



## THE PERFORMANCE EVALUATION OF PUBLIC DISTRIBUTION SYSTEM USING EXPLORATORY FACTOR ANALYSIS

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**Abstract:** - PDS aims to provide subsidized food grains to the poor through a network of fair price shops. However, PDS has come under severe criticism for its ineffectiveness in reaching the poor and its inefficiency with reference to cost of distribution. This paper tried to evaluate the performance of PDS. The study selects 23 indicators of performance evaluation based on the studies of PDS literature. The survey technique used to identify the influencing factors through factor analysis. We try to reduce the dimension of complex indicators to few comprehensive main factors and name the main factors. The result of analysis provides a simple and suggests measures which help to improve customer satisfaction and reduction of delivery cost of food grain to customer in order to improve the performance of PDS.

**Keywords:** Public distribution system, targeting error, delivery mechanism, cost, overall performance.

### 1. Introduction

PDS is the largest distribution network of its

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kind in the world. Food grains such as rice and wheat that are provided under PDS are procured from farmers, allocated to states and delivered to the ration shop where the beneficiary buys his entitlement. It was introduced around World War II as a war-time rationing measure. Before the 1960s, distribution through PDS was generally dependant on imports of food grains. By the 1970s, PDS had evolved into a universal

scheme for the distribution of subsidized food. In the 1990s, the scheme was revamped to improve access of food grains to people in hilly and inaccessible areas, and to target the poor. Subsequently, in 1997, the government launched the Targeted Public Distribution System (TPDS), with a focus on the poor. PDS aims to provide subsidized food and fuel to the poor through a network of ration shops. Food grains such as rice and wheat that are provided under TPDS are procured from farmers, allocated to states and delivered to the ration shop where the beneficiary buys his entitlement. The centre and states share the responsibilities of identifying the poor, procuring grains and delivering food grains to beneficiaries (Sakshi Balani, 2013)<sup>1</sup>.

The PDS spends lot of cost and time to fulfill their long term goals and perspectives. Thus it is extremely important to know how much the performance of the PDS has led to meet its goals. One of the main reasons for the failure to successfully implement PDS scheme can be attributed to the fact that there are many constraints which affect the overall PDS performance. Secondly, studies at some point in their analysis clearly mention the need to interlink the constraints, performance measures and overall performance of PDS (Deepankar Basu et. al<sup>2</sup>, 2015; M. S. Alhuwalia<sup>3</sup>, 2005). Researchers have typically not addressed this issue. Challenges exist in terms of identifying appropriate performance measures for the analysis of PDS. Researchers have thus far been content in limiting their choice of performance measures. For instance, M. S. Alhuwalia<sup>3</sup> (2005) considers cost as an important measure of PDS performance. Customer satisfaction has also been recognized as an important dimension of PDS (N. C. Saxena, 2008)<sup>4</sup>. The Tata Economic Consultancy Service conducted a study in 2000 to know how much food grains were diverted from the system. At the national level it was found that there was the diversion of 36 per cent of wheat supplies, 31 per cent of rice and 23 per cent of sugar. Dr. S. Nakkiran<sup>5</sup>

(2004) on leakages in PDS found that not drawing and partial drawing of quota was substantially contributed for leakages.

PDS has not been effective in ensuring food security to the needy. Sarbapriya Ray<sup>6</sup> (2011), pointed out that PDS has neither benefited the poor, nor helped reduce budgetary food subsidies.' There are many problems with the Targeted PDS; the most relevant among them are the following. First, targeting has led to the large-scale exclusion of genuinely needy persons from the PDS. Secondly, targeting has affected the functioning and economic viability of the PDS network adversely and led to a collapse of the delivery system. Thirdly, PDS has failed to achieve the objective of price stabilization through transfer of cereals from surplus to deficit regions of the country. Lastly, there are reports of large-scale leakages from the PDS, that is, of grain being diverted and not reaching the final consumer.

Though number of studies has been conducted on PDS, the overall performance of PDS has not been studied and measured quantitatively. Present study will remove this gap and will show how for the poor population have been benefited in PDS in terms of the objectives of PDS.

## 2. Literature Review:

It is worth noted that issues relating to PDS have always been discussed but little empirical study on the determinants of overall performance has been conducted. Obviously, from the previous literature, there is very limited research focusing on PDS. For the purpose of this study, Overall performance of PDS is defined as the multiple measures of performance developed by the stakeholder to gauge the ability of a PDS to meet stakeholder long-term and short-term objectives.

Among earlier study on PDS is conducted by B. Ramaswami and P. Balakrishnan<sup>7</sup> (2002) using the demand-switching model asks whether and how the inefficiency of state institutions matters to food prices. The model focuses on the implications of quality differences between

public and private grain supply. The main finding of the study indicated that, though both are procured at similar prices, the lower quality of public grain marks the inefficiency of PDS. The paper proposes and empirically validates a method to test for demand switches that occur as a result of quality preference. As a result, a reduction in food subsidies increases food prices and hurts the poor even when they are not major recipients of the subsidy.

N. C. Saxena<sup>4</sup> (2008) states that, FPS should be allotted to people who are already running a viable shop in the area. This will ensure that the shop remains open on all working days. All card holders must be photographed, and their details along with their photographs should be in the public domain. This will make it easy for the civil society or consumers to check the list. Whereas government should set up and strengthen transparent arrangements for social audit, it may be desirable to remove some of the irritants, such as no distribution can take place unless the arrival of the stock has been verified by the Inspector. Performance of PDS may improve if state governments should provide a free toll number, where complaints can be registered online. A study by Basanta Kumara et. al<sup>8</sup>, (2012) also explored the determinants of failure of PDS. They focus on the magnitude of corruption at micro level, its implications and suggestions for revamping. They found that, the failure has been primarily due to corruption in the system and the important reasons attributed to this are appointment of dealers on political lines, and no provision of margin to the dealers. They also suggested that the role of Consumer Clubs which have been established in the rural schools to strengthen PDS and to provide food security. These clubs can play a very important role in educating the rural consumers about the PDS and in ensuring their food security and welfare.

The study on PDS is conducted by Raghendra Jha et al.<sup>9</sup> (2013) using Tobit analysis to examine the factors for low income transfers through PDS to the poor household which affect

the performance in three states: Andhra Pradesh, Maharashtra and Rajasthan.. Analysis focuses on variation in real income transfers through subsidised wheat, rice and sugar in these states. The main finding of the study indicated that the program is not well targeted in some instances, that both the poor and non-poor get subsidized food grain by the PDS. He also suggested that careful attention must be given to reducing transaction costs, long distances to be travelled, long queues and waiting periods, and under-weighting by FPS. A better network of FPS, higher margins and adequate supplies would go a long way in making the TPDS more cost-effective.

Whereas, Sakshi Balani<sup>1</sup> (2013) observe that, despite the existence of challenges, several states have implemented reforms to address gaps in implementation. It is important to note that while the centre plays a big role in implementing PDS, states have flexibility to tailor PDS according to their own priorities. Tamil Nadu implements a universal PDS, such that every household is entitled to subsidized food grains. States such as Chhattisgarh and Madhya Pradesh have implemented IT measures to streamline PDS, through the digitization of ration cards, the use of GPS tracking of delivery, and the use of SMS based monitoring by citizens. She also mentions the other alternatives to PDS include cash transfers and food coupons. Beneficiaries would directly be given either cash or coupons which can be exchanged for food grains. There are several arguments both in favour and against the effectiveness of such measures. Efforts have been made to introduce cash transfers for various schemes and to improve identification and prevent leakage of subsidy.

Anjani Kumar et al.<sup>10</sup> (2014) conducted the study to assess the changes in the status of food security in India. The food security was assessed in terms of its basic pillars i.e availability, access and absorption. Findings reveal that though there has been a remarkable improvement in the status of food security in

India. It has been observed that its contribution to poverty reduction and food security improvement has been increasing over time. The PDS contributed to overall reduction in poverty by 3.1 % in 2011–2012, with 3.8 % in rural areas and 1.4 % in urban area. The PDS is basically meant to improve physical access to food and enhance the food security. Its impact in terms of reducing food security seems to be laudable. These evidences clearly suggest that food transfers through PDS have considerable impact on improving food security and thus should be further strengthened. Its impact on improving physical access to food and its absorption has been impressive in spite of its criticisms for rampant leakages and corruption in its distribution system.

Ajinkya Tanksale et al.<sup>11</sup> (2015) examined the effect of National Food Security Act 2013 (NFSA) of India to fight against hunger and protect right of the people for food. They focus mainly on the operational and strategic aspects of PDS and its implications on NFSA. They found that, there are limited resources and exponentially increasing population, lack of infrastructure, operational inefficiencies and poor performance of the PDS are the major hurdles in successful implementation of the proposed act. This study gives emphasis on the need of major reforms in procurement, storage, movement and distribution of food grains strategies. Anil Kumar et al.<sup>12</sup> (2015) used Value Stream Mapping (VSM) to examine the factors for poor performance of PDS. This paper presented a systematic approach for determining the waste in the agri-food supply chains. Authors explored that lean thinking techniques can be effective tools for identifying the factors that influence the agri-food supply chain and also for decreasing the waste. They found that 60% of children in India are underweight and malnourished and as a total 21% of the total population is malnourished; still the availability of food remains a problem for many households in India. Poor transportation system, Lack of storage facilities

etc are said to be the main reasons why food distribution in India is so poor found that Logistics network inadequate. They proposed the VSM tool for determining waste. Their reports suggest that about 16-17 millions ton of grain waste every year during transit and lack of proper storage. Authors argue that the VSM analysis can be an effective and efficient tool for a number of improvements for the identification of the wastes in the PDS.

Sudhir Ambekar et.al.<sup>13</sup> (2015) develop a framework for mapping the Indian Public Distribution System (PDS) using multi-agent system (MAS). They focus on literature related to PDS, food grain supply chain (FGSC) and MAS. Based on this a framework is proposed which will help in improving functioning of PDS. They found that the PDS has many shortcomings arising from its complex structure and practices which are used to implement it. The authors propose MAS to model it in which each entity will be modeled as an agent to improve overall performance.

### **3. Research Methodology**

#### **3.1 The selection of BPL households**

The researcher identifies his sampling close to cluster sampling in which three main districts: Thane, Nashik and Amravati Districts of Maharashtra state were chosen. The researchers focused on the three main district of Maharashtra in order to have a sample representative of the population. Apart from this, the other motive was to save time and money as the population of the prospective participants spread over great distance across different places of the state. Therefore, researcher instead of sampling individual units, used sample groups (clusters) that occurred naturally in the population. In this particular case, the cluster sampling is area sampling or geographical sampling in which main three districts of Maharashtra state are identified as clusters. The customers were then selected randomly from these clusters by approaching them in their village and towns. This paper selects 400 BPL household from the three

districts of Maharashtra state in 2015 as a sample.

**3.2 Indicator design**

We select the 23 indicators to measure the performance of PDS after synthesizing the former studies of performance evaluation and PDS literature.

**3.3 Exploratory Factor analysis**

Exploratory Factor analysis (EFA) is a method which can locate the few comprehensive indexes from several relevant indicators to reflect the key messages contained in the original index. Therefore, EFA can integrate variables with complex relationships to a few

specific integrated core factors. EFA mainly consists of seven steps: (i) collect variable values; (ii) construct the correlation matrix; (iii) determine the number of factors; (iv) extract the main factors; (v) do rotation of factors; (vi) explain the structure of factors.

**4. Result**

Before using EFA, we should test the correlation between indicators because one prerequisite of using EFA is to have a strong correlation between the original indicators. This paper uses KMO and Bartlett test to show the correlation between the primary indicators.

**Table 1: KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.851
	Approx. Chi-Square	4707.232
Bartlett's Test of Sphericity	Df	253
	Sig.	.000

As we can from the KMO and Bartlett test Table 1, the value of KMO is 0.851 which shows that the original indicators are suitable for factor analysis. Besides, the score of Bartlett test is 253. Significant value is 0, and the variables can be considered that the correlation coefficient matrix between indicators has a significant difference.

According to the total variance contribution of each factor, this paper uses principle component analysis of EFA to extract main factors from the 23 original indicators. Then, we use the main factors to replace the original indicators to reflect the whole information. The variance contribution was shown in Table 2.

**Table 2: Total number of factor extracted and Total Variance Explained in EFA model**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.243	27.142	27.142	6.243	27.142	27.142	3.118	13.555	13.555
2	2.762	12.010	39.152	2.762	12.010	39.152	3.083	13.406	26.961
3	2.266	9.851	49.003	2.266	9.851	49.003	2.854	12.409	39.370
4	2.070	9.000	58.004	2.070	9.000	58.004	2.630	11.433	50.802
5	1.669	7.255	65.259	1.669	7.255	65.259	2.584	11.234	62.036
6	1.498	6.513	71.772	1.498	6.513	71.772	2.239	9.736	71.772

Extraction Method: Principal Component Analysis.

As we can see from Table 2, this paper have extracted 6 main factors from 23 indicators after factor analysis. The variance contribution of the 6 main factors is 71.772 % which means that six factors reflect the 71.772 % of the overall

information, there is less loss of information. So it is feasible to use the factors to replace the original variables to do performance evaluation of PDS.

**Table 3: Rotated component matrix in varimax rotated method.**

	Component					
	1	2	3	4	5	6
TE1					.807	
TE2					.796	
TE3					.776	
TE4					.791	
DM1						.858
DM2						.791
DM3						.897
IA1	.860					
IA2	.863					
IA3	.862					
IA4	.841					
CS1			.750			
CS2			.787			
CS3			.815			
CS4			.811			
CO1				.783		
CO2				.770		
CO3				.747		
CO4				.785		
PER1		.816				
PER2		.840				
PER3		.792				
PER4		.813				

Extraction Method: Principal Component Analysis.

**Name the main factors**

In the analysis, due to the comprehensive of original factors are strong, sometimes it is difficult to work out their practical significance. So this paper took the varimax rotation of these factors, which shown in Table 3.

**Factor 1** - There are 4 indicators showing high load on the first factor which includes extent of unidentified households, household accessibility to PDS authority, extent of grain from the market may be preferred to PDS grain because of higher quality and greater convenience and

extent there is error in naming the ration card, issuing of ration cards to undeserved people. Therefore, the first main factor is defined as targeting error.

**Factor 2 - 3** indicators show higher load on the second main factor, including extent food grain is available in FPS, extent the ration shop itself open all working days and extent there have been leakages and diversions of subsidized grains. Therefore, the second main factor is delivery mechanism.

**Factor 3** - There are four indicators having high load on the third main factor, information is available regarding the availability of goods, quality of ration responsible to affect communication, information available regarding appropriate price of ration and quantity of ration quota being provided to you from FPS. These four indicators reflect the information necessary to access the PDS food grain, so we can define third main factor as information asymmetry.

**Factor 4** – On the fourth factor, four indicators show high load including items other than food grain available, food grain is delivered on time, any complaints solved by FPS owners and FPS owner behavior friendliness. These indicators reflect the satisfaction requirement. Therefore, the fourth factor is customer satisfaction.

**Factor 5** - There are four indicators having high load on the fifth factor. These are cost of obtaining a ration card affordable, subsidies on food grain given to customer to improve their food security, transportation cost incur to purchase food grain from FPS and customer buy other goods by saving some money after purchasing from FPS. These four indicators reflect the cost to purchase the food grain from FPS, so we can define fifth main factor as cost.

**Factor 6** – On the last factor, four indicators show high load. These are FPSs not viable because of selling only food grain, FPS owners sell other goods through FPS, FPS owners getting incentives to sell ration and BPL families utilize their PDS quota. These indicators reflect the performance requirement of PDS. Therefore, the last factor is PDS performance.

## 5. Conclusion

From the analysis above, we can see that factor analysis plays an important role in performance evaluation. By using the method of exploratory factor research, complex evaluation indicator can be integrated into several main factors. The basic causes which affect the performance of public distribution system in India lie on error in targeting the poor, improper delivery mechanism and information asymmetry. Error

of exclusion occurs when the poor are excluded because of lack of geographical coverage resulting from comparing a product performance or outcome in relation to his or her expectation. The error of inclusion of undeserved people to get the benefit of subsidized food grain is more serious to increase the cost of delivery which will affect performance of PDS. Effort should be made to minimize the targeting error in order to improve the PDS performance. Improvement is required in delivery mechanism to reduce the leakage of food grains during transportation to the ration shop and sometimes, shop owners make bogus entries in the ration cards. Information is also play the important role to improve customer satisfaction and reduce the cost of delivering subsidized food grain to the customer. Lack of information on the availability of food grains, irregular supply, and lack of customer relations are the reasons for information asymmetry. Information asymmetry means a situation where there is imperfect knowledge. In particular it occurs where one party has different information to another. The performance of PDS can be improved if some corrective measures are taken to reduce delivery cost, bring in transparency in the delivery mechanism, reduce subsidies and make the operation of fair price shops financially viable.

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