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

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Thesis submitted in partial fulfillment of the requirements for the Master of Spatial Planning Management and Design

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DECLARATION

I declare that this is my own work and this dissertation does not in corporate 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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Dr. Malani Herath Date

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

....

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...

ACKNOWLEDGEMENTS

It gives me great pleasure to acknowledge and thank the people who contributed to the development of this dissertation.

First and foremost, I would like to express my deep and sincere gratitude to my research supervisor, Dr. Malini Herath, Senior Lecturer of the Department of Town and Country Planning, University of Moratuwa, I would never have been able to finish my dissertation without her valuable guidance.

Furthermore, I would like to express my deepest gratitude to my Co-supervisor, Dr. Emeshi Warusawitharana, Senior Lecturer of the Department of Town and Country Planning, University of Moratuwa for her excellent guidance, caring, patience, and providing me with an excellent atmosphere for doing research.

I should express my sincere gratitude to Dr Rohana Rathnayake, Course Coordinator and Senior Lecturer, Department of Town and Country Planning, University Moratuwa for the great support and guidance to continue our degree programme.

My sincere thanks also go to Prof Jagath Munasinghe, Head of Department of Town and Country Planning, University of Moratuwa for their valuable advice and encouragement.

Furthermore, I also wish to thank all the other academic and non-academic staff of the department of Town & Country Planning for the assistance given to me in numerous ways.

My gratitude also goes to all the institutions and organizations, which provided me with their kind assistance to obtain necessary information and services.

Of course, My family have been a member of my journey, thanking my mother and elder brother for their kindness and being supportive at all the time.

In addition, many thanks to my batch mates; my degree program would not have been possible without their helps.

Finally, I would like to dedicate this Dissertation specially for my late father who always give proper advice, support and willing to bring me to this stage and the people who searching for the dimensions of Town and Country Planning and people who are trying hard to establish the profession of Town Planner’s in Sri Lanka.

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' Eveness 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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