A CASE STUDY ON SUSTAINABLE RESTORATION APPROACH FOR CASCADE POND SYSTEMS IN JAFFNA MUNICIPAL COUNCIL AREA FOR EFFECTIVE FLOOD MANAGEMENT

Jahapu Appuhamilage Salika Iroshan Thilakarathne

178063X

Degree of Master of Science

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DECLARATION OF THE CANDIDATE AND SUPERVISOR

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DEDICATION

I dedicate this thesis to my parents whose love, unselfish support and example over many years laid the foundation for the discipline and perseverance essentially required for me to complete this work successfully.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my research supervisors Dr. R.L.H.L. Rajapakse and Dr. T.M.N. Wijayaratna for their guidance, suggestions and encouragement throughout this research for me to overcome the obstacles which I had to face in the completion of the case study and also for the knowledge that I gained by working under their guidance.

I would also like to express my appreciation to the Research Coordinators of the Department of Civil Engineering, University of Moratuwa, Prof. A.A.D.A.J. Perera and Prof. R.U. Halwatura who led me to the successful completion of this research and for the guidance given in progress reviews. I should also acknowledge the generous support given by Dean of Faculty of Graduate Studies, Prof. S.A.D. Dias; Dean of Faculty of Engineering, Prof. N.K. Wickramarachchi; Head of the Department of Civil Engineering, Prof. J.M.S.J. Bandara.

During the data collection, many personnel and bureaus were extending an enormous support and I am very much grateful to all of them. Moreover, I am eternally grateful to all other personnel who helped me in numerous ways to develop my study and finish Master's degree research in time.

Thilakarathne J.A.S.I.
Department of Civil Engineering
University of Moratuwa
11.03.2019

ABSTRACT

A Case Study on Sustainable Restoration Approach for Cascade Reservoir Systems in Jaffna Municipal Area for Effective Flood Management

A unique characteristic of dry zone rainfall is its higher peak rainfall, even though the annual rainfall is relatively low. Jaffna peninsula is located in the northernmost part of Sri Lanka and faces these critical storm events during the second inter-monsoon. The pond system in the area was acting as the major water retention body, however due to the lack of awareness and proper rehabilitation, their retention efficiencies have severely been reduced.

Research methodology was developed to check the effect of reservoir connectivity for flood mitigation. HEC-ResSim computer simulation application was used to model Paalkulam and Nayanmarkaddu kulam pond cascades in the Jaffna Municipal Council region. Model results were used to quantify the flood affected area and the results were validated based on a water balance model. Daily rainfall data of year 2017, pond survey (contour) maps, canal network and natural stream network were used. Two scenario analyses were followed to identify the reduction in inundation area after the inclusion of reservoir cascade behaviour and the two rehabilitation approaches for sustainable pond restoration.

HEC-ResSim modeling was continued for scenario analyses, considering the insignificant deviations (6~8%) with the water balance model results. During the 2017 flood hazard, 27.5% of Paalkulam cascade catchment area out of total 156.7 ha was flooded and it was found that the affected area could have been reduced to 13.2% saving 21.73 ha area (14.3% of the Cascade land area), had the cascade connectivity been restored. The bund raising and bed dredging approaches showed a flood area reduction of 4.5 ha (20.2%) and 7.2 ha (33.3%) for downstream reservoirs and 5.8 ha (26.4%) and 3.9 ha (17.2%) for upstream reservoirs.

Furthermore, the second scenario analysis for rehabilitation approaches confirmed that the most suited rehabilitation approach for upstream and downstream reservoirs are reservoir bund raising and reservoir bed dredging, respectively.

Therefore, for a sustainable pond rehabilitation approach, proper accounting of the cascade connectivity is vital. Moreover, the best pond rehabilitation approach highly depends on the corresponding pond location in the cascade.

Key words: *Flood Mitigation; Water Balance Approach; HEC-ResSim; Reservoir Prioritization*

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