study was conducted to calculate the amount of water consumption at each stage of water treatment process. The water footprint was further assessed by taken into consideration water demand which was based on population and land use factor and also monsoonal changes for the period of five years from the year 2010 to 2015.

1.3 OBJECTIVES OF STUDY

The objectives of the study are:

i. To identify types of water footprint (WF) for each stage of Semambu Water Treatment Plant (WTP).
ii. To calculate the water footprint (WF) for each stage of Semambu Water Treatment Process for 5 years duration (2010-2015).
iii. To study the effect of population, land use and monsoonal changes to water footprint (WF) account at Semambu WTP.