

**RAINFALL PARTITIONING
AND EVAPOTRANSPIRATION OF A JUNIPER TREE**

LUQMAN MD SUPAR

**MASTER OF SCIENCE
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JUNIPER TREE**

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**Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of
Science in the School of Marine and Environmental Sciences
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DEDICATION

This thesis is dedicated to my father and mother:

Md Supar Rohani and Salbiah Mohamed

for their endless love, support and encouragement.

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu
in fulfillment of the requirement for the degree of Master of Science

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Main Supervisor : Assoc. Prof. Dr. Edlic Sathiamurthy, PhD

School : School of Marine and Environmental Science

Rainfall partitioning and evapotranspiration were studied upon an individual Juniper tree under an urban tropical climate in Kuala Terengganu. The juniper was selected for its rainfall interception capabilities as a potential to be optimized as landscaping trees for the regulation of urban microclimate and stormwater runoff. A comparative trimmed landscaping juniper and a broadleaf representative mango tree were also studied. Meteorological data and gross rainfall was recorded for a year and observed on how they influence each other. Interception loss partitioned by the planted juniper, trimmed juniper and mango tree were 23.9%, 29.7% and 26.2%, respectively. The junipers produced reasonable throughfall values with low throughfall variability, yielding significant interception losses even for larger storms with short drying period between storms which imply their effectiveness as rainfall interceptors. The broadleaf produced significant negative interception values which was resulted from large throughfall variability and exaggerated throughfall values caused by the funneling effect by broad leaves. Such negative interception losses were discarded from the final interception loss percentages and evidently suggest the

ineffectiveness of the mango tree in intercepting rainfall. Interception loss was modeled for the planted juniper using the Rutter model. Observed and modeled interception loss was 11.2% and 14.1% of gross rainfall, respectively. The 2.9% overestimation was possibly associated to small storm sample size for validation and the dependent on evaporation rates that required various derived parameters not well documented for junipers. Reference evapotranspiration rate averaged at 3.25 mm/day which was lower than the long term average possibly associated to lower overall annual solar radiation compared to long term averages of solar radiation readings at the study site. Hourly reference evapotranspiration, potential wet canopy evaporation and dry canopy transpiration from the juniper averaged at 0.14, 0.13 and 0.08 mm/h, respectively; translating into 720.17 W of evapotranspirative cooling potential. Being the earliest studies on Malaysian junipers under a tropical urban environment, this study produced comparable interception losses to past overseas forest studies and uncovers the challenges of conventional rainfall partitioning methods on small landscaping juniper trees, which should give some insight into potentially larger scaled feasibility studies in the future.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu
sebagai syarat memenuhi keperluan Ijazah Sarjana Sains

**PEMBAHAGIAN HUJAN DAN SEJATPELUHAN OLEH SEBATANG
POKOK JUNIPER**

LUQMAN MD SUPAR

2018

Penyelia Utama : Prof Madya Dr Edlic Sathiamurthy, PhD

Pusat Pengajian : Pusat Pengajian Sains Marin dan Sekitaran

Kajian pembahagian hujan dan sejatpeluhan telah dijalankan ke atas sebatang pokok Juniper individu yang ditanam di bawah iklim bandar tropikal di Kuala Terengganu. Spesies juniper dipilih untuk mengkaji potensinya sebagai pokok lanskap yang mampu mengawal iklim mikro dan air larian pempandaran melalui keupayaannya memintasan hujan. Sebatang pokok juniper lanskap yang sering dicantas dan pokok mangga mewakili jenis tumbuhan berdaun lebar juga dikaji sebagai perbandingan. Data meteorologi dan hujan telah direkod selama setahun dan dijalankan pemerhatian. Pintasan hujan oleh pokok juniper, pokok juniper lanskap dan pokok mangga, masing-masing adalah sebanyak 23.9%, 29.7% dan 26.2%. Pokok juniper telah menghasilkan bacaan dan taburan jatuhan langsung yang munasabah sebagai sebahagian daripada jumlah hujan dan juga bervariasi yang rendah, menghasilkan jumlah pintasan yang ketara walaupun untuk saiz ribut yang besar dan masa pengeringan yang singkat di antara dua sesi ribut. Dengan ini, ia membuktikan keberkesanannya dalam memintas hujan. Pokok mangga pula menghasilkan banyak pintasan yang negatif dan jatuhan yang bervariasi tinggi akibat daripada kesan

pencorongan daun. Dengan kewujudan nilai negatif tersebut, terbukti bahawa tumbuhan tersebut kurang cekap dalam memintas hujan. Jumlah hujan pintasan yang direkod dan diramalkan menggunakan model Rutter adalah sebanyak 11.2% dan 14.1% daripada hujan kasar. Perbezaan sebanyak 2.9% itu telah dikaitkan dengan sampel yang terlalu kecil dan kesilapan yang berpotensi terhasil daripada banyak pembolehubah yang kurang didokumentasikan untuk spesies juniper. Purata kadar sejatpeluhan rujukan adalah sebanyak 3.25 mm/hari yang menghasilkan jumlah purata tahunan yang rendah disebabkan oleh kadar purata radiasi matahari tahunan yang rendah. Kadar sejatpeluhan rujukan, pengewapan kanopi basah dan transpirasi kanopi kering potensi purata adalah sebanyak 0.14, 0.13 dan 0.08 mm/jam. Ini mampu menghasilkan kadar penyerapan haba sebanyak 720.17 W. Sebagai kajian yang terawal melibatkan pokok juniper tempatan di iklim tropikal kota, kajian ini telah menghasilkan nilai pintasan hujan yang setanding dengan kajian-kajian hutan di luar negara. Kajian ini juga mendedahkan cabaran-cabaran menggunakan kaedah pembahagian hujan konvensional pada pokok juniper landskap kecil sebelum dapat diadaptasi pada kajian yang berskala lebih besar di masa hadapan.