



Artificial Neural Network (ANN) Implementation with Conjugate Gradient Algorithm to Predict Sumatran Melinjo Plant Production

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ABSTRACT

Melinjo is an annual plant with open seeds. Tree-shaped and has two houses called dioecious or there are males and females. Melinjo is often found in dry and tropical areas. Indonesia can be one that produces melinjo as a trade product in large quantities. Melinjo is collected and shipped natural products after 5-6 long time after planting the seeds. In West Sumatra, it is detailed that each year produces 20,000 to 25,000 natural melinjo products and the seed generation reaches 80 to 100 kg per tree per year. Therefore, it is important to know every need for melinjo by anticipating the number of generations of Melinjo using a Manufacturing Artificial Neural System with Backpropagation strategy. With the neural structure made, it will be easier to carry out this investigation. Where the machine learning method can help to find the performance value and the best value from the simple data studied. Matlab2011b application has a feature that helps to calculate the best performance and value with the help of the Conjugate Gradient algorithm. After testing using 5 samples, namely: 4-10-1, 4-15-1, 4-20-1, 4-25-1, 4-30-1. Of the five tests, the best results are on data 4-15-1 with the MSE/Performance value of 0.011154591. 4-15-1, 4-20-1, 4-25-1, 4-30-1. Of the five tests, the best results are on data 4-15-1 with the MSE/Performance value of 0.011154591. 4-15-1, 4-20-1, 4-25-1, 4-30-1. Of the five tests, the best results are on data 4-15-1 with the MSE/Performance value of 0.011154591.

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1. INTRODUCTION

Melinjo or belinjo is one type of plant with open seeds (Gymnosperms) (Omar, 2011). Tree-shaped originating from the tropics of Asia, Melanesia, and the Western Pacific. Melinjo is also known as maninjo (Makassar), ku'lang (Selayar), belinjo, mlinjo (Javanese), Tangkil (Sundanese) or bago (Malay and Tagalog), khalet (Cambodia), bidau (Sunda), Kapuas Hulu Malay dialect.). Melinjo is widely planted in the yard as a shade or yard barrier and is basically used for natural products and leaves (Raharjo et al., 2011), especially for the manufacture of chips called emping (Handito et al., 2019). Melinjo is an annual plant with open seeds (Puarada et al., 2020). In the form of a tree and having two houses it is also called dioecious or there are males and females (Anita, 2022). Melinjo can be found in dry and damp land (Alim et al., 2022). In order to grow and bear fruit, melinjo does not need highly nutritious soil and extraordinary weather (Alim et al., 2022). Melinjo adapts to a wide

range of temperatures. Usually melinjo is easy to find in different areas, but not in coastal areas(Hidayah, 2015).

ANN is one of the incorrect presentations of the human brain that continues to try to revive the handle of learning in the human brain by modeling ANN as a system that has input and output based on normal neurons.(Susatyono, 2021). Several masterminds in various fields use ANN problem analysis techniques such as problem understanding problems of Traveling Deals agents for plan approval(West, nd). One of the ranges where ANN is well connected is the area of assurance(Setiawan et al., 2020)and one of the most frequently used assurance methodologies in ANN is backpropagation(Citra & Kusumaningrum, 2015). Estimation strategies are widely used to structure and shape decision making(Dahria, 2011). Determination arises an assessment that will occur in certain circumstances something else controls the work of determination to assist the choice maker in choosing the leading alternative(Siswanto, 2021). In this way, hope tries to expect what will happen(Hope et al., 2022)linking backpropagation impressions with the organizational structure of 2-5-4-1-2 to anticipate.

In some areas, such as in Sumatra, the melinjo plant is developed in the yard or in household cultivation and is directly used by residents(Lestari, nd). Indonesia can become a country that produces melinjo as a trade product in large quantities(Ati, nd). Melinjo is collected and then exported natural products after 5-6 years after the seed harvesting process(Agus Nurawan et al., nd). In West Sumatra, it is specified that once a year will produce 20,000 to 25,000 natural melinjo products and the seed generation reaches 80 to 10 kg per tree per year.(Sastrapradja, 2012). Therefore, it is important to know every need for melinjo by estimating the number of generations of Melinjo using an Artificial Neural System Produced using the Backpropagation strategy.

2. RESEARCH METHOD

2.1 Data collection

Information retrieval strategies applied in the discussion can be in the form of quantitative strategies(Poluan et al., 2019), in particular retrieval of information on the generation of Melinjo Vegetables in North Sumatra through the Central Insights Organization of North Sumatra. The question about the strategy used is the false neural system with the Conjugate Slope strategy(Caldirola, nd). The Conjugation Angle Strategy is an iterative method in solving the direct condition framework using a clear positive symmetric coefficient framework. Conjugation Angle Strategy is an iterative method to solve the problem of straight condition system $Ax = b$. Where A may be a network of symmetrical and strictly positive coefficients:

$$A \in R^{n \times n} \quad (1)$$

$$\forall x \in R^n, x \neq 0 \quad (2)$$

$$A^T = A \quad (3)$$

$$x^T Ax > 0 \quad (4)$$

2.2 Data source

Information that is the Complete Generation of Melinjo Vegetables in Sumatra in 2011-2020 sourced from the North Sumatra Central Insights Organization website.

2.3 Research Framework

The investigation system applied to explain the research questions is shown in Figure 1.

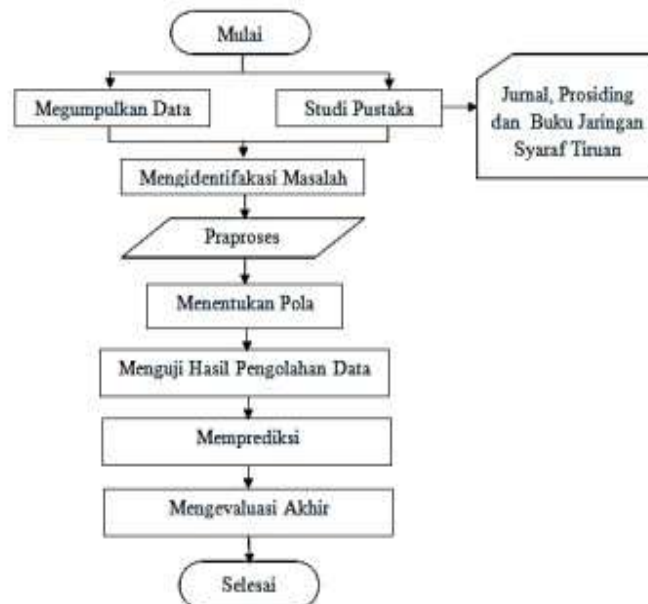


Figure 1. Research Framework

In the description of the system above, each stage can be explained as below:

1. Data collection
In this arrangement stage, information obtained from BPS is information on the General Generation of Melinjo Vegetables in North Sumatra (Abidin & Candra Pradhana, 2020).
2. Literature review
Is the main organization in the research process is to add up important information and hypotheses (Kinasih & Albari, 2012).
3. Distinguishing Problems
At this stage the problem can be identified, organize information so that it is fulfilled and accurate information is obtained, it is important in changing the information according to what has been determined (Sutabri, 2012).
4. Preprocess
Furthermore, changing the type of information and the quality of information aimed at making it easier to obtain the substance of the information record, and making information determinations by paying attention to the consistency of information (Supriyono, 2018).
5. Deciding the Model
What appears in this series are several artificial nervous system models that use the Conjugation Angle strategy to determine a pattern (Berniyanti, 2020).
6. Testing the Results of Handling Information
In testing the emergence of information (Shaban, 2015)

2.4 Data Normalization

The information will be normalized by applying condition (1) which can result in a value of 0 or 1. (Sutawinaya et al., 2017). Illustration: (x' = Information Normalization, x = data to be normalized, a = lowest data, b = highest data.

$$x' = \frac{0.8(x-a)}{b-a} + 0,1 \quad (5)$$

Table 1. Original Data

Province	Melinjo (Ton)									
	Vegetable Crop Production									
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ACEH	9908	10958	13484	14129	14871	10004	9161	10094	10630	11466
NORTH SUMATRA	3858	4214	5117	3377	2682	2451	2282	2621	2615	4483
WEST SUMATRA	9749	10282	8726	11688	11364	11510	11770	10726	7448	10445
RIAU	1865	1695	1230	1252	1364	1371	1583	1513	1404	1297
JAMBI	1617	1545	1338	1279	886	1162	2026	2003	3342	2821
SOUTH SUMATRA	1282	1151	1277	944	1169	1284	1925	1882	1481	1523
BENGKULU	1396	2287	1020	628	447	534	423	415	627	564
LAMPUNG	9129	9504	8815	8396	8076	11416	16703	12169	14108	14185
KEP. BANGKA										
BELITUNG	656	577	411	396	660	698	324	236	300	228
KEEP. RIAU	326	352	243	187	199	174	159	137	258	376

3. RESULTS AND DISCUSSIONS

3.1 Normalization Results

The results of normalization of training data in 2011-2015 where 2015 is the target in Table 2. The data is according to Table 1. Then the data is normalized based on the sigmoid function

Table 2. Data Normalization (Train)

NO	2011	2012	2013	2014	2015(t)
1	0.6296	0.6868	0.8244	0.8596	0.9000
2	0.3000	0.3194	0.3686	0.2738	0.2359
3	0.6209	0.6500	0.5652	0.7266	0.7089
4	0.1914	0.1822	0.1568	0.1580	0.1641
5	0.1779	0.1740	0.1627	0.1595	0.1381
6	0.1597	0.1525	0.1594	0.1412	0.1535
7	0.1659	0.2144	0.1454	0.1240	0.1142
8	0.5872	0.6076	0.5701	0.5472	0.5298
9	0.1256	0.1212	0.1122	0.1114	0.1258
10	0.1076	0.1090	0.1122	0.1000	0.1007

In Table 3 are the results of the normalization of the test information used, to be precise from 2016-2020. The information is obtained from Table 1 and normalized using the sigmoid function arranged in the equation conditions.

Table 3. Data Normalization (Test)

NO	2016	2017	2018	2019	2020(t)
1	0.5765	0.5358	0.5808	0.6067	0.6471
2	0.2117	0.2036	0.2200	0.2197	0.3099
3	0.6492	0.6618	0.6114	0.4531	0.5978
4	0.1596	0.1698	0.1664	0.1612	0.1560
5	0.1495	0.1912	0.1901	0.2548	0.2296
6	0.1554	0.1863	0.1843	0.1649	0.1669
7	0.1192	0.1138	0.1134	0.1237	0.1206
8	0.6447	0.9000	0.6810	0.7747	0.7784
9	0.1271	0.1090	0.1048	0.1079	0.1044
10	0.1018	0.1011	0.1000	0.1058	0.1115

In tables 3 and 4, the compilation of information was assisted by the Matlab2011b tool in determining the leading engineering event with Strong. The designs used are 5 designs consisting of: (4 – 10 – 1), (4 – 15 – 1), (4 – 20 – 1), (4 – 25 – 1) and (4 – 30 – 1). For the best technique performance with the Conjugate Slope model is to determine the smallest error from the handle preparation and testing carried out. The blunder rates used are 0.05 and 0.01. In that case the parameters and code will be analyzed using the Matlab2011b application, see table 4.

Table 4. Program Code and Parameters

Training Code	Test Code
<pre>>> net=newff(minmax(P),[hidden layer, output layer], {'logsig', 'purelin', 'trainscg'; >> >>net.IW{1,1} >>net.LW{2,1} >>net.b{1} >>net.b{2} >> >>net.trainParam.epochs = 10000; >>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.sigma = 5.0e-5; >>net.trainParam.lambda = 5.0e-7; >>net = train(net,p,t) >>[a,Pf,Af,e,perf] = sim(net,p,[],[],t)</pre>	<pre>>>PP=test data input >>TT=output test data [a,Pf,Af,e,perf] = sim(net,p1,[],[],t1)</pre>

3.2 Architectural Model Comparison

Structural views used in this consideration work input information = 4, closed layers = 10, 15, 20, 25, 35. Yield layer = 1. After preparing and testing information with architectural models: 4 – 10 - 1, 4 – 15 - 1, 4 – 20 - 1, 4 – 25 - 1 and 4 – 30 - 1 using Matlab 2011b and Microsoft Excel, so the best architecture is 4 – 15 - 1 . Comparison of the 5 architectural models used, see table 5 below:

Table 5. Model Comparison

Algorithm	Architecture	Training Function	Epoch (Iteration)	MSE Training	MSE Testing/Performance
Conjugate Gradient	3-10-1	trainscg	836	0.000000008	0.018429274
	3-15-1	trainscg	887	0.000000001	0.011154591
	3-20-1	trainscg	726	0.009341695	0.059350142
	3-25-1	trainscg	462	0.000000005	0.059350142
	3-30-1	trainscg	552	0.000000010	0.018892029

3.3 Best Architectural Model (4-15-1)

The results of the preparation using the 4-15-1 technique can be seen in Figure 2 below:



Figure 2. The best architectural model 4-15-1

In Figure 2, it is clear that the implementation of the 4-15-1 building demonstration preparation occurred in 887 age cycles, and this demonstration was the best technique compared to the other 4 models. Tables of preparation and testing are seen in tables 6 and 7 below.

Table 6. Architectural Model Training Data 4-15-1

No	Training Data					Epoch 887		
	X1	X2	X3	X4	Target	actual	Error	Perf /MSE
1	0.6296	0.6868	0.8244	0.8596	0.9000	0.9000	0.0000	0.000000001
2	0.3000	0.3194	0.3686	0.2738	0.2359	0.2359	0.0000	
3	0.6209	0.6500	0.5652	0.7266	0.7089	0.7089	0.0000	
4	0.1914	0.1822	0.1568	0.1580	0.1641	0.1641	0.0000	
5	0.1779	0.1740	0.1627	0.1595	0.1381	0.1381	0.0000	

Training Data						Epoch 887	
No	X1	X2	X3	X4	Target	actual	Error Perf /MSE
6	0.1597	0.1525	0.1594	0.1412	0.1535	0.1535	0.0000
7	0.1659	0.2144	0.1454	0.1240	0.1142	0.1142	0.0000
8	0.5872	0.6076	0.5701	0.5472	0.5298	0.5298	0.0000
9	0.1256	0.1212	0.1122	0.1114	0.1258	0.1258	0.0000
10	0.1076	0.1090	0.1122	0.1000	0.1007	0.1007	0.0000

Table 7. Architectural Model Testing Data 4-15-1 Training Data

						Epoch 887	
No	X1	X2	X3	X4	Target	actual	Error Perf /MSE
1	0.5765	0.5358	0.5808	0.6067	0.6471	0.7504	-0.1033
2	0.2117	0.2036	0.2200	0.2197	0.3099	0.1081	0,2018
3	0.6492	0.6618	0.6114	0.4531	0.5978	0.6195	-0.0217
4	0.1596	0.1698	0.1664	0.1612	0.1560	0.1023	0.0537
5	0.1495	0.1912	0.1901	0.2548	0.2296	0.0268	0.2028
6	0.1554	0.1863	0.1843	0.1649	0.1669	0.0791	0.0878
7	0.1192	0.1138	0.1134	0.1237	0.1206	0.1099	0.0107
8	0.6447	0.9000	0.6810	0.7747	0.7784	0.7080	0.0704
9	0.1271	0.1090	0.1048	0.1079	0.1044	0.1530	-0.0486
10	0.1018	0.1011	0.1000	0.1058	0.1115	0.0887	0.0228

0.011154591

4. CONCLUSION

It can be concluded that the existence of an Artificial Neural Network method can make it easier to conduct this research. Where the machine learning method can help to find the performance value and the best value from the simple data studied. Matlab2011b application has a feature that helps to calculate the best performance and value with the help of the Conjugate Gradient algorithm. After testing using 5 samples, namely: 4-10-1, 4-15-1, 4-201.4-25-1, 4-30-1. Of the five tests, the best results are on data 4-15-1 with the MSE/Performance value of 0.011154591.

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