

Optimization of Transportation Model based on Agricultural Products available in Maharashtra Region

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Abstract:

Good transport system is equally important as compared to any agricultural marketing. While analyzing transport of agriculture products, it is identified that transport costs has critical role in recognizing the link between accessibility and agricultural development. The objective of this research work is to provide an initial basic feasible solution and an optimum solution by using the scientific methods of the transportation model which reduce the cost of transportation. The application serves to plan the optimum strategies with respect to the available demand and supply of agriculture products in Maharashtra region.

Keywords: Transport System, Optimum strategies, Demand and Supply.

I. INTRODUCTION

The Maharashtra State Agricultural Marketing Board (MSAMB), Pune was established in the year 1984. It follows the provision of Maharashtra Agricultural Produce Marketing (Development and Regulation) Act, 1963, Section 39(J). The primary objective of this board is to build an infrastructure of market warehouses where the evenly balanced agriculture products of the state can be made available. The state transport facilities can boost up so that the agricultural products can be feasible in terms of storage, trade, import, export etc. The demographic of the Maharashtra state includes 36 states divided into 5 major geographical areas namely, Vidharbha Region in east, Khandesh in northwest, Paschim Maharashtra in south, Marathwada in south east, Konkan belt in East. The major Agricultural products can be divided in four categories. Food mainly includes grains, cereals, fruits, vegetables etc. Fuel mainly includes Ethanol produced from corn and sugarcane. Fiber is related to cotton crop and the last Raw material with livestock feed. The scope of this research work in terms of Source is the selection of major market places associated with nine products involving 5 from food, one each from

remaining three and additional of seafood. The 10 major market places, two each from the five subdivisions serve the parameter of destination market. In view of the cell value for road transport, the kilo-meters distance based on state highway and national highway path are considered. This does not involve the actual cost of one standard size of truck carrier, as it goes on changing as per the union prices. The annual reports of MSAMB, 2017-18[1] and 2018-19[2] was the base to put on the supply capacity of production. The demand or the requirements are based on the available trade figures from the local markets and the population composition ratio of the region. Both demand and supply are units in metric tons.

II. Literature Survey

The facts and figures available in the various annual reports, their objectives and goals were studied to build up the transportation model. This section has been divided into two parts where the first part talks about the available data to develop the transportation model. The next section covers the technical aspects of transportation model in the domain of Operations Research. Kalpit Vadnerkar and Dr. Manoj E. Patil reflected the figures in percentage of the top 10

agricultural crops, fruits grown in the Maharashtra Region. This helps in finding the market places of sources from where the distribution can be planned [3]. K.P. Kulkarni, ZainabSharief, M.C. Jadhav and Seema have worked on the cotton production in Maharashtra state using a time series model, which helped us in regulating the demand and supply figures for the current session [4]. A. Mottet et al. gave glimpses for anew sector of agricultural product under raw material i.e. Livestock. The paper talks about the utility and influence of Livestock as an agricultural product [5]. Nanda Kasabe in her blog highlighted about the recent development of Maharashtra government of setting up six clusters to boost up the farm export of the region. This provides to identify the destination parameter in terms of warehouses market places for our transportation model [6]. P. Biswas on the same lineshas talked about infrastructural and logistical investment plans of the Maharashtra government in the identified clusters of export zone [7].Dr. Shraddha Mishra provided the comparative study of various methods for solving the transpotation model problem. All the methods were used to generate the initial basic feasible solution [8]. Amir Abbas Shojaie and HosseinRaoofpanah used the approach Fuzzy logic to optimize a multi- objective function based on green transportation. The solution was given to the uncertainty in demand and supply and the transportation cost [9]. Survey paper by Ruchi Gupta and Nikita Gulati explores about the various techniques to find initial basic feasible solution for the transportation problem. A comparative analysis provides the pro and cons of each approach towards the optimal solution [10]. S. Vimala, K. Thiagarajan and A. Amaravathy in their recent study had provided an innovative approach to solve the traditional transportation problems. They have used the concept of max-max approach which can handle the degeneracy situations [11]. M. L. Aliyu et al., worked on their application problem based on cement transportation data and solved their transportation problem by using R programming as well as TORA software [12].

III. Research Methodology

The objective of the transportation model is to find the minimum transportation cost. The solution begins with finding the initial basic feasible solution by using the traditional three methods viz-

- i. Northwest Corner rule
- ii. Least Cost Cell method
- iii. Vogel approximation method.

The unique Optimum solution can be found by using

- i. Stepping Stone method
- ii. Modified Distribution method

The model under this study comprises of Nine Sources, Ten Destinations and is a case of unbalanced transportation problem since the demand total and the supply total are not equal. A Dummy Source is included which does not affect the objective function.

IV. Transportation model and its solution

The transportation model based on the agricultural products available in Maharashtra region is given in the following table.

Table no. 1 Transportation Model for Agricultural Products

		Destination Markets									Supply (in tons)	
		Nagpur	Alona	Nashik	Jalgaon	Ahmednagar	Nanded	Pune	Satara	Ratnagiri		Mumbai
Sources of Agricultural Products	Bananas (Bhusawali)	410	160	273	27	275	338	397	492	695	438	1640
	Grapes (Nashik)	660	412	10	247	187	468	211	330	532	166	3120
	Mangoes (Ratnagiri)	1004	792	537	746	426	621	318	210	10	342	1260
	Onion	622	398	60	205	143	406	21	335	537	225	4150

(L asa lga on)							6					
Or an ge s (N ag pu r)	5	25 1	64 1	43 0	590	34 4	7 1 3	80 7	100 4	84 3	18 50	
Su gar ca ne (S ata ra)	80 7	56 4	32 8	53 7	200	48 6	1 1 0	5	210	25 6	92 70	
Co tto n (N an de d)	34 4	21 8	46 8	34 7	320	5	4 4 2	48 6	621	57 3	96 30	
Li ve St oc k (P un e)	71 3	48 8	21 1	42 1	123	44 2	5	11 0	210	15 0	21 20	
Se aF oo d (M um bai)	84 3	57 7	16 6	41 2	253	57 3	1 5 0	25 6	342	10	94 0	
De ma nd (in m.t on s)	41 50	36 50	33 50	22 00	375 0	32 00	4 6 5 0	31 00	245 0	52 00	33 98 0/ 35 70 0	

The cell values are considered as the distance in kilometers based on the connected state highways and the national highways. From the above table demand total is greater than the supply total. This was observed due to the increase in outside export of many agricultural products like sugarcane, mangoes, grapes etc. SeaFood is the emerging dimension where the demand is gradually increasing inside the Maharashtra region. Using TORA software following table provides the comparative results for the initial basic feasible solution.

Table no. 2 Comparative results for initial basic feasible solution

Sr. No.	Method	Minimum Transportation cost	No. of Iteration required for Optimum solution
1	North-West Corner Rule	13773300	17
2	Least Cost Cell Method	4056810	5
3	Vogel's Approximation Method	3760950	4

The above table interprets that the Vogel's Approximation method provides the least initial basic feasible solution among all three methods. North-West Corner Rule method can affect the result if any of the column or row entity is interchanged and hence is not a considerable result in this research study. Least cost cell method can an alternative solution as it has reduced the Transportation cost unit by one third as compared to the previous method. The final estimate of the transportation cost can be obtained multiplying by the standard cost of a truck carrier and the miscellaneous tax including the GST, toll tax etc.

Since above three methods provide the initial basic feasible solution and only provide the number of allocations, the provision for obtaining the optimum solution can be verified. The summary for the unique optimum solution using Modified Distribution method is given in the following table. The first column is for sources, second column is of allocated Destination. Third column reflect the amount shipped from sources to destination in terms of allocated units. Fourth column of Obj. Coeff is the distance in kilometers and the last column is the individual contribution for calculating the optimum transportation cost.

Table no. 3 Summary for Optimum Solution based on Modified Distribution method.

TRANSPORTATION MODEL OUTPUT SUMMARY

Title: TP

Final Iteration No.: 4

Objective Value (minimum cost) =3641460.

From	To	Amt
Shipped	ObjCoeff	ObjContrib
S1: Banana(Bhusawal)	D4: JALGAON	1640
	27	44280
S2: Grapes(Nashik)	D3: NASHIK	3030
	10	30300
S2: Grapes(Nashik)	D10: MUMBAI	90
	166	14940
S3: Mangoes(Ratnagiri)	D9: RATNAGIRI	1260
	10	12600
S4: Onion(Lasalgaon)	D3: NASHIK	320
	60	19200
S4: Onion(Lasalgaon)	D4: JALGAON	80
	205	16400
S4: Onion(Lasalgaon)	D5: AHMD_NAGAR	3750
	143	536250
S5: Oranges(Nagpur)	D1: NAGPUR	1850
	5	9250
S6: Sugarcane(Satara)	D7: PUNE	4650
	110	511500
S6: Sugarcane(Satara)	D8: SATARA	3100
	5	15500
S6: Sugarcane(Satara)	D9: RATNAGIRI	1190
	210	249900
S6: Sugarcane(Satara)	D10: MUMBAI	330
	256	84480
S7: Cotton(Nanded)	D1: NAGPUR	2300
	344	791200
S7: Cotton(Nanded)	D2: AOKLA	3650
	218	795700
S7: Cotton(Nanded)	D4: JALGAON	480
	347	166560
S7: Cotton(Nanded)	D6: NANDED	3200
	5	16000
S8: LiveStock(Pune)	D10: MUMBAI	2120
	150	318000
S9: SeaFood(Mumbai)	D10: MUMBAI	940
	10	9400
S10: Dummy	D10: MUMBAI	1720
	0	0.

The above table indicates that the optimum transportation cost estimate to be 3641460. As compared to Vogel approximation method the transportation cost is further reduced by a cost of 119,490. The summary indicates that Sources for Banana, Mango, LiveStock and SeaFood supports their best single respective destinations. Grapes requires two i.e. Nashik and Mumbai. Remaining for Onion, sugarcane and Cotton requires Four Destination each. The unbalanced unit of 1720 has been allocated to the Mumbai destination which does not affect the objective function of the Transportation cost.

V. Conclusion

The main purpose of this paper was to present a model for optimizing the transportation cost based on agricultural products of the Maharashtra region. Having used scientific methods of operations research and theorized various models for restrictions imposed due to various factors we can conclude that our model helps in reducing the cost estimate.

The model presented here can help in overcoming many issues and constraints associated with transportation of agriculture products. If transport services are uncommon, agriculturalists will be at a disadvantage when they try to sell their crops. Seasonally blocked roads or slow and infrequent transport services, along with poor storage, can lead to losses as certain produces, deteriorate quickly over time. If agricultural produce is transported through rough roads then the crops like bananas, mangoes or even sea food may also suffer losses from bruising. This will also result in lower prices to the agriculturalist. Thus the agency involved in this process can plan accordingly to focus on the prominent sources and the respective destinations of the region.

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