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Measuring farmer's satisfaction and brand loyalty toward Indian fertilizer brands using DEA

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Abstract The present study has attempted to identify Indian farmers' level of satisfaction and loyalty pertaining to the purchase and use of different fertilizer brands. Fertilizer brands have to operate under certain prevailing constraints, such as uncertainty in weather conditions, the nature of the product and its usages. Added to this, there has been a reduction in the subsidy offered by the government of India, resulting in the escalation of complex fertilizer prices from INR 500 per bag to more than INR 1200 per bag. In order to gain competitive advantage through larger market share and increased profitability under the aforementioned constraints, retention of existing customers and strengthening brand loyalty have become significant preferences for fertilizer-selling firms. The study has employed data envelopment analysis as a tool to measure farmers' satisfaction and brand loyalty efficiency toward existing fertilizer brands. The European Customer Satisfaction Index model has been used as a reference for the paper. The data analysis reveals that Paradeep Phosphates Limited featured as the most preferred brand. The study has several implications. Managers can use these findings for their self-assessment of the fertilizer brands and then improve upon or manage the farmers' satisfaction and loyalty patterns.

Keywords Fertilizer brand · DEA · Brand loyalty · Farmer satisfaction · India

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Introduction

India's land area constitutes around 2.3% of the total global land mass. It supports one-sixth of the global population. Its population is expanding rapidly, with an annual growth rate of 1.4%. To meet the need of an additional 18 million people every year, India has to focus more on agricultural production (GoI 2014).[1] In the follow-up process of Indian policy developments, India has initiated major structural policy changes from the first five-year plan. Examples include the white and green revolutions; the green revolution aimed toward an increase in crop production. Fertilizer played one of the crucial roles in the success of India's green revolution (Bruinsma 2003; Hopper 1993; Pinstrup-Andersen and Hazell 1985). Agricultural labor is one of the major components of the fertilizer industry, being the end user. Hence, the socioeconomic characteristics of agricultural laborers in general and farmers in particular need to be considered to meet their aspirations.

Being connected with farmers as the end users through marketing would be critical for better performance in agriculture.[2] Today's farmers, apart from the easy availability of fertilizers, prefer to receive a better service from suppliers. Their purchasing behavior is also influenced by the value and brand image of the product.

The measurement of farmers' satisfaction and loyalty toward a product is given more significance in marketing research today. At the same time, agricultural input

[1] Annual report, Department of Fertilizers, Government of India, 2014.

[2] Saxena, Marketing *Geography*, (New Delhi: Rawat Publications, 2004), p. 57. Cf. *Barbara Harris White, A Political Economy of Agricultural Marketing In South India*, (New Delhi: Sage Publications, 1996).

suppliers are very keen on increasing their loyal customer bases, due to tough competition in the market, through different marketing strategies. The present paper focuses on Indian fertilizer brands and measures farmers' satisfaction and loyalty toward them. In India, the fertilizer industry is very well established, due to favorable and flexible government policy. There is an exclusive ministry functioning under the government of India to look after the production and distribution (allocation) of fertilizer across all districts of India. The supply of fertilizer is placed under the category of an "essential commodity," and the maximum retail price (MRP) is fixed in consultation with the government of India because fertilizer is largely subsidized for farming but not for industrial consumption.[3]

The present paper focuses on Indian fertilizer brands, particularly those in the state of Odisha (India), where nearly 60% of people earn their livelihoods through agriculture and allied activities.[4] Factors like good rainfall, easy availability of fertilizer, net cropped area, labor make Odisha a pro-agrarian state.[5] There are two major fertilizer manufacturers with an annual capacity of more than 3 million MT (metric tons) located in the state, which assures the availability of complex fertilizer to farmers. The consumption of fertilizer in this state is quite low (around 4 Lakh MT, 57 KG of NPK/hectare)[6] as compared to other states (Appendices 1, 2). This indicates that there exists huge market potential and competition among the suppliers, as the consumption is low and the supply is high. There are at present seven complex fertilizer suppliers in Odisha, namely Paradeep Phosphates Limited (PPL), Indian Farmers Fertilizer Cooperatives Limited (IFFCO), Indian Potash Limited (IPL), Coromandel International Limited (CIL), Tata Chemicals Limited (TCL), Rashtriya Chemical and Fertilizers Limited (RCF) and Nagrarjuna Ferilizers & Chemicals Limited (NFCL). There is a threat of complete withdrawal of subsidy in the near future. The repercussions would be the price of one bag of di-ammonium phosphates (DAP), which is currently Rs 1200 with the subsidy, would become Rs 1900 or more. Earlier studies have indicated that an increase in fertilizer prices resulted in a reduction in the consumption of fertilizer by Choudhury (2005) and Sharma and Thaker (2011).

Another factor, the profit of the fertilizer industry is largely based on the logistic expenditure; the maximum sale should be within 500 km (kilometers) from the factory area. Therefore, it is essential to enhance the number of satisfied farmers' within this radius to capture maximum sales. There are some intangible factors that can disrupt the quantity of sales, such as adverse climatic conditions, fertilizer as a unique product type and the late arrival of stock in the market. In such situations, the same stock would be utilized in the next crop cycle, leading to an increase in inventory carrying costs, deterioration in quality and a decrease in expected margins. Thus, there is a need for a deeper understanding of the farmers' characteristics, satisfaction levels, purchase patterns and behavior. A manufacturer with a good brand image and a large satisfied customer base will be able to achieve more sales under the above circumstances. Therefore, addressing the factors above could increase loyalty, maintain profit levels and provide better inventory turnover (Mellens et al. 1995; Webster 2000; Hoeffler and Keller 2003). Motivated by the above factors, we felt the necessity to conduct the present study. The objective of our study was to measure the farmers' satisfaction and loyalty toward Indian fertilizer brands in the state.

This study has adopted the European Customer Satisfaction Index (ECSI) model to measure farmers' satisfaction and loyalty efficiency, which has been successfully validated in different sectors, like banking, postal services and telecommunications (Chitty et al. 2007). Data envelopment analysis (DEA) has been used as a technique to empirically measure satisfaction and loyalty efficiency and to compare different fertilizer brands. DEA has been used widely in earlier studies, such as those in airports, branches of banks, universities and hospitals (Thanassoulis 2000; Cook and Seiford 2009).

The paper is organized into different sections. The literature review section follows the introduction. The details of the constructs of the model and the arguments for taking the constructs have been cited. The methodology section describes the method adopted and the tools utilized. Finally, the paper concludes with the findings, implications, and directions for future research.

Literature review

As discussed in the previous section, farmers' satisfaction and loyalty toward available brands in the fertilizer industry are gaining importance. Satisfaction is an important factor for profitability in terms of maintaining the customer base, affecting the marketing strategy and policy formulation of a firm (Anderson et al. 1994). Customer satisfaction also leads to sales of a product through word of mouth and is responsible for creating brand loyalty for that product. Farmers' pre-benchmark experience with a product leads to either satisfaction or dissatisfaction (Woodruff et al. 1983). Satisfaction is a

[3] http:www.mfms.nic.in.

[4] Agricultural Statistics at a glance 2014, Govt. of Odisha, India.

[5] Odisha is one of the states in India, earlier spelled as Orissa, http:/www.urvrak.com.

[6] NPK—nitrogen, phosphorus and potassium; KG—kilogram.

kind of consumer attitude (Mittal et al. 1999). It is computed as the difference in the expectation before the purchase and the actual performance soon after the product is consumed (Day 1984). It has also been expressed by Fornell (1992) as the post-purchase appraisal of a product. Several researchers have developed various models pertaining to customer satisfaction based on an overall view of satisfaction. Constructs like perceived quality, expectations, perceived value and the firm's image are supposed to influence satisfaction and loyalty, as per the ECSI model. These factors are the precursors of overall satisfaction, as well as having a direct effect on loyalty, and are explained below.

Image

Brand image is considered as the customer's knowledge of and beliefs about different products and services (tangible and intangible) pertaining to a specific brand and also the overall emotion about the image pertaining to a brand, which can be distinguished from other brands (Faircloth 2005). If the image is better, it will lead to good perceptions about the product by customers (Lee et al. 2011; De Chernatony et al. 2008). Firms should manage their images among customers in such a way that a good image looms large in the customers' minds, more than rival brands' images do (Grossman 1994). In the service model (Normann 1991), image is defined as one of the five most important elements of the service offered. Chang and Tu (2005) identified four elements for maintaining a store's image; the infrastructure of the store, the service provided convenience to customers and after-sales services.

Expectation

Oliver (1977) explained expectation as anticipation of future consequences based on prior experience, current circumstances, or other sources of information. Generally, farmers' expect palpable benefits or value from the brand when purchasing agricultural input, such as enhancing their crop yield. Usually, farmers using a specific brand of agricultural input over a period of time have some expectations regarding product design, packaging, color, ease of use, etc., from that brand. Regular usage of a particular brand generates some expectations in the farmer's mind. Expectations are also influenced by marketing activities, word of mouth and the external environment Grönroos (1982). The present study has used three indicators to measure farmers' expectations: overall quality, product quality and fulfillment of personal needs.

Perceived service quality

All companies aim to make their offers available to customers. This needs good service. Service differs from organization to organization. It also depends on the type of product. Service is defined as "any intangible act or performance that one party offers to another that does not result in the ownership of anything"[7] (Kotler and Keller 2009, p. 789), whereas quality is the sole thing that every consumer looks to see in an offer. Service quality can be defined as the differences between customer expectations and perceptions of service (Berry et al. 1988). Service quality is grouped into five categories as tangibles, reliability, responsiveness, assurance and empathy (SERVQUAL), (Parasuraman et al. 1985). Marketers realize the need for service of a high quality for retaining customers and for survival and growth (Kyoon Yoo and Ah Park 2007). Service quality can influence the retail store performance reported by Daskalopoulou and Petrou (2005). Service quality can be linked with product quality, the service delivered or market share (Rust and Chung 2006). The impact of service quality on repurchasing intentions has investigated by Anderson and Sullivan (1993). In the present study, perceived quality is taken as a construct to examine the experience of consumption of the product and service by the farmers.

The construct consists of the dependability and customization of a product. Dependability refers to the degree to which firms' services are free of any deficiencies and also continued valuable service, while customization is the level to which a product meets the customer's requirements.

Perceived value

According to Zeithaml (1988), the overall perceptions of consumers about the product and its assessment are referred to as perceived value. Value can be defined as the ratio or trade-off between quality and price (Johnson et al. 1996); the concept helps in comparing firms according to their price–value ratios (Anderson et al. 1994). Customers have different perceived values at the time of purchase from during or after use (Gardial et al. 1994). Customer value may be either intrinsic to the product or extrinsic. Customers' perceived value may be the customers' beliefs about the product or service (Bagozzi and Dholakia 1999). Value is a heterogeneous construct that is different from quality and satisfaction (Sweeney and Soutar 2001). Differentiated quality represents value for the customer (Band (1991). Quality can lead to value, but the same value cannot be assessed before, during and after consumption

[7] Kotler and Keller (2009).

(Woodruff 1997). Satisfaction is post-consumption only. Sheth et al. (1991a) acknowledged functional value (ability to perform and practical or technical benefits), social value (association with specific social groups), emotional value (capability to arouse feeling states), epistemic value (ability to arouse curiosity, provide novelty and/or satisfy a desire for knowledge) and conditional value (specific circumstances faced by the consumer) as the five different benefits of consumption value. Sheth et al. (1991b) provides a valid base for a perceived value scale and justify functional value as shaped by attributes like reliability, durability (both of which are aspects of quality) and price. Therefore, quality and price influence perceived value. Dodds et al. (1991) found that quality has a positive effect, while price has a negative effect.

Farmers' loyalty

The final outcome of the model (ECSI) adopted in this study is farmers' loyalty. Generally, loyalty leads to a positive attitude and behavior, as seen by repeat purchases, resistance to switch, positive word of mouth, and preference for a specific brand, service or outlet. In marketing terms, loyalty is something that farmers show to brands, services, stores, product categories, etc. Even in the case of e-retailers, around 50% of sales come from repeat purchasers, as per Balabanis et al. (2006) findings. Customer loyalty was considered first as repurchase behavior (Loveman 1998), second as repurchase behavior combined with an attitudinal component (Mcmullan and Gilmore 2003) and later as a combination of both behavioral and attitudinal factors (Mandhachitara and Poolthong (2011) considered a strong measure to capture both dimensions for decision making. In agricultural input marketing, the behavioral or attitudinal loyalty of farmers is greatly influenced by the dealers/retailers (Kashyap and Raut 2005), though private dealers are less qualified and knowledgeable (Krausova and Banful 2010). Later Blodgett et al. (1997) differentiated loyalty as a psychological and behavioral outcome triggering repurchase intentions. Kingstrom (1983) strongly argues that loyalty should be treated as a psychological construct. Further, Oliver (1999) suggested that psychological strategies are needed for achieving ultimate loyalty. Hence, a loyal customer base can be a valuable economic asset for any organization in terms of generating more-predictable sales and getting positive feedback about the performance of the organization's products and services (Rowley and Dawes 1999). Considering the widespread and deep-rooted competition in the market, customer satisfaction toward the product or service is a key determinant of customer loyalty toward it (Söderlund 2006). The majority of firms have adopted loyalty programs to retain and attract their customers, resulting in increased sales revenue, improved relationships between brands and customers, and competitive advantage Ho et al. (2009).

A number of empirical studies provide evidence regarding fertilizer and its role in obtaining good yield. The stream of literature includes topics such as motivation to use fertilizer, selection of brand, satisfaction and brand loyalty (Holland 2014) and store loyalty (Abdul Waheed and Gaur 2012). However, these topics have not received significant attention in marketing and other fields. Many studies have evaluated customer satisfaction and loyalty toward different product brands in different industries, but hardly any studies have measured the same for the fertilizer industry, focusing on the preferences of farmers for different brands. The main objective of this study is to measure the efficiency of existing fertilizer brands by adopting the ECSI model and using mode of purchase as a moderating variable.

Research methodology

Empirical model

The farmers' satisfaction and loyalty model used for the present study is based on the ECSI and is backed by accepted consumer behavior theories. The ECSI is a modified version of the American Customer Satisfaction Index (ACSI) model, which was introduced in 1994. The ESCI was later renamed the European Performance Satisfaction Index (EPSI). Based on the EPSI rating, one can understand the causes of customer satisfaction and its effects on loyalty (customer retention). According to Jonker et al. (2009), the EPSI has been developed as a common standard across Europe to measure customer satisfaction and loyalty by partnering with three organizations: the IFCF (International Foundation for Customer Focus), the EOQ (European Organization for Quality) and the EFQM (European Foundation for Quality Management). However, the Swedish Customer Satisfaction Barometer (SCB) is considered to be the first national cross-company and cross-industry measurement instrument for customer satisfaction, developed in 1989. The model links customer satisfaction to its four determinants: perceived company image, customer expectations, perceived quality and perceived value (value for money), with loyalty as its consequence. The ECSI does not incorporate complaint behavior but has company image as an additional latent variable that is expected to have an effect on customer expectations, satisfaction and loyalty, according to Johnson et al. (2001) and Grigoroudis and Siskos (2003). Following the concept of the ECSI model, the present study has not considered complaint behavior as a variable

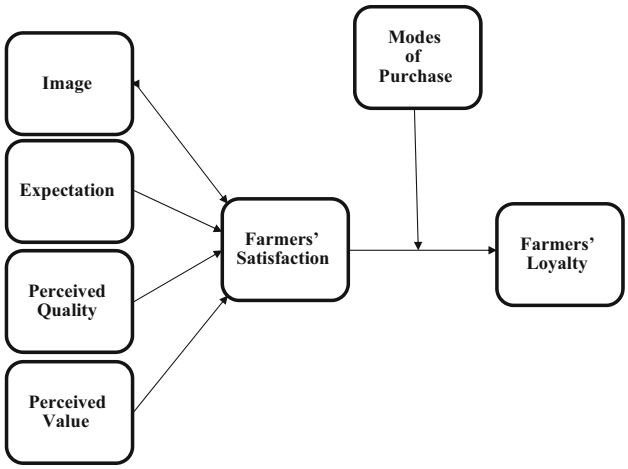

Fig. 1 Proposed model based on European Customer Satisfaction Index (ECSI)

because fertilizer is treated as a subsidized essential commodity in India; if the nutrient content is not found to be as per the prescribed grade, the government of India takes strict legal action against the supplier or manufacturer as per law. This justifies the use of the ECSI model for the fertilizer industry as compared to other models. The conceptual model of the study is given in Fig. 1 (Proposed Model based on European Customer Satisfaction Index).

We have introduced one moderating variable in the context of the fertilizer industry (mode of purchase) to the ECSI model constructs, which was conceptualized while conducting the pilot study. It was revealed during the survey that the small and marginal farmers do not possess adequate capital for the purchase of agricultural input or the adoption of improved technology at the time of planting/sowing. Under such circumstances, local agricultural input dealers or retailers extend credit facilities to farmers in the form of agricultural input or cash.

Earlier researchers like (Binswanger and Khandker 1995; Croppenstedt et al. 2003; Zerfu and Larson 2010) have also explained the role of credit in crop production. Credit resources therefore act as a constraint over the purchase of agricultural inputs (Gloy and Akridge 1999; Hansra and Vijayaragavan 2003). Hence, the proposed model considers mode of purchase as a moderator between farmers' satisfaction and loyalty. The ECSI model has been used for this study because it has all the important constructs that can measure farmers' satisfaction and loyalty to a great extent. Generally, farmers evaluate a product or service based on parameters such as quality, value and brand image before purchasing.

The detailed literature supporting the model applied in our research has been cited in Appendix 5. A few important studies in different industries have also been cited to support the proposed model.

The DEA model

The proposed model consists of four constructs as input variables (image, expectation, perceived quality and perceived value). Satisfaction and loyalty are used as output variables. DEA has been used as a tool for the analysis in the present study. DEA mainly measures and compares the efficiency of firms in their offers of products or services to customers. It classifies firms as decision-making units (DMUs). It is a widely accepted linear programming technique generally used for measuring the efficiency of multiple DMUs when the production process presents a structure of multiple inputs (minimization) and outputs (maximization) Charnes et al. (1994). This study pertains to output maximization. A DMU can be considered efficient if its output can be increased without increasing its input. Similarly, if its input is increased without increasing its output, the DMU is considered inefficient Charnes et al. (1981). If the input and output are of equal value to the DMU, it is possible to enhance the output without increasing the input and without decreasing any other output Nunamaker (1985). Efficiency is a score between 0 and 1 (or between 0 and 100%). Efficient DMUs have an efficiency rating $\Phi = 1$, while inefficient DMUs have an efficiency rating $\Phi < 1$. At the same time, the ratio efficiency (Φ) also explains the existence of an excess in inputs and shortfalls in production or output, which are also called slacks. An efficiency frontier is created, which helps the identification of inefficient firms from a group of firms in a sample. In addition to the ranking of firms in efficiency, DEA also helps in investigating the sources of inefficiency Kamakura et al. (1988). Generally, efficient firms are projected in a scatterplot with the help of an isoquant, which is convex in origin. An isoquant is a set of points representing a group of inputs that produces a specific output. The key advantage of this technique is that it does not consider prior assumptions on the basic useful associations between inputs and outputs Seiford and Thrall (1990), and the DMU need not specify the weights of different inputs and outputs used in the study; DEA itself assigns weights.

The present study is mainly based on variable return to scale (increasing return to scale), with different technical efficiency scores (Appendix 7). The nature of efficiency scores varies with respect to input and output for different brands. Therefore, it is nonparametric in nature, creating measurement problems (Al-Sharkas et al. 2008), and cannot test for the best specification. It can be used as a good benchmarking technique Avkiran (2006), to resolve complex problems accurately Sherman and Ladino (1995). The detailed mathematical formulation of the DEA is presented in "Appendix 6" (Ramanathan 2003; Bayraktar et al. 2012).

Recently, DEA has been used as an appropriate tool for data analysis in measuring efficiency in industries. Liu et al. (2013) brought out the details of the literature published till 2010 in different business sectors, like customer satisfaction and loyalty, the retail sector, not-for-profit organizations, measuring marketing productivity and efficiency, and service, in a diverse range of industries and also mention that more than 700 DEA applications were published in 2009 alone, while approximately 4500 papers were available in the ScienceDirect database before 2009. Previous studies in marketing using DEA have gathered lots of attention, such as those focusing on market orientation and performance in service industries (Haugland et al. 2007), the efficiency of sales forces (Boles et al. 1995), comparing insurance industries (Mahajan 1991) applied the same for comparing between insurance industries, retail store efficiency (Keh and Chu 2003), evaluating efficiency in website marketing (Shuai and Wu 2011), internal customer service quality in banks (Soteriou and Stavrinides 2013), channel efficiency in franchise and non-franchise systems (Yoo et al. 1998), retail productivity considering retail pricing and strategy (Gauri 2013), benchmarking of advertising spending (Luo and Donthu 2001) and the efficiency of the service profit chain (Kamakura et al. 2002). The impact of customer satisfaction efficiencies on firm financial performance and brand efficiency have been investigated by Mittal et al. (2005). In agricultural efficiency studies, parametric and nonparametric approaches and their theoretical and methodological variations are widely applied (Atici 2012).

We have adopted DEA instead of stochastic frontier analysis (SFA) because DEA can divide the total technical efficiency into pure technical and scale efficiency. It can also classify firms' different (increasing or decreasing) returns to scale. DEA does not require a practical relationship between production output and input or any prior statement on the statistical distribution of error terms, which allows data to speak for themselves. In fact, DEA has a minimum specification error and does not allow measurement errors.

Survey instrument

The constructs and items in this study have been taken from the work of the Technical Committee of the EPSI and are similar to those used in Swedish and ACSI studies. In addition, company image, taken from the ECSI model, consists of the following items: social responsibility, ethics and business practices, derived from the original work of Naumann and Giel (1995). Each construct has been described with multiple items, which ensures the accuracy of the estimates more effectively as compared to the application of a single measure. After an extensive literature review, including the work of Nunamaker (1985), the EPSI Technical Committee (1998) and Kristensen et al.

Table 1 Farmers' satisfaction and loyalty model–constructs and its items

1	Image	I feel this company is most dependable and skilled
2		This company is considered to be more ethical, maintains the best customer relationship
3		This company contributes significantly to the society **(CSR work)**
4		I can recognize the logo and physical appearance of the product among the competing brands. It comes to my mind first. I feel privileged buying it
5		This company is very innovative in launching new products and services, also looking ahead
1	Expectation	How well the product fulfill farming needs (pre-purchase)
2		I am getting quality product timely as expected
3		I am getting the required services as expected
1	Perceived quality	What about overall quality of product experienced
2		How would you rank the functional benefits of product, experienced recently
3		How would you rate the firm's customer service
4		How well the product is customized (meets your farming needs)
1	Perceived value	The feeling of having paid the right price as per perceived value
2		The purchase is worthwhile considering the price paid
1	Farmers' satisfaction	Ranking of the preferred brands performance versus ideal provider
2		The level to which the product or, services exceeds your expectations
3		Overall, **t**his brand or service does a good job of satisfying farming needs
1	Farmers' loyalty	Continue using the product or services
2		Recommendation to others
3		No switch from the brand despite suggestion from the friends, willing to buy even at a higher price

(2000), 20 items were chosen, in addition to demographic details (age, gender, education, income, land holding, etc.), pertaining to the measurement of farmers' satisfaction and loyalty efficiency in this study. The details are provided in Table 1.

While preparing the questionnaire for the survey, assistance was provided by senior marketing officials of the fertilizer industry, as well as senior academicians in the consumer behavior field. Three pilot surveys were carried out before the final survey questionnaire: the first focused on small farmers (11 farmers), the second focused on a group discussion with medium and big farmers (seven farmers) and the third focused on vegetable farmers along with dealers and retailers (one dealer and four retailers) who work in farming and the agricultural input business.

The interviewers were also trained by the researcher during the pilot study. We have used a five-point Likert scale for our study. The reason for not using a seven-/ten-point Likert scale was due to the confusing answers received from the farmers in response to the options partially agree, agree, strongly agree, neutral, partially disagree, disagree and strongly disagree. Instead, they clearly replied to agree, strongly agree, neutral, disagree and strongly disagree (Mentzer et al. 1999; Robson 1993).

Sample and data collection

Data have been collected through focused group discussions and personal interviews. Users of different complex fertilizer brands in the state have been included in the sampling frame. The researcher categorized the districts on the basis of fertilizer consumption: whether the districts were consuming fertilizer below, above or at a par with the national average. Farmers from each district were interviewed on snowball sampling basis (Appendix 3).

In total, 813 farmers were interviewed from 370 villages (25 districts), as detailed in "Appendix 4", with the help of 12 interviewers in 75 days of fieldwork from November 2014 to January 2015. A total of 744 completed questionnaires with no questions missed were taken up for analysis. Details of the respondents' demographic profile are provided in "Appendix 3." The greater proportions of the farmers were male; the participation of female farmers in decision making is very negligible in Odisha. Similar findings have been reported by earlier studies (Solano et al. 2001). Surprisingly, around 20–25% drop in complex fertilizer consumption has been observed since 2012, soon after a hike in the price of complex fertilizer in the state and in the country. In this study, around 67% of the farmers (especially small and marginal farmers) reduced their fertilizer application soon after the price hike; 25% of the farmers were using the same doses of fertilizer as before; and only 8% were using more than the previous quantity. This shows a clear relationship between the price hike in complex fertilizer and consumption. Similar studies have been undertaken by earlier researchers, like Choudhury (2005), regarding the impact of price factors on the growth of fertilizer use in India. The government of India should change the fertilizer price policy by looking at the purchase capacity of small and medium farmers.

Education is considered an important factor by researchers in agricultural productivity (Tilak 1993). This study shows that around 74% of the respondents had a low level of education, out of which 35.2% had not passed high school and 38.2% had just a high school degree. This level of education does not indicate good knowledge of improvements in agriculture. Surprisingly, 61% of the farmers out of the above (10th or $<$ 10th standard) depended completely on dealers or retails for their agricultural input purchase decisions (brand preference). This gives us evidence about the effect of mode of purchase as a moderating variable on farmers' satisfaction and loyalty.

In the initial stage of the analysis, the collected data pertaining to each construct were decoded. Respondents were asked to state clearly their preferred complex fertilizer brands and were classified accordingly. Interestingly, most of the respondents indicated leading three fertilizer brands, which forms the main theme for our study pertaining to farmers' satisfaction and loyalty evaluation. The leading brands purchased by the farmers were IFFCO, CIL and PPL, which together have a market share of more than 90%. The three least-preferred brands mentioned were IPL, TCL and RCF.

Data analysis and findings

Exploratory factor analysis was used to avoid biases in the DEA, considering the large volume of data, and to reduce the number of variables with negligible loss of data (Adler and Golany 2002). Therefore, all constructs of the ECSI have undergone EFA to form a single factor. In the case of factor analysis, the Kaiser–Meyer–Olkin (KMO) value should not be less than 0.5; the larger the measure of the sample, the better the data, as suggested by Cerny and Kaiser (1977). According to Hair et al. (2010), samples with large KMO values are most suitable for the application of factor analysis.

Cronbach (1951) developed the reliability coefficient alpha to calculate the internal consistency of a multi-item scale. As suggested by Peterson (1994), the measures should be free from error and should produce consistent results, and the Cronbach's alpha value should be more than 0.7. The details of these values are provided in Tables 2 and 7. Principal component analysis, composite

Table 2 Constructs and their unidimensionality in nature

Constructs	No. of items	1st eigenvalue	2nd eigenvalue	KMO
Image	5	3.337	0.564	0.850
Expectation	3	2.080	0.511	0.696
Perceived quality	4	2.840	0.479	0.805
Perceived value	2	1.668	0.332	0.5
Farmers satisfaction	3	2.562	0.225	0.760
Farmers' loyalty	3	2.529	0.307	0.729

Overall instrument reliability is .964 (20 items)

reliability evaluation and Cronbach's alpha calculation have been used to authenticate unidimensionality (e.g., all five items of the construct "image" formed a single factor) and for ensuring the reliability of the constructs and model. The results in Table 2 show that the first eigenvalue is greater than 1 and that the second eigenvalue is smaller than 1, along with the KMO values, which are below 0.7 except for expectation, which is also an authentication point justifying unidimensionality (Tenenhaus et al. 2005).

Four manifest variables (company's image (CI), farmers' expectations (FE), perceived quality (PQ) and perceived value (PV)) were used as inputs for the evaluation of farmers' satisfaction and loyalty efficiency (the two latent variables) toward each fertilizer brand. Output-oriented (the BCC model) DEA was chosen to maximize the importance of farmers' satisfaction and loyalty while maintaining the input levels achieved at present. DEA evaluates DMUs (in this case, different brands), and there is an intermediate level of management that encompasses all the DMUs. This intermediate level, referred to here as the "program," characterizes a combination of DMUs sharing joint features.

Brockett and Golany (1996) suggested a four-step technique for determining the program efficiency differences among a group of DMUs, popularly known as the program evaluation procedure. Similar steps as advised above have been applied here to establish the efficiency differences in different fertilizer brands on the basis of farmers' perception. The farmers were grouped as per their preferences for the fertilizer brands. The average input and output values for each fertilizer brand have been calculated to run the DEA for each brand. The details of the mean values, as well as the BCC efficiency scores of the fertilizer brands (output-oriented), the extent of analysis of the fertilizer brands and the assessment of perception, are detailed in Table 3. The homogeneity of a specific fertilizer brand is assigned a higher mean efficiency value; higher scores are a sign of superior reliability (Nunnally and Bernstein 1994; Strahan and Gerbasi 1972), which is considered a sign of the consistency and reliability of the questionnaire used in the survey (Ali et al. 1991; Carmines and Zeller 1979). PPL has the lead efficiency score of 1 in comparison with other fertilizer brands, which shows that the farmers using the PPL brand were highly consistent in their self-evaluation of satisfaction and loyalty efficiency with respect to company image, expectations, perceived quality and perceived value, while the farmers using the fertilizer of the TCL brand were the least homogeneous (0.935). In the second step farmers who evaluated their brand as inefficient were projected on to the efficiency frontier. Hence the assessment and perception difference among the specific group of farmers sharing joint features were removed from the analysis. The main objective of the above two steps was to remove the portion of managerial inefficiencies by the individual DMUs.

The overall efficiency level was found to be high in this study, which indicates homogeneity in the performance of different Indian fertilizer brands. This may be due to the prevailing flexible support of the government system since the inception of the fertilizer industry in India. Still, there is scope for improving the performance, even though the results show relatively high efficiency scores. All fertilizer brand users and their efficiency levels (adjusted) were pooled in the DEA in this stage. In implementing the next step, suitable statistics were used to measure the differences. Therefore, on the basis of DEA, the Kruskal–Wallis rank test (Sueyoshi and Aoki 2001) has been used to find the statistically significant differences among the fertilizer brands pertaining to the levels of farmers' satisfaction and loyalty, as displayed in Table 4.

The overall efficiency scores were ranked on the basis of the DEA results in ascending order, with the highest score ranked as 1 and so on. With the help of SPSS tools, the mean rank of each brand was calculated, as displayed (Chi-squared test and associated p value). The results shown below reject the null hypothesis (H0: there are no differences among the fertilizer brands in terms of efficiency levels; p value = 0.000), as the different fertilizer

Table 3 Fertilizer brand efficiencies along with average input and output values

DMUs (fertilizer brands)	Image Input	Expectation	Quality	Value	Satisfaction Output	Loyalty	Efficiency score
PPL	4.443	4.004	4.542	4.309	4.583	4.683	1
	(0.229)	(0.061)	(0.321)	(0.450)	(0.385)	(0.416)	
IFFCO	3.616	3.756	3.647	3.797	3.436	3.358	0.974
	(0.199)	(0.331)	(0.243)	(0.323)	(0.358)	(0.352)	
CIL	3.385	3.781	3.438	3.577	3.341	3.202	0.962
	(0.304)	(0.216)	(0.304)	(0.525)	(0.571)	(0.517)	
IPL	3.334	3.492	3.290	3.330	3.140	2.848	0.946
	(0.277)	(0.357)	(0.343)	(0.329)	(0.241)	(0.381)	
TCL	3.106	3.000	3.240	3.133	3.000	2.639	0.935
	(0.101)	(0.000)	(0.210)	(0.487)	(0.272)	(0.279)	

* Average mean of the group-wise efficiencies of the fertilizer brands evaluated as per farmers. The numbers within parentheses represent standard deviation

Table 4 Kruskal–Wallis rank test results indicated statistical differences between the brands

Brand name	Overall efficiency	Mean rank	KW (Chi-square)	*p* value
Paradeep Phosphates Limited	1	33.50	27.123	.000 (null is rejected)
Indian Farmers Fertilizer Cooperatives Ltd.	0.974	25.25		
Coromandel International Limited	0.962	20.92		
Indian Potash Limited	0.946	13.58		
Tata Chemicals Limited	0.935	6.08		

Table 5 Difference between different fertilizer brands (multiple comparison rank sum test)

Brands		KW	*p* value
PPL	IFFCO	8.308	0.004***
PPL	CIL	8.308	0.004***
PPL	IPL	8.37	0.004***
PPL	TCL	8.337	0.004***
PPL	RCF	8.308	0.004***
IFFCO	CIL	1.859	0.173
IFFCO	IPL	6.587	0.01**
IFFCO	TCL	8.337	0.004***
IFFCO	RCF	6.564	0.01**
CIL	IPL	3.113	0.078*
CIL	TCL	7.436	0.006***
CIL	RCF	4.333	0.037*
IPL	TCL	3.718	0.054*
IPL	RCF	0.316	0.574
TCL	RCF	2.33	0.127

(*** p is less than 0.01(two-tailed); ** p is less than 0.05, and * p is less than 0.10)

brands were found to be statistically different pertaining to the efficiency levels of farmers' satisfaction and loyalty.

The next statistical test, the multiple comparison rank sum test, was used to identify the different pairs of fertilizer brands found to be the same or different. The results of this test are shown in Table 5.

PPL had the highest mean rank and was also found to be statistically different ($p < 0.01$) from the other fertilizer brands. Therefore, the PPL fertilizer brand was best in terms of the farmers' satisfaction and loyalty efficiency. Next to PPL, the levels of farmers' satisfaction and loyalty with IFFCO and CIL were considerably healthier ($p < 0.01$) than the remaining two fertilizer brands. This would put the brands in the second and third ranks, respectively. Finally, a pair-wise comparison between the IPL and TCL fertilizer brands in the rank sum test showed no significant differences ($p > 0.1$). Their efficiency levels of farmers' satisfaction and loyalty were not notably different from each other and were not good among the six brands compared.

In addition to the fertilizer brands' ranking in terms of farmers' satisfaction and loyalty efficiency, the DEA also provides the reasons for the inefficiencies of each fertilizer brand. Through a proportional increase in output, an inefficient unit is made efficient in output-oriented DEA, without a change in the input proportions. Slack represents surplus inputs (excess use) or a lack of outputs (under-

Table 6 Fertilizer brands inefficiencies slacks (average relative)

	PPL	IFFCO	CIL	IPL	TCL
Input excess (in percentage)					
Image	0.000	0.047	0.025	0.106	0.000
Expectation	0.000	0.508	0.721	0.559	0.185
Perceived quality	0.000	0.000	0.000	0.000	0.056
Perceived value	0.000	0.313	0.302	0.196	0.104
Output deficit (in percentage)					
Satisfaction	0.000	0.000	0.000	0.000	0.000
Loyalty	0.000	0.155	0.213	0.359	0.426

production), which are measured on the basis of an isoquant (Charnes et al. 1994). The average inefficiencies or slack resulting from the differences in brand users' perceptions and evaluation errors are shown in Table 6.

The results indicate that IPL has a higher input excess image in comparison with the other brands. The images of PPL and TCL were found to be good, with zero input excess. This shows that PPL and TCL both make efforts to enhance their images (through marketing activities). The excess inputs used by IFFCO and CIL were 4.7 and 2.5%, respectively, indicating that both firms do not take full advantage of their marketing activities toward increasing farmers' satisfaction and loyalty. It can be inferred from an image point of view that all DMUs exhibit similar types of expenditure. It is highlighted that the image of a firm or brand always comes to the fore in the customer's mind before the purchase of any product.

The second construct is expectation (input excesses). The strength of any brand or firm is based on customers' expectations. Brands like CIL has 72% excess expectation, IPL has 60%, and IFFCO has 51%. Higher side of the percentage figure depicts the brand is strongly associated with the farmers. But when we compare the above firm's loyalty base with the benchmark firm, PPL (output deficit figures) are very low. Hence, there is vast scope for these firms to exploit the farmers' expectations and enhance their respective loyal farmer base.

The third construct is perceived quality. All the DMUs have zero input excess, except TCL (5.6 percent). Popular fertilizers sold by firms in the market are DAP (Di-ammonium phosphate), Urea & MOP (Muriate of Potash). Farmers' perception about a specific fertilizer sold by different firms from quality point of view is similar. This is due to the similar nutrient composition of the fertilizers. For example DAP fertilizer contains nutrients such as Nitrogen, Phosphorus & Potash (N:P:K) in ratio of 18:46:0, Urea Contains only Nitrogen of 46 percentage and does not contain phosphorus and Potash Whereas Muriate of Potash contains only potash of 60 percentage but does not contain Nitrogen and phosphorus. In our study, PPL is first for product quality and service quality in comparison with other brands. In case of perceived value, TCL (14.2%) has the least input excess, in comparison with IFFCO (31%), CIL (30%) and IPL (20%). Farmers have more faith in a cooperative system, as brands like IFFCO, CIL and IPL especially supplied to farmers through cooperative societies. Similarly, the TCL brand had very low expectations in terms of farmers' perceptions and perceived quality because of poor service and inconsistent supply. Surprisingly, the farmers were equally satisfied with the performance of the different brands. This may be due to the variations in the nutrient grades of different brands. For example, the nutrient contents of DAP are the same, but it is available in 6–8 different brands in the market.

The efficiency results indicate that the Indian fertilizer brands are functioning at a high level of efficiency (>90%). This does not mean that there is no scope for further enhancement in marketing. Moreover, being an output-oriented study, high values in inputs in image, perceived quality, expectations and perceived value are good indicators for the firms because of the farmers' reliance on and confidence in the brands. The results also reveal that there is homogeneity in the execution of prescribed processes across the fertilizer industry within the country. However, this study has not made any comparisons with foreign brands. The main aim has been to measure the output deficits. On the basis of input excesses and output deficits, it can be inferred that PPL is the most efficient brand operating in the state, as per the farmers' preferences, whereas TCL is the least efficient brand. As a major finding of the study, TCL could be equal to IFFCO if its loyal base of farmers could be increased to around 47%, which would not be easy but has huge potential.

The IPL and TCL brands have higher and lower input excesses, respectively, in comparison with the most efficient DMU. Simultaneously, their output deficits are also higher in comparison with others. Both the firms have huge potential to increase their loyal bases of farmers up to 36 and 43%, which would not be easy with the available resources. These findings also show that the farmers purchasing IPL and TCL have a propensity toward dealers and retailers offering credit facilities. The farmers' characteristics also reveal that only 7% of the farmers opted for the TCL brand in this study; surprisingly, all these farmers mentioned that they have purchased the fertilizer completely on credit or have paid the concerned retailers/dealers after around 90 days, along with minimal interest. Similarly, around 12% of farmers preferred IPL, 64% of which have used the credit facilities of local retailers/dealers.

The average scores of the IPL brand users for satisfaction and loyalty are 3.14 and 2.84, respectively, whereas for TCL brand users, they are 3 and 2.63. In the case of IFFCO and CIL, they have reasonably high input excesses

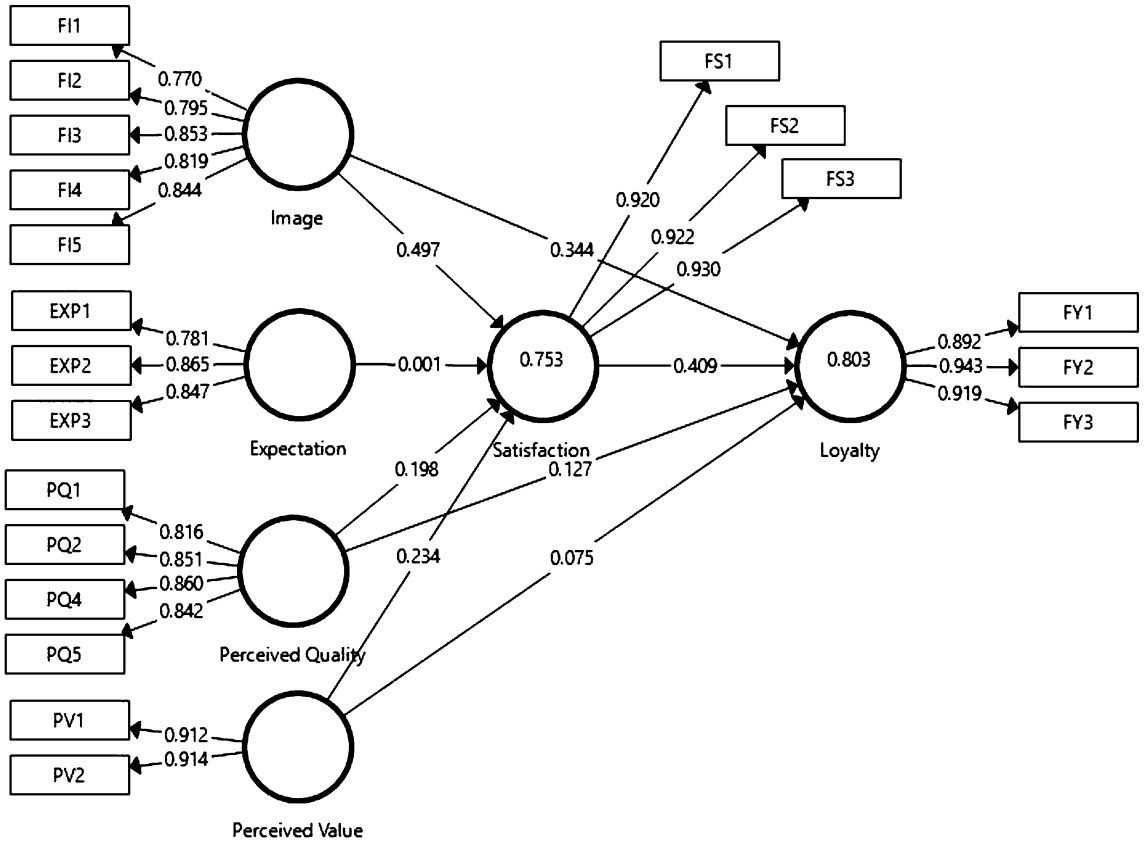

Fig. 2 PLS result

but low output deficits. Therefore, it can be stated that the IFFCO and CIL brand purchasers in the sample tend to make stronger compromise in their evaluations. The high efficiency scores in Table 3 strongly support this argument. Both IFFCO and CIL are possible competent brands that could be compared with PPL, provided they increase their loyal farmers' bases up to 15 and 21%, respectively. When we examine the average scores of IFFCO and CIL brand users toward satisfaction and loyalty, they are 3.43 and 3.35 for IFFCO and 3.34 and 3.20 for CIL, which are slightly higher than those for IPL and TCL brand users. These scores are based on the data collected on a five-point Likert scale.

To find the causal relationships among the six latent variables, we have adopted smart PLS modeling in this study as proposed by Ringle et al. (2005). Using partial least squares (PLS-SEM) in the study has been initiated by Boardman et al. (1981) and Fornell and Cha (1994). This technique has many merits pertaining to satisfaction studies, as mentioned by Cassel et al. (2000). The R^2 value should be more than 0.65, as suggested by the EPSI Technical Committee (1998), Kristensen et al. (2000) and O'Loughlin and Coenders (2004). The R^2 value for satisfaction in this study is 0.75, successfully meeting this requirement. Farmers' expectations were found to have a negligible impact on satisfaction, which may be because the type of product, fertilizer, is considered a subsidized and government-controlled product at the farmer level. Finally, the standardized root-mean-square residual (SRMR) for the model is 0.061 (saturated), which is less than 0.10, and the value for the estimated model is 0.420. A value of 0.08 or above is considered to be good fit (Hu and Bentler 1998). Additionally the global goodness of fit (GoF) is 0.772 (Wetzels et al. 2009).[8] The details of the result are mentioned in Figs. 2 and 3 and Tables 7, 8 and 9.

We have used one-way MANOVA (multivariate analysis of variance); the main effects and interactions have been assessed on a grouping of outcome variables (DVs) to measure the influence of mode of purchase on farmers' satisfaction and loyalty. Data regarding mode of purchase on two parameters (i.e., cash and credit) have been collected by the researcher. The survey data show that around 40% of the farmers purchased fertilizer using cash (denoted as "1"; mean 4.1), mainly small farmers. The majority (around 60%) of the farmers used credit facilities (denoted as "2", mean 3.6) for fertilizer purchases, mainly from local retailers/dealers, particularly medium and big

[8] ($GoF_{small} = 0.10$, $GoF_{medium} = 0.25$, $GoF_{sbig} = 0.36$) and formula is GoF $= \sqrt{\text{Ave. X } \sqrt{R^{2.}}}$

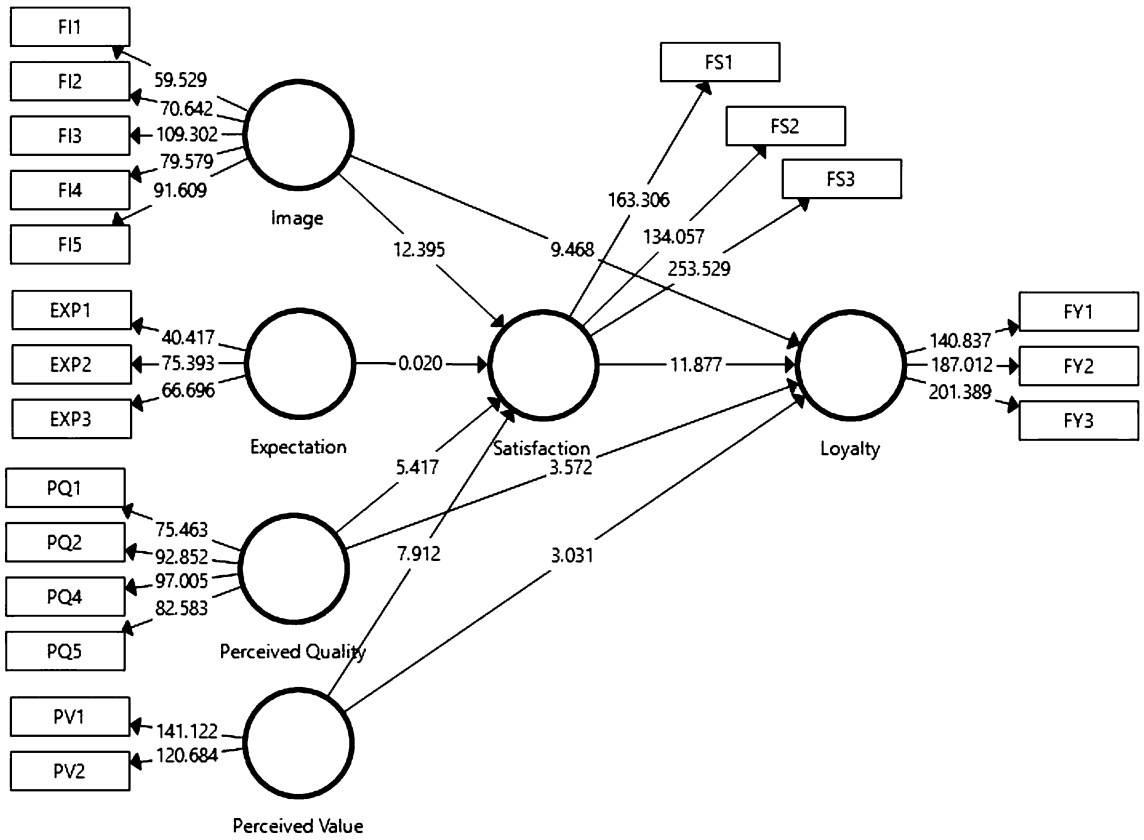

Fig. 3 PLS result after bootstrapping

Table 7 Discriminant validity

	Expectation	Image	Loyalty	Perceived quality	Perceived value	Satisfaction
Expectation	0.832					
Image	0.731	0.817				
Loyalty	0.705	0.856	0.918			
Perceived quality	0.696	0.865	0.805	0.843		
Perceived value	0.659	0.751	0.732	0.718	0.913	
Satisfaction	0.656	0.844	0.858	0.796	0.750	0.924

farmers. This indicates that credit purchasing is directly influencing brand loyalty. The cash purchase also has some effects compared to credit purchase as per the result because a farmer may hesitate to keep his interest or voice before the dealer/retailer; this may be due to the credit facility or business relationship. This is similar to the findings of Buttle (1996).

Table 10 shows the normal distribution of both dependent variables. The descriptive statistics table (Table 11) provides the means, standard deviations and number of observations for cash and credit modes of purchase for satisfaction and loyalty separately. The mean satisfaction and loyalty values for mode of purchase show differences. Box's test of the equality of covariance matrices has been used to check the presence of equal covariance across groups (Table 12). This test can be ignored in the case of equal group sizes. The significance value is 0.004 (should be >0.001), depicting equal variance across the groups. The education groups differ in the linear combination of the outcome variables, as mentioned in Table 13, which was tested through one-way MANOVA. In this study, we have considered Hotelling's trace result: F-48.516, df-2, 740 and p 0.000 ($p < .05$). Therefore, the conclusion is that mode of purchase has a significant effect on the linear combination of farmers' satisfaction and loyalty. The mode of purchase groups (cash and credit) should have equal variances across the outcome variables. Levene's test of equality has been

Table 8 Outer model results

Constructs	Items	Loadings	*t* values	AVE	CR	α
Expectation	EXP1	0.781	40.417	0.692	0.871	0.779
	EXP2	0.865	75.393			
	EXP3	0.847	66.696			
Image	FI1	0.770	59.529	0.667	0.909	0.875
	FI2	0.795	70.642			
	FI3	0.853	109.302			
	FI4	0.819	79.579			
	FI5	0.844	91.609			
Satisfaction	FS1	0.920	163.306	0.854	0.946	0.915
	FS2	0.922	134.057			
	FS3	0.930	253.529			
Loyalty	FY1	0.892	140.837	0.843	0.942	0.907
	FY2	0.943	187.012			
	FY3	0.919	201.389			
Perceived quality	PQ1	0.816	75.463	0.71	0.907	0.864
	PQ2	0.851	92.852			
	PQ4	0.860	97.005			
	PQ5	0.842	82.583			
Perceived value	PV1	0.912	141.122	0.834	0.909	0.801
	PV2	0.914	120.684			

AVE average variance extracted; *CR* composite reliability; α Cronbach alpha

Table 9 Structural path estimates

Direct effect	Path coefficient	*t* values	*p* value
Image–satisfaction	0.497	12.395	0.000
Expectation–satisfaction	0.001	0.02	0.984
Perceived quality–satisfaction	0.198	5.417	0.000
Perceived value–satisfaction	0.234	7.912	0.000
Satisfaction–loyalty	0.409	11.877	0.000
Image–loyalty	0.344	9.468	0.000
Perceived quality–loyalty	0.127	3.572	0.000
Perceived value–loyalty	0.075	3.031	0.002

Table 10 Normality test

	Kolmogorov–Smirnov[a]			Shapiro–Wilk		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
Satisfaction	.249	744	.000	.838	744	.000
Loyalty	.240	744	.000	.859	744	.000

[a] Lilliefors significance correction

Table 11 Descriptive statistics

Mode of purchase	Mean	SD	N
Satisfaction			
Cash	4.104444	.7063303	300
Credit	3.604354	.7366374	444
Total	3.806004	.7645697	744
Loyalty			
Cash	4.102222	.7686216	300
Credit	3.492492	.9065676	444
Total	3.738351	.9040718	744

Table 12 Box's test for equal variance

Box's test of equality of covariance matrices	
Box's M	13.413
F	4.457
df1	3
df2	24,571,538.407
Sig.	.004

Test the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups

[a] Design: intercept + education + mode of purchase

used (Table 14) to verify this. The p-values of all dependent variables must be >0.05; satisfaction was found to be significant. In the case of loyalty, the assumption seems to have been slightly violated.

The second part of the results section is mentioned in Table 15 regarding the effect sizes of the different options for mode of payment (cash or credit) on farmers'

Table 13 Multivariate test

Effect	Value	F	Hypothesis *df*	Error *df*	Sig.	Partial eta squared
Multivariate tests[b]						
Intercept						
Pillai's trace	.557	465.105[a]	2.000	740.00	.000	.557
Wilks' lambda	.443	465.105[a]	2.000	740.00	.000	.557
Hotelling's trace	1.257	465.105[a]	2.000	740.00	.000	.557
Roy's largest root	1.257	465.105[a]	2.000	740.00	.000	.557
Education						
Pillai's trace	.016	5.896[a]	2.000	740.00	.003	.016
Wilks' lambda	.984	5.896[a]	2.000	740.00	.003	.016
Hotelling's trace	.016	5.896[a]	2.000	740.00	.003	.016
Roy's largest root	.016	5.896[a]	2.000	740.00	.003	.016
Mode of purchase						
Pillai's trace	.116	48.516[a]	2.000	740.00	.000	.116
Wilks' lambda	.884	48.516[a]	2.000	740.00	.000	.116
Hotelling's trace	.131	48.516[a]	2.000	740.00	.000	.116
Roy's largest root	.131	48.516[a]	2.000	740.00	.000	.116

[a] Exact statistic

[b] Design: intercept + education + mode of purchase

Table 14 Homoscedasticity test

	F	df1	df2	Sig.
Levene's test of equality of error variances[a]				
Satisfaction	1.071	1	742	.301
Loyalty	7.407	1	742	.007

Test the null hypothesis that the error variance of the dependent variable is equal across groups

[a] Design: intercept + education + mode of purchase

satisfaction and loyalty. As the MANOVA results are significant, this means that the cash and credit modes of purchase have different effect sizes on farmers' satisfaction (F-85.921, df-1, $p < .05$) and loyalty (F-92.289, df-1, $p < .05$). The effect size is defined as the strength of the relationship between the mode of purchase and the outcome variable. The univariate tests (between the modes of purchase) provide a measure of the effect size. The univariate partial eta square values are 0.104 and 0.111, respectively, for satisfaction and loyalty, which indicate that the effect size is low but significant.

Discussion and conclusion

Customer satisfaction and loyalty are the ultimate outputs of any firm for sustaining competitive advantage in the market, as well as for increasing profitability. Initially, with the help of exploratory factor analysis (KMO, composite reliability and Cronbach's alpha scores), we reduced the variables, which assisted in determining the exogenous (image, expectations, perceived quality and perceived value) and endogenous latent variables (satisfaction and loyalty) as input and output variables for the model. Following this, an output-oriented BCC DEA model was used for measuring farmers' satisfaction and loyalty efficiency toward fertilizer brands. The results show that PPL was ranked as the preferred fertilizer brand, followed by IFFCO and CIL, whereas IPL and TCL were the least-preferred brands. As stated earlier, Odisha is a proactive agrarian state, with a number of agricultural input companies operating in different input marketing sectors, like fertilizer, seeds, equipment and crop protection chemicals, with steep competition for gaining and maintaining a high market share. Therefore, this study will help to make them aware of the different vital reasons for their growth and the actions required to keep the farmers highly satisfied because it is more expensive to attract new farmers than to retain existing farmers. For the older firms in the market, it is important to improve their images and accord farmers' expectations the utmost priority. The existing firms must put in all efforts and must look to provide good services and high-quality products with timely delivery, which will lead to farmers' satisfaction and, over a period of time, enhanced overall loyalty.

The major role of today's brand managers in this context is to maintain loyal farmers taluk-/block-/district-wise and formulate niche marketing strategies that could encourage farmers to consider these brands before making purchase decisions. Additionally, this could be encouraged at the state/district level by offering reward schemes for the best

Table 15 Effect size of mode of purchase on farmers' satisfaction and loyalty

Source	Dependent variable	Type III sum of squares	*df*	Mean square	*F*	Sig.	Partial eta squared	Observed power[b]
Tests of between-subjects effects								
Corrected model	Satisfaction	49.585[a]	2	24.792	47.749	.000	.114	1.000
	Loyalty	74.972[c]	2	37.486	52.182	.000	.123	1.000
Intercept	Satisfaction	482.112	1	482.112	928.516	.000	.556	1.000
	Loyalty	437.348	1	437.348	608.802	.000	.451	1.000
Education	Satisfaction	4.811	1	4.811	9.265	.002	.012	.860
	Loyalty	8.413	1	8.413	11.712	.001	.016	.928
Mode of purchase	Satisfaction	44.612	1	44.612	85.921	.000	.104	1.000
	Loyalty	66.298	1	66.298	92.289	.000	.111	1.000
Error	Satisfaction	384.748	741	.519				
	Loyalty	532.316	741	.718				
Total	Satisfaction	11211.667	744					
	Loyalty	11004.889	744					
Corrected total	Satisfaction	434.333	743					
	Loyalty	607.288	743					

[a] R squared = .114 (adjusted R squared = .112)

[b] Computed using alpha = .05

[c] R squared = .123 (adjusted R squared = .121)

crop production (district- and state-wise) or for innovative ideas that farmers have adopted in their farms; such schemes could boost farmers' inclinations toward a specific firm. This recommendation is the result of a question asked of the farmers about any suggestions to agricultural input suppliers from their side. Organizing such innovative programs for a longer period would create positive word of mouth or environment in the marketing territory about the firm.

Due to the bulky nature of fertilizer (50 KG/bag), laborers use hooks on the bags during loading and unloading in different places, such as from a railhead to a godown (a warehouse) and from a godown to different dealers/retailers point. As a result, 2–4 KG of weight loss per bag has been noticed by the farmers. Due to spillages and the increase in the price per KG of 24.00 INR, farmers can lose around Rs 100 per bag. Therefore, the majority of farmers have said that they will never hesitate to purchase complex fertilizer of any brand in sound bags, instead of cut-and-torn bags of reputed brands. Therefore, the fertilizer companies should seriously think about the supply of fertilizer to the farmers' doorsteps; this recommendation is based on an open-ended question asked of the farmers about suggestions and improvements for their preferred brands. Farmers can suggest improvements based on the good and bad results from the products they have used on their farms. Surprisingly, the educated, medium and big farmers have immense faith in dealers/retailers regarding agricultural input purchase advice, despite their own wealth of farming knowledge and experience. Therefore, firms must enhance the knowledge of dealers/retailers through conducting various training and motivational programs because they are the first and preferred source of farmers' product knowledge and influence the firms' images in the farming community.

The methodology used in this study will help managers in making accurate and timely decisions in measuring efficiency and identifying inefficiencies. Thus, managers can implement appropriate and timely measures to maintain and enhance farmers' satisfaction and loyalty.

The present study contributes to the literature in several ways. Firstly, we have attempted to measure farmers' satisfaction and loyalty toward fertilizer brands. Secondly, we have adopted the ECSI model in the Indian fertilizer industry. Thirdly, we have used the DEA model for measuring farmers' satisfaction and loyalty efficiency. We have made an important contribution to the use of the ECSI model in the context of the Indian fertilizer industry: the introduction of a moderating variable (mode of purchase). Finally, the study has been undertaken very recently in the Indian context, allowing the ECSI model to be validated for measuring farmers' satisfaction and loyalty. The model fits well, seems to be sufficiently flexible and could be extended to different agricultural input industries (seeds, pesticides and equipment) to measure farmers' satisfaction and loyalty efficiency. It can be generalizable with little modification to the instrument, according to the nature of

the business. Based on the results of this study, it can be inferred that the model is consistent and reliable and has the potential to be an excellent platform for conducting benchmarking-like measurements of national companies within the fertilizer industry. Future studies could extend this by considering satisfaction, loyalty, market share and the influence of socio-demographic characteristics at a broader level.

Appendix 1

See Table 16.

Table 16 Fertilizer consumption of different states

State name	Fertilizer consumption (Kg/hectare)
Andhra Pradesh	226.72
Punjab	216.73
Haryana	179.48
Bihar	164.87
Tamil Nadu	153.76
Uttar Pradesh	148.86
Karnataka	136.06
West Bengal	131.17
Maharashtra	127.07
Kerala	121.07
Gujarat	119.52
Chhattisgarh	100.22
Madhya Pradesh	84.43
Jharkhand	82.45
Assam	65.41
Odisha	57.11
Rajasthan	49.69
All India	125.39

Source Agricultural Statistics at a Glance 2014, Govt. of Odisha, India. High fertilizer consumption districts: >128 kilograms per hectare (Kg/Ha; medium fertilizer consumption districts: >57 kg but <128 kg/Ha; low fertilizer consumption districts: <57 kg (fertilizer consumption of India is 128 kg/Ha, consumption of Odisha is 57 kg/Ha.)

Appendix 2

See Table 17.

Table 17 District-wise complex fertilizer consumption 2013–2014

Name of districts	Total complex consumed during 2015–2016 (in MT)	Total cropped area ('000 Ha.)	Fertilizer consumption (Kg/hectare)
Nawarangpur	22519.75	269.5	154.2
Bargarh	47,638.25	466.18	109.87
Sambalpur	20,407.65	253.72	105.94
Balasore	30,968	310.24	101.76
Bhadrak	21,993.05	226	90.06
Jharsuguda	5681.1	75.77	78.53
Puri	8503.65	232.72	69.05
Rayagada	12,545	249.02	59.77
Cuttack	7223.15	289.73	58.64
Ganjam	13,182.05	674.19	56.41
Kalahandi	28,217	598.31	56.04
Jajpur	9400.3	271.58	54.9
Khordha	6947.5	187.62	51.14
Sonepur	9726.3	222.76	49.87
Boudh	5857.75	132.78	49.43
Koraput	12,578.75	356.61	49.06
Mayurbhanj	16,871.2	460.58	46.14
Balangir	17,255.3	471.78	45.83
Jagatsinghpur	9054.25	170.82	43.8
Deogarh	4142.5	101.37	40.53
Gajapati	4787.5	132.99	38.5
Sundargarh	9665.45	365.52	38.5
Nuapara	7150.8	280.76	35.88
Keonjhar	13,192.05	370.43	35.49
Kendrapara	5459.4	257.03	29.3
Malkangiri	6809.05	198.69	28.19
Dhenkanal	5571	236.89	27.93
Angul	8450.5	277.21	25.03
Nayagarh	2389.3	222.77	24.36
Kandhamal	1164.4	166.86	9.85
Total	376,849.45	8530.43	57.11

Source Agricultural Statistics at a Glance (2014), Govt. of Odisha, India

Appendix 3

See Table 18.

Table 18 Demographic abstract

Sl. No.	Variable details	Category details	Code	Frequency	Percentage
1	Marital status	Married	1	663	89.1
		Unmarried	2	81	10.9
2	Age	<24 years	1	91	12.2
		25–34	2	180	24.2
		35–44	3	277	37.2
		>45 years	4	196	26.3
3	Education	Below high school	1	262	35.2
		High school	2	288	38.7
		Intermediate or, higher secondary	3	95	12.8
		Graduation	4	91	12.2
		Postgraduation	5	3	.4
		Professional degree	6	5	.7
4	Land holding	<1 Hectare (marginal)	1	20	2.7
		1.1–2.0 Hectare (small)	2	126	16.9
		2.1–4.0 Hectare (semi-medium)	3	392	52.7
		4.1–10.0 Hectare (medium)	4	187	25.1
		>10.1 Hectare (big)	5	19	2.6
5	Long association in farming	<10 years	1	183	24.6
		11–20 years	2	287	38.6
		21–30 years	3	212	28.5
		>31 years	4	62	8.3
6	Purchase influential	Agri. officer	1	289	38.8
		Dealer/retailer	2	455	61.2
7	Mode of purchase	Cash	1	300	40.00
		Credit	2	444	60.00
8	Preferred brand	PPL	1	320	43.0
		IFFCO	2	150	20.2
		CIL	3	137	18.4
		IPL	4	88	11.8
		TCL	5	49	6.6

Appendix 4

See Table 19.

Table 19 District-wise village-wise respondents' details

Sl. No.	Districts name	No. of villages	No. of respondents	Percentage of respondents
Districts profile				
1	Angul	3	8	1.08
2	Balangir	10	14	1.88
3	Balasore	65	24	3.23
4	Bargarh	43	159	21.37
5	Bhadrak	10	33	4.44
6	Cuttack	14	32	4.30

Table 19 continued

Sl. No.	Districts name	No. of villages	No. of respondents	Percentage of respondents
7	Deogarh	1	1	0.13
8	Dhenkanal	22	23	3.09
9	Gajapati	6	14	1.88
10	Ganjam	5	9	1.21
11	Jagatsinghpur	5	5	0.67
12	Jajpur	4	5	0.67
13	Kalahandi	7	26	3.49
14	Kandhamal	1	1	0.13
15	Kendrapara	19	26	3.49
16	Keonjhar	8	34	4.57
17	Khordha	16	30	4.03
18	Koraput	14	24	3.23
19	Mayurbhanj	48	43	5.78
20	Nayagarh	3	6	0.81
21	Nawarangpur	7	90	12.10
22	Puri	25	39	5.24
23	Rayagada	3	9	1.21
24	Sambalpur	37	87	11.69
25	Sonepur	1	2	0.27
	Total	377	744	1.0

Appendix 5

See Table 20.

Table 20 List of literature adopted ECSI model and their findings

Sl. No.	Author (Year)	Model adopted	Finding of the study
1	Chitty, B., S. Ward, and C. Chua. (2007)	ECSI	Result reveals that a significant relationship exists in between satisfaction and loyalty to their respective university and image played a bigger role toward university selection
2	O'Loughlin, C. and Coenders, G., (2002)	ECSI	Product quality found to be sole driver for customer satisfaction in postal services, whereas image and satisfaction were the only predictors of loyalty
3	Stout, B.L., (2009)	ECSI	Customer satisfaction index found to be a useful measurement to evaluate customer satisfaction and loyalty in comparison with traditional measurement
4	Johnson, M.D., A. Gustafsson, T.W. Andreassen, L. Lervik, and J. Cha. (2001)	ECSI	Corporate image has a direct effect on customer satisfaction in the ECSI model
5	Gronholdt, L., Martensen, A. and Kristensen, K., (2000)	ECSI	The model fits well and can be implemented in different industries to measure the customer satisfaction and loyalty
6	Kristensen, K., A. Martensen, and L. Gronholdt. (2000).	ECSI	The model fits well and was applied to measure the satisfaction status in different industries such as telecommunication, retail banking, supermarkets and various kinds of processed food which are among the industries measured in Denmark during spring, 1999
7	Eskildsen, J. and Kristensen, K., (2007)	ECSI	Based on EPSI rating, initiatives analyzed the effect of transparency of products and services on customer satisfaction in Danish mobile companies, banks and super markets
8	Kaveh, M., Mosavi, S.A. and Ghaedi, M., (2012)	ECSI	Perceived value was mostly influenced by image, technical dimension, functional dimension and price as suggested by the study. It also reveals that customer satisfaction was most influenced by perceived value. Simultaneously, satisfaction has an effect on trust and repurchases intention

Table 20 continued

Sl. No.	Author (Year)	Model adopted	Finding of the study
9	O'Loughlin, C. and Coenders, G., (2002)	ECSI	The new maximum likelihood (ML) method is better in robustness and unbiased and better than PLS, which is little biased. The ML and PLS techniques were adopted to compare the perception of man post office products and services using CSI format
10	Cassel, C. and Eklöf, J.A., (2001)	ECSI	Based on the ECSI result using a common measurement instrument (questionnaire), measurement problem was identified, especially with perceived value
11	Bayraktar, E., E. Tatoglu, A. Turkyilmaz, D. Delen, and S. Zaim. (2012)	ECSI	The ECSI constructs are treated as input and output variables with the help of DEA technique. Based on efficiency scores, managers can adopt this technique timely and take decisions

Appendix 6

The Mathematical formulation of DEA.

$$\text{Max} \quad \varnothing_o^b + \varepsilon\left(\sum_{i=1}^{n} e_{io}^b + \sum_{j=1}^{m} d_{jo}^b\right)$$

$$\text{Subject to} \sum_{l=1}^{B}\sum_{U=1}^{Ul} \lambda_u^l x_{iu}^l + e_{io}^b = i = 1,\ldots,n$$

$$\sum_{l=1}^{B}\sum_{U=1}^{Ul} \lambda_U^l y_{ju}^l - d_{jo}^b = \Phi_o^b y_{jo}^b, \quad J = 1,\ldots,n$$

$$e_{io}^b, d_{jo}^b, \lambda_u^1 \geq 0, \quad \text{for all i, j, u, 1}$$

where $\varnothing_o^b$, efficiency score of fertilizer brand b according to user o; X_{iu}^l, value of input i for the fertilizer brand l according user u. y_{ju}^l value of output j for the fertilizer brand l according to user u. e_{io}^b, d_{jo}^b, the amounts of excess input i and deficit output j for fertilizer brand b according to user o, respectively. $\varepsilon > 0$ predefined non-Archimedean element. λ_u^l dual variable utilized to construct a composite ideal fertilizer brand to dominate fertilizer brand under evaluation. B the number of fertilizer brands. U_l the number of fertilizer users of brand l. m the number of outputs. n the number of inputs.

Appendix 7

See Table 21.

Table 21 Return to scale table

DMU	CRSTE	VRSTE	SCALE	
Efficiency summary				
PPL	1	1	1	
CIL	0.962	1	0.962	irs
IPL	0.946	0.969	0.977	irs
TCL	0.935	1	0.935	irs
IFFCO	0.972	1	0.972	irs
Mean	0.963	0.993	0.969	

Note: crste = technical efficiency from CRS DEA; vrste = technical efficiency from VRS DEA; scale = scale efficiency = CRSTE/VRSTE

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