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Determining the Location of Nenas Processing Factories in North Sumatra Using Dijkstra Algorithm

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ABSTRACT

Pineapples have many health advantages. In addition to having many health benefits, this fruit can be processed into juice, jam, syrup, and chips. Pineapple is often eaten as fresh fruit and utilized primarily for its flesh. The community has not utilized this potential to its fullest extent. The production of pineapples is ranked second after oranges, according to statistics from the Central Statistics Agency of the North Sumatra Province for the year 2018-2019. This indicates that pineapples have a lot of potential for development both domestically and eventually for export. Determining the best route for transportation to the pineapple processing factory and the lack of one in North Sumatra provide the primary research challenges. In literary works, the factory's location is ascertained by analyzing production levels and utilizing Dijkstra algorithm programming to find the shortest transit path from the producing region to the factory. Using Google Maps, the 10 highest generating regions were identified for this study, with the district capital serving as the vertex and the distance between regions serving as the edge. According to the research findings, the pineapple processing plant was located in the middle of North Tapanuli Regency, and the shortest path between each region and the processing factory location was identified.

Keyword: Pineapple, Shortest route, Dijkstra's algorithm

1. Introduction

The varying harvest area and yield indicate that pineapple farming development in Indonesia has not received significant attention. Numerous factors contribute to this, such as inadequate advancement in the application of superior varieties and inadequate cultural planting methods. Favourable soil and climate conditions bolster North Sumatra, one of the Indonesian provinces with exceptional potential for agricultural output. Data from the Central Statistics Agency for 2018–2019 shows that pineapple production in North Sumatra Province is second only to oranges, indicating significant potential for this commodity's development to support the economy. The primary issue, however, is that pineapple production is declining annually. This may be due to the fact that people typically only eat pineapples as fresh fruit.

To boost pineapple fruit production in agriculture once more, a container that can handle distribution and processing is required. Plants that process pineapples are the answer to this issue. The presence of a pineapple

processing factory can lead to higher output levels, which in turn can become North Sumatra's primary economic driver. The processing factory's location plays a crucial role in promptly assimilating and processing regional production results to the highest quality. North Tapanuli, Karo, Humbang Hasundutan, and Dairi are the main pineapple-producing regions in North Sumatra. The research focuses on strategically placing pineapple processing facilities to optimize production, with the producing area's length, position, and marketing distance from the city center as key factors. In order to ascertain the processing factory's location, this study employs a literature review using BPS data to ascertain the processing factory's location. We examine the production volume and program the factory's route using the Dijkstra method. Dijkstra's algorithm [1] can resolve the shortest path problem of a directed graph. A directed graph is one that connects two points, or vertices, with values. The points represent possible production areas, and the edges represent the separation between producing areas. You can use the Dijkstra algorithm to determine the shortest path to the pineapple processing factory's site.

2. Methods

This investigation involved a review of the literature. Since previous years' fruit production data was based directly on all districts, we used data from the Bureau of Statistics (BPS) for fruit production by regency or city in North Sumatra Province from 2018 to 2019. The researchers began by gathering information at the North Sumatra Province's Central Statistics Agency. Using this data and the amount of production, the investigation then identified the location of the pineapple processing factory. After establishing the factory's location, apply the Dijkstra algorithm to determine the shortest path from the producing region to the processing plant centre. Researchers utilized Google Maps as a reference to calculate distance.

Dijkstra's algorithm

The Dijkstra algorithm is a useful tool for figuring out the shortest path or route between two locations. The idea behind this technique is to use the two shortest pathways to get a location point. Each iteration updates the known point distance (from the beginning point) if a new point proves to provide the shortest distance [4]. This approach uses a directed graph, often known as a graph with values (weights) [5].

In 1959, Edsger Wybe Dijkstra discovered Dijkstra's algorithm [6, 7]. A node that has been picked is connected to another node that has not been selected by a minimum weight in the Greedy method, which incorporates Dijkstra's method [1, 2]. In a few steps, Dijkstra's algorithm can determine the shortest path.

3. Results and Discussion

Kabupaten/Kota *Regency/Municipality*	Nenas/*Pineapple* (kw/*qui*)	
	2018	2019
(1)	(34)	(35)
Nias	122	114
Mandailing Natal	70	152
Tapanuli Selatan	553	661
Tapanuli Tengah	11	13
Tapanuli Utara	1 417 572	1 340 969
Toba	410	633
Labuhan Batu	215	325
Asahan	998	875
Simalungun	1 806	1 453
Dairi	1 649	1 794
Karo	12 325	11 788
Deli Serdang	5 530	4 661
Langkat	3 748	4 142
Nias Selatan	223	870
Humbang Hasundutan	6 541	9 385
Pakpak Bharat	2 927	2 772
Samosir	111	403
Serdang Bedagai	120	182
Batu Bara	-	-
Padang Lawas Utara	-	-
Padang Lawas	497	518
Labuhan Batu Selatan	49	264
Labuhan Batu Utara	-	-
Nias Utara	178	1
Nias Barat	124	39
Kota Sibolga	-	-
Kota Tanjung Balai	6	20
Kota Pematang Siantar	2	4
Kota Tebing Tinggi	76	118
Kota Medan	84	208
Kota Binjai	86	80
Kota Padangsidimpuan	37	210
Kota Gunungsitoli	104	210
Sumatera Utara	**1 456 174**	**1 382 864**

Figure 1. North Sumatra's Pineapple Production, 2018–2019

Additionally, the researchers only identified possible pineapple-producing locations using the data from figure 1. The regions selected were South Tapanuli regency, Dairi, Asahan, West Phakpak, Simalungun, Karo, Humbang Hasundutan, Deli Serdang, Langkat, and North Tapanuli regency. According to Figure 1, North Tapanuli Regency is the region that produces the most pineapples. Researchers identified North Tapanuli Regency as the pineapple processing factory's location and selected it as the center point in the Dijkstra algorithm due to the disparate production figures.

Table 1. Areas that produce pineapples.

10 Pineapple Producing Regions in the Province of North Sumatra	
Tapanuli Utara	Karo
Humbang Hasundutan	Deli Serdang
Dairi	Langkat
Phakpak Barat	Simalungun
Asahan	Tapanuli Selatan

The researchers used Google Maps to determine the separation between producing areas. The researchers utilized the distance between the capitals of the districts and municipalities. The producing regions will become

vertices, and the distances will become edges, according to the researchers. Dijkstra's algorithm, based on the smallest vertex and edge, finds the shortest path.

We obtained the following results by using data from Figure 1 and distance measurements from Google Maps as input for the shortest route search process, which utilized the Dijsktra algorithm in the programming language:

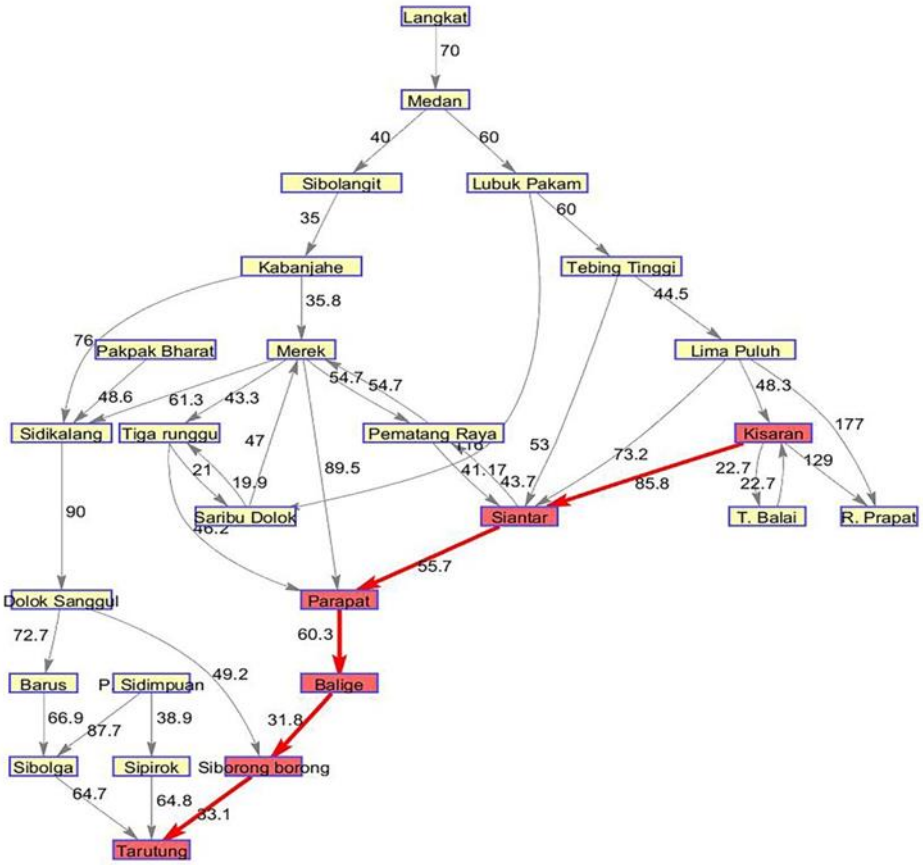

Figure 2. Dijkstra's Algorithm Implementation in Matlab

The Dijkstra Algorithm Programming form displays the cities' names and provides the following node descriptions:

Table 2. Description of Nodes

Node			
Node 1 : Medan	Node 8: Barus	Node 15 : Siantar	Node 22 : Tigarunggu
Node 2 : Langkat	Node 9 : Sibolga	Node 16 : Kisaran	Node 23 : Tanjung Balai
Node 3 : Sibolangit	Node 10 : Tarutung	Node 17 : Lima Puluh	Node 24 : Phakpak Barat
Node 4 : Kabanjahe	Node 11 : Siborongborong	Node 18 : Rantau Prapat	Node 25 : Pdg. Sidempuan
Node 5 : Merek	Node 12 : Balige	Node 19 : Tebing Tinggi	Node 26 : Sipirok

Node 6 : Sidikalang	Node 13 : Parapat	Node 20 : Lubuk Pakam
Node 7 : Dolok Sanggul	Node 14 : Pematang Raya	Node 21 : Saribudolok

After inputting the vertices and edges into the Dijkstra algorithm, the final results will be obtained. Several factors hinder the process of determining the ideal location for the pineapple processing factory.

a. Distance to factory location
b. Building construction permit
c. Distance to port for export

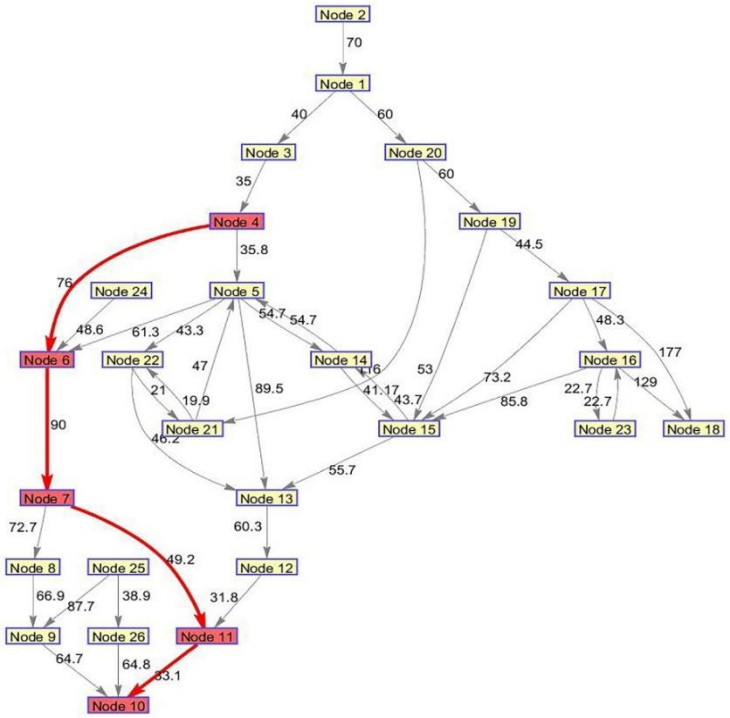

Figure 3. Shortest route from Karo Regency to North Tapanuli Regency

```
clear all
clc

jarak = [  60 40 116 60 35 76 35.8 90 72.7 66.9 64.7  44.5 53 73.2 48.3 177 8
5.8 22.7 129 43.7 55.7 43.3 61.3 89.5 54.7 60.3 31.8 49.2 33.1 23.5  21 46.2 22.7
41.17 54.7 23.5 19.9 70 48.6 87.7 38.9 64.8 ]

a= [ 1 1 20 20 3 4 4 6 7 8 9  19 19 17 17 17 16 16 16 15 15 5 5 5 5 13 12 7 11 21
22 22 23 14 14 21 21 2 24 25 25 26]

b= [ 20 3 21 19 4 6 5 7 8 9 10 17 15 15 16 18 15 23 18 14 13 22 6 13 14 12
 11 11 10 5  21 13 16 15 5 5 22 1 6 9  26 10 ]

DG= sparse (a,b,jarak)

h = view(biograph(DG,[],'ShowWeights','on'))
[dist,path,pred] = graphshortestpath(DG,4,10)
set(h.Nodes(path),'Color',[1 0.4 0.4])
edges = getedgesbynodeid(h,get(h.Nodes(path),'ID'));
set(edges,'LineColor',[1 0 0])
set(edges,'LineWidth',2)
```

Figure 4. Source Code in MATLAB

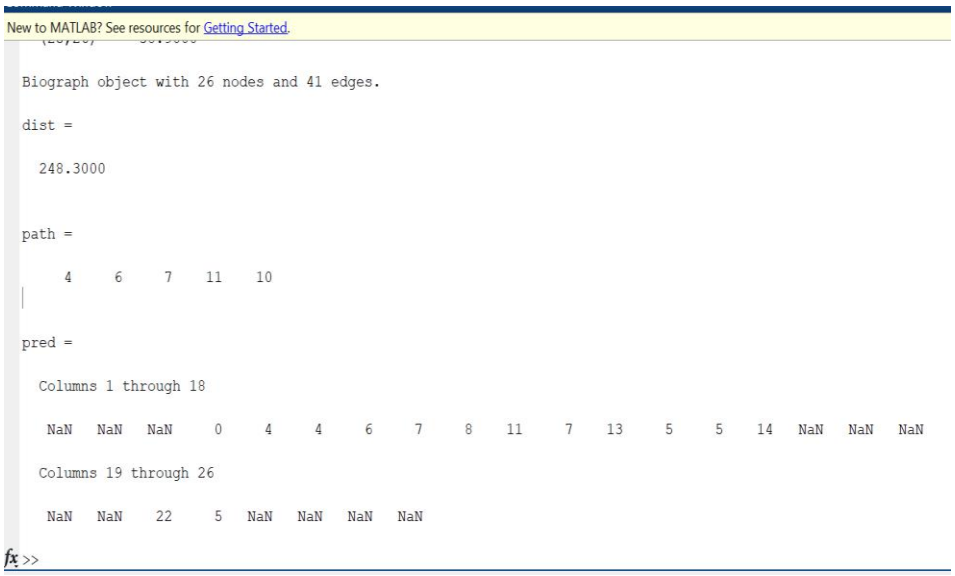

Figure 5. Distance, Steps, Prediction in MATLAB program

4. Conclusion

We determined the site of the pineapple processing factory based on the parameters for the quantity of pineapple production in the 2018–2019 timeframe. We determined the core location of the pineapple processing factory as the North Tapanuli Regency, using data from the North Sumatra Core Statistics Agency. The distance value, or the distance traveled from the origin vertex or node to the destination vertex or node with the shortest route from each producing area, is produced by utilizing the Dijkstra method with Matlab programming.

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