Pertanika 2(2), 152–154 (1979)

SHORT COMMUNICATION (II)

Rainfall interception, throughfall and stemflow in a secondary forest

INTRODUCTION

The presence of forest or any other vegetative cover over an area of land influences the distribution pattern of rainfall. Some of the rain is intercepted and retained by the leaves and other parts of the trees and eventually lost to the atmosphere in the form of evaporation. The rain water that reaches the soil surface will arrive there by throughfall (passes directly through open spaces not covered by foliage or as drips from the vegetative parts of the tree) and also by stemflow (flows down the surface of the stem). Measurements of the amount of interception, throughfall and stemflow are therefore necessary towards understanding the role of a forest cover in the hydrological cycle in a forest ecosystem.

Studies of rain interception, throughfall and stemflow have received little attention in Malaysia. Kenworthy (1970) reported one such study under primary and disturbed forests at Ulu Gombak Reserve. Teoh (1971) conducted a similar study in a rubber plantation at Sungei Buloh and Low (1972) reported the work done at Sungai Lui catchment area.

This paper describes the results obtained from an investigation conducted at the Air Hitam Forest Reserve, Puchong, Selangor to find out the percent interception, throughfall and stemflow. The vegetation is typically a secondary lowland dipterocarp forest of the "Kedondong Kempas" type. An attempt was also made to relate crown area and diameter of trees at breast height (D.B.H.) to stemflow.

PENDAHULUAN

Pokok-pokok hutan atau lain-lain tumbuhan akan mempengaruhi corak penyebaran hujan sesuatu kawasan. Sebahagian daripada jumlah hujan yang turun akan ditahan oleh daun dan lain-lain bahagian tumbuhan dan air ini seterusnya sejat ke atmosphera. Jumlah hujan yang tidak ditahan oleh tumbuhan akan jatuh ke tanah melalui aliran terus dan aliran di batang pokok. Untuk memahami peranan pokok-pokok hutan di dalam proses edaran hydrologis jumlah tampanan, aliran terus dan aliran di batang patut dikaji.

Kajian dalam bidang ini di Malaysia tidak dititikberatkan. Kenworthy (1970) melapurkan satu kajian di kawasan hutan dara dan hutan pamah di Ulu Gombak. Teoh (1971) mengkaji di kawasan pokok getah di Sungei Buloh dan Low (1972) menjalani kajian yang sama di Sungai Lui.

Kertaskerja ini menerangkan keputusan-keputusan yang didapati dalam satu kajian ke atas peratus tampanan, aliran terus dan aliran di batang yang dijalankan di Hutan Simpan Air Hitam, Puchong, Selangor. Jenis hutan di kawasan kajian ialah hutan pamah rendah (belukar tua) yang mengandungi tumbuhan jenis kedondong-kempas. Dalam kajian ini pertalian di antara padat silara dan garis pusat pokok dengan aliran di batang juga ditentukan.

MATERIALS AND METHODS

Two plots each measuring 16 m square were marked in the study area.

Stemflow was caught in two overlapping plastic sheet collars tied around the stem at D.B.H. of six dominant trees per plot. Plasticine was used to ensure water tightness around the top rim of the collars. The second collar was installed to further ensure water tightness of the apparatus. The lower margin of the second collar was upturned and fashioned into a circular collecting channel around the stem. A circular rattan ring was used to hold the upturned margin rigid. To facilitate drainage the base of their collecting channel was made oblique with a drainage outlet at the lower end. A funnel and tubing service drained the collected water into a covered bucket.

Throughfall was collected in eleven double-layered plastic troughs each measuring 0.7 m square. The water was drained through a central hole in the plastic and collected in a bucket via rubber tubing.

Gross rainfall was measured using two rain gauges installed in an open area (forest gap) close to the study plots.

Crown area measurement was done using the crown area projection method.

Readings obtained on throughfall, stemflow and interception were expressed on the basis of the area of study plot and calculated using the following standard formula:-

Gross rainfall = interception + throughfall + stemflow

RESULTS AND DISCUSSION

The average percent values for interception, stemflow and throughfall were found to be 26.91%, 0.89% and 72.20% respectively. By comparison the percent interception between logged-over forests the value in this study was more than that reported by Kenworthy (1970) which was only 20 percent. This difference could be due to higher stand density of the Air Hitam Forest compared to Ulu Gombak Reserve. Figure 1 shows the relationship between percent throughfall and interception with gross rainfall. The gross rainfall at which throughfall starts is termed the "Canopy Saturation Point" and from Figure 1, it is about 0.32 mm. At gross

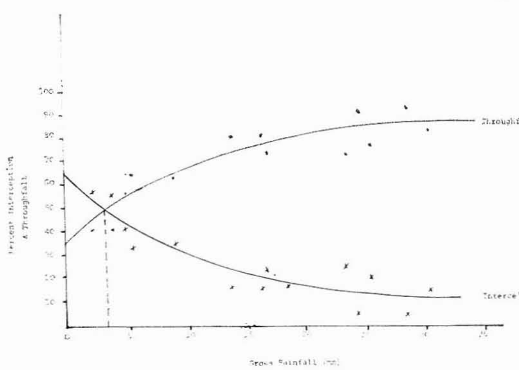

Fig. 1 : Percent Interception and Throughfall vs Gross Rainfall.

ainfall of about 3.6 mm, throughfall approximately equals interception and this level is termed "Interception-Throughfall Balance Point". With a further increase in gross rainfall, absolute amount of throughfall and interception increased. This change is due to the increase in intensity, duration and magnitude of rainfall. However, interception values tend to level off beyond gross rainfall of about 25.8 mm. Beyond this gross rainfall value, it appears that the crowns are fully saturated and will not hold any more intercepted water.

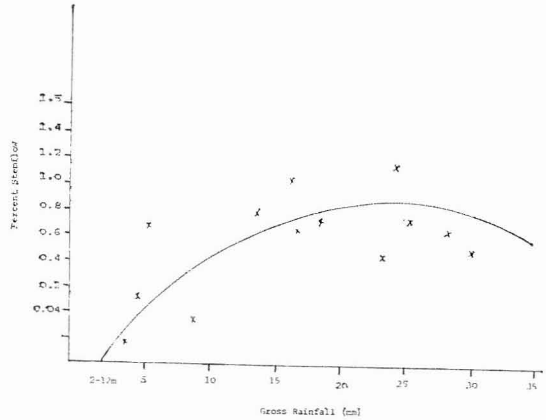

Fig. 2 : Percent stemflow vs gross-rainfall.

The amount fo gross rainfall at which stemflow starts is termed the "Crown Saturation Point". Figure 2 shows a value of 2.12 mm for Crown Saturation Point. This value is almost twice the value reported by Aldridge and Jackson (1973) for temperate forest types in New Zealand.

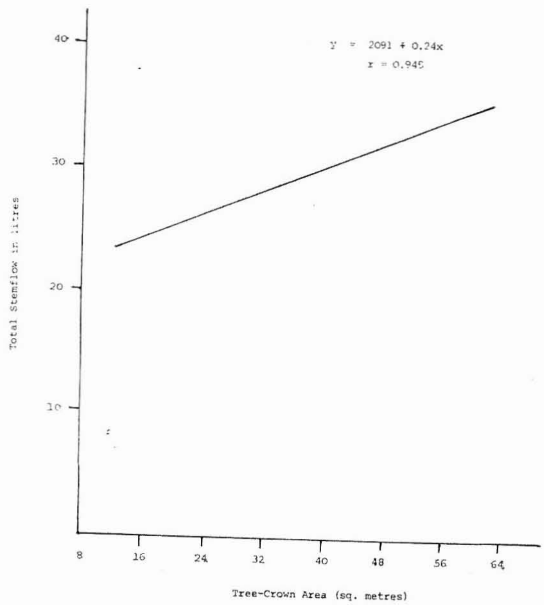

Fig. 3 : Regression of total stemflow on individual tree crown-area.

This indicates that a tropical forest needs a larger amount of rainfall to initiate stemflow. It could be due to denser canopy depth and higher leaf area which causes higher rainfall interception and therefore more rainfall is needed for stemflow initiation. It was also observed that stemflow increased with an increase in gross rainfall until at 25.0 mm at which point stemflow remained constant and gradually decreased.

Linear regression shows that total stemflow is highly correlated to crown area (Figure 3) and to a lesser extent D.B.H. (Figure 4). Amount of stemflow increased linearly with increase in crown area and diameter of trees suggesting that more water is intercepted in forests with larger trees.

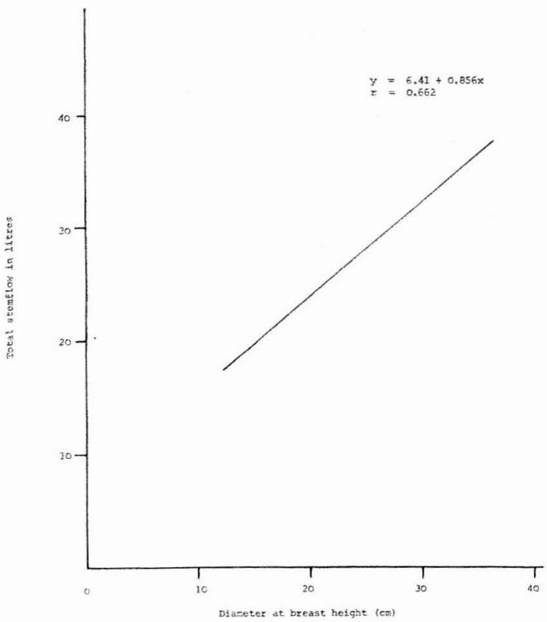

Fig. 4: Regression of total stemflow on diameter-breast height.

The study shows that interception, throughfall and stemflow are important components of the hydrological cycle in a forest ecosystem. Tropical rain forest vegetation therefore utilizes a high amount of rain water. It could also be concluded that the presence of forest vegetation will prevent some of the rain from falling directly to the soil surface; this les hstnseeimpact of the rain drops on the soil surface and therefore reduces the hazards of soil erosion.

ACKNOWLEDGEMENTS

The authors are grateful to Professor Abdul Manap Ahmad, Dean, Faculty of Forestry, Universiti Pertanian Malaysia for encouragement and facilities to conduct the study. They are also thankful to Dr. P.B.L. Srivastava for valuable criticism and suggestions.

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REFERENCES

ALDRIDGE, R., and JACKSON, R. J. (1973): Interception of rainfall by Hard Beech *(Nothofagus truncata)* at Taita, New Zealand. *N.Z. Jl. Sci.* **16(1):** 185–198.

KENWORTHY, J. B. (1970): Water and nutrient cycling in a tropical rain forest. In Flenley, J. (ed.)., The Water Relation of Malesian Forests. Trans. First Aberd. Hull Symp. Males. Ecol., Dept. Georgr. Univ. Hull Miscel. Ser. No. **11:** 49–59.

LOW, K. S. (1972): Interception loss in the humid forested areas (with special reference to Sungai Lui CatchMent, West Malaysia). *Malay. Nat. J.* **25:** 104–111.

TEOH, T. S. (1971): Where does the rainfall go? *Plrs' Bull. Rubb. Res. Inst. Malaya,* **155:** 215–219.

(Received 3 September 1979)