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Implementation of the Fletcher-Reeves Algorithm in Predicting the Growth of Forest Plant Cultures

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ABSTRACT

Forest protection and development are essential because forests are the world's lungs. In addition, the HTI organization (modern manor backwoods) began to hide again. However, due to the great interest in wood to be used as raw material for material and property production lines, large organizations started to develop hamlet wood which was then marketed abroad, such as pressed wood, rattan, sawn timber, and done jobs for individuals in the area around the hamlet. By making a prediction, knowledge about the growth of forest plants can be known so that they can anticipate or minimize the risks that may arise. They can assist in determining policies and making decisions. This study aims to predict the growth of forest plants in the following year using an Artificial Neural Network Algorithm. The information used in this study is from the Central Bureau of Statistics from 2011 to 2022. The method of implementing this research uses the Fletcher-Reeves Algorithm, one of the Artificial Neural Network methods using 5 models, including 7-10-1, 7-15- 1, 7-20-1, 7-25-1, and 7-30-1. Of the five models, the structural model is 7-20-1 with an MSE value of 0.00037397. It can be said that this model can be used because it produces a fast combination and a short period of time.

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1. INTRODUCTION

Dangerous atmospheric damage has brought about extraordinary environmental changes, given its effect on rising temperatures, changes in windy climates and humidity [1, 2]. By restoring or rebuilding cut down forests, it will be clear in the future, and even reduce global temperature rise and Restore original soil PH [3]. The motivation behind carrying out afforestation (reforestation) is to prevent successive flooding, soil disintegration, government individual assistance, and restore soil fertility [4]. Forests in Indonesia are in decline due to illegal logging, wilderness violations, and the use of forest areas where the land is used for individual interests such as property development, lodging, plantations, even land use by certain individuals which results in forests becoming damaged and unsustainable. again holds carbon well [5]. The environmental balance on earth is due to the presence of forests which transmit oxygen and retain carbon dioxide [6], then again the population is growing population growth causes tension in the hamlet, for example the forest is expected to add to provide their normal goods to the people.

The depletion of forests combined with the development of properties that utilize glass materials makes the earth's environment warm and accelerates environmental change [7]. The forest area continues to decrease yearly because forest land has completely shifted to other grounds such as modern areas, settlements, and even lodging [8]. In Indonesia, many people don't care about the condition of the forest, where there was a big fire in Indonesia which caused half of the forest to be cleared due to people wanting to open up new land [9]. So with that, the government must be able to provide policies such as predictions in order to overcome forest problems. By developing forest plants in certain areas to carry out reforestation (reforestation) [10]. To overcome this problem, data on forest cultivation is needed [11], So that it is used as the basis for formulating policies in the forestry sector by utilizing the progress and the correct period.

To help overcome this problem, data is needed on companies that carry out forest plant planting. From these figures, the public can decide on a strategy to anticipate the riots that will occur [12]. Therefore, it is essential to direct researchers in predicting the value of planting crops in the following several periods by utilizing the progress and the correct period. Previous researchers said that the Flecther-Reeves algorithm is one of the techniques commonly used to anticipate in artificial neural networks [13, 14]. The Fletcher Reeves method is one of the Artificial Neural network methods, a development of the backpropagation algorithm [15, 16]. Conjugate Gradient Algorithm according to some literature, Fletcher-Reeves is an optimization technique that works well when used with backpropagation techniques because it can adjust the time needed for training to reach the lowest convergence level [17]. This study aims to predict the growth of forest plants in the following year using an Artificial Neural Network Algorithm.

2. RESEARCH METHOD

The stages of this research are shown in Figure 1.

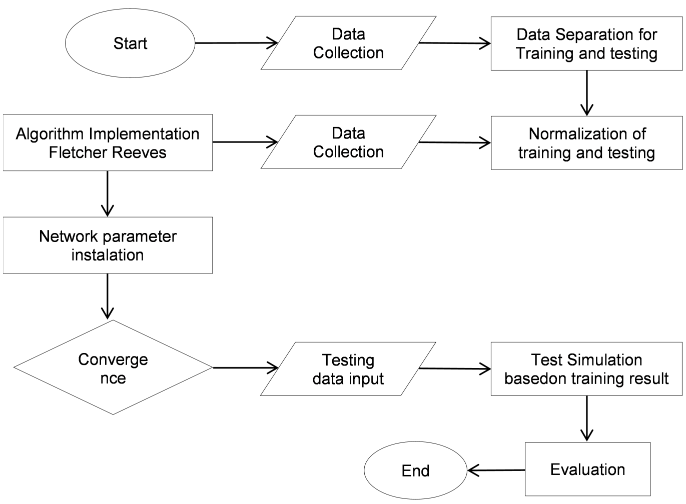

Figure 1. Research Stages

Judging from Figure 1, it is very reasonable that the initial nine steps 0 taken from the examination stage are 6 collecting six research datasets (Judging from 7 Figure 1). The next stage isolates the examination data set into two sets, specifically for preparing and testing information. The next step is standardising the preparation and testing information using the conditions equation.

2.1. Data Collection

The data used in this study was taken from the Central Statistics Agency from 2011 to 2020. The data can be seen in the Table 1.

Table 1. Forest Plant Cultivator Data

Region	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Sumatera	77	75	90	94	100	94	106	108	111	113
Jawa	60	68	70	73	66	64	74	72	70	71
Nusa Tenggara	0	3	0	3	3	7	5	6	7	7
Kalimantan	60	56	69	71	72	72	87	84	100	100
Sulawesi	2	5	1	2	4	4	10	9	9	10
Maluku/Papua	7	6	5	5	6	6	6	6	6	9
Indonesia	206	213	235	248	251	247	288	285	303	318

2.2. Normalization

Based on Table 1, X' is the consequence of standardized information, 0.8 and 0.1 are typical inverse values of the standardization equation [18]. X is the information to be standardized, b is the lowest value from the data set. and an is the most important value of the data set, using the formula (1).

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

Where x' is result of data normalization, x is data to be normalized, a is smallest data from a dataset, and b is The largest data from the dataset.

In addition, standard preparation information was placed into the Matlab 2011b application [19] for treatment, followed by creating a multifaceted brain organization (preparing information input). Next is the use of the Powell-Beale calculation [17, 20]. The formation of this multifaceted brain network utilizes the ability of tansig and logsig [21]. The next stage is to introduce organizational boundaries regarding the preparation capabilities used (traincgf). Then enter the command to perform the preparation cycle and see the results when the execution is found. Assuming the preparation results arrive at the combination, it will continue to include standardized test information. However, if the preparation results have yet to reach assimilation, then return to the stage of recognizing organizational boundaries. The next stage is followed by the reenactment of the test information considering the consequences of the preparation. After all that is done, the last stage is the assessment to see to see the best structural model based on the Execution/MSE test, which is most minimum (slightly).

2.3. Research Variable

The variables used are input and output from 2011 - 2015 for training data, then 2016-2020 for data testing. As for the output variable, the years 2016-2020.

3. RESULT AND ANALYSIS

3.1. Normalized Data Results

The basic step that is performed after the dataset [22] can be accessed-is to divide the information into two parts (preparing the information and testing the information). The preparation information uses the years 2011-2014 as information and 2015 as the target (outcome). 2016-2019 is used as information for test information, and 2020 is a goal (result). Then, these data are normalized using the sigmoid function as written in equation (1).

Table 2. Training Data Normalization Results

No	Region	2011	2012	2013	2014	2015 (target)
1	SUMATRA	0,3454	0,3454	0,3454	0,3996	0,4187
2	JAWA	0,2912	0,3167	0,3231	0,3327	0,3104
3	NUSA TENGGARA	0,1000	0,1096	0,1000	0,1096	0,1096
4	KALIMANTAN	0,2912	0,2785	0,3199	0,3263	0,3295
5	SULAWESI	0,1064	0,1159	0,1032	0,1064	0,1127
6	MALUKU & PAPUA	0,1223	0,1191	0,1159	0,1159	0,1191
7	INDONESIA	0,7566	0,7789	0,8490	0,8904	0,9000

Table 3. Normalization Results of Test Data

No	Region	2016	2017	2018	2019	2020 (target)
1	SUMATRA	0,3293	0,3599	0,3650	0,3726	0,3777
2	JAWA	0,2529	0,2783	0,2732	0,2682	0,2707
3	NUSA TENGGARA	0,1076	0,1025	0,1051	0,1076	0,1076
4	KALIMANTAN	0,2732	0,3115	0,3038	0,3446	0,3650
5	SULAWESI	0,1000	0,1153	0,1127	0,1127	0,1153
6	MALUKU & PAPUA	0,1051	0,1051	0,1051	0,1051	0,1127
7	INDONESIA	0,7191	0,8236	0,8159	0,8618	0,9000

3.2. Training and Testing

Data processing is carried out using Matlab 2011b tools [23] which aims to determine the best architectural model. The method used in architecture is the Fletcher Reeves method[24]. The architecture used is 5 models, namely 7-10-1, 7-15-1, 7-20-1, 7-25-1, and 7-30-1. The parameters of the Fletcher-Reeves algorithm used can be seen in Figure 2.

```
% Nilai parameter default Fletcher-Reeves (traincgf)
net.trainParam.epochs = 1000;
net.trainParam.show = 25;
net.trainParam.showCommandLine = 0;
net.trainParam.showWindow = 1;
net.trainParam.goal = 0;
net.trainParam.time = inf;
net.trainParam.min_grad = 1e-6;
net.trainParam.max_fail = 5;
net.trainParam.searchFcn = 'srchcha'
```

Figure 2. Parameter Fletcher-Reeves

1. Model 7-10-1

Training with the 7-10-1 model, up to 223 Epoch iterations. The training and test schedule is shown in the Table 4 (Training Results) and Table 5 (Testing Results).

Table 4. Training Results

No	X1	X2	X3	X4	Target(Y1)	Epoch 131		
						Actual	Error	Perf
1	0,3454	0,3454	0,3454	0,3996	0,4187	0,4187	0,0000	
2	0,2912	0,3167	0,3231	0,3327	0,3104	0,3104	0,0000	
3	0,1000	0,1096	0,1000	0,1096	0,1096	0,1099	-0,0003	
4	0,2912	0,2785	0,3199	0,3263	0,3295	0,3295	0,0000	0,00000004
5	0,1064	0,1159	0,1032	0,1064	0,1127	0,1124	0,0003	
6	0,1223	0,1191	0,1159	0,1159	0,1191	0,1190	0,0001	
7	0,7566	0,7789	0,8490	0,8904	0,9000	0,9000	0,0000	

Table 5. Test Result

No	X1	X2	X3	X4	Target(Y1)	Epoch		
						Actual	Error	Perf
1	0,3293	0,3599	0,3650	0,3726	0,3777	0,4221	-0,0444	
2	0,2529	0,2783	0,2732	0,2682	0,2707	0,2255	0,0452	
3	0,1076	0,1025	0,1051	0,1076	0,1076	0,1140	-0,0064	
4	0,2732	0,3115	0,3038	0,3446	0,3650	0,2484	0,1166	0,00259523
5	0,1000	0,1153	0,1127	0,1127	0,1153	0,1117	0,0036	
6	0,1051	0,1051	0,1051	0,1051	0,1127	0,1135	-0,0008	
7	0,7191	0,8236	0,8159	0,8618	0,9000	0,8774	0,0226	

2. Model 7-15-1

The results of model training produce epochs with six iterations. The Table 6 (Training Results) and Table 7 (Testing Results).

Table 6. Training Results

No	X1	X2	X3	X4	Target(Y1)	Epoch 274		
						Actual	Error	Perf
1	0,3454	0,3454	0,3454	0,3996	0,4187	0,4188	-0,0001	
2	0,2912	0,3167	0,3231	0,3327	0,3104	0,3105	-0,0001	
3	0,1000	0,1096	0,1000	0,1096	0,1096	0,1104	-0,0008	
4	0,2912	0,2785	0,3199	0,3263	0,3295	0,3293	0,0002	0,00000046
5	0,1064	0,1159	0,1032	0,1064	0,1127	0,1113	0,0014	
6	0,1223	0,1191	0,1159	0,1159	0,1191	0,1197	-0,0006	
7	0,7566	0,7789	0,8490	0,8904	0,9000	0,9000	0,0000	

Table 7. Test result

No	X1	X2	X3	X4	Target(Y1)	Epoch		
						Actual	Error	Perf
1	0,3293	0,3599	0,3650	0,3726	0,3777	0,3775	0,0002	
2	0,2529	0,2783	0,2732	0,2682	0,2707	0,2213	0,0494	
3	0,1076	0,1025	0,1051	0,1076	0,1076	0,1150	-0,0074	
4	0,2732	0,3115	0,3038	0,3446	0,3650	0,3132	0,0518	0,00097682
5	0,1000	0,1153	0,1127	0,1127	0,1153	0,1105	0,0048	
6	0,1051	0,1051	0,1051	0,1051	0,1127	0,1129	-0,0002	
7	0,7191	0,8236	0,8159	0,8618	0,9000	0,8595	0,0405	

3. Model 7-20-1

An epoch with 160 iterations was generated from training with this model. The Table 8 (Training Results) and Table 9 (Testing Results).

Table 8. Training Results

No	X1	X2	X3	X4	Target(Y1)	Epoch 47		
						Actual	Error	Perf
1	0,3454	0,3454	0,3454	0,3996	0,4187	0,4096	0,0091	
2	0,2912	0,3167	0,3231	0,3327	0,3104	0,3405	-0,0301	
3	0,1000	0,1096	0,1000	0,1096	0,1096	0,1427	-0,0331	
4	0,2912	0,2785	0,3199	0,3263	0,3295	0,3131	0,0164	0,00054510
5	0,1064	0,1159	0,1032	0,1064	0,1127	0,1420	-0,0293	
6	0,1223	0,1191	0,1159	0,1159	0,1191	0,1410	-0,0219	
7	0,7566	0,7789	0,8490	0,8904	0,9000	0,9111	-0,0111	

Table 9. Test result

No	X1	X2	X3	X4	Target(Y1)	Epoch		
						Actual	Error	Perf
1	0,3293	0,3599	0,3650	0,3726	0,3777	0,3776	0,0001	
2	0,2529	0,2783	0,2732	0,2682	0,2707	0,2746	-0,0039	
3	0,1076	0,1025	0,1051	0,1076	0,1076	0,1350	-0,0274	
4	0,2732	0,3115	0,3038	0,3446	0,3650	0,3479	0,0171	0,00037397
5	0,1000	0,1153	0,1127	0,1127	0,1153	0,1453	-0,0300	
6	0,1051	0,1051	0,1051	0,1051	0,1127	0,1360	-0,0233	
7	0,7191	0,8236	0,8159	0,8618	0,9000	0,9110	-0,0110	

4. Model 7-25-1

An epoch with 368 iterations was generated from training with this model. The Table 10 (Training Results) and Table 11 (Testing Results).

Table 10. Training Results

No	X1	X2	X3	X4	Target(Y1)	Epoch 120		
						Actual	Error	Perf
1	0,3454	0,3454	0,3454	0,3996	0,4187	0,4186	0,0001	
2	0,2912	0,3167	0,3231	0,3327	0,3104	0,3105	-0,0001	
3	0,1000	0,1096	0,1000	0,1096	0,1096	0,1096	0,0000	
4	0,2912	0,2785	0,3199	0,3263	0,3295	0,3294	0,0001	0,00000011
5	0,1064	0,1159	0,1032	0,1064	0,1127	0,1121	0,0006	
6	0,1223	0,1191	0,1159	0,1159	0,1191	0,1197	-0,0006	
7	0,7566	0,7789	0,8490	0,8904	0,9000	0,9000	0,0000	

Table 11. Test result

No	X1	X2	X3	X4	Target(Y1)	Epoch		
						Actual	Error	Perf
1	0,3293	0,3599	0,3650	0,3726	0,3777	0,3363	0,0414	
2	0,2529	0,2783	0,2732	0,2682	0,2707	0,2685	0,0022	
3	0,1076	0,1025	0,1051	0,1076	0,1076	0,1118	-0,0042	
4	0,2732	0,3115	0,3038	0,3446	0,3650	0,3168	0,0482	0,00102257
5	0,1000	0,1153	0,1127	0,1127	0,1153	0,1070	0,0083	
6	0,1051	0,1051	0,1051	0,1051	0,1127	0,1100	0,0027	
7	0,7191	0,8236	0,8159	0,8618	0,9000	0,8450	0,0550	

5. Model 7-30-1

Training with this model produces epochs with 125 iterations as a result. The Table 12 (Training Results) and Table 13 (Testing Results).

Table 12. Training Results

No	X1	X2	X3	X4	Target(Y1)	Epoch 80		
						Actual	Error	Perf
1	0,3454	0,3454	0,3454	0,3996	0,4187	0,4151	0,0036	
2	0,2912	0,3167	0,3231	0,3327	0,3104	0,2573	0,0531	
3	0,1000	0,1096	0,1000	0,1096	0,1096	0,1397	-0,0301	
4	0,2912	0,2785	0,3199	0,3263	0,3295	0,2927	0,0368	0,00086824
5	0,1064	0,1159	0,1032	0,1064	0,1127	0,1321	-0,0194	
6	0,1223	0,1191	0,1159	0,1159	0,1191	0,1297	-0,0106	
7	0,7566	0,7789	0,8490	0,8904	0,9000	0,9224	-0,0224	

Table 13. Test result

No	X1	X2	X3	X4	Target(Y1)	Epoch		
						Actual	Error	Perf
1	0,3293	0,3599	0,3650	0,3726	0,3777	0,3472	0,0305	
2	0,2529	0,2783	0,2732	0,2682	0,2707	0,1417	0,1290	
3	0,1076	0,1025	0,1051	0,1076	0,1076	0,1523	-0,0447	
4	0,2732	0,3115	0,3038	0,3446	0,3650	0,2195	0,1455	0,00617546
5	0,1000	0,1153	0,1127	0,1127	0,1153	0,1378	-0,0225	
6	0,1051	0,1051	0,1051	0,1051	0,1127	0,1494	-0,0367	
7	0,7191	0,8236	0,8159	0,8618	0,9000	0,8745	0,0255	

3.3. Result Analysis and Evaluation

Using Matlab and Microsoft Excel tools, training and testing of data-driven architectural models 7-10-1, 7-15-1, 7-20-1, 7-25-1, and 7-30-1 (Table 14). The best architectural model is 7-20-1 with MSE value is **0,00037397** (Figure 3).

Table 14. Comparison of Overall Results Model00

Algorithm	Architecture	Training Fuction	Epoch (Iteration)	MSE Training	MSE Testing/Performance
	7-10-100	Traincgf	131	0,00000004	0,0025952300
	7-15-1	Traincgf	274	0,00000046	0,0009768200
Fletcher-Reeves	**7-20-1**	**Traincgf**	**47**	**0,00054510**	**0,00037397**
	7-25-1	Traincgf	120	0,00000011	0,0010225700
	7-30-1	Traincgf	80	0,00086824	0,0061754600

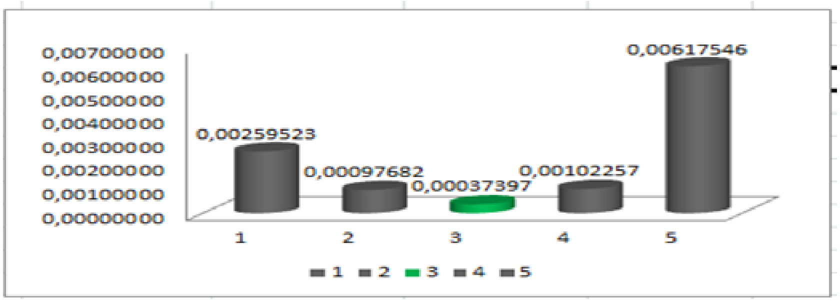

Figure 3. Comparison of Overall Results Model

4. CONCLUSION

The Ranger Service Plant Development Organization, as shown by the Island 7-20-1 building model, can be used because the preparation time to complete the combination is not too long, and the subsequent execution is perfect. Furthermore, in contrast to the other four compositional models, they tend to be close to results and conversations. In general, it can also be estimated that the Fletcher-Reeves (traincgb) calculation can achieve a higher level of improvement, judging by its ability to produce Execution/MSE test results (low), short pooling time, and high emphasis Fast enough.

5. DECLARATIONS

AUTHOR CONTIBUTION

All authors contributed to the writing of this article.

FUNDING STATEMENT

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COMPETING INTEREST

The authors declare no conflict of interest in this article.

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