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AL-HAMMAR MARSH RESTORATION STRATEGY

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Abstract - Al- Hammar Marsh is considered as the largest marsh in the southern part of Iraq, it lies between the cities of Nasiriyah on the west side and Basrah on the southeast side, with an approximated area of 3000 km². Originally, Al-Hammar Marsh receives water from different branches on the right of Euphrates, in addition to the seasonal excess flow that flows from Al-Qurnah Marsh. The marsh outlets are transported to channels toward the Shatt Al-Arab. This study is an attempt to estimate the storage of Al- Hammar marsh and how water quantity can be raised. Data of effecting parameters (inflow, outflow, evaporation, transpiration, evapotranspiration) have been collected for five years (2013- 2017). Storage has been computed using the flood routing equation. In order to predict the future storage for the next five years, the effecting parameters are used to generate a predicted model using Artificial Neural Networks ANN. A general equation has been obtained, which can be applicable for variables data to compute the storage for any period time. With an accurate model implicating, semi-accurate results of predicted storage are presented, while the coefficient of determination (R^2) and root mean square error (RMSE) of the predicted equation were (0.94, 0.43), respectively. The results show that future predicted storage quantities will increase as average to be ($5.0*10^9$) m^3 in comparing with the actual previous quantities which were ($3.0*10^9$) m^3.

Keywords - Artificial Neural Networks, Flood Routing, Marsh Restoration

I. INTRODUCTION

Al- Hammar Marsh is considered as one of the largest marshlands in Iraq. The marsh lies south the reach of Euphrates River before joining Tigris River at Al Qurna City. This reach of the river is running from Al Nasiriyah City, in Al Nasiriyah Governorate to Al Chibaeich City, north of Al Basrah Governorate. The marsh is located between latitude 46o to 47o, and longitude 30o to 30.5o, bounded by Euphrates River as the north boundary, Shatt Al Arab River as the east boundary, main supply channel of Al Basrah Water Supply Project and the Main Outfall Drain,(MOD), as the south boundary, and SuqAshuyukh City as the west boundary. Historically, the area of the marsh reaches 4500km2, nowadays, it area varies between 360 and 790km2. Figure 1 shows the location of Al Hammar Marsh, CRIM, 2010.

Twenty-five years ago, the agricultural development and water resource management, associated with the marshes, had progressively transformed the Marshes into a desert. The results of this environmental disusing are devastating for the south of Mesopotamia, where more than 10% of Iraqi population lives. The climate has been drastically

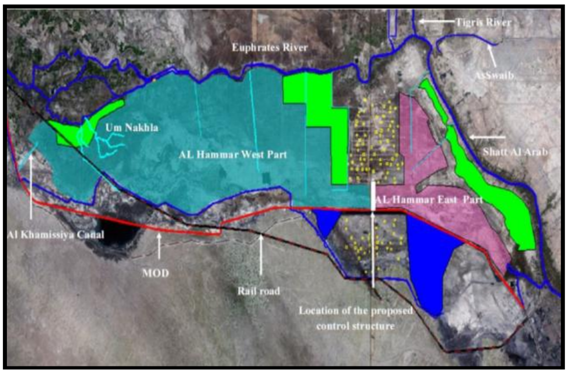

Fig. 1: Location of Al Hammar Marsh, CRIM, 2010.

modified as the combined effect of the loss of evaporation and biological and photochemical processes have been halted and this has led to the modification of rainfall regimes. The average temperature increase of 5 degrees Celsius and the increased intensity of sand storms, all these environmental pollutions urge marshes restoration naturally by scientific measurements and modeling.

This marsh began to decline in the 1950s as dam-building upstream the two Rivers in Turkey, Syria and Iraq attenuated the river flows (the Slow phase) (UNEP, 2001; UNEP, 2003). The area of the Al Hammar Marsh was reduced greatly due to the reduction in the supplied water. The problem of reduction in the supplied water to the marsh is a result of the massive increase in demand for water in Turkey, Syria, and Iraq. To reduce the effects of this problem, part of the water of the MOD was suggested to be supplied to the marsh, as a temporary solution, that will prevent the marsh to dry.

In this study, we tried to find solutions for this problem by using the technique of Artificial Neural Networks (ANNs). An artificial neural network (ANNs) is computational models based on the structure and functions of biological networks. ANNs are considered nonlinear statistical data modeling tools where the complex relationships are modeled or patterns are formed. Neural Power software is a program used to solve the artificial neural networks (ANNs) structure. Artificial neural systems are the most beneficial researcher's subjects that deal with many sciences. The main objective of the study is developing optimal Artificial neural networks (ANNs) models for estimation of the suitable restoration strategy to left storation of AL-Hammar marsh for time steps 2013 to 2017. The study also compares the performance of ANNs models with that obtained by the manual solution.

II. PROCEDURE FOR PAPER SUBMISSION

Available Data

Available data are presented such as topographical data, inflow discharge is coming to the marsh from Intakes and rainfall and outflow discharge from outtakes and evaporation, evapotranspiration for the study area, which is collected data from (Iraqi Ministries of Water Resources, a center for restoration of Iraqi marshes and wetlands, 2017). Moreover, this section presents the discharges of Al Hammar and their water quality that was provided by CRIMW,2017 and the Precipitation within the study area that was provided by the General Iraqi Meteorological Authority and Seismology.

Flood Routing

Flow routing is a procedure to determine the time and magnitude of flow (i.e., the flow hydrograph) at a point on a watercourse from known or assumed hydrographs at one or more points upstream. If the flow is a flood, the procedure is specifically known as flood routing. In a broad sense, flow routing may be considered as an analysis to trace the flow through a hydrologic system, given the input. The difference between lumped and distributed system routing is that in a lumped system model, the flow is calculated as a function of time alone at a particular location, while in a distributed system routing the flow is calculated as a function of space and time throughout the system. Routing by lumped system methods is sometimes called hydrologic routing, and routing by distributed systems methods is sometimes referred to as hydraulic routing (Chow, 1959).

Lumped System Routing

For a hydrologic system, input I(t) output Q(t) and storage S(t) are related by the continuity equation as:

$$ds/dt=I(t)-Q(t) \qquad (1)$$

If the inflow hydrograph I(t)is known, eq. 1 cannot be solved directly to obtain the outflow hydrograph, Q(t), because both Q and S are unknown. The restoration strategy of AL- Hammar marsh needed many available data as inflow discharge coming to the marsh from Intakes, rainfall and outflow discharge from outtakes and evaporation, all these data are collected from (Iraqi Ministries of Water Resources, center for restoration of Iraqi marshes and wetlands). Also, the study needs measurements of leakage but we couldn’t get it from the centers concerned in marshes because they had not devices or field measurements in that centers; also they haven’t previous studies about the infiltration; so it can consider that the bottom of the marsh as a permeable layer. All of this data is collected for the last five years. Artificial Neural Networks (ANN) Technique has been applied to the estimation of monthly restoration of Al Hammar marsh using data collecting for the steady area (Inflow, Evaporation, Rainfall, Outflow, Evapotranspiration, and Storation). The success of any model depends on the availability of accurate field data such as discharge, stage, etc. Artificial neural networks (ANN) modeling is used widely in techniques which can approximate the non-linear relationship between input and output data sets without considering physical processes and the corresponding equations of the system. Also, the ANN model is much faster than the physical based model.

III. ARTIFICIAL NEURAL NETWORKS APPROACH (ANNS)

The artificial neural networks (ANNs) system is considered as one of the most statistical processes. This system has the ability to solve most complex problems so that it looks like the human brain and is used to predicting the hydraulic properties of the phenomenon by interpolating and extrapolating the data. ANNs is a mathematical model represented by neurons. Each neuron receives input data, which is the weighted summation of the outputs of previous neurons. The neuron acts on this input by means of an activation function and a bias value. ANNs system contains at least three main parts, the first part noun as an input layer, the second part noun as a hidden layer and the third part noun as an output layer. ANNs system may have more than one hidden layer each hidden layer has a learning value to threshold the processing of the input layer. Fig. 2 explains the neural network structure and shows the procedure of reading the neural and obtaining the corresponding neural number and its connections.

Precipitation and Evaporation

Fig. 3 shows precipitations within Al Hammar Marsh Region, while fig. 4 Shows the annual value of evaporation within Al Hammar Marsh region Marsh lies within a region of high evapotranspiration with an annual value. The results of evaporation have computed the depth of evaporating multiplied by the submerged area of Al-Hammar marsh divided by time period.

Transpiration

The results of transpiration have computed the depth of transpiration multiplied by the submerged area of Al-Hammar marsh divided by time as shown in fig. 5.Plants play a large role in the hydrologic cycle. Transpiration and evaporation of water from leaves of natural and cultivated vegetation have returned to the atmosphere by about 60 % of the incident precipitation over land surfaces.

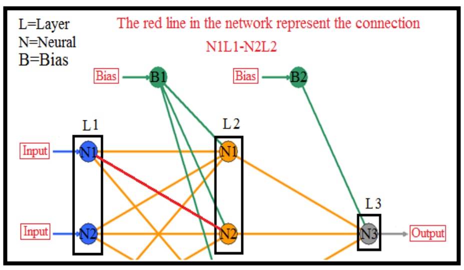

Fig. 2: Section in Neural Network Explains Neural Reading

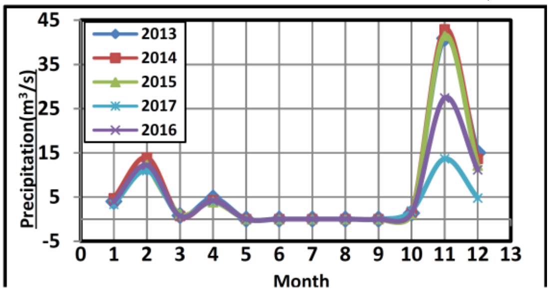

Fig. 3: Precipitations within Time in AlHammar Marsh Region.

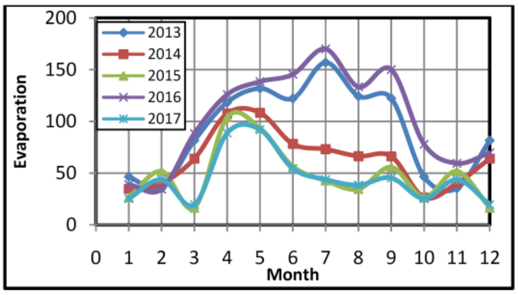

Fig. 4: Evaporation within Time period in AlHammar Marsh Region.

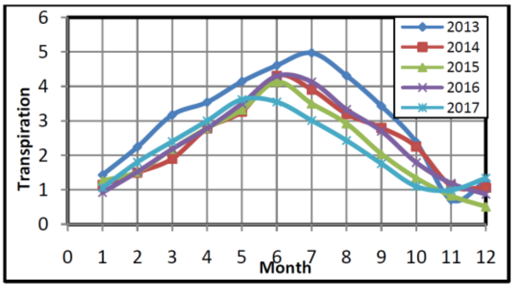

Fig. 5: Transpiration within Time in AlHammar Marsh Region.

Discharge of Feeders:

A complete set of mean monthly discharge measurements for the main feeders of the marsh during 2013-2017, the Inflow within the time period in Al Hammar Marsh Region are shown in fig. 6

ANN Models Outputs

In the regions of the study area, the change of storage (ΔS) is correlated with (Inflow I, Evaporation E, Transpiration T, and Rainfall R). The ANN model for the study area are shown in Table1 and fig. 7 where the quantity of predictivestorage is compared to the actual amount of storage which can be calculated from the following equation, this equation took into consideration

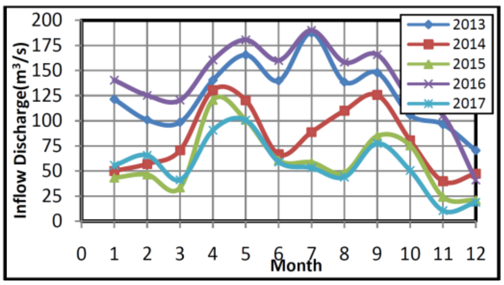

Fig. 6 Inflow with Time in AlHammar Marsh Region.

Connection	Weights	Connection	Weights	Connection	Weights
$N_1L_1\text{-}N_1L_2$	-0.4409	$N_3L_1\text{-}N_2L_2$	0.6405	$N_3L_2\text{-}N_1L_3$	0.9160
$N_1L_1\text{-}N_2L_2$	-0.3443	$N_3L_1\text{-}N_3L_2$	-0.2733	$N_4L_2\text{-}N_1L_3$	-0.9340
$N_1L_1\text{-}N_3L_2$	0.7007	$N_3L_1\text{-}N_4L_2$	-0.7395	$B_1\text{-}N_1L_2$	-0.1970
$N_1L_1\text{-}N_4L_2$	-0.4994	$N_4L_1\text{-}N_1L_2$	0.2490	$B_1\text{-}N_2L_2$	0.8691
$N_2L_1\text{-}N_1L_2$	-0.3066	$N_4L_1\text{-}N_2L_2$	0.3133	$B_1\text{-}N_3L_2$	0.8444
$N_2L_1\text{-}N_2L_2$	-0.2716	$N_4L_1\text{-}N_3L_2$	-0.6238	$B_1\text{-}N_4L_2$	-0.8614
$N_2L_1\text{-}N_3L_2$	0.2777	$N_4L_1\text{-}N_4L_2$	0.5422	$B_2\text{-}N_1L_3$	-0.8326
$N_2L1\text{-}N_4L_2$	0.4977	$N_1L_2\text{-}N_1L_3$	0.8647	$R^2 = 0.94$ RMSE = 0.43	
$N_3L_1\text{-}N_1L_2$	-0.5351	$N_2L_2\text{-}N_1L_3$	-0.3862		

Table 1: The Weight of Connection for Al Hammar Marsh.

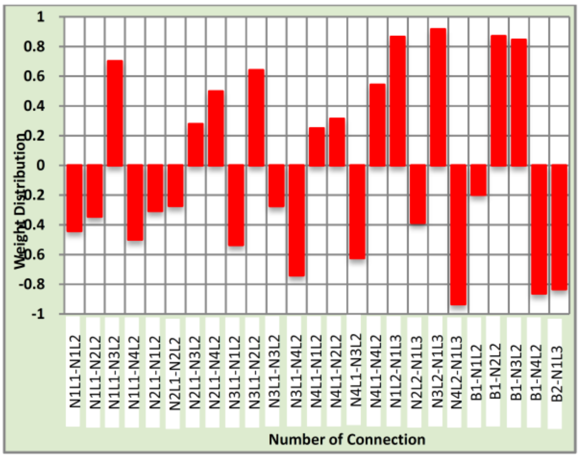

Fig. 7ANNs Weight Distribution Model for Al Hammar Marsh.

the factors affecting the quantity of storage, assuming that the surface area is stable, The equation is as following

$$Y = 0.6783 \times X_1 + 0.3963 \times X_2 + 0.0033 \times X_3 - 3.3846 \times X_4 + 10.957 \quad (2)$$

Where:

X_1: represent the rainfall (m^3/s).

X_2: represent the inflow (m^3/s).

X_3: represent the evaporation (m^3/s).

X_4: represent the transpiration (m^3/s).

Y: represent the Results(Storation) (m^3).

Predicted storage for five years coming(m^3)					
Month	2018	2019	2020	2021	2022
Jan.	$6*10^7$	$7*10^7$	$1*10^8$	$1*10^7$	$4*10^7$
Feb.	$5*10^6$	$12*10^7$	$8*10^7$	$4*10^7$	$7*10^7$
Mar.	$1*10^7$	$11*10^7$	$1*10^8$	$5*10^7$	$9*10^7$
Apr.	$5*10^7$	$2*10^8$	$1*10^8$	$1*10^8$	$1*10^8$
May	$2*10^7$	$1*10^8$	$1*10^8$	$8*10^7$	$1*10^8$
Jun.	$1*10^8$	$1*10^8$	$8*10^7$	$1*10^8$	$1*10^8$
Jul.	$1*10^8$	$1*10^8$	$1*10^8$	$1*10^8$	$8*10^7$
Aug.	$7*10^7$	$3*10^7$	$5*10^7$	$8*10^7$	$7*10^7$
Sep.	$1*10^8$	$7*10^7$	$9*10^7$	$1*10^8$	$9*10^7$
Oct.	$7*10^7$	$6*10^7$	$5*10^7$	$7*10^7$	$6*10^7$
Nov.	$5*10^7$	$4*10^7$	$3*10^7$	$5*10^7$	$7*10^6$
Dec.	10^7*5	$5*10^7$	$4*10^7$	$6*10^7$	$1*10^7$

Table 2: Predicted storage (m3)for Al Hammar Marsh.

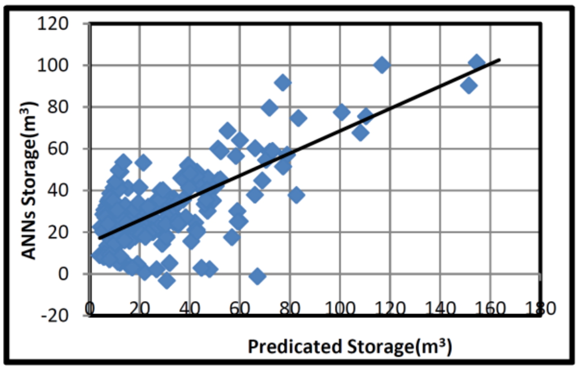

Fig. 8 Storage Values Estimated by Artificial Neural Networks Approach (ANNs) for Hammar Marsh.

In Table 2 the net amount of average storage for the coming five years increases by $(5.0*10^9)$ m^3 comparison with the previous years by $(3.0*10^9)$ m^3 due to increasing rainfall and waterways compared with the volume of evaporation and transpiration, while fig. 8represents the best fit of Storage Values Estimated by Artificial Neural Networks Approach (ANNs) with predicted storage for Al Hammar Marsh.

IV. CONCLUSION

1. The inflow discharge from intake, evaporation, rainfall, and transportation outflow have influenced (Storation) for time steps in the regions of the study area.
2. The ANNs was a good way to get results and accurate approach,it gives an equation of difficult practical application;that will enable us to calculate the storation for coming years as the surface area is not variable.
3. Avoid the absence of any element of the available data, to give more accurate results in the ANN models.
4. The predict storation obtained from ANN model is a good rating for future to keep level water and increase it, as a rate $(5.0*10^9)m^3$ more than actual storation$(3.0*10^9)m^3$.
5. The values coefficient of determination (R^2) and root mean square error (RMSE) are (0.94, 0.43) between predicated storage and ANNS storage respectively.

REFERENCES

[1] CRIM, "Possibility of Using the Water of the main Outfall Drain to Restore Al Hammar Marsh after Operating the Pumping Station in Al Nassiriyah," 2010.
[2] UNEP, Hassan Partow,"The Mesopotamian Marshlands: Demise of an Ecosystem. Early Warning and Technical Assessment Report," UNEP/DEWA/TR.01-3 Rev.1, Division of Early Warning and Assessment, United Nations Environmental Programme, Nairobi, Kenya, 2001.
[3] UNEP, "Environment in Iraq: UNEP Progress Report," UNEP. Geneva, Switzerland, 2003.
[4] CRIMW, "Iraqi Ministries of Water Resources, center for restoration of Iraqi marshes and wetlands," 2017
[5] VenTeChow ," Open Channel Hydrualics," McGraw-Hill, NewYork. USA, 1959.

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