Distribution Optimization With The Transportation Method

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ABSTRACT

Indonesia has several potential plantation commodities, one of them is tea plant, because tea is one of the most consumed beverages in the world. West Java Province accounts for 70% of national tea production. The X Indah Tea Factory is one of the managers of tea from the results of the people's tea plantations located in Tasikmalaya, which supplies processed dried tea to various cities. The tendency of high distribution costs requires a combination of the right product allocation so that it can make distribution costs to be optimal (minimum cost). The transportation method is a method used to find the cheapest way to distribute products from several sources (distribution centers: factories, warehouses) to several destinations so that total transportation costs are minimized. The transportation method used is North West Corner, Least Cost and Vogel's Approximation Method (VAM) to find the initial problem resolution followed by the Stepping Stone method and Modified Distribution (MODI) to determine the optimum solution. Before using the Transportation Method, X Indah Tea Factory spent a distribution cost was IDR. 69,900,000,- in March 2019, after using the transportation method, the distribution cost was IDR. 64,400,000,- so the company saves distribution costs of IDR. 5,500,000 every month. This method is recommended that factories located in Bojonggambir should distribute dry tea only to Singaparna, Bandung, Sumedang and Purwakarta. Whereas the factory located in Bantarkalong should distribute the tea to Subang, Sukabumi and fulfill some of the requests from Purwakarta in order to achieve optimum distribution costs.

Keywords : distribution cost; transportation method; stepping stone; MODI; tea plant

ABSTRAK

Indonesia memiliki beberapa komoditas perkebunan yang potensial, salah satunya adalah tanaman teh, karena teh merupakan salah satu minuman yang paling banyak dikonsumsi di dunia. Provinsi Jawa Barat menyumbang 70% produksi teh nasional. Pabrik Teh X Indah merupakan salah satu pengelola teh hasil perkebunan teh rakyat yang berada di Tasikmalaya yang menyuplai olahan teh kering ke berbagai kota. Kecenderungan biaya distribusi yang tinggi membutuhkan kombinasi alokasi produk yang tepat sehingga dapat mengoptimalkan biaya distribusi (biaya minimum). Metode transportasi merupakan metode yang digunakan untuk mencari cara yang paling murah dalam mendistribusikan produk dari beberapa sumber (pusat distribusi: pabrik, gudang) ke beberapa tujuan sehingga total biaya transportasi dapat diminimalkan. Metode transportasi yang digunakan adalah North West Corner, Least Cost dan Vogel's Approximation Method (VAM) untuk mencari penyelesaian masalah awal diikuti dengan metode Stepping Stone dan Modified Distribution (MODI) untuk menentukan solusi yang optimal. Sebelum menggunakan Metode Transportasi, Pabrik Teh X Indah mengeluarkan biaya distribusi sebesar Rp. 69.900.000, - pada Maret 2019, setelah menggunakan metode transportasi, biaya distribusinya sebesar Rp. 64.400.000, - sehingga perusahaan menghemat biaya distribusi sebesar Rp. 5.500.000 setiap bulan. Cara ini disarankan agar pabrik yang berlokasi di Bojonggambir mendistribusikan teh kering hanya ke Singaparna, Bandung, Sumedang dan Purwakarta. Sedangkan pabrik yang berlokasi di Bantarkalong harus mendistribusikan teh ke Subang, Sukabumi dan memenuhi beberapa permintaan dari Purwakarta agar biaya distribusi bisa optimal.

Kata Kunci: biaya distribusi; metode transportasi; batu loncatan; MODI; tanaman teh.

INTRODUCTION

Indonesia is a country with a tropical climate that makes a variety of plants can flourish, so that Indonesia has several potential plantation commodities, one of them is a tea plant. Tea is one of the most consumed beverages in the world, although in Indonesia it only produces black tea and green tea, but the potential of tea plantations in Indonesia is quite good, as evidenced in 2014 Indonesia's tea exports ranks 7th in the world. During this time, Indonesian tea was exported to several countries such as Russia, Pakistan, the United States, United Arab Emirates, Germany, and the Netherlands. The provinces that produce the most tea are West Java, Central Java and North Sumatra. West Java Province is the largest tea producer in the country, more than 70% of the national tea plantation production is produced from the area, thus making tea a leading commodity in West Java Province. Areas of tea plantations are spread out among others are in Bandung, Sukabumi, Cianjur, Bogor, Perwakarta, Subang, Garut, Tasikmalaya, Ciamis, and Majalengka regencies. In Tasikmalaya, the area of community plantations reaches 9,283 hectares with a productivity of 13,238 tons (Statistik Komoditas Perkebunan Teh Indonesia, 2017). Bojonggambir Subdistrict, which is located in the southern Tasikmalaya Regency, is one of the big tea producers, because the area is indeed composed of many hills, so it is very suitable to be used as plantations, especially tea. Tea plantations in Bojonggambir District

are all smallholder plantations, there are several companies that manage tea factories. One of them is X Indah Tea Factory. X Indah is a company engaged in the field of small-scale public transportation and tea plantation. X Indah has two tea factories that process wet tea (tea directly picked without going through processing) into dry tea. The tea comes from community plantations and tea plantations owned by X Indah itself. X Indah's dried tea products are distributed to various cities in West Java, namely to the City of Tasikmalaya, Garut, Sukabumi, Bandung, Purwakarta, Sumedang and Subang. In accordance with the request to be made into finished products including tea packaging. The following is the assumption of the distribution costs of the Tea X Indah Factory presented in table 1.

Table 1st. Distribution Costs for X Indah Tea Factory

Time	Cost Distribution (IDR)
1 Month	70.000.000
1 Year	840.000.000

Distribution is one of the important aspects in a company, considering its role, which is to deliver products to consumers. So that distribution management must be good in order to be efficient because it will have an impact on distribution costs (Karo, 2015). Product distribution will depend on the capacity of the existing factory (Liu, Wang, & Xing, 2019), especially if the company has more than one factory and has to send products to more than one destination. Each company will try to form an intermediary structure or intermediary structure to achieve company goals. One of the company's goals is to deliver products to consumers with efficiency (Prasetyo, 2008; Sai-wei, Chen, Qi-hui, & Yu-mei, 2019; Wang, 2009). Distribution channels connect producers and consumers (Gultom, Hariyani, & Ismail, 2014). According to Tjiptono (2008: 187) Distribution channel is a route or series of intermediaries managed by marketers or independent, in delivering goods from producers to consumers. There are many ways to deliver products to consumers with a variety of distribution channels determined by the company. Companies can choose the direct distribution channel, the type of distribution channel where producers sell their products directly to consumers, or choose the indirect distribution channel, which is the type of channel where producers distribute their products using one or more intermediaries. (Kotler, 2009). The more intermediaries in the distribution channel, the higher the distribution costs will be (Dedeh & Lestari, 2018; Vieira, Mayerle, Campos, & Coelho, 2019), this will have an impact on the product selling price and the company's profit. Moreover, if a company has more than one distribution center, whether it is a factory or a warehouse, which must distribute its products to various destinations.

In general, optimization is looking for the best value from a number of choices, Optimization comes from English, namely Optimization which means optimal. Oxford Advanced Learner's Dictionary (2008: 358), Optimization is the process of finding the best solution to some problems where the "best" accords to prestated criteria. The point is optimization is the process of finding the best solution of a problem based on predetermined criteria. In line with that, Soekartawi in Karo (2015) states that optimization is an effort to achieve the best. From the above definition it can be seen that optimization is an activity to find the best solution in several problems, where the best one is in accordance with certain criteria. Distribution activities are one of the most important activities in a company, because distribution plays a role in delivering products from producers to consumers. Tjiptono (2008: 185) states that distribution is a marketing activity that seeks to facilitate and facilitate the delivery of goods and services from producers to consumers, so that their use is as needed. Distribution activities can make activities smoother and easier to carry out. Therefore it can be interpreted that distribution is the activity of moving or delivering products (goods or services) from producers to consumers. One technique for decision making in this case is transportation modeling or transportation methods. This transportation model deals with determining the lowest cost plan for sending one item from a number of sources (for example, factories) to a number of destinations. The purpose of this model is to determine the amount of goods that must be sent from each source to each destination so that total transportation costs can be minimized (Taha, 2008). The transportation method is the cheapest way to send or distribute goods from several sources to several destinations (Heizer & Render, 2009). So that transportation is a method used to determine the distribution from more than one distribution center to several destination points. So that with this method will be known how much the optimum distribution costs for company distribution.

The location of a factory, warehouse or distribution center is strategic with substantial cost implications, almost all companies that have more than one factory, warehouse or distribution center will consider and evaluate existing locations to meet the demand in several locations or points that are different, then to take a rational decision requires a number of techniques to help make decisions (Heizer & Render,

2009). One technique for decision making in this case is transportation modeling. According to Heizer & Render (2009), transportation modeling looks for the cheapest way to deliver goods from several sources to several destinations. The source referred to here can be in the form of a factory, warehouse or other point from which the goods are sent. While the intended destination is the location or points of recipients of goods. More than one distribution center location that has to meet several demand locations will produce various costs for each distribution at different locations (Heizer & Render, 2009). So that distribution costs tend to increase every year. To optimize (minimize) the cost of distribution, the transportation method is one method that can be used (Irwan & Yuniral, 2016). Taha (2008:203) states that the purpose of the transportation method is to determine the amount that must be sent from each source or to each destination so that the total transportation costs are minimized. Based on the description above. According to Iheonu & Inyama (2016) in his research conducted in Nigeria with the title "On the Optimization of Transportation Problem" states that the cost of distributing returnable glass bottles to companies can be reduced by 11.58% by using the VAM and MODI transportation methods. According to Primadiarta, Narto, & Achmadi (2017) in his research entitled "Optimization of Product Distribution with Transportation Methods Based on Product Demand at PT. XYZ Surabaya "states that the application of transportation methods for chlorine gas distribution costs is a minimum compared to distribution costs before using transportation methods. Furthermore, research conducted by Ardhyani (2017) entitled "Optimizing the Distribution Cost of Animal Feed by Using the Transportation Method (Case Study at PT X Krian)" states that the distribution of animal feed products at PT.X by using the transportation method obtained optimal results, the company can save distribution costs by IDR. 117,478,904, -. Likewise with research conducted by Nelwan, Kekenusa, & Langi (2013) entitled "Optimization of Water Distribution Using the Least Cost Method and Modified Distribution (Case Study of PDAM North Minahasa Regency) the results of the study showed that operational costs incurred before minimization were IDR. 603,364,240 and operational costs incurred after minimization using the least cost method of IDR. 588,814,656Simbolon, Situmorang, & Napitupulu (2014) in his research entitled "Application of Transportation Methods in Optimizing the Cost of Distribution of Poor Rice (RASKIN) at the Bulog Sub Divre Medan" states that by using the VAM method for the initial solution and MODI for the final solution, the total minimum distribution cost obtained is IDR.954,800,485 , 30, while with company calculations the total distribution costs obtained amounted to IDR.958,073,750.40, resulting in savings of IDR.3,273,265.10. The difference, this study uses the transportation method with the initial solution using the North West Corner, Least Cost and VAM methods, while the optimization test uses the Stepping Stone method and Modified Distribution on the distribution of dry tea in Tasikmalaya. So the aim of this study is to find out and assess distribution activities carried out by the company, distribution costs incurred by the company, data analysis using transportation methods, initial solutions that are feasible using the North West Corner method, Least Cost and Vogel's Approxation Method (VAM) and optimal solutions with the Stepping Stone method and Modified Distribution (MODI) in an effort to determine the optimal distribution costs. This study is entitled "Optimization of Distribution Costs by Using the Transportation Method (Case Study at X Indah Tea Factory in Tasikmalaya").

RESEARCH METHOD

The research method is a method used by researchers in gathering research data. The research method used in this study is descriptive quantitative approach. The use of this descriptive method is to analyze the results of the use of transportation methods at the X Indah Tea Factory. The transportation method used is North West Corner, Least Cost and Vogel's Approximation Method (VAM) to find the initial problem resolution followed by the Stepping Stone and Modified Distribution (MODI) method to determine the optimum solution with steps according to the explanation in the literature review, then compare the total distribution costs before using the transportation method and after using the transportation method.

RESULT AND DISCUSSION

Data Required

The X Indah Tea Factory has 2 factories located in Bojonggambir District and Bantarkalong District, Bantarkalong Regency with destinations in Singapore, Bandung, Subang, Sumedang, Sukabumi and Purwakarta.

1.   Amount of Dry Tea distributed and Factory Location (Source)

The following is data on the distribution of dry tea in March 2019 from factories in Bojonggambir and Bantarkalong.

Table: 2nd Number of Dried Tea Products Distributed in March 2019

Factory Location (P)	Amount of Dried Tea (Kgs)
Bojonggambir (P1)	86.000
Bantarkalong (P2)	70.000
Total	156.000

2. Number of Requests for Dry Tea and Destination Location

The X Indah Tea Factory distributes dried tea products to 6 regions namely Singapore, Bandung, Sumedang, Subang, Sukabumi and Purwakarta, which are presented in 3rd table below:

Table: 3rd Number of Demand for Dry Tea Products and Destination Locations

Destination (K)	One Time Demand Send (Kgs)	Demand Frequency in a month (time)	Total Demand in a Month (Kgs)
Singaparna (K1)	1.000	8	8.000
Bandung (K2)	5.000	8	4.0000
Sumedang (K3)	5.000	4	2.0000
Subang (K4)	5.000	8	4.0000
Sukabumi (K5)	4.000	4	16.000
Purwakarta (K6)	4.000	8	32.000
Total Demand			**156.000**

3. Transportation Costs

Each shipment of dried tea from the source or from the factory to various locations (cities) of destination has different transportation costs, these transportation costs include vehicle fuel and employee costs (driver and conductor) which are presented in 4th table.

Table: 4th Transportation Cost From Factory to Destination (IDR)

Sources \ Destination	Singaparna	Bandung	Sumedang	Subang	Sukabumi	Purwakarta
Bojonggambir	500.000	1.500.000	1.500.000	2.500.000	2.500.000	2.000.000
Bantarkalong	600.000	1.700.000	1.600.000	2.200.000	2.200.000	2.000.000

Selanjutnya dihitung biaya transportasi dari masing-masing pabrik ke seluruh kota tujuan untuk setiap kilogramnya.

Tabel: 5th Transportation Cost From Factory to Destination per Kilograms (IDR)

Sources \ Destination	Singaparna	Bandung	Sumedang	Subang	Sukabumi	Purwakarta
Bojonggambir	500	300	300	500	625	500
Bantarkalong	600	340	320	440	550	500

Calculation by Transportation Method

This transportation method is carried out in 2 stages, there are:

1.   Determine a feasible initial or feasible solution

The first step is to find a feasible or feasible initial solution using the North West Corner (NWC), Least Cost, and Vogel's Approximation Method (VAM) method.

2.   Perform Optimization Test

Furthermore, the results of a reasonable initial formula will be recalculated using the Stepping Stone and Modified Distribution (MODI) methods.

The following calculations are for the feasible initial solution stage and optimization test.

1.   Determine a feasible initial or feasible solution

a)   North West Corner (NWC) Methode

Table: 6th Calculation of the North West Corner Method

Destinantions / Sources	K1	K2	K3	K4	K5	K6	Supply
P1	500 / 8.000	300 / 40.000	300 / 20.000	500 / 18.000	625 / x	500 / x	86.000
P2	600 / x	340 / x	320 / x	440 / 22.000	550 / 16.000	500 / 32.000	70.000
Demand	8.000	40.000	20.000	40.000	16.000	32.000	156.000

So that the Total Cost obtained by the NWC method of:

= (500x8.000) + (300x40.000) + (300x20.00) + (500x18.000) + (440x22.000) + (550x16.000) + (500x38.000)

= IDR 65.480.000,-

b)   Least Cost Method

Table: 7th Calculation of The Least Cost Method

Destinantions / Sources	K1	K2	K3	K4	K5	K6	Supply
P1	500 / 8.000	300 / 40.000	300 / 20.000	500 / x	625 / x	500 / 18.000	86.000
P2	600 /	340 / x	320 / x	440 / 40.000	550 / 16.000	500 / 14.000	70.000
Demand	8.000	40.000	20.000	40.000	16.000	32.000	156.000

Source: X Indah Tea Factory (2019)

So that the Total Cost obtained by the Least Cost method of:

       = (500x8.000) + (300x40.000) + (300x20.00) + (440x40.000) + (550x16.000) + (500x18.000) + (500x14.000)

= IDR. 64.400.000,-

c)   Vogel's Approximation Methode (VAM) Method

d)

Table: 8th Calculation of The Vogel's Approximation Methode (VAM) Method

Destinantions / Sources	K1	K2	K3	K4	K5	K6	Supply	Difference in Cost in Lines
P1	500 / 8.000	300 / 40.000	300 / 20.000	500 / 18.000	625 / x	500 / x	86.000	200
P2	600 / x	340 / x	320 / x	440 / 22.000	550 / 16.000	500 / 32.000	70.000	20
Demand	8.000	40.000	20.000	40.000	16.000	32.000	156.000	
Cost Difference in Columns	100	40	20	60	75	0		

So that the Total Cost obtained by the Vogel's Approximation Methode (VAM) method of:
= (500x8.000) + (300x40.000) + (300x20.00) + (500x18.000) + (440x22.000) + (550x16.000) + (500x38.000)
= IDR. 65.480.000,-

2.   Optimization Test

An early solution that is not necessarily produce a maximum solution so it needs to be tested again with the optimization test to obtain the optimal solution.

a)   Stepping Stone Method

The Stepping Stone method is a continuation of the North West Corner (NWC) method in Table: 6 by filling in the previously unused lane. Closed Path calculation to find out which path should then be filled by looking at the largest minimum value:

a. P1 - K5 = +625 - 500 + 440 - 550 = 15
b. P1 - K6 = +500 - 500 +440 -500 = - 60 (Required path)
c. P2 - K1 = +600 - 500 + 440 - 500 = 40
d. P2 - K2 = +340 - 440 + 500 - 300 = 100
e. P2 - K3 = +320 - 440 + 500 - 300 = 80

Fill in the blank Paths on P1 to K6:

Table: 9th Calculation of The Stepping Stone Method

Destinantions / Sources	K₁	K₂	K₃	K₄	K₅	K₆	Supply
P1	500	300	300	500	625	500	
	8.000	40.000	20.000	x	x	18000	86.000
P2	600	340	320	440	550	500	
	x	x	x	40.000	16.000	14.000	70.000
Demand	8.000	40.000	20.000	40.000	16.000	32.000	156.000

Source: X Indah Tea Factory (2019)

So that the Total Cost obtained by the Stepping Stone method of:
= (500x80.00) + (300x40.000) + (300x20.000) + (440x40.000) + (550x16.000) + (500x140.00) + (500x18.000)
= IDR. 64.400.000,-

b)   Modified Distribution (MODI) Method

The Modified Distribution method is a continuation of the North West Corner (NWC) method in Table: 6 by filling in the path that has the largest positive improvement index.

Set the cost coefficient with b1 + kj, with the cost of sending Cij

Calculate Cij = Ui + Vj with row (Ui) and Column (Vj) values, with U1 = 0 for example or determined.

U1 + V1	= 0 + 500	= 500	→	V1 = 500
U1 + V2	= 0 + 300	= 300	→	V2 = 300
U1 + V3	= 0 + 300	= 300	→	V3 = 300
U1 + V4	= 0 + 500	= 500	→	V4 = 500
U2 + V4	= 440	= U2 + 500	= 440	→	U2 = -60
U2 + V5	= 550	= -60 + V5	= 550	→	V5 = 610
U2 + V6	= 500	= -60 + V6	= 500	→	V6 = 560

So that is obtained value U1 = 0, U2 = -60, V1 = 500, V2 = 300, V3 = 300, V4 = 500, V5 = 610, V6 = 560.

Next calculate the improvement index Iij = Ui + Vj-Cij for all non-base boxes. If Iij <0, then the solution is optimum.

I21	= U2 + V1 - C21	= -60 + 500 – 600	= -160
I22	= U2 + V2 - C22	= -60 + 300 – 340	= -100
I23	= U2 + V3 - C23	= -60 + 300 – 320	= -80
I15	= U1 + V5 – C15	= 0 + 610 – 625	= -15
I16	= U1 + V6 – C16	= 0 + 560 – 500	= 60

Iij value <0, then the results are optimum. Then select the value of Iij which has the largest positive value that is in I16 or the path that must be filled is the path from P1 to K6, to then be made a closed path with the same steps as in the Stepping Stone Method.
Fill in the blank Paths on P1 to K6

Table: 10th Calculation of The *Modified Distribution* (MODI) Method

Sources ╲ Destinantions	K₁	K₂	K₃	K₄	K₅	K₆	Supply
P₁	500 / 8.000	300 / 40.000	300 / 20.000	500 / x	625 / x	500 / 18000	86.000
P₂	600 / x	340 / x	320 / x	440 / 40.000	550 / 16.000	500 / 14.000	70.000
Demand	8.000	40.000	20.000	40.000	16.000	32.000	156.000

Source: X Indah Tea Factory (2019)

So that the Total Cost obtained by the Stepping Stone method of:
= (500x80.00) + (300x40.000) + (300x20.000) + (440x40.000) + (550x16.000) + (500x140.00) + (500x18.000)
= IDR. 64.400.000,-

Discussion of Calculation of Transportation Methods

X Indah Tea Factory is a dry tea manufacturing company that distributes dry tea to several companies in 6 cities namely Singaparna, Bandung, Sumedang, Subang, Sukabumi and Purwokerto which are distributed from 2 different factory locations, the first located in Bojonggambir and the second located in Bantarkalong. When the company does not use the Transportation Method, the total shipping cost to 6 cities with 2 different factory locations is IDR. 68,000,000, - with the following details:

Table: 11st Allocation of Shipment from Bojonggambir Factory to Various City Destinations Before Using the Transportation Method

Destinations	One Time Shipping Fee	Shipping Frequency (Times)	Cost Distributions (IDR)	One Time Amount (Kgs)	Total One Month Delivery (Kgs)
Singaparna	500.000	3	1.500.000	1.000	3.000
Bandung	1.500.000	3	4.500.000	5.000	15.000
Sumedang	1.500.000	0	-	5.000	-
Subang	2.500.000	8	20.000.000	5.000	40.000
Sukabumi	2.500.000	4	10.000.000	4.000	16.000
Purwakarta	2.000.000	3	6.000.000	4.000	12.000
Total Shipping Costs			42.000.000		86.000

Tabel: 12nd Allocation of Shipment from Bantarkalong Factory to Various Destination Cities Before Using the Transportation Method

Destinations	One Time Shipping Fee	Shipping Frequency (Times)	Cost Distributions (IDR)	One Time Amount (Kgs)	Total One Month Delivery (Kgs)
Singaparna	600.000	5	3.000.000	1.000	5.000
Bandung	1.700.000	5	8.500.000	5.000	25.000
Sumedang	1.600.000	4	6.400.000	5.000	20.000
Subang	2.200.000	0	-	5.000	-
Sukabumi	2.200.000	0	-	4.000	-
Purwakarta	2.000.000	5	10.000.000	4.000	20.000
Total Shipping Costs			27.900.000		70.000

The total shipping cost from the factory in Bojonggambir is IDR. 42,000,000, - and from the Bantarkalong Factory is IDR. 27,900,000 so that the total cost without using the transportation method is IDR 68,000,000. After using the Transportation method, the most optimum distribution fee is IDR. 63,308,000, - thus saving distribution costs by IDR. 69,900,000 - IDR. 64,400,000 = IDR 5,500,000 every month. The route that should be used based on the most optimum method of transportation is:

Tabel: 13rdDelivery Allocation from Bojonggambir and Bantarkalong Factories to Various Destination Cities After Using Transportation Methods

Jalur (Pabrik ke Kota Tujuan)	Jumlah Satu Kali Kirim (Kg)	Total Pengiriman (Kg)	Frekuensi Pengiriman (Kali)	Biaya Pengiriman (Rp)	Total Biaya Pengiriman (Rp)
Bojonggambir - Singaparna	1.000	**8.000**	8	500.000	4.000.000
Bojonggambir - Bandung	5.000	**40.000**	8	1.500.000	12.000.000
Bojonggambir - Sumedang	5.000	**20.000**	4	1.500.000	6.000.000
Bojonggambir - Purwakarta	4.000	**18.000**	4,5	2.000.000	9.000.000
Bantarkalong - Subang	5.000	**40.000**	8	2.200.000	17.600.000
Bantarkalong - Sukabumi	4.000	**16.000**	4	2.200.000	8.800.000
Bantarkalong - Purwakarta	4.000	**14.000**	3,5	2.000.000	7.000.000
Total Teh Kering yang Dikirim		**156.000**	**Total Biaya**		**64.400.000**

With this method it is recommended that the factory which is based on Bojonggambir should distribute dry tea only to Singaparna, Bandung, Sumedang and Purwakarta. Whereas the factory located in Bantarkalong should distribute the tea to Subang, Sukabumi and fulfill some of the requests from Purwakarta in order to achieve optimum distribution costs. The company will save distribution costs by IDR. 5,500,000 for each month. The optimum distribution cost is obtained by the Optimum Test method, namely the Stepping Stone method and the Modified Distribution method. The results of this study are consistent with research conducted by Ardhyani (2017) entitled "Optimizing the Distribution Costs of Animal Feed Using the Transportation Method (Case Study at PT X Krian)" states that the distribution of animal feed products at PT.X by using the transportation method obtained optimal results, the company can save the distribution costs of IDR. 117,478,904, -. Likewise with research conducted by Nelwan, Kekenusa, & Langi (2013) entitled "Optimization of Water Distribution Using the Least Cost Method and Modified Distribution (Case Study of PDAM North Minahasa Regency) the results of the study showed that the operational costs incurred before minimization were IDR. 603,364,240 and operational costs incurred after minimization using the least cost method of IDR. 588,814,656. Simbolon, Situmorang, & Napitupulu (2014) in his research entitled "Application of Transportation Methods in Optimizing the Cost of Distribution of Poor Rice (RASKIN) at the Bulog Sub Divre Medan" states that by using the VAM method for the initial solution and MODI for the final solution, the minimum total distribution cost obtained is IDR.954,800,485 , 30, while with company calculations the total distribution costs obtained amounted to IDR.958,073,750.40, resulting in savings of IDR.3,273,265.10.

CONCLUSION

Distribution is one of the company's main activities to meet consumer needs, so distribution costs are important to reduce company costs. The X Indah Tea Factory has two different factory locations in Kecamatn namely Bojonggambir and Bantarkalong Districts, while shipping to several related cities to Singapore, Bandung, Sumedang, Subang, Sukabumi and Purwakarta. Before using the Transportation Method, X Indah Tea Factory spent a distribution fee of IDR. 69.9 million, - in March 2019, after using the transportation method the cost was IDR. 64,400,000, so the company saves distribution costs of IDR. 5,500,000. With this

method, it was agreed that the approved factory, Bojonggambir, would allow dry tea only for Singaparna, Bandung, Sumedang and Purwakarta. Meanwhile, the factory located in Bantarkalong can be accessed to Subang, Sukabumi and fulfills most of the requests from Purwakarta in order to achieve optimal distribution costs.

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REFERENCES

Ardhyani, I. W. (2017). Mengoptimalkan Biaya Distribusi Pakan Ternak Dengan Menggunakan Metode Transportasi (Studi Kasus di PT. X Krian). *Teknika : Engineering and Sains Journal*, *1*(2), 95–100. https://doi.org/10.5281/zenodo.1116483

Dedeh, & Lestari, R. M. (2018). Pengaruh biaya saluran distribusi terhadap volume penjualan. *AKUISISI Journal Akuntansi*, *14*(1), 37–43.

Gultom, T. S. S., Hariyani, & Ismail, H. Z. (2014). Pengaruh Merek, Saluran Distribusi Terhadap Kepuasan Pelanggan, Loyalitas Pembelian Produk Aqua (Studi Kasus Pada PT. Bintang Suryasindo Cabang Pangkalpinang Bangka). *Jurnal Ilmiah Progresif Manajemen Bisnis (JIPMB)*, *1*(1), 1–11.

Heizer, Jay & Barry Render. 2009. *Operations Management*. Edisi Sembilan. Jakarta: Salemba Empat.

Kotler, Philip. 2009. *Manajemen Pemasaran*. Jakarta: Erlangga.

Iheonu, N. O., & Inyama, S. C. (2016). On The Optimization Of Transportation Prolem. *British Journal of Mathematics & Computer Science*, *13*(4), 1–11. https://doi.org/10.9734/BJMCS/2016/17279

Irwan, H., & Yuniral. (2016). Optimasi Penjadwalan Produksi Dengan Metode Transportasi. *PROFISIENSI*, *4*(2), 79–89.

Karo, N. B. (2015). Analisis Optimasi Distribusi Beras Bulog DI Provinsi Jawa Barat. *Jurnal OE*, *VII*(3), 252–270.

Liu, L., Wang, H., & Xing, S. (2019). Optimization of distribution planning for agricultural products in logistics based on degree of maturity. *Computers and Electronics in Agriculture*, *160*(February), 1–7. https://doi.org/10.1016/j.compag.2019.02.030

Nelwan, C., Kekenusa, J. S., & Langi, Y. (2013). Optimasi Pendistribusian Air Dengan Menggunakan Metode least Cost dan Metode Modified Distribution (STudi Kasus: PDAM Kabupaten MInahasa Utara). *Jurnal Ilmiah Sains*, *13*(1).

Prasetyo, S. B. (2008). Analisis Efisiensi Distribusi Pemasaran Produk Dengan Metode Data Envelopment Analysis (DEA). *Jurnal Penelitian Ilmu Teknik*, *8*(2), 120–128.

Primadiarta, A. S., Narto, & Achmadi, F. (2017). Optimasi Distribusi Produk Dengan Metode Transportasi Berdasarkan Permintaan Produk Di PT. XYZ Surabaya. *Prosiding SNST Ke 8*.

Oxford Advanced Learner's Dictionary. 2008. Oxford University Press.

Sai-wei, L. I., Chen, Z. H. U., Qi-hui, C., & Yu-mei, L. I. U. (2019). Consumer confidence and consumers ' preferences for infant formulas in China. *Journal of Integrative Agriculture*, *18*(8), 1793–1803. https://doi.org/10.1016/S2095-3119(19)62589-X

Simbolon, L. D., Situmorang, M., & Napitupulu, N. (2014). Aplikasi metode Transportasi Dalam Optimasi Biaya Distribusi Beras Miskin (Raskin) Pada Perum Bulog Sub Divre Medan. *Saintia Matematika*, *02*(03), 299–311. https://doi.org/10.1039/JR9550002326

Statistik Perkebunan Komoditas Teh Indonesia. 2017. http://ditjenbun.pertanian.go.id/tinymcpuk/gambar/file/statistik/2017/Teh-2015-2017.pdf. Downloaded on 1st August 2018.

Taha, Hamdy A. 2008. Riset Operasi Suatu Pengantar.. Jilid 1. Jakarta: Binarupa Aksara.

Tjiptono, Fandy. 2008. Strategi Pemasaran. Yogyakarta: Andi.

Vieira, B. S., Mayerle, S. F., Campos, L. M. S., & Coelho, L. C. (2019). Optimizing Drinking Water Distribution System Operations. *European Journal of Operational Research*. https://doi.org/10.1016/j.ejor.2019.07.060

Wang D. 2009. Dairy industry lost 20 billion because of melamine scandal: Mengniu and Yili face heavier pressure. [2018-428]. http://news.hexun.com/2008-10-31/110843063.html (in Chinese