

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirements for the degree of Master of Science

**DIVERSITY, COMPOSITION AND ACTIVITY OF SOIL BIOTA FROM
DIFFERENT CONTRASTING HABITATS OF TERENGGANU, MALAYSIA**

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DECEMBER 2025

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Tropical soil biodiversity remains poorly understood compared to temperate and boreal regions, despite its critical role in maintaining ecosystem functioning such as organic matter transformation and regulating climate processes. Although numerous studies on soil biodiversity have been conducted in Malaysia, information on belowground communities across different natural and anthropogenic habitats in Terengganu remains understudied. Addressing this regional gap is important for conserving biodiversity, enhancing soil functions such as organic matter transformation, as well as informing sustainable land-use practices. This study examined the diversity, composition, and metabolic activity of soil bacteria, fungi, and soil meso- and macrofauna across natural and anthropogenic habitats in Terengganu using a combination of amplicon sequencing, greenhouse gas (GHG) flux measurements, volatile organic compound (VOC) profiling, and litterbag experiments. Results showed that tropical rainforests harbored the highest microbial and faunal diversity, whereas urban soils showed the lowest biodiversity. Soil texture emerged as the primary environmental factor influencing the structure of soil communities, and both taxonomic and functional groups varied distinctly among habitats. GHG

emissions and VOC profiles differed across land-use types, reflecting changes in microbial metabolic activity. Litterbag experiments revealed significant differences in decomposition rates among habitats, incubation periods, and accessibility for soil meso and macrofauna. Soil macrofauna accelerated decomposition in permaculture systems, whereas mesofauna played a greater role in urban soils, likely because urban soils support fewer large soil invertebrates but still maintain active mesofaunal communities. Overall, faunal effects became more pronounced with longer incubation periods. These findings highlight the complex relationships between soil biota and environmental factors in tropical ecosystems and demonstrate the key contribution of soil organisms to litter decomposition and ecosystem processes. This research expands understanding of tropical soil biodiversity in Terengganu, underscores its ecological importance, and provides baseline knowledge to guide conservation, land-use management, and climate change mitigation strategies.

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

**DIVERSITI, KOMPOSISI DAN AKTIVITI BIOTA TANAH DARIPADA
HABITAT BERBEZA DI TERENGGANU, MALAYSIA**

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Kepelbagaian biodiversiti tanah tropika masih kurang difahami berbanding kawasan beriklim sederhana dan boreal, walaupun ia memainkan peranan penting dalam mengekalkan fungsi ekosistem seperti penguraian bahan organik dan pengawalan proses iklim. Walaupun banyak kajian mengenai biodiversiti tanah telah dijalankan di Malaysia, maklumat tentang komuniti bawah tanah merentasi habitat semula jadi dan antropogenik di Terengganu masih kurang diterokai. Menangani jurang pengetahuan ini penting bagi pemuliharaan biodiversiti, meningkatkan fungsi tanah seperti penguraian bahan organik, serta memberi panduan kepada amalan guna tanah yang lestari. Kajian ini meneliti kepelbagaian, komposisi dan aktiviti metabolik bakteria tanah, kulat, mesofauna dan makrofauna tanah merentasi habitat semula jadi dan antropogenik di Terengganu dengan menggunakan gabungan kaedah penjujukan amplicon, pengukuran fluks gas rumah hijau (GHG), pemprofilan sebatian organik meruap (VOC), dan eksperimen "litterbag". Hasil kajian menunjukkan bahawa hutan hujan tropika mempunyai kepelbagaian mikrob dan fauna yang tertinggi, manakala tanah "urban" menunjukkan tahap biodiversiti yang paling rendah. Tekstur tanah muncul sebagai faktor persekitaran utama yang mempengaruhi struktur komuniti tanah, dan kumpulan taksonomi serta fungsi berbeza dengan jelas antara habitat. Pelepasan GHG dan profil VOC turut berbeza mengikut jenis guna tanah,

mencerminkan perubahan dalam aktiviti metabolik mikrob. Eksperimen "litterbag" menunjukkan perbezaan ketara dalam kadar penguraian antara habitat, tempoh inkubasi, serta tahap kebolehcapaian oleh mesofauna dan makrofauna tanah. Makrofauna tanah mempercepatkan penguraian dalam sistem permakultur, manakala mesofauna memainkan peranan lebih besar dalam tanah bandar, kemungkinan kerana tanah bandar menyokong bilangan invertebrata besar yang lebih sedikit tetapi masih mengekalkan komuniti mesofauna yang aktif. Secara keseluruhannya, kesan fauna menjadi lebih ketara dengan tempoh inkubasi yang lebih panjang. Penemuan ini menekankan hubungan kompleks antara biota tanah dan faktor persekitaran dalam ekosistem tropika serta menunjukkan sumbangan penting organisma tanah terhadap penguraian sampah daun dan proses ekosistem. Kajian ini memperluas pemahaman tentang biodiversiti tanah tropika di Terengganu, menegaskan kepentingan ekologinya, dan menyediakan pengetahuan asas untuk membimbing usaha pemuliharaan, pengurusan guna tanah, serta strategi mitigasi perubahan iklim.