

CASE 9.3 Supply Chain of a Dairy Farm

Sourav Sinha, head of operations, Central Dairies, is quite worried about the high supply chain costs that are currently being incurred at his dairy farm. Supply chain is a critical aspect of modern day dairy farming. Raw milk needs to be procured from different vendors located at different places. Then the raw milk has to be processed and finally shipped to the various distribution centers. Transportation and material costs play a key role in the dairy supply chain. It is extremely important to streamline the entire supply chain as efficiencies lead to reduction in inventories, waste, and cost and in turn increase in overall profitability of the farm. Apart from the high costs, Sourav is also concerned about the demand that Central is losing due to unavailability of processed milk at the distribution centers. On delving deep into the lost-sales issue, Sourav came to know that only some of the distribution centers face stock-outs whereas there is excess milk in the other distribution centers. This overall inefficiency in the supply chain is giving nightmares to Sourav and he really needs to come up with a plan for optimizing the supply chain.

Central Dairies is one of the biggest dairy farms in West Bengal, India, with an annual turnover of Rs. 5 crores. Right now Central procures cow milk from five vendors located at Bashirhat, Barasat, Kakinara, Rishra and Hoogly. These vendors are small-scale dairy farms that in turn obtain raw milk from rural farmers. In order to maintain freshness, raw milk is chilled and then transported to the processing plants located at Haringhata, Bishnupur and Madhyamgram in insulated tankers by road. Keeping milk cold slows down the multiplication rate of bacteria. In the processing plants, highly automated processes are used to ensure high product quality and safety. Unprocessed milk may contain small dirt particles invisible to the naked eye. In order to remove these particles, milk has to be processed. Processing of raw milk starts with clarification or separation, using centrifuges. The clarification process removes impurities like blood cells from the milk that will be sold as whole milk, i.e., milk containing butterfat. Separation process removes butterfat as well as impurities from milk. Skim milk is produced when all the butterfat is removed from the raw milk. Milk is then pasteurized to kill harmful bacteria. Processed milk is then chilled in a cooler and placed in sterile containers and packed individually in containers, which are usually plastic bottles or paper cartons. Prior to the milk being dispatched in tankers, it is tested for quality to ensure it meets quality standards. Finally, the processed milk is sent to four distribution centers located at Howrah, South 24 Parganas, North 24 Parganas and Haldia that cater to customer demand in Kolkata and the suburban areas.

Dairy industry in India is one of the foremost agro industries of the country. Dairy development in India has been acknowledged by the world over as one of modern India's most successful development programs. Operation Flood that was implemented in the 70's had made spectacular landmarks in Indian milk production scenario. Operation Flood was a rural development program started by India's National Dairy Development Board (NDDB). One of its kind the program's objectives was to create a nationwide milk grid. This initiative was highly successful and resulted in making India the largest producer of milk and milk products. It is also called the White Revolution of India. The dairy industry in India has been witnessing rapid growth in the recent past. The value of processed milk amounted to Rs. 1179 billion in 2004-05 and with 1/5th of the world bovine population India provides ample opportunities for dairy farming. With a huge market for milk consumption, there are immense possibilities for forward looking dairy farms such as Central Dairies to increase their profitability. The top management at Central Dairies is aware of the opportunities that lie in front of them but they are also concerned about the rising costs and are focusing on cost cutting. They have assigned Sourav to come up with an optimized procurement and transportation schedule that minimizes the supply chain costs.

Per liter cost of transporting raw milk from the vendor locations to the processing plants is shown in Table 1 and the per liter transportation cost for processed milk from the plants to the distribution centers is shown in Table 2. Table 3 represents the per liter cost of raw milk as charged by the different vendors. All the costs are in rupees. The vendor supply capacities for each week are presented in Table 4 and the weekly demand requirements at the four distribution centers are presented in Table 5. The processing plants have a capacity of processing 8000 liters of milk every week.

Table 1:

Vendor Locations	Processing Plants		
	Haringhata	Bishnupur	Madhyamgram
Basirhat	10.00	12.50	11.50
Barasat	13.00	15.00	12.00
Kankinara	13.00	14.00	16.00
Rishra	13.00	15.00	12.50
Hoogly	14.00	16.00	13.50

Table 2:

Processing Plants	Distribution Centers			
	Howrah	South 24 Parganas	North 24 Parganas	Haldia
Haringhata	19.00	15.00	17.00	19.00
Bishnupur	18.00	13.00	16.00	29.00
Madhyamgram	21.00	12.00	25.00	17.00

Table 3:

Vendor Locations	Per liter cost of raw milk (Rs.)
Bashirhat	12.00
Barasat	12.50
Kankinara	13.00
Rishra	11.50
Hoogly	11.00

Table 4:

Vendor Locations	Weekly Supply Capacities (liters)
Bashirhat	3500
Barasat	4000
Kankinara	6000
Rishra	3000
Hoogly	2500

Table 5:

Distribution Centers	Weekly Demand Requirements (liters)
Howrah	3000
South 24 Parganas	5000
North 24 Parganas	4500
Haldia	1000

Case 1: Solution Plus

Solution Plus is an industrial manufacturing company that manufactures computer components like CPU, monitor, keyboards etc. The company has several manufacturing units of producing these components. Solution plus has three manufacturing units for manufacturing central processing units (CPUs). The CPUs are manufactured in Seattle, Columbus and New York. The solution plus has five warehouses located at Pittsburgh, Mobile, Denver, Los Angeles, and Washington, D C, where these CPUs are stored for further distribution. Each manufacturing unit is working with varied production capacity, the capacity of each manufacturing unit is shown in the following table. As per the customer requirements, the demand of each warehouse is also varied and shown in the following table. The distances between the manufacturing units and warehouses are also varied and hence different transportation cost is incurred to ship the CPU from a manufacturing unit to a warehouse. The shipping cost from manufacturing unit to warehouse is given in the following table.

Plant	Warehouse					CPU's Available
	Pittsburgh	Mobile	Denver	Los Angeles	Washington	
Seattle	10	20	5	9	10	9000
Columbus	2	10	8	30	6	4000
New York	1	20	7	10	4	8000
CPU's required	3000	5000	4000	6000	3000	21000

Solution plus is facing a problem of deciding how many units it should supply to each warehouse from a specific manufacturing unit because of the different shipping costs.

Requirements

- Develop the network representation of the problem
- Determine the amount that should be shipped from each plant to each warehouse to minimize the total shipping cost.
- The Pittsburgh warehouse just increased its order by 1000 units, and Solution Plus authorized the Columbus plant to increase its production by 1000 units. Will this production increase lead to an increase or decrease the total shipping cost?