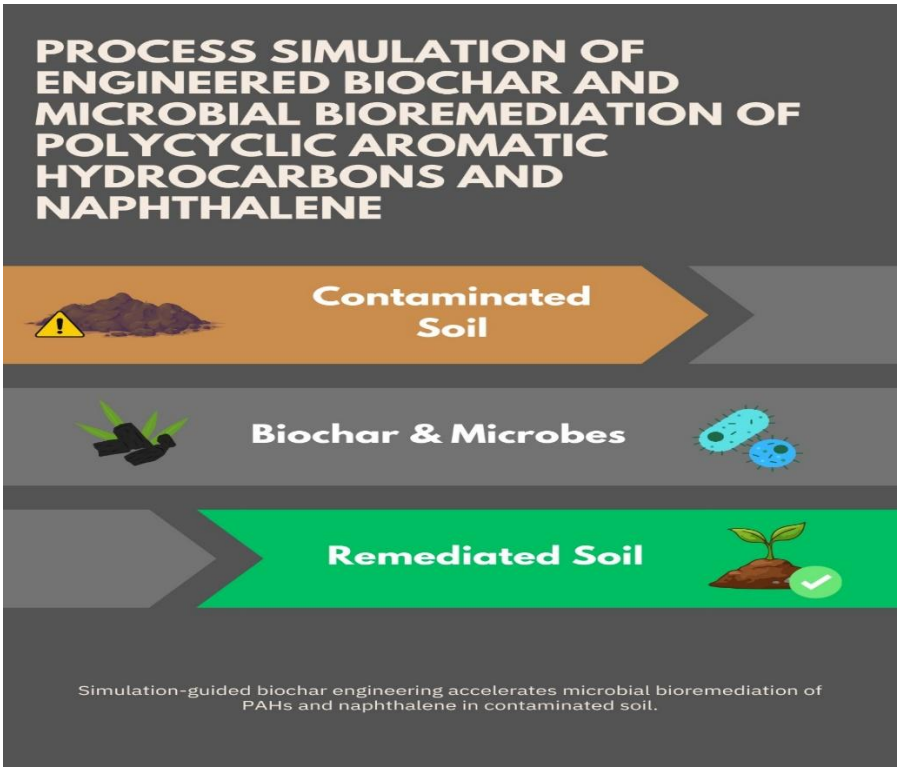
Masters Thesis Information Showcase
Spring/Fall Semester-2025
Year 2025

	Department: Environmental Engineering Programme: Masters in Engineering Specialization: Environmental Engineering
1	**Title of the Thesis** Process stimulation of engineered biochar and microbial bioremediation of polycyclic aromatic hydrocarbons and naphthalene
2	**Abstract** (min 300 to 500 words) In Karachi alone, organic waste accounts for 36.1 to 93% of the total solid waste generated daily. An estimated 55,000 tons of solid waste are generated daily as a result of the nation's growing urbanization. Agricultural waste generates approximately 140 billion metric tons of biomass annually, making it a significant contributor to solid waste. This research focuses on the microbial remediation of polyaromatic hydrocarbon (PAH) and naphthalene-containing soil near agricultural fields along the Malir River, using Pongamia pinnata-derived biochar. The study reveals the physicochemical properties of soil and biochar, and also the porous structure of biochar and the functional groups present in it. The research addresses the effect of Pseudomonas aeruginosa on biochar and its impact on contaminated soil. A comparative study was conducted on the growth of Vigna radiata using biochar samples pyrolyzed at different temperatures.
3	**Impact on SDG#__"** (min 500 words) (Please mention the impact of the relevant attained SDG) **UN SDG Goal 12:** Ensure sustainable consumption and production patterns. Following the SDG 12 in this research to prevent agri-waste going into landfill sites and transform the waste into valuable material that can be used to increase crop yield. Soil degradation and the depletion of essential nutrients that could have enhanced agricultural systems. This study contributes to a circular agricultural economy by redirecting agricultural waste from landfills and converting it into bio-compost, biochar, or organic fertilizers—waste that is repurposed as inputs for soil enrichment and sustainable crop yield enhancement. Organic waste materials like crop residues, husks, and animal manure can be transformed through composting, vermicomposting, or anaerobic digestion into nutrient-rich amendments that enhance soil structure, boost microbial activity, and decrease reliance on chemical fertilizers. Such practices can decrease environmental pollution and, at the same time, enhance farm productivity and farmers' economic returns. The implementation of circular agri-waste practices can lead to a reduction in greenhouse gas emissions, an enhancement of resource efficiency, and a contribution to long-term food security. **UN SDG Goal 13:** Take urgent action to combat climate change and its impacts Agri-waste, when disposed of in landfills, produces methane gas, a potent greenhouse gas. GHG emissions are responsible for climate change. To avoid such emissions, it is important to reduce the dumping of agriwaste, produce a sustainable end product, and promote a circular economy. If agricultural waste is not managed correctly, it can pose serious risks to the environment. Agricultural waste—like crop residues, organic by-products, and husks—when deposited in landfills, experiences anaerobic decomposition that emits methane (CH_4) into the atmosphere. Methane, a powerful greenhouse gas (GHG), has a global warming potential

	that is roughly 28–36 times that of CO_2 over a century. These emissions play a major role in climate change, impacting ecosystems, agricultural output, and human health. To lessen these impacts, it is crucial to decrease the amount of agricultural waste being sent to landfills and instead direct it toward sustainable and circular applications. As an example, agricultural waste can be transformed into valuable items such as bioenergy (including biogas and bioethanol), compost, biodegradable packaging, and construction materials like fiberboards and bio-bricks. These approaches not only prevent methane emissions but also create economic value and green jobs, promoting a circular economy where waste is reused and recycled instead of discarded.
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6	**Graphical Abstract**