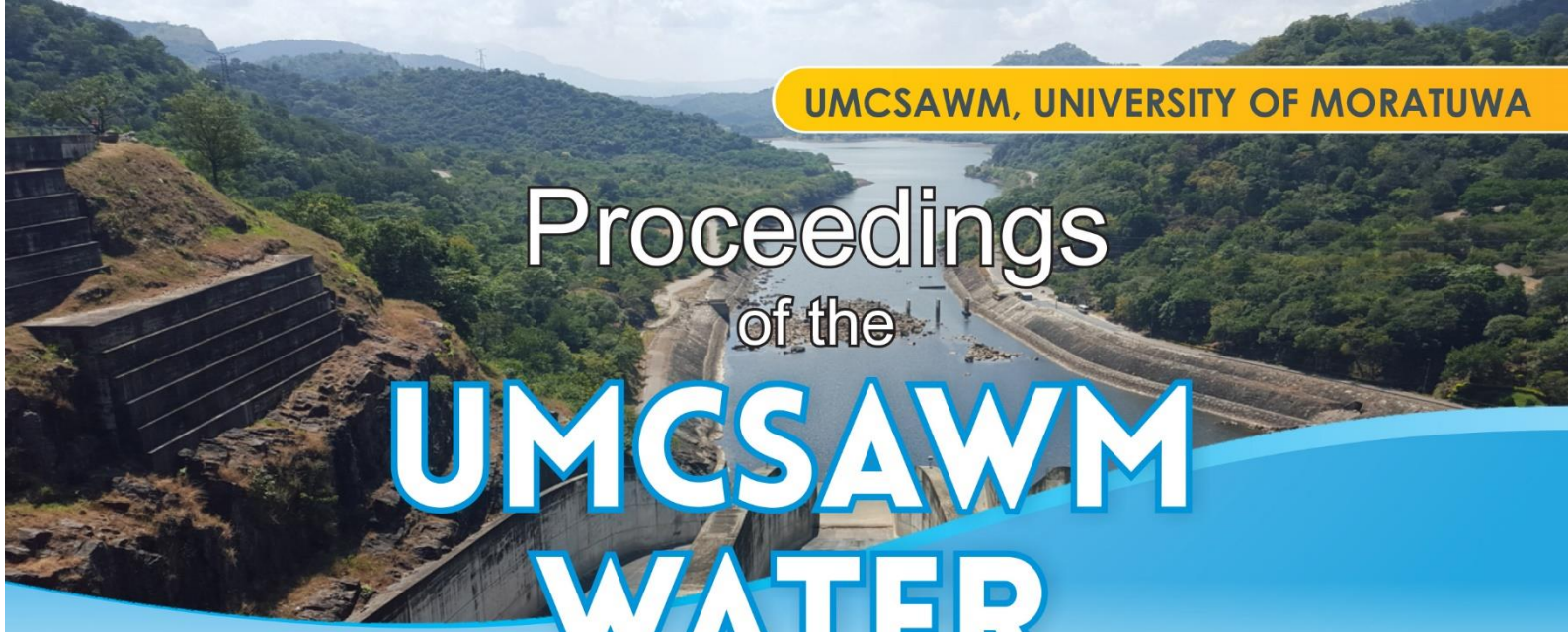

UMCSAWM, UNIVERSITY OF MORATUWA

Proceedings of the UMCSAWM WATER CONFERENCE

on

DEMONSTRATING THE STRENGTH OF WATER ENGINEERING AND MANAGEMENT CAPABILITY THROUGH CASE STUDY APPLICATIONS

19th January 2017
Civil Engineering Auditorium
University of Moratuwa
Moratuwa
Sri Lanka.

University of Moratuwa

UNESCO - Madanjeet Singh Centre for South Asia Water Management

United Nations Educational, Scientific and Cultural Organization

UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM)
Department of Civil Engineering
University of Moratuwa
Sri Lanka

UMCSAWM Water Conference

on

Demonstrating the Strength of Water Engineering and Management Capability through Case Study Applications

This book is published as supplementary reading material demonstrating the strength of water engineering and management capability. The contents are designed and developed through case study applications. Reproduction of this book is permitted only for non-commercial purposes. Use of this book is encouraged for teaching and training activities with proper acknowledgements of Editor and Publisher.

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UNESCO Madanjeet Singh Centre for
South Asia Water Management (UMCSAWM)

Vision

To be a premier centre of knowledge and outreach focused on sustainable water management in urban and rural environments

Mission

To promote techniques, technologies, management approaches, research and policy that support sustainable utilisation of water

Preface

Though water resources engineering and management is vital for development activities of any country, water data collection is limited in most of the developing nations. Until recently, streamflow was gauged only in about 40 locations within the 103 river basins in Sri Lanka. The demand for data is on the rise with the increase in computational power of computers, the advances in mathematical modelling of hydrology, the demand for physics based distributed models and the demand for more water due to population rise. The biggest problem faced by civil engineers who deal with water resources is the lack of gauged data. Application of mathematical models to estimate, forecast and determine design parameters for ungauged watersheds require very clear up-to-date guidelines.

Solving of challenging field level problems in water engineering and management involves a thorough knowledge in the application of mathematical models, a clear understanding of hydrologic and hydraulic principles, a sufficient insight on the social and environmental parameters and an understanding on the methods to converge when ungauged situations are encountered.

It is a great relief that the Irrigation Department Guidelines developed 1984, under the guidance of Engineer A.J.P Ponrajah is currently serving as the only Sri Lankan guideline for drainage and water resources designs. Though this guideline contains immensely valuable information, most of the data, parameters, topics and methods require updating because world over research has advanced tremendously with the scientific advancements especially in the areas of computers and information technology. However, until the authorities' initiate action to update these guidelines, the civil engineers in Sri Lanka in any sector dealing with irrigation, drainage and floods have to be content with the current Irrigation guideline of 1984.

The civil engineers must not only be conversant about water and its text book parameters which are mostly applicable to other parts of the world, but also must be aware of the strengths and weaknesses of available Sri Lankan guidelines and data. They should also be aware of solving practical problems without weeping over lack of updated guidelines and sufficient gauged data. The postgraduate degree programs of the UMSAWM and associated research are designed to cater to these needs.

This conference is to demonstrate the potential of our postgraduate students to systematically apply hydraulic and hydrologic principles, available guidelines, parameters and data to solve real life problems while verifying the solutions to ensure satisfactory implementation. In this conference proceedings, there are 19 selected papers on hydrology, water resources, Irrigation, GIS, water supply, solid waste planning, Integrated water resources management and mathematical modelling amidst situations of climate change. This conference will provide the opportunity for the decision makers from the industry to observe, question and discuss about the practical problems in the country and the solutions proposed by our students through their Problem Bbased Learning projects and research projects.

It is our fervent hope that the Sri Lankan industry and International institutions will identify the strength and potential of thorough teaching in the current postgraduate degree program conducted by UMCSAWM and the Department of Civil Engineering, which would then lead to a wider participation enhancing the critical mass of water engineers and managers.

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UMCSAWM Water Conference

on

Demonstrating the Strength of Water Engineering and Management Capability through Case Study Applications

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8.15 am	Arrival of Invited Guests and South Asian Foundation (SAF) Delegates
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8.35 am	National Anthem
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9.00 am	Address by Prof. Saman Bandara Head, Department of Civil Engineering, Faculty of Engineering
9.10 am	Address by Prof. Kapila Perera Dean, Faculty of Engineering
9.20 am	Address by Prof. Ananda Jayawardane Vice Chancellor
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Message from the Vice Chancellor, University of Moratuwa

I am pleased to send this message to mark the UMCSAWM Water Conference organized by the UNESCO Madanjeet Singh Centre of South Asia Water Management (UMCSAWM) and Department of Civil Engineering, University of Moratuwa. The UNESCO Centre is an important entity of the University as it is our first ever UNESCO affiliation, first centre with a building facility of its own, and first centre with fulltime international students. Most importantly, it covers the globally important topic of management of water resources.

With our vision to be the most globally recognized Knowledge Enterprise in South Asia, the Hydraulic and Water Resources Engineering Division of the Department of Civil Engineering with its competent staff, has been providing quality education in water and irrigation to our nation and regional nations. The opening of the UNESCO Madanjeet Singh Centre and the commencement of the fulltime International Master's Degree programme in Water Resources Engineering and Management in 2013 were remarkable achievements in this direction. I have no doubt that this UMCSAWM Water Conference is another huge stride by the University of Moratuwa towards this national and regional development mission. It demonstrates the quality of the Water Management and Engineering Education at our University aligning with our objective of carrying out nationally and regionally relevant, high-impact research to expand the boundaries of knowledge while enhancing the associated technological capabilities.

I note that the Centre and its programmes are progressing remarkably well with ongoing postgraduate research, projects undertaken, publishing and extending direct applications to the industry through knowledge sharing by leading the way through hosting important events in this nature. These efforts are substantially supported by the South Asia Foundation (SAF) which provides full scholarships to SAARC country students to join the programme as a result of visionary leadership of the **UNESCO Goodwill Ambassador Late Shri Madanjeet Singh** who also donated **a new building for our regional centre.**

While taking this opportunity to thank all those who have worked tirelessly to make this Conference a reality, I wish the programme, the Department and Centre, and its staff, alumni and students all the success and strength to do even better in the years to come.

Prof. A.K.W. Jayawardane

Vice Chancellor
University of Moratuwa
Moratuwa
Sri Lanka

Message from the Dean, Faculty of Engineering, University of Moratuwa

Engineering Faculty of University of Moratuwa is a well-established entity, leading the arena of technical education in the country. The Faculty at present comprises 12 academic departments, over 200 academic staff and around 3500 undergraduate and postgraduate students and offers Bachelor of the Science of Engineering degree in 9 disciplines and a a large number of post-graduate degrees. The UNESCO Madanjeet Singh Centre is affiliated with the Faculty of Engineering and is found to host the cross faculty and interdisciplinary water management course.

The existence of water is essential for life on earth. Although 70% of the earth surface is covered with water, less than 1% of this is available as drinking water and other needs of the 7 billion human population and all the other species. This limited capacity coupled with industrialization where water has also become much accepted renewable source of electricity generation, different political and institutional governance structures unique for each country etc., have made water resource management extremely complex. Prior to industrialization, water had been used predominantly for agriculture. Industrialization had resulted not only water pollution but also climate change which in turn had led to drought conditions. Ultimately there is a stiff completion for sharing of water between agriculture, industry and humans which has become difficult to manage.

Arising with the above described complexity, the Centre and its program have evolved addressing topics that include a broad range of application trends and are catering to the most pressing requirements such as water infrastructure, irrigation, water resources engineering and management, climate change, flood risk assessment and mitigation, trends in GIS and remote sensing, and industry applications and gap filling.

Furthering in this context, the Water Conference organized by the UNESCO Madanjeet Singh Centre for South Asia Water Management of the Department of Civil Engineering, University of Moratuwa, Sri Lanka will certainly demonstrate the strength of water engineering and management capability through case study applications. This forum where dissemination of the research projects and project based learning through case studies undertaken by the participants of the International Master's program on Water Resources Engineering and Management is scheduled to take place, is timely to Sri Lanka and the South Asian countries because of the prevailing drought conditions.

There is a need for the industry to step up contributing towards research and training and I hope that this Conference will be successful platform not only for knowledge sharing and dissemination, but also in developing industry links and collaborations much needed in pursuing its future goals and aspirations.

Prof. K.K.C.K. Perera

Dean, Faculty of Engineering
University of Moratuwa
Sri Lanka

Message from the Head, Department of Civil Engineering, University of Moratuwa

The Department of Civil Engineering is one of the strongest department in the Faculty of Engineering, and leadership in pioneering activities of University of Moratuwa has mostly been provided by the Department of Civil Engineering. The launching of the first ever fulltime postgraduate program in Water Resources Engineering and Management is one of them.

Over 35 years ago in 1982, Department of Civil Engineering commenced the first postgraduate programme in the university. Presently there are six (6) groups of research specializations for administrative purposes, namely; Building and Structural Engineering, Construction Engineering and Management, Environmental Engineering, Geotechnical Engineering, Hydraulic and Water Resources Engineering, and Transportation Engineering with highly qualified and talented staff cadre of 43, out of which 41 are with postgraduate qualification (33 with PhD's), while 17 are professors. They are involved in undergraduate and postgraduate teaching, research and training while over and above contributing immensely to the development projects and activities of national interest.

The commencement of the UMCSAWM and its programme have been instrumental in further strengthening infrastructure facilities and capabilities of the Department. The cutting edge, state of the art research facilities under construction will be useful in enhancing postgraduate and undergraduate teaching and research. The recruiting of regional students from SAARC nations, undertaking of industry based projects and organizing of international workshops and conferences by UMCSAWM are helping to strengthen much needed industry and overseas research collaborations benefitting both undergraduate and postgraduate programs.

I would like to wish this UMCSAWM Water Conference which is based on students' research projects an absolute success.

Prof. J.M.S.J. Bandara

Head, Department of Civil Engineering
Faculty of Engineering
University of Moratuwa
Sri Lanka

Message from the Head, Hydraulic and Water Resources Engineering Division, Department of Civil Engineering, University of Moratuwa

The Water Group of the Department of Civil Engineering is extremely proud of its achievements to date, including the introducing of the first postgraduate program in the University of Moratuwa. The establishment of the UNESCO Madanjeet Singh Centre of South Asia Water Management (UMCSAWM) is another milestone in the history line.

The biggest strength of the Water Group is its well-versed staff equally qualified with academic credentials and field expertise covering vast arena of water and related fields including surface and groundwater hydrology, hydraulics, irrigation, water resources management, coastal and engineering and estuarine modelling, water related GIS and remote sensing applications, and hydrodynamic modelling and applications, etc.

The staff is involved in teaching and pioneering research in water resources management, irrigation practices, coastal wave dynamics and various other themes of timely importance, and industry based research and applications while serving in various departmental, faculty and university committees and various other for a of national and international recognition.

The fully equipped hydraulic engineering laboratory has the apparatus and computer facilities required for studying hydraulic engineering problems of practical interest. These include, channel flow simulators and hydraulic flumes, pipe friction and hydraulic machinery, hydraulic benches for multiple test platforms, etc. Computer aided exercises are also carried out for the students to acquaint themselves with the use of computer packages used in the industry.

The newest additions to the group's strengths are the UNESCO Water Centre and the international postgraduate program conducted by the Department of Civil Engineering in collaboration with the South Asia Foundation (SAF-India).

With all these facilities, strengths and expertise available, the Water Group is even more determined to serve the Department, University, nation and the region in the years to come.

Mr. A.H.R. Ratnasooriya

Head, Hydraulic and Water Resources Engineering Division
Department of Civil Engineering
Faculty of Engineering
University of Moratuwa
Sri Lanka

Message from the Center Chairman, UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa

In 2003, UNESCO Madanjeet Singh Center for South Asia Water Management (UMCSAWM) project was initiated by then Honourable Foreign Minister Lakshman Kadiragarmar and it was finalized when South Asia Foundation (SAF) received the generous patronage of then UNESCO goodwill ambassador Shri Madanjeet Singh. Professor Malik Ranasinghe then Dean Engineering at University of Moratuwa and Professor Dayantha Wijeyasekera then Vice Chancellor extended their fullest support enabling the construction of buildings and commencing the fulltime international Master's Degree program in Water Resources Engineering and Management. SAF supported the water management program by extending eight full time scholarships for member nations while Shri Madanjeet Singh provided personal contributions to fulfill fifty percent of requirements for UMCSAWM building. The UMCSAWM attached to the Faculty of Engineering, University of Moratuwa, Sri Lanka was established through a Cabinet Memorandum No. HE/UD/2010/31dated 29.09.2010.

The UMCSAWM building and the postgraduate degree program on water management was inaugurated in 2013. Since then, the center has stood up to its expectations. The collaborative Master's Degree Programme with the Department of Civil Engineering from its inception reached the international standards. Presently the third intake is finishing their academic sessions. A salient feature of research and training spearheaded by the UMCSAWM is its strong emphasis on the practical applications and providing solutions for the gaps in the industry.

Other than the postgraduate programs, the UMCSAWM is proud about three new initiatives. One is the first irrigation and hydraulic research facility providing the capability to use full scale field canal level hydraulic structures for students to carryout research and for the industry personnel to obtain systematic field scale-training. This facility is the first of its kind not only in Sri Lankan universities but also in the industry filling a major gap in the determination of model parameters for water management. This facility located in front of the center is nearing completion. UMCSAWM is proud about this initiative which will no doubt encourage the industry to develop advanced field level experimental facilities further strengthening the hydraulic, irrigation and water management in the South Asian region.

Second initiative is the Urban Drainage Research facility that enables research on surface and subsurface drainage with the changes to the landcover, soil type, slope and rainfall. A major problem in our South Asian monsoon region is the poor drainage infrastructure designs associated with the roads, especially in Urban areas. With the slightest rain, most highways not only in Sri Lanka, but also in the region, become waterways thus negatively contributing to national economic growth. This research facility nearing completion at the UMCSAWM would provide opportunity to carryout infiltration and runoff research for the sustainable drainage infrastructure modelling and help to fill the lack of local parameters for road drainage structure designs.

The third initiative is research on the use of IoT (Internet of Things) breakthroughs for water management. This research facility is on "Precision Irrigation" which uses several soil moisture sensors to determine the moisture in the root zone of an agricultural crop and then provide water to fulfil the requirements of the plant growth without undue loading of the environment. This research facility uses the cloud based, wireless, low energy consuming technologies providing the plant-water status and control of solenoid water valves through a remote personnel computer linked via internet. This facility is a hybrid research facility intended to experiment between expensive research grade sensors and low cost freely available sensors for rain, soil moisture and water valve controls to compare the difference in water use and associated cost. This facility is also located in the vicinity of UMCSAWM and has achieved the establishment of equipment. This demonstrates the attempts made by UMCSAWM to combine

developments in the IT and Electronics engineering, with Water Management in the Civil engineering domain.

Last but not least, it is necessary to state that the UMCSAWM has established sufficient goodwill to secure the support of state institutions for research and training. The Mahaweli Authority enabled the establishment of a fully-fledged meteorological and water quality data collection station within the UMCSAWM compound linking the center to the national water data collection grid. The National Water Supply and Drainage Board and the Department of Irrigation have expressed their willingness to provide support for collaborative research.

Today, UMCSAWM has reached another milestone. It is this first water conference demonstrating the strength of our own postgraduate students to provide solutions for water resources engineering and management problems even in data scarce situations. This conference highlights the possibility of applying water management principles with state of the art modelling tools to ensure water and food security amidst climate change.

I wish that Late Shri Madanjeet Singh and Late Honourable Lakshman Kadirgamar were with us to share the joy and satisfaction felt by us. These two noblemen, the pioneers, persons with vision, commitment and faith entrusted University of Moratuwa to contribute towards the task of water management while achieving international standards and regional expectations. We gratefully acknowledge their contributions. The past and present vice chancellors of our university, the past and present board members of the UMCSAWM, past and present members of the SAF Sri Lankan Chapter and the SAF India, the university administrative and academic staff members, the Department of Civil Engineering heads and staff, the Water Division, Our past & present students and well-wishers are sincerely thanked for their tremendous contributions towards our impact on the regional water management.

Let me especially mention Ms. France Marquet, the Trustee, the other board members, and the governing council members for taking their time to visit the centre and to spend time with our past and present students. The initiative taken by Dr. Nishchal Pandey to hold the governing council meeting in Sri Lanka, the support given by Mr. Prabhakaran and other key personnel at SAF India, towards the UMCSAWM activities are gratefully acknowledged. We appreciate your kindness, consideration and look forward to your future visits and contributions.

The present conference is dedicated to selected projects and research conducted by our postgraduate students. Conference proceedings will demonstrate the comprehensiveness of the applications. I am confident that this event will project the quality of water resources management research and projects carried out by postgraduate candidates from the University of Moratuwa.

Prof. N.T.S. Wijesekera

Center Chairman, UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM)
Department of Civil Engineering
Faculty of Engineering
University of Moratuwa
Sri Lanka

Message from the Course Coordinator, MSc/PG Diploma in Water Resources Engineering and Management, UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa

In 1995, the Hydraulic Division of Department of Civil Engineering which is presently known as the Hydraulic and Water Resources Engineering Division conducted the first Master of Engineering / Postgraduate Diploma Course of University of Moratuwa. This program in Water Resources Engineering and Management was conducted once in two years until the year 2006. In 2013 with the Initiation of UNESCO Madanjeet Singh Center (UMCSAWM) and the support of the South Asia Foundation (SAF), the Hydraulic and Water Resources Engineering Division commenced the ongoing, Master of Engineering / Postgraduate Diploma in Water Resources Engineering and Management. This Master's degree program which consists of two components as one-year full time and two-year part time offer eight fully paid Madanjeet Singh Scholarships funded by SAF to SAARC member countries and facilitate pioneer water management research in areas of relevance to South Asian countries. This postgraduate programme which is especially designed to teach Water Management in a regional context enables participants possessing a wide range of water management backgrounds to obtain a firm grounding in the principles, techniques, issues and practice of Water Resources Engineering and Management. This course is designed mainly for practicing civil engineers to update their knowledge and keep abreast with recent developments in hydraulic engineering and water resources management fields. The programme is run as a self-financed programme where the course fee paid by the students is used as the main financial resource for recurrent expenditure, development of the course and laboratory facilities.

This programme is designed to systematically cover all taught courses within the first 12 months. During this period, students follow a series of intensive lectures, attend seminars, complete subject specific assignments, experiments and field visits. Lectures and other academic activities for full time (international) students are conducted from Tuesday to Saturday while for part time (local) students, activities are usually conducted only on Fridays and Saturdays. The total of 60 credits required for the one-year fulltime program is comparable with any other international program usually conducted over a period of two years. This all-embracing program structure based on taught courses, research and especially with Problem Based Learning (PBL) approach common to all modules brings together the scientific study of water resources with practical planning and management skills, encouraging participants to study water management from a multi-disciplinary perspective and to seek integrated solutions.

The greatest strength of this postgraduate program is the individual "Problem Based Learning Project" that a student is required to complete to successfully complete each course module. Each of these individual PBL projects are based on real life data and experiences related to the water sector and to each specific subject module. These projects are the core of continuous assessment mechanism. World over almost all problem based projects are group activities. The problem based projects incorporated to the present program are hybrids because they are student driven, carefully guided, facilitated with time for group discussions and group working sessions, field data and literature backed, regularly supervised, closely monitored, and externally and internally evaluated.

This concept of problem based learning is new in the world, challenging in postgraduate programs, demanding at individual project basis and taxes additional time from academics. Over the last three programs, conducting and completing the PBL projects had been a great challenge. Determined efforts of Water Division Academics and commitment of UMCSAWM staff to achieve international dominance has made this effort a success.

Though most of the student reactions for PBL at the initial stage of each program indicated negative, the end of program feedbacks expressed a tremendous appreciation for the guidance and opportunity given to build confidence in practical applications. The consensus of student opinion had been that the water-maturity gained by attending the Master's degree program was because of the individual projects for which the students had to find solutions on their own, produce a report, back the workings with field data and literature, and then carryout a final presentation as part of a viva.

In the recent three intakes the program has admitted 12 international and 7 fulltime students on scholarships, 40 part time local students. 06 have thus far graduated with a Master's Degree while 04 have obtained the Postgraduate Diploma.

The present conference on Demonstrating the Strength of Water Engineering and Management Capability through Case Study Applications is an attempt to show the strength of the PBL and Research projects conducted by our present and past students. They demonstrate the case study applications and rigorous research undertaken as part of the program and exhibit the competence and maturity of our students when handling field level problems in water management.

As the course coordinator and the conference chair let me take this opportunity to thank all those involved in the program for their support and encouragement. During the past three years during my tenure as the course coordinator we have passed many milestones and conquered tough challenges. I am certain that the postgraduate program has served to its expectations and the SAF would be pleased with the outcomes. At this point of time it is my duty to first acknowledge the pioneering vision of Late Shri Madanjeet Singh and Late Honourable Lakshman Kadirgamar which has given us tremendous strength to shine among similar international postgraduate programs.

I would like to take this opportunity to thank the past and present vice chancellors of our university, the past and present board members of the UMCSAWM, the Director of the UMCSAWM, past and present members of the SAF Sri Lankan Chapter and the SAF India for all the support extended to us. Without such support and encouragement, this task would not have been fulfilled. We would not have been able to achieve these targets without the unstinted support given by the academic and non-academic staff of the Department of civil engineering. The support given by the Head civil engineering, Dean faculty of engineering, the Registrar, Bursar, Librarian and staff of their divisions are gratefully acknowledged. With the continued support of the university and the SAF, we are certain to achieve greater heights.

Dr. R.L.H.L. Rajapakse

Course Coordinator, MSc/PG Diploma in Water Resources Engineering and Management
UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM)
Department of Civil Engineering
Faculty of Engineering
University of Moratuwa
Sri Lanka

Message from the Director, Postgraduate Studies, Faculty of Engineering, University of Moratuwa

I feel very much honoured to add a message to the proceedings of the Water conference organized by the UNESCO Madanjeet Singh Centre for South Asia. First of all, I wish to congratulate the program Director, the Course Coordinator and the conference committee for organizing this event.

Water is an essential natural resource which is vital for the functioning of ecosystem and human wellbeing. At the same time, this precious resource is under considerable pressure with the global climate change, demographic and economic changes. Therefore, water resource management has been identified as a key theme in sustainable development all over the world. The ever increasing demand for drinking, sanitation, manufacturing, leisure and agriculture has exploited this limited resource. With that water resource management has evolved, aiming at optimizing the use of water and minimizing the environmental impacts. The functions involved in water resource management are complex and needs players at different levels. Significant management of any resource requires accurate knowledge of the resource availability, its uses, the competing demands, and policy decisions on the evaluating significance of competing demands. For water as a resource this is particularly difficult since the natural sources of water cross many national boundaries and hard to assign a financial value.

In this context, the Water Conference organized by the UNESCO Madanjeet Singh Centre is very timely and I am sure will demonstrate the strengths of Water Engineering and Management. Another prominent feature of the Masters course offered by the Madanjeet Singh Centre is its contribution towards international recognition of our university. At the Strategic planning workshop of University of Moratuwa, held on 6th and 7th of January 2017, one of the key themes identified as to position our university at a reputed international ranking system. Currently we are working on the QS ranking system with the hope of going for Times Higher Education ranking in the future. The international collaborations initiated and strengthened by the Masters course offered by the Madanjeet Singh Centre for South Asia is contributing to this exercise immensely. The course is in the right direction of internationalization and also run in a very systematic manner. As the Director, Postgraduate studies, Faculty of Engineering, I am happy to say that this is one of the best courses run by the Faculty with excellent coordination and also in terms of other administrative work. Our job at the Board of Studies has been made very easy with the commitment of the staff and the able course coordination.

The timely topics of this conference, on climate change impacts and adaptation options for water management, flood risk assessment and damage mitigation, GIS application for water resource planning and management will definitely pitch at the state of the art research and development.

I wish all the participants a very productive and a pleasant conference with knowledge sharing and dissemination.

Prof. Mrs. C. Jayasinghe

Director, Postgraduate Studies Division,
Faculty of Engineering,
University of Moratuwa
Sri Lanka