DECLARATION

I, hereby declare that this thesis entitled **"CLIMATE CHANGE IMPACT ON OPERATION POLICY AND PERFORMANCE INDICES OF A RESERVOIR USING MACHINE LEARNING TECHNIQUES"** is a bonafide record of work done by me during the course of project work and that it has not previously formed the basis for the award to me for any degree/diploma, associateship, fellowship or other similar title of any other University or Society.

Place: Tavanur **Er. Vinnakota Yesubabu**

Date: **(2020-28-002)**

CERTIFICATE

Certified that this thesis entitled **"CLIMATE CHANGE IMPACT ON OPERATION POLICY AND PERFORMANCE INDICES OF A RESERVOIR USING MACHINE LEARNING TECHNIQUES"** is a record of project work done independently by **Er. Vinnakota Yesubabu** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

Place: Tavanur

Date:

Dr. Anu Varughese
(Major Advisor, Advisory Committee)
Associate Professor
Department of Irrigation and Drainage Engineering
KCAEFT, Tavanur

CERTIFICATE

We, the undersigned members of the advisory committee of Er. Vinnakota Yesubabu (2020-28-002), a candidate for the degree of **Doctor of Philosophy in Agricultural Engineering** with major in Soil and Water Conservation Engineering, agree that the thesis entitled **"CLIMATE CHANGE IMPACT ON OPERATION POLICY AND PERFORMANCE INDICES OF A RESERVOIR USING MACHINE LEARNING TECHNIQUES"** may be submitted by **Er. Vinnakota Yesubabu (2020-28-002),** in partial fulfilment of the requirement for the degree.

Dr. Anu Varughese
(Major Advisor, Advisory Committee)
Associate Professor
Dept. of IDE
KCAEFT, Tavanur

Dr. Sathian K. K.
(Member, Advisory Committee)
Professor
Dept. of SWCE
KCAEFT, Tavanur

Dr. Rema K. P.
(Member, Advisory Committee)
Professor and Head
Dept. of IDE
KCAEFT, Tavanur

Dr. Sajeena S.
(Member, Advisory Committee)
Professor
Dept. of IDE
KCAEFT, Tavanur

Er. Shivaji K. P.
(Member, Advisory Committee)
Assistant Professor
CoA, Padanakkad

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

Words are very poor substitute to express one's emotions and feelings, there are other alternative to give vent to one's sentiments, particularly on an occasion like this, when one sits in acknowledging the debts of others.

It is my proud privilege to express my sense of gratitude and veneration to Dr. Anu Varughese, Assistant Professor, Department of Irrigation and Drainage Engineering, KCAEFT, Tavanur and Chairman of my Advisory Committee, for her inspiring guidance, constructive criticism and whole hearted encouragement throughout the period of my Research work. Words are inadequate to express my deepest feelings of my gratitude from the innermost core of my heart for all the support and trust she had in my ability. She left no stones untuned in the present accomplishment which led me explore in all the directions of my life.

With deepest sense of reverence and indebtedness, I pronounce utmost of gratitude to the esteemed members of my advisory committee Dr. Rema K. P., Professor and Head, Department of Irrigation and Drainage Engineering, Dr. Sathian K. K. Professor, Department of Soil and Water Conservation Engineering, Dr. Sajeena S. Associate Professor, Department of Irrigation and Drainage Engineering and Er. Shivaji K. P. Assistant Professor, College of Agriculture, Padanakkad. Besides their persistence efforts, sagacious guidance and impeccable planning, I am grateful to them for their kind cooperation and congenial discussion on an array of topics. I express my utmost regards to Dr. Asha Joseph Professor, Department of Irrigation and Drainage Engineering, Dr. Abdul Hakkim V. M. Professor and Head, Dr. Jinu A. Assistant Professor Department of Soil and Water Conservation Engineering for their unstinted cooperation.

I wish to extend my sincere thanks to Dr. Jayan P. R. Dean, Kelappaji College of Agricultural Engineering and Food Technology, Tavanur for providing me the essential facilities to conduct the proposed investigation. I express my sincere thanks to the authorities of Kerala Agricultural University for their whole hearted cooperation during the course of my study.

I wish to place on record my appreciation and sincere thanks to Er. Siddaram Patil, Er. Aravind, Er, Rajesh and Er. Samba Siva Rao for extending their kind co-operation.

I will ever be grateful to my mother Smt. Vinnakota Vijaya Lakshmi for her unconditional love, trust and sacrifices for me. I express my special thanks to my wife Vinnakota Priya Sahithi and daughter Vinnakota Lakshmi Chetana for their support and valuable prayers. INSPIRE fellowship provided by Department of Science and Technology during the course of the study is duly acknowledged.

Er. Vinnakota Yesubabu

CONTENTS

LIST OF TABLES

LIST OF FIGURES

SYMBOLS AND ABBREVIATIONS

%	Percentage
<	Less than
>	Greater than
∑	Sum
≤	Less than or equal to
≥	Greater than or equal to
&	And
$^{\circ}$C	Degree Celsius
AI	Artificial Intelligence
AOGCM	Atmospheric Ocean General Circulation Model
ANN	Artificial Neural Network
CMIP	Coupled Model Interpolation Project
CN	Curve Number
CP	Compromise Programming
DEM	Digital Elevation Model
ET	Evapotranspiration
et al.	and others
Fig.	Figure
GA	Genetic Algorithm
GCM	General Circulation Model/ Global Climate Model
Geo-HMS	Geospatial Hydrological Modelling System
GIS	Geographic Information System
ha	Hectare
HEC	Hydrologic Engineering Centre
HMS	Hydrological Modelling System
HSG	Hydrologic Soil Group
Int.	International
IHACRES	Identification of Unit Hydrograph and Component flows from Rainfall Evaporation and Streamflow data
IMD	Indian Meteorological Department

IPCC	:	Intergovernmental Panel on Climate Change
J.	:	Journal
Km^2	:	Square Kilometer
LBC	:	Left Bank Canal
LP	:	Linear Programming
MCM	:	Million Cubic Meter
MIP	:	Malampuzha Irrigation Project
ML	:	Machine Learning
MLR	:	Multiple Linear Regression
No.	:	Number
RBC	:	Right Bank Canal
RCP	:	Representative Concentration Pathways
RF	:	Random Forest
SSP	:	Shared Socioeconomic Pathways
SVM	:	Support Vector Machine
SWAT	:	Soil and Water Assessment Tool
USGS	:	United States Geological Survey
WANN	:	Wavelet coupled ANN
WCRP	:	World Climate Research program
WRF	:	Wavelet coupled RF
WSVM	:	Wavelet coupled SVM