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Research Paper

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Artificial Neural Network (ANN) Reliability Analysis of Poultry Bird Production Through Nigerian Made Incubator

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Abstract— Promotion of local content has been focus of Nigeria government and world at larg. But it is important to be sure about the standard of the content produced. This will avoid mixing quality with quantity. These research work specially focus on reliability analysis of poultry bird production through Nigerian made incubator. The researcher evaluate an incubator at Arise Gods Farm, Odo-Ona Elewe Ibadan. The Artificial Neural Network (ANN) model was used to model time-series data and future forecast for a locally fabricated poultry egg incubator with the data made available between 36 months of use by a local poultry farmer with three of our researchers on field within the period. The ANN model was developed with 70% of the data for training, 20% for testing and 10% for model validation. Based on this model, forecasting was carried out on hatching process and also the failure rate of the machine. The input parameters include, months, numbers of eggs loaded in the incubator, number of birds produced, hatchability rate, failure rate, temperature and relative humidity. The result of the statistical analysis shows the effect of input parameters which include the number of eggs loaded, hatchability, failure rate, production period, had no significant difference at $R^2 = 1$. While the month, temperature and relative humidity point significantly ($p < 0.005$) influence on the machine reliability.

Keywords— ANN, analysis, artificial intelligence, incubator, Nigerian made, poultry.

I. INTRODUCTION

[2] has cited by [3] has described a hatchery as a machine, which helps the hen's job of furnishing ripe eggs with ideal ecological conditions (temperature, egg turning, relative stickiness and ventilation) to invigorate undeveloped advancement until incubating. Four components are vital in hatching eggs artificially: temperature, humidity or dampness, ventilation, and turning. Of these elements, temperature is the most basic. Be that as it may, mugginess will in general be ignored also, causes many incubating issues. Broad research has demonstrated that the ideal hatchery temperature is 100°F when relative dampness is 60 percent. Centralizations of oxygen ought to be above 20 percent, carbon dioxide ought to be beneath 0.5 percent, and air development past the egg ought to be 12 cubic feet per minute [8].

[1] has observed that the heat required for incubation is normally given by coal, oil, gas or power. For small hatchery about 58% relative humidity is kept at 38 to 39^{o}C up to the 18th day of brooding after which, the moistness goes to 70% and the temperature is brought down to (36^{o}C) until the chick is incubated. Hatcheries are generally set away from dividers at corners of rooms in order to permit satisfactory ventilation and give adequate work space to the hatchery operator.Hatching eggs crumble with capacity and ought not ordinarily be kept for longer than seven days before being set for brooding. The capacity temperature ought to be about 12.5^{o}C at which undeveloped advancement is captured [4]. The relative moistness ought not be under 80% to avoid lack of hydration of the eggs. On the off chance that the capacity temperature is too low (- 2^{o}C) the blastoderm may solidify

The goal of this research work is to develop models through Artificial Neural Network to investigate the reliability of Nigerian made incubator and the performance evaluation of the study.

II. RELATED WORK

[5] has discovered that Artificial neural systems is a branch of Artificial Intelligence that are utilized for crop choice and harvest yield forecast just as for crop illness prediction [2]. Also Artificial neural systems (ANN) are utilized to deal with test information, and their advantages have been increasingly more perceived in different fields of innovation and science, (for example, science, nature, material science, science, agronomy, economy, medication, arithmetic and Computer Science). In this way ANN frameworks which can foresee the more precision utilizing meteorological information. These days, there is a ton of yield expectation models, that a greater amount of them have been commonly arranged in two gatherings: a) Statistical Models, b) Crop Simulation Models (for example CERES). As of late, the use of Artificial Intelligence (AI, for example, Artificial Neural

Networks (ANNs),, Fuzzy Systems and Genetic Algorithm has demonstrated more proficiency in dissolving the issue. Utilization of them can make models simpler and more precision from complex common frameworks with numerous data sources [6].

[7] contribution to ANN research, manages the expectation of harvest yield levels, utilizing a computerized reasoning methodology, in particular a multi-layer neural system model. Therefore, we are standing out this methodology for a few non-straight relapse models, the handiness of which has been tried and distributed a few times in the particular periodicals. The primary pressure is set on making a decision about the precision of the individual techniques and of the execution. A neural system reenactment gadget is what empowers the client to set a sufficient setup of the neural system versus the necessary assignment. The ends can be summed up for different errands of a comparable sort, particularly for the undertakings of a non-direct character, where the advantages of this strategy increment.

III. METHODOLOGY

The research work makes use of Multilayer neural perceptron (MLP) in the configuration 1-2-1 (one neuron input, two hidden layer and one at the output, along with a non-linear activation functions) with time series forecast and regression analysis. The learning implemented the Back propagation algorithm. The empirical linear regressive model was used in finding out the usefulness of a neural networks prediction approach. The Artificial Neural Network (ANN) model was used to model time-series data and future forecast for a locally fabricated poultry egg incubator with the data made available between 36 months of use by a local poultry farmer with three of our researchers on field within the period. The ANN model was developed with 70% of the data for training, 20% for testing and 10% for model validation. Based on this model, forecasting was carried out on hatching process and also the failure rate of the machine. The input parameters as shown in Table 1 include, months, numbers of eggs loaded in the incubator, number of birds produced, hatchability rate, failure rate, temperature and relative humidity [8].

Regression Model

Regression Analysis is a measurable methodology assigned to evaluate the estimations of a stochastic amount based on knowing different amounts. The backward assignment might be partitioned into two sections. The initial segment is the choice or the production of a reasonable information model, one which would compare to the character of the observationally decided numerical information. The second piece of the errand is finding appropriate parameters for the model, in such a design, that the subsequent capacity best depicts the solidly estimated qualities. For understanding the subsequent part, there are appropriate techniques for scientific insights, while the arrangement of the initial segment of the assignment has been typically conceivable just observational.

The model analysis was carried out by the help of GMDH Shell Data Science and IBM SPSS (Statistical Packages for Social Sciences) respectively.

The equation below represents the model developed for the case study.

E(y)= $\alpha + \beta_1$*X + β_2*W + β_3*Z…

Y1 = -3.08888e-11 + ""Production Period (Days)", cubert"*N3*0.178604 + N3*0.507246

Artificial Neural Network

For the background propagation algorithms;

Where: $\Delta w_{ij} = \eta d_j o_i = -\eta \frac{\partial E}{\partial w_{ij}} = -\eta E W_{ij}$

For output nodes: $\Delta w_{ij} = \eta d_j o_i = -\eta \frac{\partial E}{\partial w_{ij}} = -\eta E W_{ij}$

For hidden nodes: $d_i = EI_i = EA_i o_i (1-o_i) = o_i(1-o_i)\sum_j EI_j w_{ij}$

Objective: $\frac{\delta E}{\delta w_{ij}}$ was computed for all

<u>Definitions:</u>

w_{ij} = weight from node i to node j

x_j = totaled weighted input of node

O_j = output of node

E = error for 1 pattern overall output nodes

IV. RESULTS AND DISCUSSION

Figure 1 above predicted decrease in the failure rate of the machine (incubator) over 12 consecutive months at the rate of the failure moves from 12% in 1st month to 5% in the 12th month respectively. This simply means that the locally made incubator is reliable over time. The result of the residual regression chat was revealed in figure 2, that there is a spread of data points around the line. This shows a random pattern and indicates the linear model provides a good fit. The predictions are close to the observed values. The spread is not too large. This simply means that the information from the model is useful in determining the reliability of locally made incubator for poultry production through artificial intelligence.

The figure 3 below shows the column Predictions containing accuracy measures calculated for withholding observations, with predicted values. Number of observations in the table informs about the number of actual observations both in the fitted and the withheld sub-samples as 29 and predictions as 7. The largest underestimation error (Maximum Negative Error) for the model fit is lower than that of the predictions, this simply means that the model that produced them does a good job at predicting the output of the research.

The Mean Absolute Error (MAE) described the magnitude of the residuals. The model MAE is 2.8E-13 while the prediction is 2.5E-13. This simply means the model prediction is good as the predicted MAE is smaller than the model fit.

The result of the statistical analysis shows the effect of input parameters which include the number of eggs loaded, hatchability, failure rate, production period, had no significant difference at $R^2 = 1$. While the month, temperature and relative humidity point significantly ($p < 0.005$) influence on the machine reliability.

Discussion

Table 2 shows the case processing summary for the of the input, while table 3 revealed the artificial neural network information which has to do with the factors, covariant, hidden layers and output of the network, respectively. Figure 4 revealed the architectural layer model of the network where the input (numbers of birds produced) produced the output through the hidden layers.

Weighted input results in a guess about what that input is. The neural then takes its guess and compares it to a ground-truth about the data, effectively asking an expert. The difference between the network's guess and the ground truth is its *error*. The network measures that error, and walks the error back over its model, adjusting weights to the extent that they contributed to the error. The sum of squares and relative error are significant, hence shows that the model independent variable reliably predicts the dependent variables of the model developed.

V. CONCLUSION AND FUTURE SCOPE

Artificial Intelligence has been successfully deployed through Artificial Neural Network (ANN) to investigate the reliability of the locally produced poultry incubator. Based on this model, forecasting was carried out on hatching process and also the failure rate of the machine. The input parameters include, months, the numbers of eggs loaded in the incubator, number of bird produced, hatchability rate, failure rate, temperature and relative humidity. The result of the statistical analysis shows the effect of input parameters which include the number of eggs loaded, hatchability, failure rate, production period, had no significant difference at $R^2 = 1$. While the month, temperature and relative humidity point significantly ($p < 0.005$) influence on the machine reliability.

It is therefore recommended that further study should be carried out in the area of artificial intelligence on the reliability of the locally made technology in Nigeria, for quality assurance.

Figures and Tables

Table 1: The Raw Input

Month	Number of eggs loaded	Number of birds produced	Hatchability (%)	Failure Rate (%)	Production Period (Days)	Average Temperature (^{0}C)	RH (%)
1	96	86	89	11	20	38	61
2	86	70	81	19	21	39	59
3	79	66	84	16	23	37	62
4	42	33	79	21	21	38	30
5	61	48	78	22	21	38	59
6	93	77	83	17	22	37	54
7	91	81	89	11	20	37	59
8	90	81	90	10	20	37	60
9	53	48	90	10	21	37	64
10	84	76	90	10	21	38	62
11	70	63	90	10	21	39	60
12	76	63	83	17	21	37	61
13	95	82	86	14	21	37	59
14	69	58	84	16	23	37	60
15	96	77	80	20	21	39	62
16	96	82	85	15	21	37	60
17	49	42	86	14	21	38	60
18	90	71	79	21	23	38	60
19	76	60	79	21	22	37	62

20	71	57	80	20	21	37	62
21	58	47	80	20	21	37	60
22	76	61	80	20	21	37	60
23	70	56	80	20	21	38	59
24	69	61	89	11	21	38	59
25	92	80	87	13	23	39	59
26	86	75	87	13	21	39	60
27	95	82	86	14	21	39	60
28	84	73	87	13	22	39	60
29	56	48	86	14	21	37	60
30	92	78	85	15	21	37	60
31	90	81	90	10	21	37	60
32	58	52	90	10	21	38	57
33	57	50	87	13	22	37	59
34	60	54	90	10	23	38	61
35	86	77	90	10	21	37	60
36	52	46	89	11	21	38	63

Table 2: Case Processing Summary

		N	Percent
Sample	Training	28	90.3%
	Testing	3	9.7%
Valid		31	100.0%
Excluded		5	
Total		36	

Table 3: Network Information

Input Layer	Factors	1	Number of birds produced
	Covariates	1	Month
		2	Hatchability (%)
		3	Failure Rate (%)
		4	Production Period (Days)
		5	Average Temperature (0C)
		6	Ave.Relative Humidity (%)
	Number of Units[a]		27
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		7
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Number of eggs loaded
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares

a. Excluding the bias unit

Table 2 shows the case processing summary for the of the input, while table 3 revealed the artificial neural network information which has to do with the factors, covariant, hidden layers and output of the network respectively.

Table 4: Model Summary

Training	Sum of Squares Error	16.647
	Relative Error	1.233
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.07
Testing	Sum of Squares Error	.096
	Relative Error	.041

Dependent Variable: Number of eggs loaded

a. Error computations are based on the testing sample.

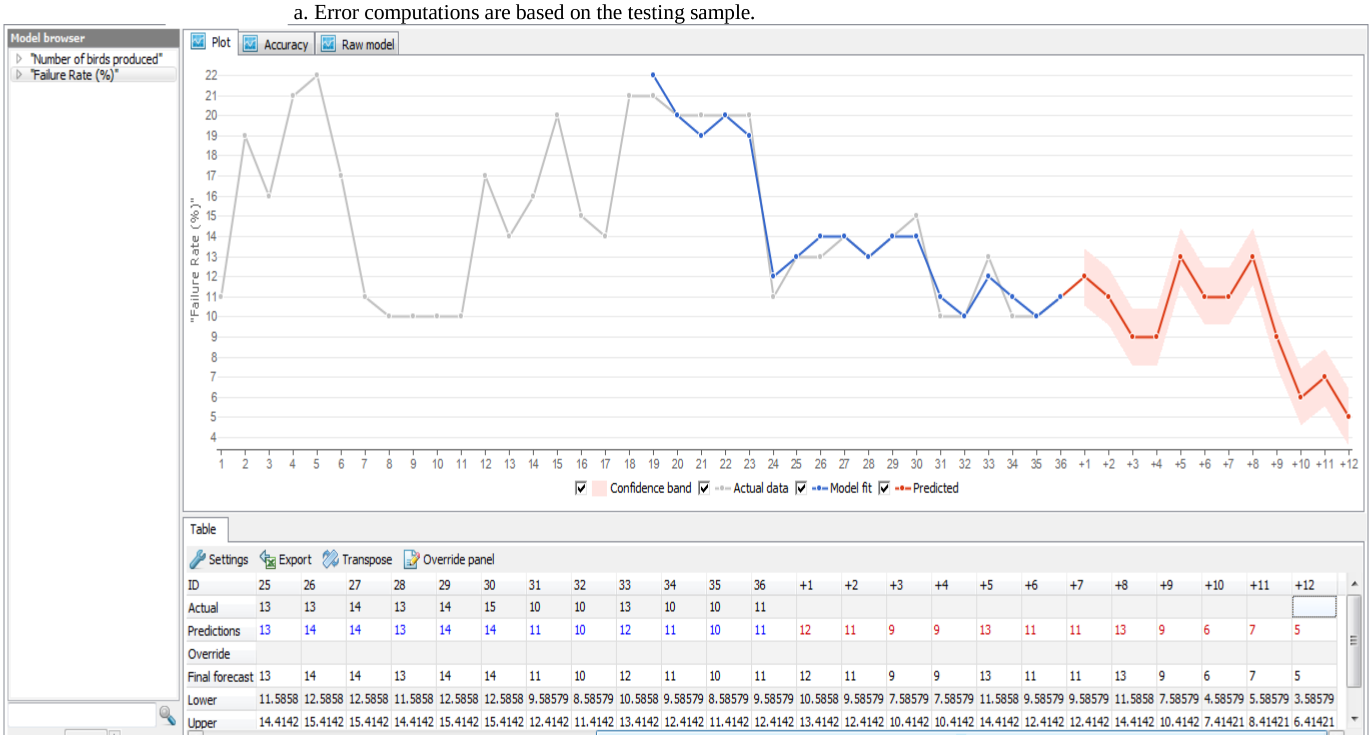

Figure 1: Failure Rate Prediction Using Regression Model of ANN

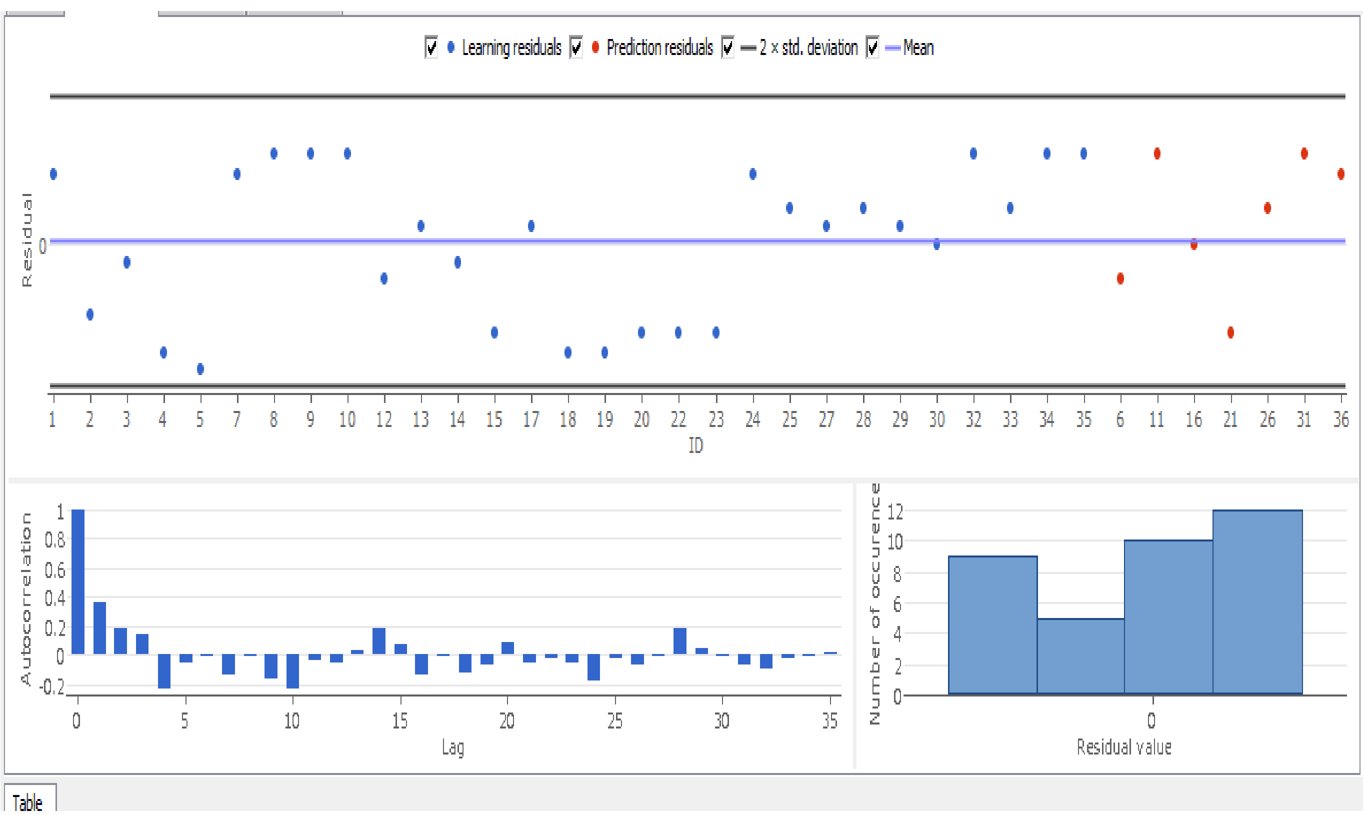

Figure 2: Incubator Failure Rate Residual Value

Model browser

"Failure Rate (%)"

Plot | Residuals | Accuracy | Raw model

Error measure: Absolute — Target: "Failure Rate (%)"

Postprocessed results	Model fit	Predictions
Number of observations	29	7
Max. negative error	-5.40012E-13	-3.8014E-13
Max. positive error	3.94351E-13	3.94351E-13
Mean absolute error (MAE)	2.81889E-13	2.5478E-13
Root mean square error (RMSE)	3.20293E-13	2.91966E-13
Residual sum	3.19744E-14	7.24754E-13
Standard deviation of residuals	3.20291E-13	2.72991E-13
Coefficient of determination (R^2)	1	1
Correlation	1	1

Figure 3: Failure Rate Accuracy

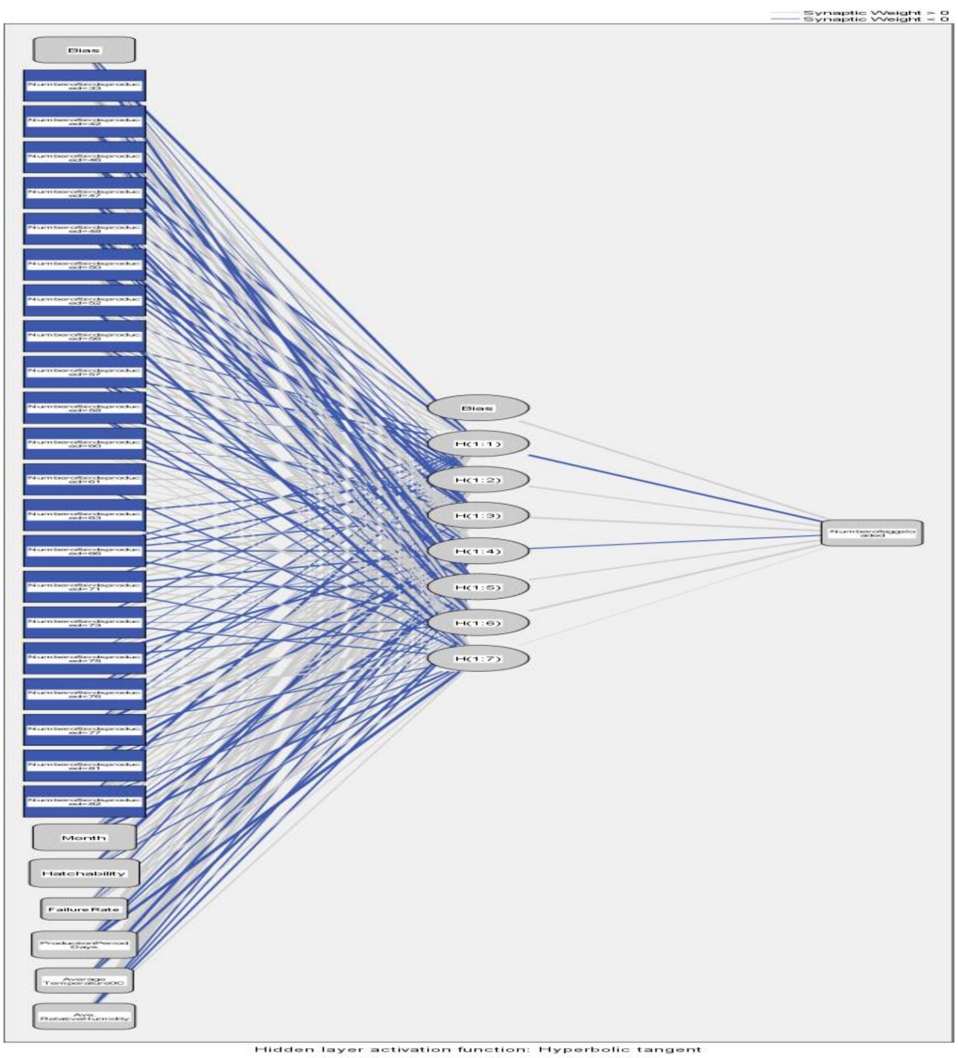

Figure 4: Architectural Layer of the model

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REFERENCES

[1] T. A Adegbulugbe., A. O. Atere, O. G Fasanmi, "Development of Automatic Egg Incubator," *International Journal of Scientific & Engineering Research*, Vol.**4**, Issue **9,** pp.914, **2011.**

[2] N.A. French, "Modelling incubation temperature: The effect of incubator design, embryonic development and egg size," *Poultry Science Journal*,Vol.**76**, Issue.**5,** pp.124-133, **1997.**

[3] G. A. Ogunwande, E. O. Akinola and A. R Lana, "Development Of A Biogas Powered Poultry Egg Incubator," *Ife Journal of Science,* Vol.**17**, Issue.**1**, pp.219, **2015.**

[4] J. C Phillip, "Poultry Extension Specialist," Journal of Animal and Poultry Sciences. *Virginal Cooperative Extension*, Vol.**6**, pp.5, **2016.**

[5] C.N Jaime, "Artificial Neural Networks in Mexican Agriculture: An Overview*," International Journal of Research in Agriculture and Forestry*, Vol.**5**, Issue.**7**, pp.3, **2018.**

[6] S.D Snehal and V.R Sandeep, "Agricultural Crop Yeild Prediction Using Artificial Neural Network Approach," *International Journal of Innovative Research in Electrical, Electronics and Instrumentation and Control Engineering*, Vol.**2**, Issue.**1**, pp.652, **2014.**

[7] S Jiri, Vladimir K, and T Oldrich, "Agricultural Data Prediction by Means of Neural Network," *International Journal of Agricultural Economics- Czech Republic*, Vol.**57**, Issue.**7**, pp.356, **2014.**

[8] AM Negm, AA Ibrahim, GM Abdel-Aal, AA El-Saiad, "Modeling of characteristics of hydraulic jumps at asymmetric sudden expansions and symmetric divergence using neural networks," *Scientific Bulletin, Faculty of Engineering, Ain Shams University, Faculty of Engineering, Cairo, Egypt*, Vol.**6**, Issue.**9**, pp.22, **2001.**

