شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

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HANAA ALY

ESTIMATION AND MODELLING OF POTATO WATER FOOTPRINT USING MACHINE LEARNING APPROACH IN NILE DELTA, EGYPT

By

AMAL MOHAMED ABD EL-HAMEED

B.Sc. Agric. Sci. (Agricultural Engineering), Fac. Agric., Cairo Univ., 2010
M.Sc. Agric. Sci. (Agricultural Engineering), Fac. Agric., Cairo Univ., 2016

THESIS

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APPROVAL SHEET

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Date: / / 2021

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DEDICATION

First of all, I would like to express my deepest thanks to ALLAH (God) for helping me to carry out and complete this work.

I dedicate this work to whom my heart feels thanks; to my mother, my lovely sister Eman and my brother Mohamed for their Patience, help and for all the support they lovely offered throughout the period of my post-graduation. I have no one to love more than you my lovely family.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning of abbreviation
A	Model accuracy.
ANN	Artificial neural network.
BWF	Blue water footprint (m^3/ton).
CAPMAS	Central Agency for Public Mobilization and Statistics
CWR	Crop water requirement (m^3/ha).
ET_c	Crop evapotranspiration (m^3/ha).
Eto	Reference evapotranspiration (mm).
GWF	Green water footprint (m^3/ton).
Kc	Crop coefficient.
MAE	Mean absolute error.
MAPE	Mean absolute percentage error.
MBE	Mean bias error.
ML	Machine learning.
NSE	Nash–Sutcliffe model efficiency coefficient
P_{eff}	Effective precipitation (mm/year).
R^2	Coefficient of determination.
RF	Rendom forest.
RMSE	Root mean square error.
SI	Scatter index.
SM	Soil moisture.
SR	Solar radiation.
SVM	Support vactor machine.
T_{Dew}	Dew point.
T_{max}	Maximum air temperature.
T_{min}	Minimum air temperature.
VPD	Vapor pressure deficit.
WF	Water footprint (m^3/ton).
W_S	Wind speed (m/s).
XGB	Xtreme gradient boost.
Y	Crop yield (ton/ha).

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Supervisors: Dr. Mohamed Abd EL-Wahap Kassem,
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Department: Agricultural Engineering
Branch: **Approval: / / 2021**

ABSTRACT

Egypt suffers from water scarcity due to the increase in the population, climate change, and the lack of integrated management of water resources. Therefore, accurate evaluation of irrigation water needs for crops is urgent to achieve water management sustainability. Water footprint considers an indicator of water management sustainability. So this study investigated the impact of climate change on potato yield and water footprint in 10 governorates in the Nile Delta, Egypt during the period from 1990 to 2016. Based on the results of the BWF calculation, Three governorates were selected (Al-Gharbia, Al-Dakahlia, Al-Beheira) to develop and compare between four machine learning (SVM, RF, XGB and ANN). To select the best model in the best scenario, which achieve a high degree of accuracy and low error for predicting blue WF of potato. The results showed that, the spatial distribution of climate parameters shows that the highest precipitation was reported in Alexandria followed by Kafr El-Sheikh during winter season. On contrast, the maximum ET_C was in the south part followed by the middle governorates and the lowest located in the northern governorates. The potato water footprint in Delta Egypt decreased from 170 m^3 ton^{-1}in 1990 to 120 m^3 ton^{-1} in 2016. The blue water footprint contributes more than 75% of the total water footprint, while the green water footprint contributes less than 25%. The XGB and ANN models generated good result in estimating WF through the testing stage with high accuracy more than 90% and less errors 0.25, R^2 = 0.90, RMSE = 3.6 m^3/t, NSE= very good, SI = Fair in the three governorates. The results demonstrated that Sc.5 with the XGB and ANN model is good enough for assessing BWFP if only vapor pressure deficit, precipitation, solar radiation, crop coefficient data are available.

Keywords: Climate change, potato yield, Water footprint, Machine learning, Food security.

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