MARKET RELATED RISK MITIGATION AND PERISHABLE FOOD PRODUCT MANAGEMENT OF AGRICULTURAL SUPPLY CHAIN IN NORTH EAST REGION OF UTTAR PRADESH

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ABSTRACT

A new system is suggested and analyzed for the development of optimized food supply chain and reducing the market related risks in agriculture based supply chain in North East region of Uttar Pradesh, where the data is collected to estimate the losses at each level of supply chain and then a model is suggested to reduce the cost. The model is based on transportation technique which not only reflects the improvements in terms of perishable product management and reduction of commission holders in between the food chain but also prove a tool for better transportation solution for highly productive area in the food chain scenario. The overall market related risks in agriculture based supply chain will reduce, responsiveness and efficiency will be increased and it will also increase the quantity and quality of the food products which are perishable in nature.

Keywords : *Risk management, Perishable products, Agro supply chain management, Agriculture supply chain.*

INTRODUCTION

The fertile area of North east Uttar Pradesh (Ganga - Yamuna basin) are ideal for production of cereals and vegetables and other seasonal fruits like water melon etc, which feeds to nearly 10 million customers residing nearby in this area but a huge amount of such perishable products gets wasted due to mismanagement and lack of development of supply chain in its proper foam. Lot of such products is wasted due to delay in supply chain but local markets are in abundance in this area. Perishable food products have been area of interested for many and written over again and again for its overall development and hence the model as given by Francis Vanek & Yao Sun (2008) will be the basic model for such supply chains but changes are to be embedded in it according to the market. The rise in fuel cost will have to be dealt accordingly and the overall cost also needs to be dynamic, the rate of rise in truck's transportation charges is found to be more than train, so we suggest a network based on combined train and truck transportation system in this study. The same point of view is being held by many present literature sources, some of these sources suggest that with nodes representing the cold storages, rest rooms are created for truck drivers and these nodes are supplied from the train fed bigger network of supply chain so that techniques of network reduction can be involved for optimizing. Analysis is done for waste reduction and value addition at the various levels of supply chain.

The level of overall investment can be paid off by government also and will result in industrialization in the North east Uttar Pradesh where labor is in plenty and supplier development can be undertaken for uplift of basic producer and hence the efficiency of over all food chain can be increased.

Today agriculture markets work in a some what monopolistic environment, which does not provide many choices to small farmers. Wheat in wholesale mandis in some parts of Northern India sells at Rs 1000/qt mp variety, while in retail in Delhi it is old at Rs 1900/ qt. This price disparity is a basic problem in our regulated agriculture markets since long. In this paper a system is developed for better

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working patterns for agricultural based supply chains by eliminating intermediaries and providing efficient transport system.

LITERATURE SURVEY

Role of supplier is given more and more importance as the time passes by even their participation has increased in new product development (Song and Benedetto, 2008). Various hypothesis have been tested in which it is conferred that the increase in supplier involvement results in improved new product performance, whereas the new venture's market sustaining power and supplier's net investment have overall positive effect on each other. The paper helps us to understand the contingent nature of the key inter relationships between the various supplier's factors. Maffin and Braiden (2001) and Petersen et al. (2005) stresses upon the tailor made model for product development in which each project and involving supplier party, the firm itself have to decide upon the various factors according to their need. Small scale factories have been mainly discussed in order to find the relationship attributes between such firms and their suppliers. Petersen et al. (2005) also talks about the financial returns in the case of such supplier involvement in projects.

Koufteros et al. (2007) refers the black box (supplier having own product development proceedings) and grey box (supplier working with customer's researcher for product development) concept in relation to supplier's involvement, mainly all the areas specific to supplier integration is discussed in this study. Where grey box integration is said to have positive effect on product innovation especially for larger firms. Simulation techniques are also helping to analyze the scenario for such market chains as referred by Holguin-Veras (2000). Use of railways can also be done since in our study area of North east Uttar Pradesh a dense network of railways is also present as stressed by Kwon et al. (1995) in which the transportation reliability by railways is discussed, Assignment model can be used for optimization of supplies as stated by Maher and Huges (1997), in this study a profit based stochastic user equilibrium assignment model is given which can also be applied in our study in future. Energy efficiency is also a major factor that will be holding greater stress in future and it is also seen as a perspective in our study, Vanek and Sun (2008) has also stressed on energy efficient economy, the same concept is used in our study, when the penetration and expansion area of our conceptual supply chain will be increased in future supply chain will be more efficiently managed. Supplier input on technical objectives is having less important effect on team effectiveness in case of grey box as compared to black box. So the type of supplier integration we have proposed in our supply chain is basically of grey box type which results in saving cost and reducing perishability charges.

Osvald and Stirn (2008) have devised a vehicle routing algorithm for the distribution of fresh vegetables and similar perishable food, where the effect of perishability is studied with respect to the over all conditions prevailing in the supply chain and its effect on the overall cost is studied by putting it as a factor in the model, similarly Vanek and Sun (2008) and Abad (2003) also stresses on perishability with respect to life cycle energy consumption, lot-sizing and backordering but the role of perishability is found to be profound on every factor and it increases when the product is having short shelf life like agriculture products which are non processed, as in our case. Our study presents an area based transportation system in which a system is developed through which effective management of supply chain is done where we have minimal losses due to pershability by the use of better transportation techniques along with preservation measures.

The demand for food grains is expected to touch 215 million tons by the year 2015. This increase in demand can be met by enhanced agricultural production and by reducing the high level of wastages that occur during the harvesting, procurement and storage stages. India wastes more grain than Australia produces. The complex food chain in India from farmer to the consumer involves several intermediaries with multiple-point handling and long transit periods. The value of wastages in the food chain is estimated to be Rs 50,000 crores. Our production of 127 million tonnes of fruits and vegetables is one of the highest in the world. India wastes more fruits and vegetables than UK produces.

The overall supply chain is always subjected to risks and such a risk can be subdued by better management of resources, which is the central thought for writing such a paper. The overall study is actually based on better management of supply chain in North East region of Uttar Pradesh.

RESEARCH METHODOLOGY

In the development of model the comparison between traditional systems of distribution channel is done with the suggested methodology in which the series of commission is removed. The steps taken to derive the results are -

I. Arranging data related to market price and the price received by farmer for same product, by survey in local shops for the perishable agricultural products in North East region of Uttar Pradesh.

II. Calculating optimum transportation solution for large districts taken as node under consideration by applying transportation technique.

III. Arranged the data for calculating the commission at each step and re calculating reduced prices by fever commission producing intermediaries achieved by providing direct transportation to market.

IV. Analyzing the result on the basis of increase in profit for farmers when direct transportation at the nodes is done with fewer intermediaries in between for sample perishable agricultural products like potato, tomato, mango and sugar cane.

The traditional system of distribution and modern system suggested in this study are shown below in Figure 1. The core idea is to remove the series of intermediaries which results in longer lead time and perishability related problems.

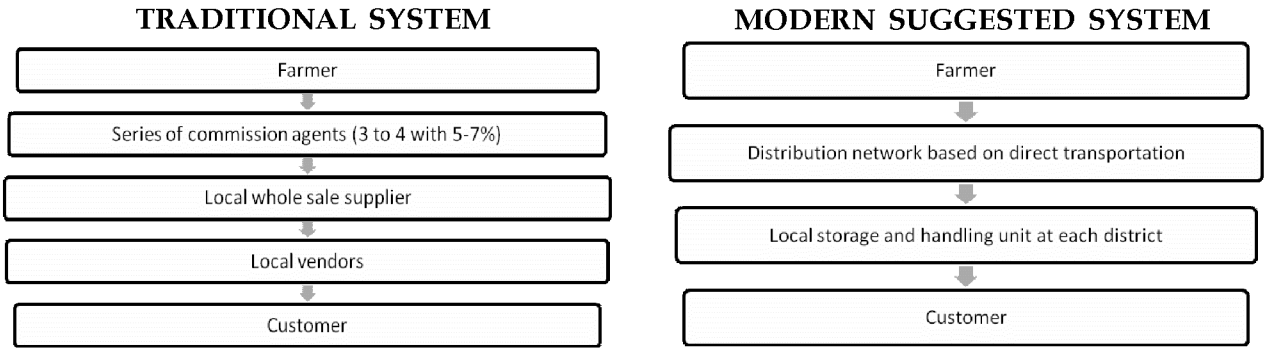

Figure 1: Showing traditional and suggested modern systems of distribution

What we can see over here is that the previous system of agents in between takes away a considerable portion of profit from supply chain can be eliminated, that is the direct supply chain in between these districts can be very helpful in reducing the profit loss in supply chain to 1/3 of its previous value by eliminating series of commission agents (3 to 4 with 5-7%). so we hereby see that the need for a distribution network is present over in this area.

DATA COLLECTION AND ANALYSIS

Nodal centers or districts in North East region of Uttar Pradesh under consideration are needed to be fixed from where excess products can be supplied and separate distances needed to be taken out and energy per unit can be multiplied to give transportation cost for each perishable product and then comparison is being done from the present system from the data available historically. The figure 2 shows the network diagram and distance matrix for the geographical location with districts taken as nodal centre. Figure 3 shows the simplified road transport system suggested with nodes as centre for distribution to nearby areas. Figure 3 and figure 4 gives the data input for applying the transportation model in the later part of the study, the analysis done for transportation is based on the various factors, the factors like distance, demand and supply are taken in our study and for this the normal transportation distance and demand - supply scenario is being taken by further analysis in the transportation technique in the study and hence the figure 3 is comprised of data on which the analysis is based that is distance and demand - supply between the nodes. The figure 4 gives the account of various major nodes present in the area that is it presents an account of rods present in between the nodes and national highways are the selection criteria on which the transportation is an ease and this particular figure 4 indicates the presence of rods in the area and hence along with the distance the presence of roads is also taken as a factor for

transportation in our study.

Now on the basis of data available identification for the best route for each product is done, for a general perishable product to be transported from outside the nodes it is needed to develop a model based on nodes and super nodes.

City or Tow	ALLD	SULT	LUCK	PRATP	KANP	JHAUN	VARA	MIRZA	CAPACITY
ALLD	10	90	175	50	185	75	125	80	60
SULT	90	10	135	45	175	75	125	125	32.5
LUCK	175	135	10	150	75	215	260	250	25.3
PRAT	50	45	150	10	175	75	125	100	22
KANP	185	175	75	175	10	240	295	270	21.1
JHAUN	75	75	80	215	240	10	255	75	37
VARA	125	125	260	125	295	255	10	50	47
MIRZA	80	125	250	100	270	75	50	10	24
DEMAND	29	36	40	17	35	26.8	21	29	

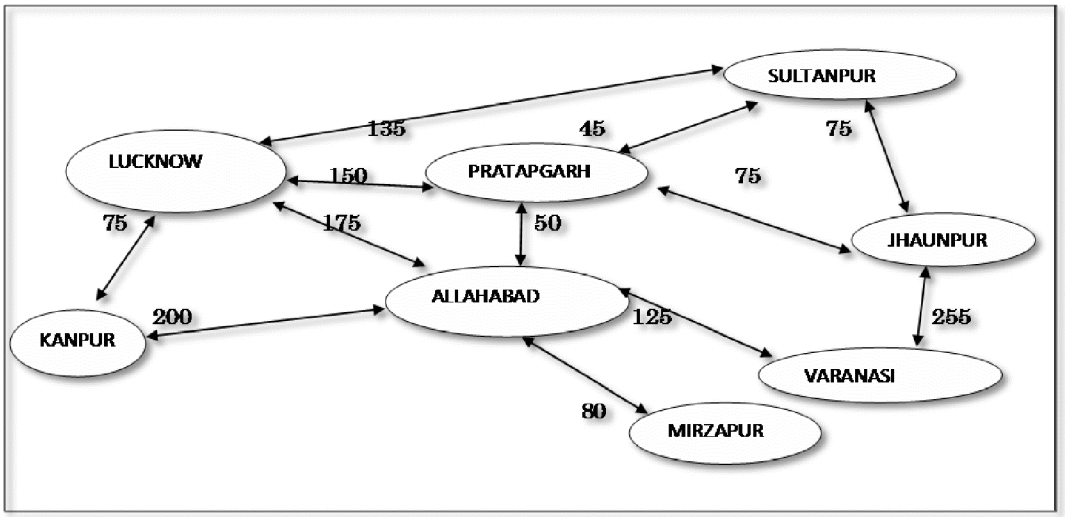

Fig 2 - Network diagram and Distance matrix for transportation of goods with districts as nodal centers.

Modern Suggested Distribution Network Diagram (Roads)

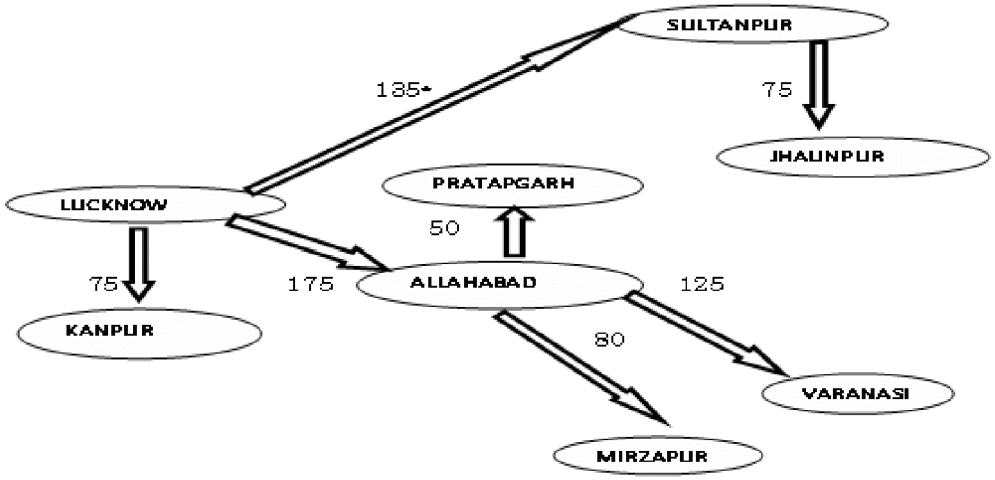

Figure 3: Showing the transportation data for major nodes present in our case study

*For perishable product direct transport between Lucknow and Sultanpur can be done.

According to data available for the different food products like sugarcane, tomato, potato and mango (all perishable), all having shelf life of less than 10 days. Data is collected for

1. Lucknow
2. Pratapgarh
3. Sultanpur
4. Jhaunpur
5. Varanasi
6. Mirzapur
7. Kanpur
8. Allahabad

The wastage will be reduced once the losses are overcome by efficient transfer of goods, so this system works in two way approaches in between the overall sectors where we are entrusted upon the increase in shelf life. The overall advantage is that the product line is fresher and it is reaching without intermediaries. This initiative can be started by state or central government too so we can say that the modern system we are entrusting shows remarkable increase in responsiveness of the supply chain and it works in a three way approach.

Table: 1 Data for a sample crop is shown below (in rupees/ton)

Production costs, transaction costs and net returns (base 2002) (Rs/tonne)			
Particulars	**Producer members**	**Independent Producers**	**Per cent difference**
Crop Yield (Rs/tonne)	8.6	8.3	4
Cost of production	1485	1171	-12.9
Transaction cost	35	437	-92
Total cost (production + transaction)	1520	2067	-26.5
output price	3311	3074	7.7
Net revenue	1791	1007	77.9

Source: DARE/ICAR Annual Report 2007-2008

SURVEY FOR DATA COLLECTION

The information stated below in table 2 and table 3 explains the profit margin with and without intermediaries, based on facts collected from survey based on local "mandis" in and around North - east of Uttar Pradesh region. In the survey local transportation bodies are asked about the price rates they practice through which the idea for commission and loss due to perishability is accounted. The data received by the survey is shown below in table 2. Since study concentrates the nearby cities only, the result will be applicable to these nearby areas only and gives us an idea of losses in a supply chain and what changes can be brought the with the adoption of centrally controlled supply chain with the elimination of intermediaries.

Table 2: Showing the analysis on the data collected by survey

Loss in traditional system				
Price/kg ↓	**Potato**	**Mango**	**Tomato**	**Sugar cane**
End consumer	25	39	57.5	10
Received by farmer	15.6	21.8	38.9	8.6
Commission %	37.6	44.1026	32.3478	14

Traditional distribution system				
Mark up %				
Price/kg	**Potato**	**Mango**	**Tomato**	**Sugar cane**
End consumer	25	39	57.5	10
Received by farmer	15.6	21.8	38.9	8.6
Markup %	160.2564	178.8991	147.8149	116.2791
Traditional system handling cost				
	Potato	**Mango**	**Tomato**	**Sugar cane**
% Wastage	21	43	28	27
Handling cost / kg	1.9	2.4	2.5	1.5

From the modern system the following changes are suggested from the traditional method shown in table 3.

Table 3: Showing the suggested modern method based analysis for commission reduction

Modern system commission reduction				
	Potato	**Mango**	**Tomato**	**Sugar cane**
Commission new % (1/3 of original)	12.53	14.70	10.78	4.66
Modern system commission				
Price/kg	**Potato**	**Mango**	**Tomato**	**Sugar cane**
End consumer	25	39	57.5	10
Consumer (new)	3.13	5.733	6.2	0.46
Farmer received	21.86	33.266	51.3	9.533
Previous farmer getting	15.6	21.8	38.9	8.6
% Profit increase	40.17	52.59	31.87	10.85

Modern system markup				
Price/kg	**Potato**	**Mango**	**Tomato**	**Sugar cane**
End consumer	25	39	57.5	10
Received by farmer	21.86	33.266	51.3	9.53
Markup % (new)	114.32	117.23	112.08	104.89
Markup % (old)	160.25	178.89	147.81	116.27
% Decrease	45.92	61.66	35.72	11.38

For analyzing the situation and elimination of series of commission agents (3 to 4 with 5-7%), a central transportation system is developed in this study for this region and has taken distance and other inputs for each node from the matrix form shown in figure 3. By following such a system the profit of farmer is increasing and surprisingly for perishable product like mango it is as high as 52 % and along with this potato, tomato both have shown remarkable increase in the profit of about 40 % and 31 % (shown in table 3) respectively. The system devises a method for removal of intermediaries by having almost direct transportation between farmers and consumers, this is done on the basis of a transportation model in which demand and supply for each city or node is analyzed and optimum transportation schedule is calculated. Now this transportation model is discussed in next section.

TRANSPORTATION MODEL

On the basis of distances, demand and supply given as distance matrix in figure 2 the transportation technique is applied to find the solution. Transportation technique is applied to achieve the optimum cost and quantity to be transported from each nodal centre to another. A dummy row is added since the supply in this fertile region is more than the demand. The solution is shown in table 4. Allahabad was the major excess producer and nearest node to Lucknow and Kanpur where as Pratapgarh is nearest to Sultanpur and Varanasi will supply to Mirzapur. Accordingly the transportation volume (Table 4) from each node is received as a solution from transportation technique.

Table 4: Transportation volume from each node

City or Town	Supply
Allahabad	45.9
Sultanpur	32.5
Lucknow	25.3
Pratapgarh	22
Kanpur	21.1
Jhaunpur	37
Varanasi	26
Mirzapur	24

Though India is one of the largest producers of various kinds of primary products but we add value to only about 2 % of our produce. At the same time the capacity utilization of various capacities created for processing are about 40- 50 %. This poses a big paradox before us. The main reason for it is lack of markets. Processed food markets are quite elastic and any price reduction can influence the markets.

Hence the above mentioned transportation technique based solution and with few intermediaries in between for commission, better supply chain management can be done and risk related to Agro supply chain can also be reduced.

CONCLUSION

There is a percentage profit increase for farmer in the following manner-

Table3: Percentage profit increase

Product	Potato	Mango	Tomato	Sugar cane
% Profit increase	40.17	52.59	31.87	10.85

So a huge amount of profit increase is predicted by following our own system of transportation. Along with that a distribution network for perishable goods is given as in transportation matrix provides the optimal distribution and results in fewer losses. The transportation model gives the amount of transportation that needs to take place when commission making intermediaries are to be eradicated. Allahabad, Sultanpur and Jhaunpur emerge as a major supply node to nearby areas from the solution of transportation problem. On following this system of transportation the problem of mismatch is demand and supply can be eradicated and efficient transportation system from rails and roads can also be applied, although more accurate studies have to be done for railways perspective but since the region under consideration is very well connected with railways this system can also be very efficiently applied.

This means that if intermediaries are removed the commission is reduced and goods can be saved from perishing off due to short shelf life, since the lead time is also getting reduced. Although the study is done at a very basic level but it can also be developed for other large number of market places.

FUTURE RESEARCH

The growth of the agribusiness sector is positively affected by agricultural productivity, ripples in consumption patterns away from food staples, improvements in transport and communication infrastructure, international food product based trade and supportive government policy. In India, components of commercial agriculture such as fruits, vegetables, oilseeds and sugars are growing faster than food grains. Such supply behavior has its counterpart in consumption pattern which has also seen a more rapid growth are in the consumption of items such as fruits, vegetables, oils and milk products than in food grains. In the future, these trends may be reinforced for international trade. Food inflation is in double digit and the above method minimizes "black-marketing" and can provide a respite in both food inflation and black marketing.

A separate model can be developed in which special trains that are air conditioned can be used to transport different goods in a channel that can be used for more than one perishable product and which will also help in reduction of waste.

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