



Machine Learning Algorithm for Determining the Best Performance in Predicting Turmeric Production in Indonesia

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ABSTRACT

The herb that has many uses in everyday life is turmeric. Not only in Indonesia but in other countries also use turmeric for consumption. Therefore, by making predictions on the level of turmeric production in the country, so that the government or other parties can use this as a reference and reference to solve problems. The method we use is Resilient Backpropagation where this method is one of the methods that is often used to forecast data. By using turmeric plant production data in Indonesia starting from 2016-2021 taken on the website of the Indonesian Central Statistics Agency. According to the data to be tested a network architecture model is formed, namely 2-15-1, 2-20-1, 2-25-1 and 2-30-1. From this model, the Fletcher-Reeves method is used. From the 4 models that have been trained and tested, a 2-15-1 model is obtained to be the best architectural model for each method. The accuracy level of the Fletcher-Reeves method with the 2-15-1 model has an MSE value of 0.002481597.

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1. INTRODUCTION

Turmeric is a medicinal plant and spice with a fairly high selling value, which can become a livelihood in some areas (Suminar, 2017) high yields and productivity, farmers must be able to understand the character of turmeric and turmeric cultivation techniques optimally (Prastia & Putra, 2020). Turmeric plant contains many benefits for the health of the body (Idea, 2013).

Based on data from the Indonesian Central Statistics Agency for the past 6 years starting from 2016-2021 (Nur Salman, 2022) The production of turmeric plants in Indonesia is increasing every year (SI Aisyah & Darusman, 2014). In 2016, Indonesia succeeded in producing 107,302,194 kg of turmeric and in 2021 Indonesia produced 184,825,890 kg. So that the production of turmeric in Indonesia has increased by 77,523,696 kg in the period of 6 years 2016-2021. Every year there is an increase in production, Indonesia must export turmeric to foreign countries so that Indonesian farmers can prosper (Setiawan, 2005).

Therefore, this study was conducted to predict turmeric production in the coming year so that the government can take the right policy to overcome the problem of turmeric production in Indonesia (Solihah et al., 2014), so that it can make the production of turmeric plants in Indonesia continue to increase and stabilize (Kusbiantoro, 2018). The method used in this study is an artificial neural network with a resilient method to determine performance (Aprilianto et al., 2018) best predictor of turmeric production in Indonesia. This method is the result of the development of Backpropagation, with this method we can predict the production of turmeric plants using time series data (SN Aisyah, nd).

Knowing the performance of an artificial neural network algorithm is very important to produce accurate forecasting data (Cynthia & Ismanto, 2017). Several studies have been conducted, such as research by Gunawan et al (2020) (Gunawan & Fitra, 2021) using the backpropagation algorithm and Fletcher-reeves to identify the image of the turmeric plant. In that study, the backpropagation algorithm was superior in terms of prediction accuracy with 95% comparison 67%, but in terms of performance (Septiani, 2017), MSE and speed, Fletcher-reeves algorithm is much better. Keshtegar et al.(2019) created a new nonlinear architecture using a modified Fletcher-Reeves conjugate gradient to predict air explosions caused by explosion induction (Surya et al., 2021). J Adler et al(2018) developed the Levenberg-Marquardt algorithm to identify color patterns in Google Maps images (Adler & Primary, 2018). There are also previous studies that became references in this study, including: Research in applying Kascing to the production and growth of turmeric plants, this method can affect the production and development of turmeric plants (Tika & Sudarti, 2021). The next study predicts the harvested area of biopharmaceuticals in Indonesia using Artificial Neural Network analysis, using this method it can predict the harvested area that will be carried out in the coming year with an accuracy rate of 87% (Surya et al., 2021).

Therefore, it is necessary to predict turmeric plants in Indonesia in the next few years (Hartato et al., 2018), so that the government can become a benchmark for taking a strategy in overcoming the problems of import and export of turmeric plants (Prawirosentono & Primasari, 2022). But making predictions is not easy, it takes data and methods to take the right steps to explain the forecast results later (Nadiyah Guest, 2021). One of the best methods is the elastic backpropagation method (Rosyidi et al., 2009). Resilient method is a method that is often used in predicting artificial neural networks (Sinaga et al., 2019), so that this method can produce the best data from the previous data, in order to produce the best value on predictions based on existing data (Sinaga et al., 2019).

2. RESEARCH METHOD

The method used to research is Artificial Neural Networks with the Resilient method. This Resilient method is the development of Backpropagation (Nurhayati, nd). The weight change in Backpropagation is affected by the learning rate and depends on the slope of the error curve (Apriliyah et al., 2008). The lower the learning rate used, the longer the learning time (Situmorang, 2020). Meanwhile, the higher the learning rate, the higher the weight will be far from the minimum weight (Zurahmah, 2011). To overcome this, a new method was developed, namely Rprop (Resilient Badkpropagation) (Surya et al., 2021).

2.1 Data

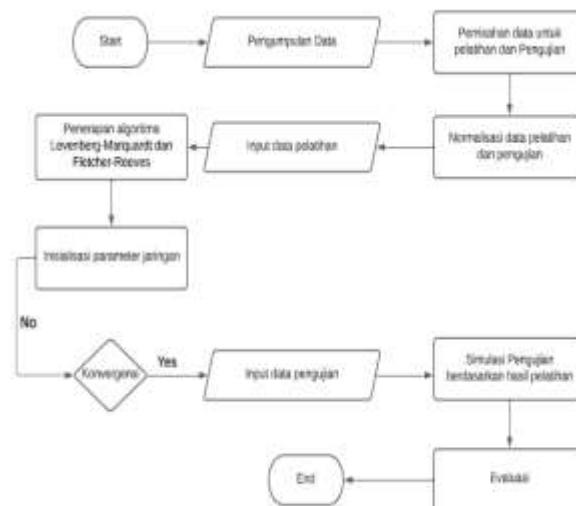
The data used in this study is data on turmeric production in Indonesia in 2016-2021 (Table 1), sourced from the website of the Indonesian Central Statistics Agency.

Table 1. Turmeric Plant Production
(Source: Indonesian Central Statistics Agency)

No	Province	2016	...	2021
1	Aceh	3050746	...	1246598
2	North Sumatra	1913923	...	14114104
3	West Sumatra	2600943	...	4354848
4	Riau	1095883	...	1144591
5	Jambi	2426152	...	719965
6	South Sumatra	2196660	...	1741904
7	Bengkulu	4535612	...	6313750
8	Lampung	771828	...	942425
9	Kep. Bangka Belitung	364887	...	846065
10	Kep. Riau	29668	...	26378
11	DKI Jakarta	2617	...	600
12	West Java	9758369	...	20047217
13	Central Java	27612177	...	20272747
14	In Yogyakarta	2928667	...	3374060
15	East Java	33326049	...	82988205
16	Banten	1450069	...	667836

No	Province	2016	...	2021
17	Bali	1642842	...	5228218
18	West Nusa Tenggara	632582	...	1401294
19	East Nusa Tenggara	1733560	...	1366902
20	West Kalimantan	794113	...	816783
21	Central Kalimantan	309963	...	220943
22	South Kalimantan	4126455	...	2162178
23	East Kalimantan	256715	...	525390
24	North Kalimantan	55471	...	134099
25	North Sulawesi	1171746	...	406292
26	Central Sulawesi	388652	...	372073
27	South Sulawesi	1579225	...	9808610
28	Southeast Sulawesi	87783	...	107851
29	Gorontalo	53894	...	12085
30	West Sulawesi	146263	...	123638
31	Maluku	172526	...	362287
32	North Maluku	24887	...	2106441
33	West Papua	14224	...	807076
34	Papua	47043	...	62437

2.2 Research Step



Figuree 1. Research Step

The picture above describes the steps of data collection. The data used is turmeric production data in Indonesia. Then divide the data into two, namely training data and testing data. Next, determine the architectural model and determine the method to be used for the training and testing process, after obtaining results based on the methods and models used. Then choose the best model to be used.

2.3 Normalization

Based on table 1, the data is divided into two. Data for 2016-2017 with a target of 2018 are used as research data, then data for 2019-2020 with a target of 2021 are used as test data. Then the data will be divided by 2 normalized by equation.

$$x' = \frac{0.8(x-a)}{b-a} + 0.1 \quad (1)$$

Information :

x' = Normalization result

- x = Data to be normalized
a = smallest data from dataset
b = The largest data from the dataset

2.4 Research data

The research data that will be used in this article are input data and output data. There are 4 input data, namely in 2016-2018 for training data and in 2019-2021 for data testing. There are 2 output data, namely the production of turmeric plants in 2018 and production of turmeric plants in 2021 (Manurung et al., 2022).

3. RESULTS AND DISCUSSIONS

3.1 Normalization Results

The table below is the normalization of training data and test data, which is 2016 to 2017 as training data and 2018 as test data. the data is taken from table (1). Normalized data apply sigmoid function (Kurniawan & Susanto, 2019).

Table 2. Training Normalization Data Results

2016	2017	2018
0.1208	0.180	0.1487
0.1131	0.1312	0.1176
0.1178	0.1130	0.1122
0.1075	0.1046	0.1049
0.1166	0.1051	0.1053
0.1150	0.1096	0.1090
0.1310	0.1278	0.1282
0.1053	0.1058	0.1061
0.1025	0.1017	0.1018
0.1002	0.1002	0.1001
0.1000	0.1001	0.1001
0.1667	0.1535	0.1969
0.2886	0.2906	0.2759
0.1200	0.1213	0.1215
0.3277	0.4906	0.9000
0.1099	0.1055	0.1058
0.1112	0.1169	0.1324
0.1043	0.1071	0.1065
0.1118	0.1116	0.1056
0.1054	0.1046	0.1050
0.1021	0.1012	0.1011
0.1282	0.1221	0.1119
0.1017	0.1017	0.1012
0.1004	0.1009	0.1006
0.180	0.1110	0.1074
0.1027	0.1031	0.1030
0.1108	0.1198	0.1685
0.1006	0.1012	0.1009
0.1004	0.1002	0.1003
0.1010	0.1027	0.1024
0.1012	0.1007	0.1011
0.1002	0.1030	0.1074
0.1001	0.1000	0.1000
0.1003	0.1001	0.1001

The table below is the normalization of training data and test data, which from 2019 to 2020 as training data and 2021 as test data, the data is taken from table 1. The normalized data applies the sigmoid function.

Table 3. Normalization Testing Data Results

2019	2020	2021
0.1352	0.1121	0.1097
0.1088	0.1236	0.2099

2019	2020	2021
0.1195	0.1240	0.1339
0.1066	0.1067	0.1089
0.1033	0.1039	0.1056
0.1156	0.1139	0.1136
0.1320	0.1318	0.1492
0.1059	0.1049	0.1073
0.1027	0.1027	0.1066
0.1002	0.1003	0.1002
0.1001	0.1000	0.1000
0.2651	0.2324	0.2561
0.2827	0.3341	0.2579
0.1242	0.1240	0.1263
0.8160	0.9000	0.7463
0.1078	0.1092	0.1052
0.1961	0.1500	0.1407
0.1065	0.1048	0.1109
0.1289	0.1063	0.1106
0.1058	0.1069	0.1064
0.1013	0.1018	0.1017
0.1165	0.1112	0.1168
0.1016	0.1033	0.1041
0.1015	0.1023	0.1010
0.1070	0.1026	0.1032
0.1021	0.1017	0.1029
0.1744	0.1735	0.1764
0.1050	0.1009	0.1008
0.1001	0.1003	0.1001
0.1025	0.1009	0.1010
0.1013	0.1026	0.1028
0.1102	0.1121	0.1164
0.1001	0.1009	0.1063
0.1001	0.1017	0.1005

In Tables 3 and 4, data processing is assisted by using Matlab 2011b tools to determine the best architectural model using Resilient. The architecture of the Fletcher-Reeves method consists of 4 models, namely: 2-15-1, 2-20-1, 2-25-1, 2-30. Determining the best architectural model in the Resilient method is the determination of the minimum error in the training data process and the test data being carried out. In this study, the parameter codes used will be analyzed using the Matlab 2011b application which can be seen in table 4 below.

3.2 Training and Testing with Model 2-15-1

The results of the training in using the 2-15-1 architectural model with the `traincgf` method are shown in Figure 2 below.

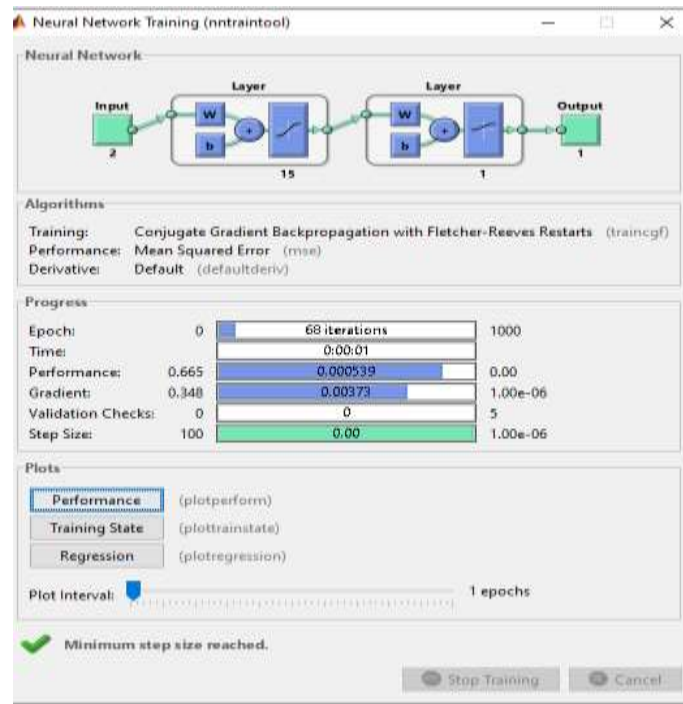


Figure 2. Training in the 2-15-1 . model

Explanation of figure 2: The results of the training in the application of the 2-15-1 model created 68 iterations of epochs.

3.3 Training and Testing with Model 2-25-1

The results of the training in the application of the 2-25-1 architectural model with the Traincgf method can be seen in Figure 4 below.

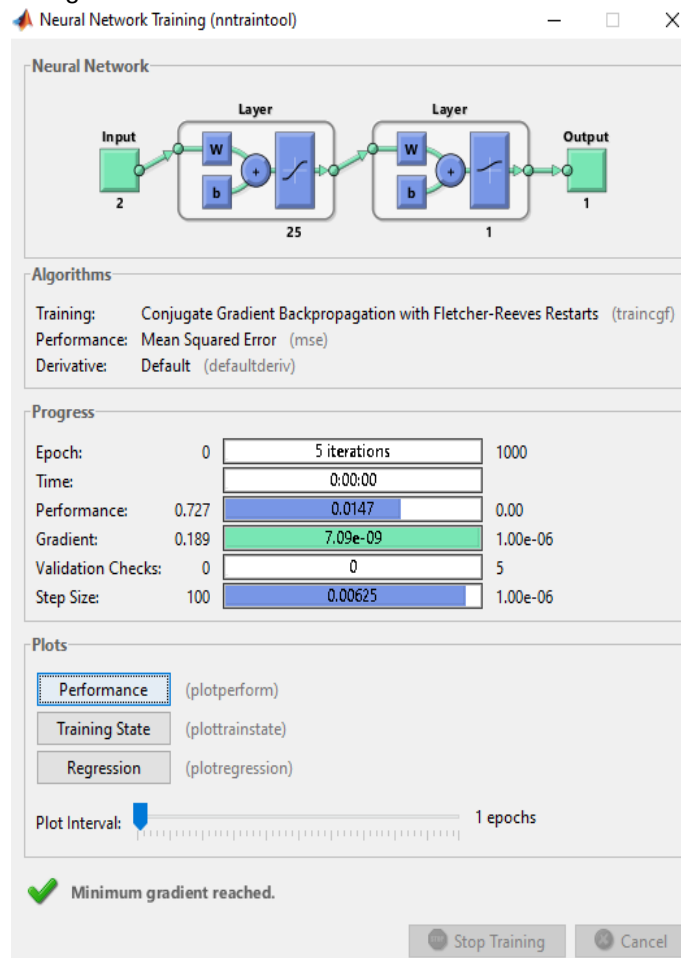


Figure 4. Model training with 2-25-1

In Figure 4: The results of the training in the application of the 2-25-1 model created 5 iterations of epochs.

3.4 Training and Testing with the 2-3-1 . Model

The results of the training using the 2-3-1 architectural model with the Traincgf method can be seen in Figure 5 below.

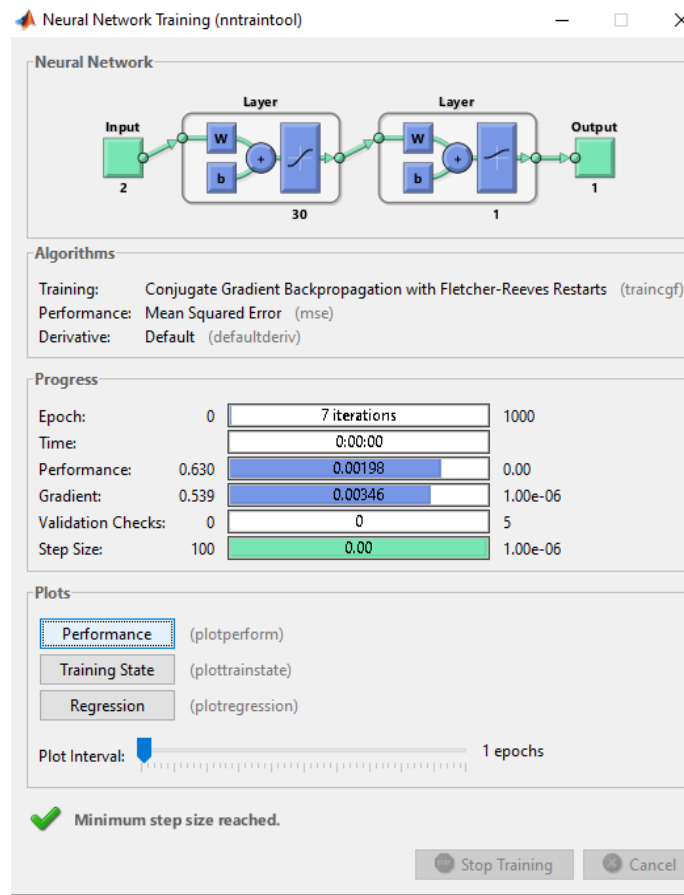


Figure 5. Model training with 2-3-1

Explanation of Figure 5: The results of the training in the application of the 2-30-1 model created 7 iterations of epochs.

3.5 Best Architecture Determination Model

After doing testing and research on the 2-15-1, 2-20-1, 2-25-1 and 2-30-1 models with the help of Matlab and Microsoft Excel tools, the best architectural model is 2-15-1 for the trainlm method and also 2-15-1 for the traincgf method because the accuracy rate is higher than the other models.

Table 4. Comparison of Overall Model Results

Algorithm	Architecture	Training Function	Epoch (Iteration)	MSE Training	MSE Testing / Performance
Fletcher-Reeves	2-15-1	traincgf	68	0.000538764	0.002481597
	2-20-1	traincgf	487	0.00001585	0.036912172
	2-25-1	traincgf	5	0.014665796	0.021375756
	2-3-1	traincgf	7	0.001981718	0.003805479

4. CONCLUSION

From the discussion and decomposition results in the article above, it is concluded that to determine the best prediction results for turmeric production in Indonesia, resilient backpropagation algorithms are used to get the best results. in order to be able to work harder to make turmeric plants continue to be improved in the future. The data used is data on the production of turmeric plants in Indonesia from 2016-2021 obtained from the website of the Indonesian Central Statistics Agency. In predicting the production of turmeric plants in Indonesia for the coming year, one way that can be used is to predict using the Fletcher Reeves method. ,using the best architectural model 2-15-1, with MSE 0.002481597.

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