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Reducing the buyer–seller information asymmetry in agricultural inputs markets in India

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Abstract Buyer–seller information asymmetry causes problems in economic exchanges between farmers and the agricultural inputs (agri-inputs) industry. This study examines farmers' information needs regarding four important agri-inputs: seeds, fertilizers, agrochemicals, and farm machinery. The study reveals that while purchasing agri-inputs, farmers in India consider the experience and credence attributes like germination percentage, yield, packaging, impact on health, and soil condition critical to product quality and more important than price. The agri-inputs industry can reduce the buyer–seller information asymmetry while marketing their products, ensure their competitive advantage, and make farming more productive.

Keywords Marketing, buyer-seller information asymmetry, agri-inputs, experience attributes, credence attributes, India

JEL codes M31, O13, D82, D63

Information is a productive resource (Nair 2006) and a crucial element of economic exchange (Shen et al. 2019; Mascarenhas et al. 2008). A firm's perception of its products' quality may differ from that of consumers; this is a measure of information asymmetry (Parker 1995), which leads markets to fail (Stiglitz 1977; Spence 1973; Akerlof 1970) and restricts the efficient functioning of markets (Baron 2004). Buyers and sellers have complete and equal information in perfect market conditions; usually, though, sellers have more information (both quantitative and qualitative) about their products and services than prospective buyers. That is buyer–seller information asymmetry, recognized as a common feature of markets (Oberholzer-Gee and Yao 2018; Mascarenhas et al. 2008; Baron 2004: Kirmani and Rao 2000) and a serious problem in the market for agricultural inputs (agri-inputs)—'experience' products whose quality (for example, yield or germination rate for seeds) can be verified only after purchase and use. Agri-inputs are also 'credence' goods (Ford et al. 1988), where some qualities (impact of chemical fertilizers on soil health, effect of pesticides on human body) cannot be realized in the short run even after purchase and use. Farmers buy these in the belief that suppliers offer what they really need; the credentials (brand, reputation) of sellers and manufacturers dominate the decision to purchase credence goods (Mascarenhas et al. 2008).

The agri-inputs industry is experiencing profound, rapid changes in all developing countries, including India. New technologies have made the industry increasingly knowledge-intensive. Purchasing has become a vital task for farmers; in the developed regions of India, about 70% of the total per-acre expenditure is on seeds (high-yielding variety (HYV) and local), fertilizers (chemical and organic), and pesticides (Venugopal and Kaundinya 2014). Farmers' livelihoods depend on agri-inputs; therefore, farmers should be involved in both purchase and product, and they should exhibit problem-solving buying behaviour by conducting substantial search and evaluation for alternative choices. But the asymmetry of information between buyers and sellers makes it difficult to

ascertain the utility or quality of agri-inputs; it also limits consumers' ability to assess competitive offerings (Nayyar 1990) and identify, and differentiate between, products and buy superior products (Lowendahl 2000). Information asymmetry may lead farmers to buy a low-quality product, or over-pay, the phenomena Mascarenhas et al. (2008) term 'buyer's curse' and 'winner's curse'. Uncertainty is the difference between the information available on a product and the information a buyer needs (Galbraith 1974). Asymmetry of information makes buyers uncertain; they may make uninformed decisions, postpone the decision to buy, or purchase inferior products with less uncertainty. If the uncertainty about quality is removed, the demand as well as willingness to pay for agri-inputs can be increased.

Fairbairn et al. (2016) and Ashour et al. (2016) reported that marketing communication related to fertilizers and herbicides in Tanzania and Uganda, respectively, is unclear and often doubtful, resulting in the reduction of demands of respective products. Michelson et al. (2018) found that farmers in Tanzania were willing to pay about 47% more price for lab-certified urea fertilizers that make information on nutrient contents available than for which information was not available. Asymmetry of information between input dealers and smallholders can lead to a low-cost, low-quality-inputs equilibrium and, in turn, to suboptimal productivity levels (Brauw and Kramer 2018). The lack of information on appropriate inputs and use was among the most crucial problems facing resource-poor farmers in south-west Bangladesh (Goodland et al. 2001); they had no confidence in sellers or inputs, but they had to depend on unscrupulous inputs sellers, and they perceived themselves as being vulnerable to them. Most smallholders in Kenya could not access agri-input supplies or extension and information services and, therefore, could not transition from subsistence agriculture to commercialized production (Kilelu et al. 2017). From the social justice perspective, buyer–seller information asymmetry, or partial information, can make farmers vulnerable—by forcing them to choose agri-inputs.

A customer's perception of benefits and costs determines a purchase (Barnard et al. 2012). A product's value is the outcome of a customer's perception of its quality, and it is a key factor of a firm's marketing strategy. New agri-input products and marketing plans are designed based on key assumptions about farmers' decision-making processes, particularly purchase motivations and willingness to make trade-offs between product features (Anderson 1987). A marketer must be aware of how a customer perceives and values their products, especially as product attributes are used to improve consumers' understanding (Assael 1998). A mix of the search, experience, and credence qualities of goods and services moderates the role of information in buyers' behaviour (Nayyar 1990). Customers decide on their purchase by selecting a subset of the alternatives available and weighting the alternatives in their subset on various attributes (Venugopal et al. 1997). Marketers view customer information needs as a reflection of desires for product attributes; eliciting these needs and preferences is crucial in the process of developing new products (Zaltman 2003), which aims to capture valuable information about a product's important attributes, such as functionality, cost, shape, and color (Ulrich and Eppinger 1995). Some studies segment agri-input customers based on the importance of the product attributes in their decision criteria (Feeney and Berardi 2013; Reimer et al. 2009; Alexander et al. 2005; Gloy and Akridge 1999).

Farmers purchase agri-inputs after evaluating the information on attributes they consider crucial. The manufacturer, intermediaries, or sellers know the quality of their products—otherwise unobservable—and they can inform farmers objectively and accurately. If the information is not available, and if farmers use poor quality agri-inputs, they may lose money or produce a suboptimal crop. Minimizing the asymmetry in information between buyers and sellers in agri-inputs markets would benefit farmers and help markets to survive and extend. Therefore, our first research question is: How we can reduce the buyer–seller information asymmetry in farmers' decisions to purchase agri-inputs? And our second research question is: Can the socio-economic characteristics of farmers impact their perceived choice of brand and price attributes of critical agricultural inputs?

Conceptual framework

As buyers of agri-inputs, farmers pass through various stages—from awareness, to decision, to adoption—when they evaluate their decision based on predefined parameters (Figure 1) (Kotler et al. 2012). Farmers may be aware of a brand from fellow farmers, extension

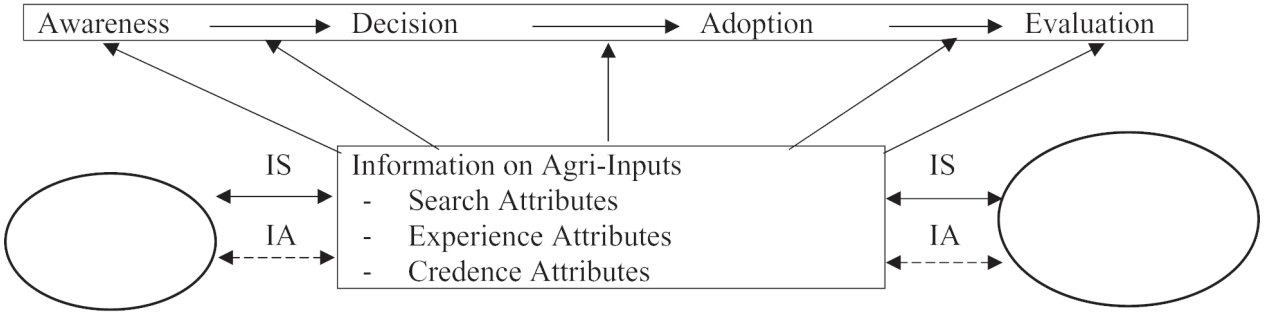

Figure 1 Role of information in rational purchase of agri-inputs
IS – Information symmetry will lead to rational purchase by farmers and to brand loyalty.
IA – Information asymmetry will lead to perception-based purchase by farmers and to market failure.

agents, or retailers; the information on its experience and credence attributes would help farmers to make a rational purchase decision, and a positive post-purchase evaluation would result in brand loyalty. Farmers should exhibit problem-solving behaviour in buying agri-inputs, where the information becomes absolutely necessary. But reliable information is absent, and farmers exhibit picking behaviour in buying agri-inputs or subcontract the decision-making process, where someone else—usually a dealer or retailer—makes the decision for them. The marketing process, thus, requires agri-input companies to transmit quality signals through the appropriate product attributes and change the way farmers evaluate brands. Once the brands are differentiated, agri-input firms can start increasing the importance of an attribute by increasing the product performance risk. Larger companies spend considerable revenue in creating a competitive advantage and communicating it to farmers (Venugopal and Kaundinya 2014); any asymmetry in information creates a zero-sum game for buyers and sellers.

A firm's marketing strategy aims to inform prospective buyers about the value of its products and services and to persuade them that the firm provides the best product or service for their needs (Reddy 2018; Barnard et al. 2012). Tailoring marketing strategies to signal quality in specific market segments can increase the customers' perception of value, improving a firm's ability to attract and retain customers (Alexander et al. 2010). For agri-inputs corporations, disseminating information is crucial for improving production, product marketing, and distribution.

Research methodology

To elicit their need for information on the attributes of agri-inputs (seeds, agrochemicals, fertilizers), we selected 278 farmers from eight states in India (Table 1). The sample selected from each state was small, but we chose a cross-sectional sample from two to three villages in districts to capture the variations in cropping pattern and level of agricultural development. We ensured that the respondents represented a diversity of socio-economic backgrounds. We assumed that if a farmer had not purchased inputs regularly and recently, they would not have a preference for the inputs or attributes, and we ensured that they were the primary decision-makers; recently, on a minimum of three occasions, they had bought frequently purchased inputs (seeds, fertilizers, pesticides). We used these criteria

Table 1 Sample farmers across states

	State	Number of sample farmers	Percentage
1	Andhra Pradesh	22	07.90
2	Madhya Pradesh	48	17.30
3	Maharashtra	34	12.20
4	Odisha	70	25.20
5	Rajasthan	55	19.80
6	Tamil Nadu	19	06.80
7	Uttaranchal	15	05.40
8	West Bengal	15	05.40
	Total	278	

Table 2 Number of interviewed farmers for different agri-inputs

	Agri-input	Number of respondents
1	Seed	278 (100.00)
2	Agrochemicals	196 (70.50)
3	Fertilizers	167 (60.07)

Note Figures in parentheses indicate the percentage of the total number of respondents.

and took the help of ofûcials of the agriculture department of each state government to select the respondents for agri-inputs randomly (Table 2).

We used a structured questionnaire; professionals translated it into the local languages, and they helped us to weed out the inconsistencies to make the questionnaire uniform for all respondents (Waheed and Gaur 2012; McGorry 2000). We used it to conduct personal interviews. In the first component we asked farmers about their socio-economic profile—age, education level, landholding, number of years in farming, number of crops grown in a year. We asked them about the product attributes they needed information most importantly on and how conscious they were of the quality of agri-inputs. We measured their intention and action to buy high-quality products only on a 3-point Likert scale (1 = negligible; 2 = high; and 3 = extremely high). We used the 3-point scale instead of the 5-point scale to let farmers differentiate their responses easily, because of their low literacy level.

When farmers buy agri-inputs, they consider some of its attributes more important than others and need information on those; we asked the farmer to indicate the importance of each product attribute on a 3-point scale (1 = little or not important; 2 = important; 3 = extremely important). We performed factor analysis to identify the importance of a different set of product attributes; using varimax rotation with Kaiser normalization, we conducted principal component analysis (PCA), a data reduction technique that processes a set of correlated variables to a new set of fewer, uncorrelated variables.

An orthogonal rotation (varimax method) was conducted and the standard criteria of eigenvalue=1, scree test and percentage of variance were used in order to determine the factors in the first rotation (Hair et al. 2010). A varimax solution yields results that make it as easy as possible to identify each variable with a single factor. This is the most common rotation option. The number of factors was decided on the basis of the total variability of the original variables explained by each factor solution. The factors were named based on the variables that are loading on the same factor and should make theoretical sense during interpretation. An analysis of variance (ANOVA) was conducted to test whether the socio-economic characteristics of farmers are crucial for explaining their buying behaviour in terms of the price and brand attributes of agri-inputs.

The findings of this study represent an average of all the selected states; they may not be related to any single state. An analysis of results disaggregated by state would have been much more meaningful, and it would have helped to draw more generalized findings, as the diversity in agroclimatic conditions and farmers' characteristics is great in a country like India. In terms of the number of farmers, a state is a large unit, but the sample chosen from each state is small, and it may be considered a major limitation of this study.

Findings

Farmers' profile

Low literacy is common among farmers in India; 31% of the respondents were illiterate and more than 47% had studied until 8th grade (Table 3). More than 75% had over 10 years' farming experience. Small and marginal farmers made up 80% of the sample, aligned with the scenario in India. None was a member of a farmers' cooperative or group; they were individually responsible for their buying decisions. Agriculture contributed more than 50% of the total income of over 75% of the farmers. Approximately 75% of the farmers intend to buy only high-quality seeds, agrochemicals, and fertilizers (Table 4).

Importance of product attributes

Farmers in India are considered to be price-sensitive (Venugopal and Kaundinya 2014; Dharni and Singh 2011; Ingene and Levy 1982), but this study finds that they focus on input quality, not price. In buying agri-inputs, farmers focused on their experience and

Table 3 Profile of sample respondents

	Attribute	Percentage of respondents
1	Education	
	Illiterate	31.70
	Up to 8th standard	47.50
	Up to 12th standard	17.60
	Graduation and above	03.20
2.	Farming experience	
	Up to 10 years	21.60
	>10 to 20 years	39.60
	>20 to 30 years	21.60
	More than 30 years	17.30
3.	Landholding size	
	Up to 2 acres	41.70
	>2 to 5 acres	38.50
	>5 to 10 acres	11.90
	More than 10 acres	07.90
4.	Membership of farmers' cooperative / group	
	Yes	0
	No	100
5.	Income from agriculture	
	100 %	32.30
	More than 50% but less than 100 %	43.90
	Less than 50%	23.80
6.	Average distance of from city market	
	0–10 km	7.20
	11–20 km	18.00
	21–40 km	46.80
	41 and above	28.00

Table 4 Consciousness about quality of agri-inputs (% of farmers)

	Agri-input	Extremely high	High	Negligible
1	Seed	29.51	47.52	27.82
2	Agrochemicals	24.53	51.05	24.52
3	Fertilizers	22.20	50.31	27.55

credence attributes, besides search attributes, although their relative importance varied by input.

Before and during purchasing seeds, farmers want detailed information on the three most vital experience attributes—germination percentage, disease resistance, and yield (Table 5). Feeney and Berardi (2013) and Borchers et al. (2012) also report that performance and price were the two most important considerations for seed buyers. When buying agrochemicals, farmers sought information on their effects on the human body and crop yield.

Table 5 Importance of various product attributes in purchase of agri-inputs

No.	Attribute	Mean	Mode	S.D.
A.	Seeds			
A.1	Variety	1.85	1	0.68
A.2	Size	1.98	2	0.70
A.3	Cleanness	1.46	2	2.87
A.4	Packaging material	1.69	2	2.17
A.5	Price	1.97	2	0.61
A.6	Germination percentage	2.47	3	2.15
A.7	Disease resistance	2.71	3	0.70
A.8	Brand	2.43	3	0.72
A.9	Yield	2.51	3	1.56
B.	Agrochemicals			
B.1	Impact on crop yield	2.44	3	0.89
B.2	Ease of application	1.71	2	0.64
B.3	Effect on human body	2.07	3	0.71
B.4	Brand	2.36	2	0.75
B.5	Price	1.53	1	0.94
B.6	Packaging material	1.62	1	1.43
C.	Fertilizers			
C.1	Impact on crop yield	2.49	3	0.66
C.2	Impact on soil health	2.91	3	0.80
C.3	Size of the granules	2.12	2	0.73
C.4	Brand	2.27	3	1.02
C.5	Packaging material	1.52	2	0.66
C.6	Price	1.56	1	0.68

While purchasing fertilizers, the impact on crop health (experience attribute) and soil health (credence attribute) were the two crucial attributes. Farmers base their decision to use fertilizers on their own experience of growth and density of crop seeding, yield gain from fertilization, and soil fertility (Zhou et al. 2010); farmers consider as vital experience attributes such as the germination percentage of seeds and credence attributes like the effect of fertilizers on crop yield and soil health and the effect of agrochemicals on crop yield and human body.

Importance of attributes for seed (factor analysis)

We used PCA to group the responses to nine product attributes into search attributes and experience or credence attributes (Table 6). The loading scores for the variables were higher than 0.58, indicating a good correlation between the items and factor groups. The first factor, search attributes, indicates a variance of 22%, and loads high on the seed size, colour, cleanness, packaging, brand, and price. The experience and credence attributes—yield, germination percentage, and disease resistance—explained more than 36% of the variance.

Table 6 Factor analysis—rotated component matrix for product attributes of seed

Attributes	Search attributes	Experience & credence attributes
Size	**0.77**	–0.16
Color	**0.74**	–0.22
Packaging	**0.67**	0.28
Cleanness	**0.67**	0.36
Brand	**0.68**	0.33
Price	**0.61**	0.02
Yield	0.01	**0.72**
Germination percentage	–0.16	**0.65**
Disease resistance	0.13	**0.58**
% variance explained	22.0	36.10
Cumulative (%)	22.0	56.10

Extraction Method: PCA
Rotation Method: Varimax with Kaiser Meyer-Olkin's sphericity normalization

Importance of attributes for agro-chemicals (factor analysis)

We deduced that experience or credence attributes, and brand value and packaging, influenced the purchase of agrochemicals, and these had a factor load of more than 0.59 (Table 7). Farmers considered experience or credence attributes—ease in application, effect on human body, and effect on yield—vital, and these attributes accounted for more than 28% of the variation. Brand value and packaging—brand, size of packaging, and packaging material—account for more than 21% of the variation; most small and marginal farmers are resource-poor, and they consider packaging size and material vital factors because these let farmers store the agrochemicals longer and use them as they require (Table 2).

Table 7 Factor analysis—rotated component matrix for product attributes of agrochemicals

Attributes	Experience/ credence attributes	Brand value and packaging
Ease of application	**0.72**	–0.05
Effects on human body	**0.56**	0.20
Impact on crop yield	**0.56**	0.26
Brand	0.10	**0.70**
Size of packing	0.30	**0.68**
Packaging material	–0.18	**0.64**
% variance explained	28.30	21.30
Cumulative (%)	28.30	59.60

Extraction Method: PCA
Rotation Method: Varimax with Kaiser Meyer-Olkin's sphericity normalization

Importance of attributes for fertilizers (factor analysis)

Farmers considered yield and soil health, and brand value and packaging, crucial information in purchasing fertilizers; these two factors—a combination of search, experience, and credence attributes—accounted for more than 52% of the variation (Table 8). The first

Table 8 Factor analysis—rotated component matrix for product attributes of fertilizers

Attributes	Yield and soil health	Brand value and packaging
Impact on crop yield	**0.90**	0.08
Composition of nutrients (N, P, K)	**0.82**	0.08
Impact on soil health	**0.74**	0.22
Price	**0.42**	0.05
Size of packaging	0.0	**0.84**
Packaging material and colour	0.03	**0.79**
Brand	0.24	**0.29**
% variance explained	30.70	22.0
Cumulative (%)	30.70	52.70

Extraction method: PCA
Rotation method: Varimax with Kaiser Meyer-Olkin's sphericity normalization.

Table 9 ANOVA between importance of product attributes and characteristics of farmers

Attribute	Product	Education	Land size	Experience in farming	No. of crops grown	Quality consciousness
Price	Seed	0.334	1.094	1.133	1.65***	1.810***
	Agrochemicals	0.804	3.319*	0.582	1.682***	1.572***
	Fertilizers	0.571	1.515**	1.085	4.329*	4.535*
Brand consciousness	Seed	2.367***	1.440**	1.030	0.681	4.941*
	Agrochemicals	3.718*	1.350***	1.029	0.158	2.062**
	Fertilizers	3.721*	0.797	0.501	1.093	3.604**

Note * significant at 1% level, ** significant at 5% level, *** significant at 10% level

factor, yield and soil health, indicates a variance of more than 30%, and loads high impact on crop yield, soil health, and composition of nutrients (N, P, and K). The second factor, brand value and packaging—packaging size, packaging material, and brand—accounted for a 22% variation. Though not directly related to increasing crop production, these attributes contribute towards increasing, and improving, fertilizer use.

Farmers' characteristics and the importance of price and brand

We conducted an ANOVA to determine how the selected socio-demographic characteristics of farmers affected the perceived importance of information on brand and price attributes (Table 9). Landholding significantly influenced the importance of prices and brands of most inputs, and education explained the brand's importance for all inputs, but education did not influence farmers' responses to the importance of prices, and farming experience did not influence the variation in responses on the importance of price or brand.

The number of crops grown—a proxy variable for the commercialization of farming—significantly influenced the importance of price of all the agri-inputs (correlation coefficient $p = 0.77$), but it did not explain the variations in the importance farmers attach to the brand. Quality consciousness significantly influenced the information need in terms of both price and brand. Characteristics such as education, land size, experience in farming, and quality consciousness significantly influence farmers' preference for detailed information on brand and price attributes. Farm size and farmers' age and education have been found to have some predictive power consistent with the prior expectations (Gunderson et al. 2005).

Conclusions and implications

Farmers in India continue to suffer from small, fragmented landholdings and low education levels, but they have become quality-conscious in their purchases of agri-inputs; experience and credence attributes are now more important than price, the traditional attribute, in buying decisions. One can counter-argue that farmers buy seeds and fertilizers subsidized by the government, but a subsidy aims to support low-income, resource-poor farmers in increasing their use of seeds and fertilizers; it does not signal that a product is of inferior quality.

Few small and marginal farmers can make their purchase decisions themselves; because their information is rarely complete or reliable, they base their decision to purchase on the advice and recommendations of dealers—some of whom sell poor-quality products that harm their fields and crops. If buyers and sellers have the same information, buyers can select the products they need and perceive as valuable, and sellers can develop those products and market them appropriately.

Moreover, information search is expensive (Stigler 1961) and, sometimes, exploitative (Goodland et al. 2001). The nature of demand for agri-inputs is derived, complementary, and dependent on the product's agro-economic potential (Gandhi 1997), and that makes the behaviour of agri-inputs buyers unique. Since agri-inputs firms are not aware about buyers' requirements, they do not share that information, or they share it in formats that farmers do not understand—thus creating buyer–seller information asymmetry.

The agribusiness environment is dynamic, and the product portfolio of agri-inputs firms changes continually. Firms introduce new seed varieties at frequent intervals, making the information on existing varieties redundant and changing the information farmers require. If the information on the changes in the farm sector is not updated as the changes occur, the asymmetry in information between buyers and sellers will continue. In this sense, buyer–seller information asymmetry is a dynamic concept, not a static one.

Our first research question was: How we can reduce the buyer–seller information asymmetry in farmers' decisions to purchase agri-inputs? This study highlights that suppliers should inform farmers on the quantity and quality of attributes (germination percentage, yield, packaging, impact on health, and impact on soil condition). Our second research question was: Can the socio-economic characteristics of farmers impact their perceived choice of brand and price attributes of critical agricultural inputs? This study finds that socio-economic characteristics—education, land size, experience in farming, and quality consciousness—significantly influences their preference for detailed information on the brand and price attributes of agri-inputs. Thus, the study results provide agri-inputs firms in India a valuable insight: they should shift their marketing focus from a production approach to a customer-centric approach.

Almost every aspect of agricultural production and trade requires a substantial exchange of information, communication, knowledge, and skill transfer (McNamara et al. 2017). A market-led approach will let firms identify their customers' information needs and tailor their marketing and communication strategy and cost-effective methods to deliver the information customers need. Small and marginal farmers need relevant and meaningful information about agricultural inputs to adopt new technologies (Samaddar 2006; Munshi 2004); farm inputs suppliers should educate farmers on the credence attributes of their products through proper communication so that farmers may exhibit a problem-solving behaviour in buying agri-inputs. If agri-inputs firms reduce the buyer–seller information asymmetry, they will ensure their competitive advantage and make farming more productive in the long run. Thanks to large-scale extension education programmes and campaigns, farmers are gradually learning about the effect of fertilizers on soil health, and the impact of pesticides on human health, and looking for information on these credence attributes in their purchases.

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