Supply chain challenges in public distribution system

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Abstract
The paper aims to discuss supply chain management challenges in Public Distribution System, a food security scheme in India, based on the data collected from the stakeholders. With particular focus on supply chain strategy, we explore how the social objectives lead to supply chain design which affect system's performance.

Keywords: Public Distribution System, supply chain, public service

INTRODUCTION

Public Distribution System (PDS) is food security infrastructure in India, aimed for providing food grains at subsidized prices to poor population of the country. Although, National Food Security Act was enacted in 2013, PDS has been operating for more than six decades by Government of India in collaboration with the state governments. It was started initially for providing food security to urban poor. The aim was to provide access of food to the section who cannot afford it. At the same time, maintaining availability of food grains by ensuring sufficient wages for farmers. The farmer welfare was taken care by procurement of food grain directly from them at Minimum Support Price (MSP). Also, green revolution was inducing scientific measures for increasing productivity in the agricultural economy. PDS comes under the umbrella of poverty alleviation programs, under food security programme (Yesudian, 2007). Radhakrishna & Subbarao (1997) have considered PDS under in-kind transfer schemes for food security program under poverty alleviation programs, where the benefits are given to poor in the form of subsidized food grains rather than money.

As per the report published by Reserve Bank of India (RBI) in 2012, around 21.92% of population of India is living below the poverty line, accounting for nearly 270 million people. Of which 25.7% is observed to be living in Rural India, while 13.7% are from urban areas.

Due to welfare goals associated with PDS, type of product to be supplies, and its huge coverage & infrastructure, various supply chain challenges. For example, un-synchronized production and consumption of food grains, geographically concentrated production of food grains while evenly distributed consumption, vulnerable sections at the sourcing and consumption end of the chain, etc. This paper aims to discuss a perspective on supply chains meant for social objectives.

PDS- A PUBLIC SERVICE

PDS is a public service infrastructure which is managed, controlled and financed by the government. Hence, it aims to attain three social objectives: (1) Ensuring fair remuneration for the farmers, thus, promoting agriculture; (2) Safeguard poor people by providing food grains at affordable prices, and (3) Efficient use of tax payers money. Off the three social objectives, determining the fair remuneration for framers as sourcing partners is completely driven by the policy design. Since, the sourcing activity also aimed at providing protection to the farmers, rather than strategic sourcing from the low cost, high quality and reliable vendor. While, the second and third objective focusing on a reliable customer service and efficient system respectively, can be handled through supply chain operations.

Unique Features of PDS

Public Distribution System poses to be a complex system because of the product category involved and the other phenomena of supply chain. Due to this the system presents unique set of challenges.

- Seasonal production: Demand is not synchronized with the production of food grains. Since the production happens once or twice a year based on the agricultural cycle, while consumptions happens throughout the year.
- Uncertain production: The production of food grain is highly dependent on weather and climate condition of the region. Unfavourable weather may result in poor or low quality productivity with nearly same demand.
- Shelf life of product: The perishability of food grains. Food grains have their own shelf life and storage requirements which are different from the manufactured products. Thus, speculating the risk of spoilage leading to wastage.
- Handling and logistical needs: According to estimates by FAO, about 40% of India's fresh fruit and vegetables – worth an annual $8.3billion or so perish before reaching consumers. Each year, some 21 million metric tonnes of wheat, especially grain rot in India because of improper storage in the custody of the government-controlled Food Corporation of India.
- Geographically distributed market: The production and consumption of food grains in a geographic location is not synchronized. Also, all the geographic locations do not have cultivable land and hence, long distance movement of food grain to match the demand of the region is a common phenomenon.
- Lack of professionalism among supply chain entities: Since, both at sourcing and the distribution end community run organizations are involved in the functioning of the system. The chain lacks the professional approach towards supply chain management.

- Commission based infrastructure: Nearly all the value adding entities in PDS supply chain and community based organizations and rely on commission based financial incentives.

The best supply chain design the food supply chain should follow is the Make-to-stock supply chain. In order to take care of the seasonal production and uniformly distributed consumption pattern. During the harvesting season, the procurement drives are carried out to procure the food grains from the farmer, who generally retain the food grains for their own consumption and sell the excess to the government or private millers.

Furthermore, the products involved in PDS supply chains are basic commodity product. Also, size of the market and hence, indirect demand is known through surveys regarding Below Poverty Line families in each state, thus, providing considerable time duration for government to plan the distribution process. This suggests that lean supply chain should be the preferred supply chain strategy for PDS (Fisher 1997; Lee 2002).

Customers

The customer characteristics play important role in the success of any organization. Various marketing literatures have acknowledged the role of customer characteristics affecting important relationships (especially, customer satisfaction) as a moderating variable (Cooil et al. 2007; Mittal & Kamakura 2001). But the homogeneity among these customers is- they are able to make purchase at the offered prices and they have options to buy the same product from different vendors, hence, the focus of marketing literature is on how to gain customers.

This is not the case with the customers of the PDS or for any other public service meant for underserved community. The customers of PDS are mainly the poor families of India living below the poverty line (BPL families). These families are not able to earn enough livelihoods to get access to daily nutrition required for a healthy living. The poor customers of PDS are underserved, neglected and vulnerable. Since, they do not have money; they are bound to buy food grains offered by the government at subsidized prices. Hence, the system has monopoly. Secondly, the educational qualification and awareness among the poor population is very low, thus, they do not have much idea about their rights and have little say about their preferences. All these projects the power imbalance in the PDS, where the customers are vulnerable and the system is powerful.

Furthermore, the identification of these customers is the responsibility of state government due to lack of knowledge and awareness hence, the system is suffering from various inclusion (families not eligible for entitlement are included) and exclusion (families eligible for entitlement are excluded from getting the service) errors. Table 1 discusses few of the problems encountered by the customers.

Table 1: Problems faced by customer's of PDS

Problem	Cause	Effect	References
Leakages	Considerably high inclusion and exclusion errors; Black marketing	Genuine needy are deprived from access to food	Ahluwalia (1993)
Inactive participants	Many beneficiaries are not able to claim their entitlement due to distance	Half of the BPL population does not purchase the full quota while, one-third of	Khera (2011)

	between the shop and home; non-availability of food grain during visits to FPS; malpractices at the FPS; incorrect or small variety of food grain stocks; lack of awareness among cardholders about their entitled quantities; incorrect inclusion in the BPL list	BPL cardholders do not purchase food grain from the PDS	

Supply chain is an important link providing the infrastructure for satisfying the needs of the customer. The end consumers seek an array of values in the form of product and services. Supply chain helps in managing these offerings (Morash & Clinton 1998). Hence, customer needs are essential not only for developing the supply chain infrastructure but also, regulating performance of the system.

Input-Output Transformation for PDS

As a public service the supply chain of the PDS can be better explained by the Input-Output transformation process developed by Pidd (2012) as shown below in figure 1.
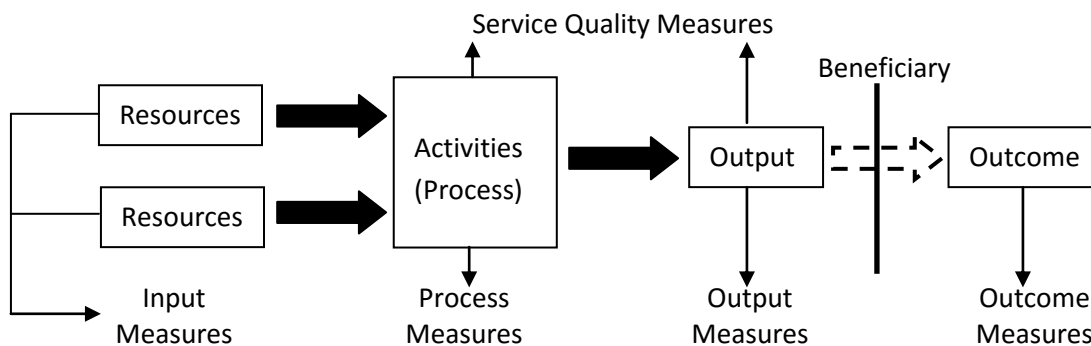

Figure 1: I/O Transformation Process for Public Service (Pidd, 2012)

It can be noted that whole I/O transformation for public service is similar to that of the traditional for-profit business organizations. Resources enter into the supply chain in the form of raw material, finance and labours, which are then processed and transformed into finished products or services, thus, resulting into measurable output (number of customers served, number of units produced, throughput time, profit earned, etc.). At the point of supply chain market interaction, another important thing is the outcome. Most of the business organizations mostly consider the output measures. While, few of the market focused business entities considers customer satisfaction as the outcome measure; but the outcome measures of public services are much larger (societal improvement). Customer satisfaction can be assessed and evaluated in short term while the outcomes relevant for the public services are development and hence have long term focus in terms of assessment and evaluation.

Public services like PDS aim beyond providing maximum value to the customer. They look for the social impact of the delivered service on the community; the focus is more on outcome

than output. Outcome represents the after effect or impact of service consumption on the society. Additionally, there is also a significant difference in the target of business process and public service. While the former focus on segments which deliver profits. The later focuses on providing services to disadvantaged community of the population to bridge out the developmental inequality.

The parameters of Public Distribution System are presented below along the dimensions of Input-Output transformation processes:

- Input: Paddy is the input for the CG PDS, which is procured from local farmers at MSP. As per the objectives of PDS, the state has to act in the interest of farmers, procuring the entire paddy during procurement season, i.e., within 4 months. Procurement of raw material affects economic dimension of the process. Efficiency dimension is not under consideration when we consider input to the PDS because in the interest of farmers the State Government procures entire paddy which arrives at the procurement centre irrespective of whether it is beyond the need and capacity.
- Process Measures- *How well did we do what we do?*: The assessment of process measure can be performed in terms of time taken and expenses incurred to provide the service to the beneficiaries. It includes all the processes starting from the procurement centre till the PDS commodities reach FPS. The food grains procured from the farmers are stored in warehouses or sent for milling by the private millers. These millers process the food grains and convert them into consumable state (mostly by removing the husk from the harvested grains). The milled food grains are then deposited at the state warehouses which then allocate the food grains to the retail outlets or Fair Price Shops (FPS). These measures considerably affect all the three dimensions of economy (carrying cost, monitoring cost and opportunity cost because of diversion), efficiency (prone to diversion of food grains during the process) and effectiveness (standardization of processes to ensure timely delivery).
- Output Measures- *How much did we do?*: This measure checks how much the objective desired by the system is achieved. For Public Distribution System, the output will be the number of targeted families benefited from the scheme.
- Service Quality Measures- *Are the people satisfied?*: This checks whether the targeted families are able to get the benefit from the service meant for them. The service quality includes the inclusion of BPL families, receipt of entitlement, time spent for collecting entitlement, behaviour of FPS shopkeeper, etc. This is the measure perceived by beneficiaries and is affected by effectiveness dimension.
- Outcome Measures- *Are people better off as a result of what we do?*: This reflects after-effect of public service on the beneficiaries, which is again determined by the effectiveness dimension. In PDS, the outcome should be social welfare and development of weaker section of the society through food security.

Table 2 compiles problems observed in PDS supply chain by various authors.

Table 2: Problems in PDS Supply Chain

Problem	Cause	Effect	References
Excess cost	High administrative costs; still lack of monitoring and control	Higher subsidy burden on the government	Ahluwalia (1993); Jha and Ramaswami (2010)
Movement of	Concentration of	Huge transportation	Banerjee (2011)

food grain	procurement activities in few states while PDS operates across the country	logistics cost, losses due to transportation, delay in transit and lack of control over monitoring of the stocks	
Concentration in certain crops	Price stabilisation mechanism developed through MSP	Excess stocks for reserved commodities and reduces the supply of other commodities	Ramaswami (2002)
Speculation in the market	Large-scale procurement and subsequent selling under the open market scheme	Reduces private stocks and leads to higher prices for consumers in the open market; uncertainty in managing the demand-supply gap	Ramaswami (2002)

Performance Parameters

Economy, effectiveness and efficiency are the dominant performance parameters on which a public services can be accessed (Pidd, 2012). **Economy** is the performance indicator from input rather than output perspective. It refers to how much capital we put in for delivering the specified output. PDS being a public service for providing support to BPL at subsidized prices incurs huge cost for delivering the service. The Minimum Support Price for procurement itself is higher than the distribution price. For example, rice is procured at the rate of Rs. 13.6 per kg and is sold at Re. 1 per kg under Antodya scheme during 2014-15. These overhead operational expenses of the process are incurred through food subsidy budget. The government allocates separate fund for procurement and distribution.

Effectiveness of a service means the system should be able to serve the right customer at right time. In terms of PDS, effectiveness is identification of the needy section of the society and delivering PDS commodities to right family at right time in sufficient quantity. The decentralized paddy procurement and computerization has enabled automatic allocation of PDS commodities, reducing the time delay for information flow about allocation from nearly 15 days to less than an hour. This has ensured timely delivery of PDS commodities to FPS in sufficient quantity.

A system is said to be *efficient* if it provides maximum value to the customer with same amount of input. In terms of PDS, efficiency improvement can be in terms of reducing the leakages (unethical diversion of food grain from PDS supply chain) and pilferage (stealing small quantity of food grains all through the food supply chain for personal benefit). Computerization, automated allocation, public audit, etc. have induced transparency and accountability within the system through supply chain integration, thus, making the system more efficient.

SUPPLY CHAIN CHALLENGES

Various supply chain challenges faced by the PDS are mapped along the level 1 (process types) of SCOR/ Supply-Chain operations reference model. These processes are: plan, source, make, deliver and return. SCOR is a process reference model developed by supply chain council,

as a unified framework for mapping and understanding the supply chains so that it can be improved (Huan et al. 2004).

- Plan (P): Includes the planning related activities in the supply chain like, assessing the customer requirement, checking the resource availability and planning to balance the demand and supply.
- Source (S): Describe the sourcing, ordering, receipt and storage of inbound goods. The process also incorporates, identification of suppliers, quality specification of the inbound material, sourcing schedules, etc.
- Make (M): Describes activities associated with the transformation of raw materials or to finished goods. The make process incorporates the production planning and control which is to be followed during daily operations, like, schedule of production activities, production and testing for quality, etc. PDS process essentially has to be a Make-to-stock supply chain.
- Deliver (D): This process describes activities which are associated with the fulfilment of customer orders, thus, linking the supply chain with the market.
- Return (R): The activities associated with the reverse flow of goods back from the customer. It is an important activity in case of white goods, but the same is not applicable in case of consumable items like, food grains, unless it is a return in case of quality dissatisfaction.

Table 3: Challenges in PDS Supply Chain

Process	Operations in PDS	Challenges
Plan	Planning is performed by the Central and state governments, who decide on the duration of procurement season, the amount of food grains to be procured. Also, the governments have the poverty information, hence the market size is already known to them.	Uncertainty about productivity of food grains due to excessive dependence on the climatic conditions. Differences at the state level operations, even targeting approaches, makes it difficult to assess the performance of the system. Identification of the market, i.e. identification and inclusion of genuine beneficiaries.
Source	Farmers are the suppliers who supply the food grains via. Cooperative societies created by farmers during the procurement season of around 3-4 month.	Ensuring sufficient remuneration to regulate market prices of food grains. Lack of professional approach for quality assessment. Also, limited space at the societies during procurement season due to huge inflow of food grain results in in-efficient procurement process.
Make	The only transformation activity required in PDS is remove husk from the procured food grain through milling. Milling is mainly performed by the private millers through government contracts.	Maintaining quality of the food grains. Ensuring sufficient remuneration for private millers, who often demand for hike in the wages. High cost of administration and monitoring to handle corruption and leakage at this point of supply chain.
Deliver	This process provides an interface between the PDS supply chain and	High cost of administration and monitoring to handle pilferage and ensure better service

customers/beneficiaries through a network of retail stores, FPSs. The registration and operations of FPSs is the responsibility of state government. Some of them favour community based organizations while others allow even private owners to operate FPS to increase the reach of the system.	delivery during distribution of food grains to the beneficiaries.

At each level of the supply chain, issue of quality remains an important component. Due to the bulky nature of this system and involvement of various stakeholders, like, farmer societies, private millers, community based organizations; it is difficult to maintain the superior quality and service delivery to poor beneficiaries.

CONCLUSION

Supply chain is an important part of any value delivery system. Public services for underserved community provide unique set of context and difficulties, due to vulnerable customer, non-profit nature and involvement of community based organizations. Also, the system is bulky due to its span across the length and breadth of the country. Public Distribution System (PDS) is one such public service operational in India for providing food security to poor population of the country. The paper discusses the challenges and issues encountered at various process of the PDS supply chain. The challenges of the system are greatly influenced by the purpose/goal of the supply chain, which is to ensure the sufficient supply of food grains to poor. Hence, the customer characteristics also, play a critical role. Lack of power, knowledge and awareness are the important characteristics of poor beneficiaries, which makes them highly dependent on the system for inclusion. Also, the whole supply chain process is bulky and involves multiple echelons. The chain also tries to produce employment at the local level, thus, addressing multiple social objectives.

Depending on the characteristics of the product and the demand pattern it is suggested to follow lean strategy for such kind of supply chains. The paper aims to discuss supply chain challenges of such public service along the process classification of SCOR model. It should be noted that due to the involvement of food as the product in-transit state, PDS should follow a unidimensional supply chains. Also, the inherent characteristics of the supply chain demands intensive monitoring to ensure the quality of product and service which is costly.

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