THE IMPACT OF TRANSPORTATION COST ON POTATO PRICE: A CASE STUDY OF POTATO DISTRIBUTION IN BANGLADESH

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Abstract

Potato is an important vegetable crop in Bangladesh primarily grown by resource-poor farmers. Among the major staple foods of the world, the status of potato is third. It is rich in calories and carbohydrates. Potato is the vegetable crop grown in the winter season; though it is used throughout the year. Therefore, at the end of the season consumer have to pay high price. To keep the price reasonable, it necessary to reduce the total cost. Transportation cost incurs a significant in the cost function. If transportation cost can be minimized, the total cost will automatically be reduced. To minimize the transportation cost, Least Cost Model has been used in the paper. The model also helps show the movement of potato to and from among the regions.

Keyword: Potato producing region, transportation cost, transportation model, least cost model.

1. *Introduction:*

Bangladesh, the most densely populated country in the world, produces substantial quantity of potato. Potato is said to be one of the most important vegetables and cash crops. It is entitled as the alternative food in our country. Every household in our country is related with this product. It contributes a substantial amount carbohydrates and calories in our body.

In Bangladesh, every year 8 million tons potato produced on average. Most of the potatoes are produced in Bogra, Rajshahi, Dinajpur, Rangpur, and Comilla region mainly. Potato is produced in the rest of the regions as well, but the quantity is not sufficient to fulfill the local demand. These five major producing regions at first store the potatoes and then supply to scarce regions over the year. Farmers store potatoes in two ways: Local System and Cold Storage System. The number of cold storage is meager to store all the produced potatoes. Electricity is an important input in cold storage system. Cooling machine is operated by electric power. If electricity supply is interrupted, the temperature in the cold storage may increase. Due to increase in temperature, potato respiration and microbial activity may also increase resulting in the spoilage of potato. During load shedding, potato storing-chamber becomes dark and this is why loading, unloading, bag checking, inversion, etc. gets hampered

The last year they grew about 10 million tons of potato, the highest ever national output. The growers are getting Tk 5.0 to Tk 6.0 per kg, whereas the consumers have to pay Tk 13.0 to Tk 14.0 in the retail market. Only three million tons of potato could be stored in the cold storages. It indicates that a large quantity of potato will rot due to lack of storage space.

The consumers have to pay a high price at the end of the season every year. Last year potato was sold at a maximum price of Tk 36 per kg in Dhaka retail market. But the growers did not get the due price or any added benefit. The government should set up 65 cold storages to mitigate the spoilage in potato growing areas. A 10.000 tons cold storage could be set up by Bangladesh Agriculture Development Corporation (BADC) in each district to support the growers. It would prevent the wastage and provide a reasonable price for both the growers as well as the consumers. There should be facilities to store potato seeds of BADC for the next crop.

Transportation is another important factor to keep the price at par. Significant amount of cost incurs during transportation leading to a higher price of potato. The transportation model is a special class

of linear program that deals with shipping a single homogeneous commodity from several sources (e.g., factories) to different destinations (e.g., warehouses). The objective is to determine the shipping schedule that minimizes the total shipping cost while satisfying supply and demand limits. The two common objectives of such problems are either (i) to minimize the cost of shipping m units to n destinations or (ii) to maximize the profit of shipping m units to n destinations [Md Sharif et al 2011].

The government should initiate a project under BADC to keep up potato production year after year. Supportive price followed by good seeds and quality fertilizers would certainly encourage the growers.

2. *Methodology:*

With today's ever-increasing costs, knowing our total cost of potato is more important than ever. To find the total cost (TC) of potatoes, some cost levels can be identified as given in the following equation

Total cost = PC + SC + TC, where   PC = Production Cost

SC = Storage Cost

TC = Transportation Cost

3. *Production Cost:*

In production level, the costs incurred stretches from crop inputs to machinery costs, land value, taxes, etc. These types of cost are considered as fixed cost (FC). A farmer determines the production cost allocating expenses according to the following equation. Once potatoes commodity expenses are identified, total production cost as well as the cost per acre and per cwt can be calculated as follows:

PC = FC + S + L + F; where   S = Seed

L = Labor

F = Fertilizer

4. *Storage Cost:*

As mentioned earlier, there are the two ways for storing potatoes: Local System and Cold Storage System. In local system, it is cost effective but very risky. Here, farmers use a large space to store potatoes using chemicals. Here they incur costs as below: have to allocate House rent (H), Chemical C), and Labor (L) to take care of it.

SC = H + C + L; where   H = House Rent

C = Chemical

L = Labor

In case of Cold Storage System, the storage cost equation takes the form of following equation: Electricity (E) cost, Labor (L) cost, Repair and Maintenance (Rm) cost, and Fuel and oil (Fu) cost are considered.

SC = E + L + Rm + Fu; where   E = Electricity

L = Labor

Rm = Repair and Maintenance

Fu = fuel and oil

5. *Transportation Cost:*

Transportation cost means the necessary cost to shift potato from producing area to non producing area. To determine this cost, the equation below gives a realistic view:

TC = Fu + L + Tf; where   Fu = Fuel

L = Labor

Tf = Toll or Ferry

All of the costs discussed above depend on the quantity of potato. Transportation cost additionally considers the distance among producing areas to non-producing areas. Therefore, it is necessary to find out from which regions potatoes are collected. Transportation modeling indicates the supplies from several origins to several destinations. *Origin points* (or *sources*) can be factories, warehouses, car rental agencies, or any other point from which goods are shipped. *Destinations* are points from where goods are received. To use the transportation model, following facts are deemed important:

1. The origin points and the capacity of supply per period at each.

2. The destination points and the demand per period at each.

3. The cost of shipping one unit from each origin to each destination.

The transportation model is actually a class of linear programming models discussed in Quantitative Model. As it is for linear programming, software is available to solve transportation problems. To use such programs properly, the assumptions underlying the model need to be understood thoroughly. Least Cost Method is one of the important models to solve such problems. It shows an efficient way to collect potatoes from producing region and distribute those to non-producing region. Following steps must be fulfilled to apply the Least Cost Method:

1. Identify the cell with the lowest cost
2. Allocate as many units as possible to that cell without exceeding supply or demand; then cross out the row or column (or both) that is exhausted by this assignment
3. Find the cell with the lowest cost from the remaining cells
4. Repeat steps 2 and 3 until all units have been allocated

6. *Data Analysis and Result Discussion:*

The secondary data on agricultural production of Bangladesh in 2011 have been collected directly from Bangladesh Bureau of Statistics (BBS); situated in Agargoan Sher-e-Bangla Nagar, Dhaka. BBS usually preserves all types of information especially about agricultural production on seven divisions of Bangladesh. Moreover, they have available data on potato production for all of the districts of Bangladesh. Based on the geographic location and favorable weather for potato cultivation, BBS divided the whole country into 23 regions. Among these 13 regions produce almost 85% of total harvest and disburse to rest of the regions all around the country.

In this study, the demand of each region is considered based on population of respective region. The population of each region is collected from Population & Housing Census-2011.

According to Bangladesh Cold Storage Association (CSA), 3 million tons of potato is stored in cold storages and 4 million tons is stored locally. Most of the cold storages are located in potato producing region. That is why, here in the report, the transportation cost from potato-surplus area to potato-deficit area has been considered. While doing this, it is a must to fulfill the local demand of producing region. Soon after that it is possible to serve rest of the deficit regions with surplus production. This surplus amount of production is known as the capacity of these regions. The relevant information is given below:

Region	Population	Demand	Production	Surplus	Units (Appr)
Bandarban Region	383000	22407.46	3758	-18649	-3730
Chittagong Region	9784000	572414	56464	-515950	-103191
Comilla Region	10505000	614596.2	631470	16873.8	3374
Khagrachari Region	608000	35571.11	3569	-32002	-6400
Noakhali Region	6203000	362907.2	4888	-358019	-71603
Rangamati Region	596000	34869.05	3334	-31535	-6307
Sylhet Region	9808000	573818.1	44065	-529753	-105950
Dhaka Region	23106000	1351819	1262407	-89412	-17882
Faridpur Region	6351000	371566	31853	-339713	-67942
Jamalpur Region	3599000	210559.9	149354	-61206	-12241
Kishoregonj Region	5060000	296035.9	46171	-249865	-49972
Mymenshing Region	5042000	294982.8	40285	-254698	-50940
Tangail Region	3571000	208921.8	41948	-166974	-33395
Barisal Region	5748000	336287.4	83146	-253141	-50628
Jessore Region	6126000	358402.3	80820	-277582	-55516
Khulna Region	5728000	335117.3	70310	-264807	-52961
Kustia Region	3708000	216937	110590	-106347	-21270
Patuakhali Region	2399000	140353.8	36152	-104202	-20840
Bogra Region	4280000	250401.9	1674798	1424396	284879
Dinajpur Region	5331000	311890.8	1118484	806593	161318
Pabna Region	5569000	325815	34527	-291288	-58258
Rajshahi Region	8480000	496123.3	1056697	560574	112114
Rangpur Region	10334000	604591.8	1741299	1136707	227341

Table-1:- Population, production and demand of different regions

In the table above, the highlighted regions have surplus potato after fulfilling their local demand. The negative figures indicate the deficit regions where production is insignificant enough to meet demand. In this paper, shifting potato from highlighted regions to negative-figured regions is the major task. Usually, trucks are used to transport potatoes to and from the regions. The capacity of

each truck is 5 tons. Thus, each truck is defined as one unit (5 tons=1 unit) and fractions are ignored in order to avoid complexity. Uddin S. M. et al (2011) calculated the average transportation cost from the perspective of Bangladesh and found the cost Tk 10 per kilometer for shifting one unit. The distance (Source: Google Map) between producing regions to non producing region are shown below;

	Band	Cttg	Khag	Noak	Rang	Syl	Dhk	Frd	Jama	Kish	Mym	Tang	Bari	Jess	Khul	Kust	Patu	Pabn
Comilla	175	167	91	95	243	257	97	241	205	115	290	157	373	370	431	373	160	257
Bogra	430	492	350	420	568	575	229	356	110	170	422	140	438	320	381	224	315	158
Dinajpur	526	678	440	605	753	760	414	541	152	253	607	210	673	549	566	609	405	343
Rajshahi	440	534	372	462	610	616	270	269	150	221	464	133	401	233	265	137	280	109
Rangpur	496	599	403	526	675	681	335	462	115	213	528	180	594	426	488	330	395	264

Table-2:- Distance (in Kilometer) between producing and non producing regions

Now to find the transportation cost each of the distance need to be multiplied with Tk. 10. The matrix table indicating transportation cost is given below:

	Band	Cttg	Khag	Noak	Rang	Syl	Dhk	Frd	Jama	Kish	Mym	Tang	Bari	Jess	Khul	Kust	Patu	Pabn	Capacit
Comilla	1750	1670	910	950	2430	2570	970	2410	2050	1150	2900	1570	3730	3700	4310	3730	1600	2570	3374
Bogra	4300	4920	3500	4200	5680	5750	2290	3560	1100	1700	4220	1400	4380	3200	3810	2240	3150	1580	284879
Dinajpur	5260	6780	4400	6050	7530	7600	4140	5410	1520	2530	6070	2100	6730	5490	5660	6090	4050	3430	161318
Rajshahi	4400	5340	3720	4620	6100	6160	2700	2690	1500	2210	4640	1330	4010	2330	2650	1370	2800	1090	112114
Rangpur	4960	5990	4030	5260	6750	6810	3350	4620	1150	2130	5280	1800	5940	4260	4880	3300	3950	2640	227341
Demand	3730	103191	6400	71603	6307	105950	17882	67942	12241	49972	50940	33395	50628	55516	5296	21270	20840	58258	

Table-3:- Matrix table

Applying the Least Cost Method gives the following table;

	Band	Cttg	Khag	Noak	Rang	Syl	Dhk	Frd	Jama	Kish	Mym	Tang	Bari	Jess	Khul	Kust	Patu	Pabn	Cap
Comilla	1750	1670	910 (3374)	950	2430	2570	970	2410	2050	1150	2900	1570	3730	3700	4310	3730	1600	2570	0
Bogra	4300	4920	3500 (3026)	4200 (3690)	5680	5750	2290 (17882)	3560 (67942)	1100 (12241)	1700 (49972)	4220	1400	4380	3200 (55516)	3810 (52961)	2240 (809)	3150 (20840)	1580	0
Dinajpur	5260	6780 (49061)	4400	6050	7530 (6307)	7600 (105950)	4140	5410	1520	2530	6070	2100	6730	5490	5660	6090	4050	3430	0
Rajshahi	4400	5340	3720	4620	6100	6160	2700	2690	1500	2210	4640	1330 (33395)	4010	2330	2650	1370 (20461)	2800	1090 (58258)	0
Rangpur	4960 (3730)	5990 (54130)	4030	5260 (67913)	6750	6810	3350	4620	1150	2130	5280 (50940)	1800	5940 (50628)	4260	4880	3300	3950	2640	0
Demand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Table-3:- Least Cost Method calculation table

The result shows which non-producing region to collect what quantity of potatoes from which producing region in order to minimize the transportation cost. The given table shows the result;

	Comilla	Bogra	Dinajpur	Rajshahi	Rangpur
Bandarban					3730
Chittagong			49061		54130
Khagrachari	3374	3026			
Noakhali		3690			67913
Rangamati			6307		
Sylhet			105950		
Dhaka		17882			
Faridpur		67942			
Jamalpur		12241			
Kishorgonj		49972			
Mymenshing					50940
Tangail				33395	
Barisal					50628
Jessore		55516			
Khulna		52961			
Khustia		809		20461	
Patuakhali		20840			
Pabna				58258	

Table-4:- Which region collect potato from where and how much.

From the aforementioned table, the flow of actual potato from producing region to non-producing region is shown in the following diagram. The Red circles indicate the regions with surplus production and Green rectangles show deficit regions. The dotted arrow presents the flow of product.
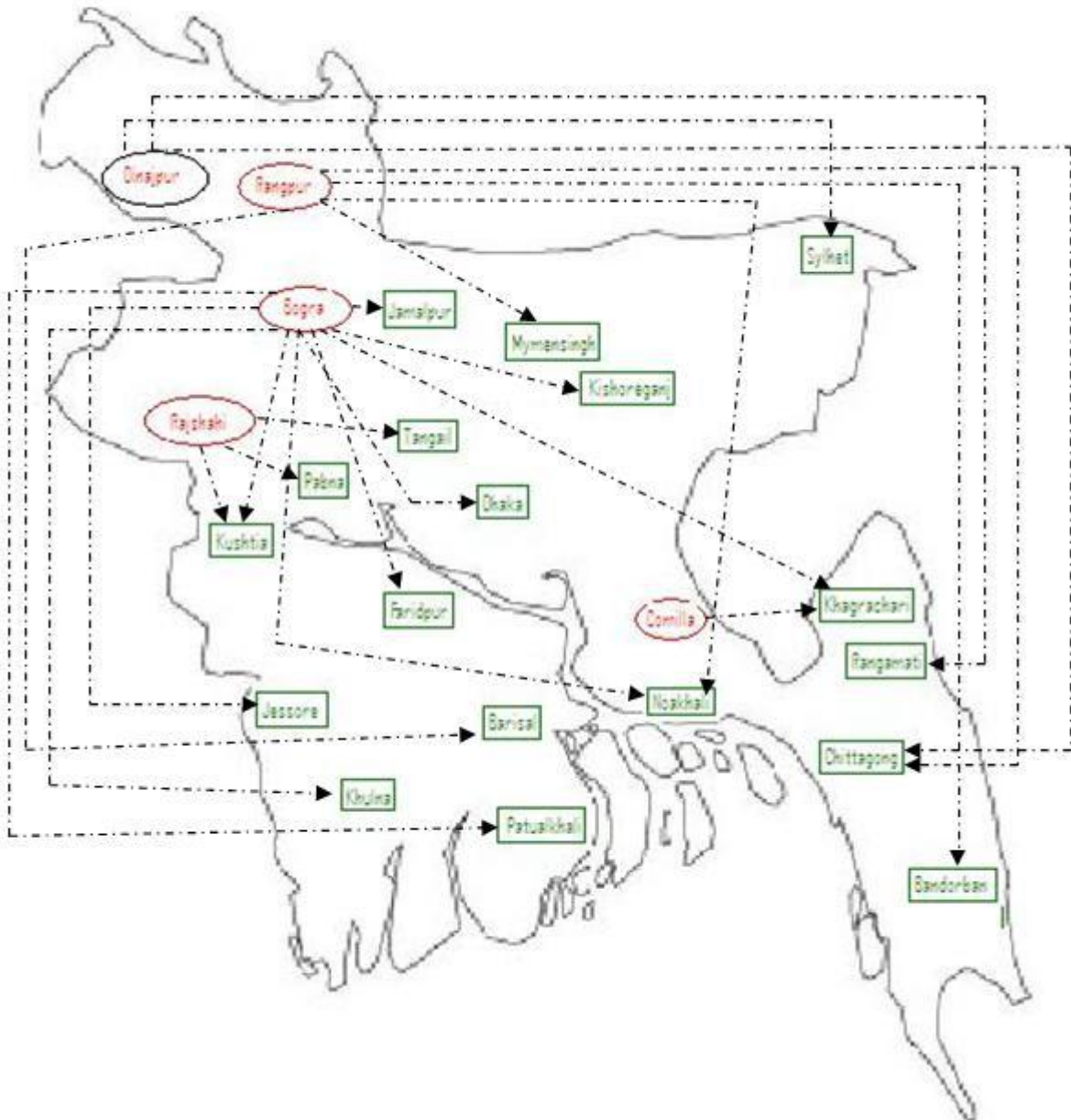
Fig:- 1

7. Conclusion:

For the comprehension of the study, it can be said that if each non-producing regions collect potatoes in the above way, the transportation cost will be minimized. As a result the potato price will decrease automatically. The price level will come to reasonable condition. Therefore it plays an important role to minimize the potato price. At last consumer can get potato at cheap rate.

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