

**A STUDY OF THE IMPACT OF LANDSCAPE
FRAGMENTATION ON THE TANK CASCADE
SYSTEM IN JAFFNA MUNICIPAL COUNCIL**

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Master of Spatial Planning, Management and Design

Department of Town & Country Planning

University of Moratuwa

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Thesis submitted in partial fulfillment of the requirements for the Master
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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Master's thesis under my supervision.

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The above candidate has carried out research for the Master's thesis under my Co-supervision.

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Dr. Emeshi Warusawitharana

.....
Date

I am Dedicate this

To Mom and My Late Dad,

Who always picked me up on time

And encouraged me to go on every adventure,

Especially this one...

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ABSTRACT

The traditional tank cascade systems of Sri Lanka, vital for water security, flood regulation, and ecological stability, are increasingly threatened in the Jaffna Municipal Council (JMC) area, where rapid urbanization and landscape fragmentation have disrupted natural water flow and storage, leading to rising flood risks over time.

This study focuses on the Jaffna Municipal Council (JMC) area, with two key objectives to analyse the extent and spatial patterns of landscape fragmentation from 1994 to 2024, and to assess the degree of fragmentation and its impacts on the functioning of the cascade system. Using GIS-based mapping and FRAGSTAT metrics of Patch density, largest patch index, Edge Density, Landscape Shape Index, Simpsons' Evenness Index, Shape Index, the research confirms significant fragmentation over the 30-year period. The quantitative metrics strongly aligned with visual observations, professional and community insights, revealing that fragmentation has reduced connectivity and impaired the ecological performance of cascade reservoirs. Comparative analyses of land use, urban expansion, population density, and flood inundation patterns further demonstrated the negative consequences of fragmentation, particularly the diminished capacity of the cascade system to regulate flooding and sustain water resources. FRAGSTAT analysis and map comparisons confirm increased landscape fragmentation in JMC, as rising patch density and urban sprawl reduced ecosystem connectivity and intensified edge effects that alter water flow in the cascade system. Landscape fragmentation in the study area intensified, with of higher patch density, edge complexity, shape irregularity, and diversity, alongside decreased largest patch size, reflecting increased urban sprawl and irregular urban development.

The study concludes that unregulated development, land-use change, and urban sprawl have significantly weakened the cascade system in JMC, leading to increased flooding and ecological disruption. The research recommends strengthening planning, protecting tank and cascade, restoring landscape connectivity, and applying lessons from other regions to rebuild the fragmented landscape and cascade system resilience and ensure sustainable water management in JMC.

Keywords: Landscape fragmentation, Tank cascade systems, Urbanization, Flood risk, GIS, FRAGSTAT, Ecosystem connectivity, Urban sprawl.

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