REFEREED ARTICLE

Brand Loyalty in Argentine Commercial Crop Seed Markets

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ABSTRACT

This paper focuses on identifying and characterizing different groups of producers based on their loyalty to seed brands in Argentina. A In order to do so, we resorted to a two-step methodology: the first step identifies groups of producers in terms of their loyalty to seed brands, using a multivariate analysis. Then, to identify variables associated with brand loyalty, and have an initial group characterization, we use independency tests for qualitative variables.

Our findings show that almost 44% of Argentine producers consider themselves loyal to the seed brands they purchase. These producers are willing to buy the brand regularly, in spite of price increase. By contrast, only 21% of Argentine producers consider themselves disloyal, meaning that they are willing to try other products and would change seed brand if price increased in even a small proportion.

Our results have strong business implications, as they establish a clear profile of producers who are loyal to a brand in the heart of the Argentine Humid Pampa. Such findings can help ag input companies determine where to focus their attention and resources.

KEYWORDS: Agriculture producers; brand loyalty; seeds; Argentina; cluster analysis

1. Introduction and Motivation

The agricultural inputs markets for crop seeds, crop protection, animal health, animal breeding, and farm machinery are large, with global sales of more than 400 billion dollars by 2018 (McDougall, 2019). They are characterized by their oligopolist nature, large R&D expenditures, and increasing concentration in terms of firm and patent ownership. This puts pressure on companies in these markets on how to compete and differentiate their products in order to be profitable (Gazdecki, 2018; Sheldon, 2017).

Since the 1990s, there has been a high market concentration in ag input markets, and it has been particularly intense in the crop seed industry. The four leading global seed companies almost tripled their market share in 15 years, from 1994 to 2009 (Fuglie *et al.*, 2012; ETC Group, 2013). Nowadays, the sector is going through a new process of reorganization and consolidation. The 'big six' (Monsanto, Bayer, Dow, BASF, Syngenta and Dupont) are turning into four, through the acquisition of Syngenta by ChemChina, the Monsanto takeover by Bayer and the merger between Dow and Dupont (McDougall, 2019; OECD 2018; Anderson and Sheldon, 2017; Bryant *et al.*, 2016).

Seeds[3] are the means by which innovation in ag biotechnology is converted into higher yields, improved product quality, or cost savings for agricultural producers. The upstream seed markets compete for genetic traits (for example herbicide-tolerance and insect-resistance) and downstream markets for treated seeds (Moss, 2016; Moss 2013, Moss 2011). Obtaining crop seed traits is a long and complicated process; it is costly and presents a considerable risk at each stage of research and development (Shetty *et al.*, 2018; Fernandez-Cornejo *et al.*, 2014; Rothstein *et al.*, 2014). There are not only technical risks – the possibility of pre-launch failure – but also commercial risks. The deregulation of a seed trait is a milestone but does not imply successful sales.

Crop seeds in Argentina purchased in formal markets represents a significant share of agricultural producers' input costs and is also a key production input because the quality of seeds strongly influence yield potential. Although formal and informal seed markets coexist in Argentina, it is noteworthy that seed companies do not make large profits in the informal market. Corn and sorghum require cross-pollination and therefore, are mainly marketed in the formal channel, while soybean and wheat, two self-pollinated crops, prevail mostly in the informal market. Only 30% of soybean and wheat

seeds are sold through formal channels (Craviotti, 2018; Bisang, 2017; Ministry of Agriculture, 2016). Foreign multinational crop seed firms are focused on hybrid seed (for crops such as corn and sorghum) where there is a 'natural' barrier against multiplication and agricultural producers are compelled to purchase crop seeds every planting season. On the other hand, soybean and wheat seeds are provided with genetic material of local origin[4] (Craviotto, 2018; Filomeno, 2014).

What distinguishes seed markets in Argentina, among the leading agriculture countries, is the low recognition of intellectual property rights for crop seeds. The legal framework in Argentina for plant varieties is, complex, and faces frequent changes, which creates uncertainty in seed firms (Gallo and Kesan, 2006). As well as Brazil, the Argentina's legislation does not allow patents for plants, and law grants the rights to agricultural producers to save seeds, and of breeders to employ existing protected varieties to develop new ones. However, Brazil's legislation provides a recognition for the protected varieties and the agricultural producers' right to save seeds is limited, while Argentine legislation does not allow this. Argentina is a particular market with poor patent protection and weak legal enforcement regime, so understanding local agricultural producers and defining strategies to keep them purchasing their brands is a double challenge for seed firms (Correa, 2020; Craviotto, 2018, Perelmuter, 2015).

A previous study (Feeney and Berardi, 2013) analyzed the Argentine seed market, dividing producers into market segments and explaining the factors that affect their seed buying decisions[5]. Four groups of Argentine producers were found, following the importance given to each purchasing factor (i.e., performance, price, balance, convenience). The results obtained showed the performance-oriented cluster as the largest, while in a similar work for the US (Alexander et al., 2005) the largest segment was the balance-oriented. This study also revealed that Argentine producers tend to be more brand-loyal and have less price sensitivity than American producers.

The increasing global competitiveness in the seed market and high innovation costs make it crucial for companies not only to attract clients but also to establish long-term relations with them and differentiate their products from competitors. Brand loyalty is a concept that gains significant relevance for firms selling crop seeds, as a means of developing brands which producers can perceive and associate with as high quality, valuable and reliable products. In this way, firms would persuade agricultural producers to develop a greater inclination to purchase their products, increase sales and achieve profitability. According to experts (Fortes et al., 2019), achieving customer brand loyalty is a key factor for companies facing markets with great rivalry and competition.

2. Problem Statement and Objectives

Input products such as crop seed, agrochemicals, and farm machinery compete far more through product differentiation than through price (Borchers et al., 2012; Krause, 2011). As a differentiation strategy, brands and branding help agricultural producers identify the most productive crop inputs. A brand, according to Gajanova et al. (2019), is a name, symbol, or other characteristic that distinguishes a firm's product in the marketplace and differentiates it from those of competitors. It also has been conceptualized as the sum of perceptions and associations that are held about a person, a company or a product. Branding, on the other hand, is portrayed as the universe of the firm's undertaken actions that affects those perceptions by customers.

Firms need to build brands that have appeal for customers, so that they can evaluate similar products and/or services and perform an effective distinction among them. Thus, the survival and growth of a company is defined by its aptitude to retain its current customers, and to make them loyal to the brand. Brand loyal customers help firms creates barriers to entry and a capacity to counter threats of competitors, increase turnover and make customers less sensible to prices (Gajanova et al., 2019; Ehsan et al., 2016).

Branding is an important concept for agribusinesses, as thriving brands help businesses obtain a leading position in a highly competitive environment. Thus, in order to gain a competitive advantage, agribusinesses should be able to reach brand loyal customers and implement strategies that will keep these customers loyal (Wiese, 2014).

Due to the significance of brand loyalty in agribusiness, and the importance of distinguishing customers with different degrees of brand loyalty, this article examines how loyal Argentine producers are to crop seed brands sold in the formal seed markets and the main characteristics of producers included in each loyalty segment.

Therefore, the objective of this paper is to identify and characterize different groups of farmers based on their loyalty to crop seed brands available in the Argentinean formal or commercial markets. Specifically, the study seeks to: 1) identify brand-loyal agricultural producers in the Argentine commercial crop seed products, 2) describe the main characteristics of those producers who are loyal to crop seed brands, 3) provide insights to input providers seeking to gain a more in-depth knowledge of agriculture producers and design marketing strategies targeting them.

3. Literature Review

Brand loyalty has been described in the literature as an asset that companies possess (Bisschoff and Schmulian, 2019; Aganbi, 2017; Brahmbhatt, et al. 2017) since it represents a strategic resource that provides value to the firm. There is abundant literature that seeks to explain the factors that determine customer's brand loyalty (Fortes, et al. 2019; Ikramuddin et al., 2018; Gupta et al., 2017; Syahida et al. 2017; Bisschoff and Moolla, 2014; Coelho and Henseler, 2012; Evanschitzky et al., 2006) and the ability of companies to profit from customer' brand loyalty once they have assured it (Khamitov, et al., 2019; Watson et al. 2015; Coelho and Henseler, 2012; Moolla, 2010; Bourdeau, 2005).

Assessing customers' brand loyalty is not an easy task given the variety of concepts that it involves

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[4] Two local companies, Don Mario and Nidera, hold a leading role in the soybean seed market, controlling between around 90% of the market. Nidera has been bought by the Chinese state-owned firm COFCO (Craviotti, 2018).

[5] In our literature review we identified some papers regarding agribusiness input market segmentation such as Borchers et al. (2012); Wang et al. (2017); and Baker et al. (2017). However, not specific additional papers were found referring to segmentation in the Argentine seed market.

(Mathews, 2019; Pan *et al.*, 2012; Dick and Basu, 1994) and the different ways it has been conceptualized (Ehsan *et al.*, 2016; Watson *et al.*, 2015; Moolla, 2010), as we synthesize in Table 1. Despite the variety of definitions, there is a consensus as to the relationship between brand loyalty and visible patterns of buying behaviors (repeated patronage), psychological attitudes, beliefs, and commitment towards the brand. Considering loyalty only from the point of view of buying behavior may be considered ''spurious loyalty'' (Watson *et al.*, 2015; Maseshwari *et al.* 2014; Bourdeau, 2005; Møller Jensen and Hansen, 2006).

Several studies focused on measuring the impact of different dimensions on brand loyalty. Moolla (2010) identified 12 key brand loyalty influences, which he applied to fast-moving consumer goods, such as toothpaste, soaps, and detergents. He tested the strength and relationship of these influences on brand loyalty for these types of goods. The results show that the most important influences are commitment, brand effect, and brand relevance; while the least important are brand trust, brand performance and customer satisfaction. Even though the model was originally developed to measure brand loyalty in the fast-moving consumer goods sector, its validity was confirmed across several industries such as pharmaceutical products (Du Plooy, 2012), the banking industry (Scholtz, 2014), and farming/agribusinesses, as we will see below.

Wiese (2014) and Bisschoff and Wiese (2014), as well as Hill (2018), adapted the framework developed by Moolla (2010) to measure brand loyalty in the farming/agribusiness environment in two different regions of South Africa. The results of these studies were quite similar, as brand trust, customer satisfaction, repeated purchase, brand relevance, perceived value and involvement appear as the most important factors when agricultural producers are considering their brand loyalty toward agricultural business brands.

Narayandas (2005) developed a loyalty ladder. The author hypothesizes that customers display their loyalty to companies in a predictable way, as they move up the loyalty ladder: from customers wanting to grow their relationship with the company's brand, to endorse the product, resist the competitors' cajolery, willing to pay premium prices, seek to collaborate with the company to develop new products, and finally as a higher level of loyalty, invest in the firm.

Holland *et al.* (2014) measured loyalty levels of US large agricultural producers to agribusiness input suppliers, applying the loyalty ladder framework, developed by Narayandas (2005). In particular, the results for seed brands show that the more the agricultural producer tends to use hired custom fertilizer services, the more loyal he would be to seed brands. On the other hand, the more the agricultural producer uses hired custom harvesting services and the more years of education he has, the least he would tend to be loyal to seed brands. Non-family members and spouses are positive influences on the primary decision-maker to be loyal to seed brands.

Bianchi *el al.* (2014) established that brand trust has a direct effect on brand satisfaction but not on brand loyalty. Therefore, the authors conclude that brand trust indirectly influences brand loyalty through brand satisfaction. These findings challenge previous research supporting a direct connection between brand trust and loyalty.

Bisschoff and Schumulian (2019) applied Moolla's brand loyalty framework to measure consumers' brand loyalty to poultry products (chicken pieces and whole birds) in the province of KwaZulu-Natal in South Africa. They found that the most important influences on poultry brand loyalty are brand trust, customer satisfaction, and perceived value, while those of the least importance are culture and relationship proneness. These results established the validity of Moola's model (2010) to measure brand loyalty for poultry brands and identify the most important brand loyalty factors.

As firms need to identify customers with different levels of brand loyalty, studies on loyalty-based segmentation attempt to identify the types of relationships between customers and brands and classify customers

Table 1: Previous Brand Loyalty Conceptualizations and Approaches

Aaker (1991)	As a measure of emotional involvement.
Dick and Basu (1994)	As a relationship between relative favorable attitude and repeated patronage.
Assael (1998)	As repeated purchase under high involvement.
Oliver (1999)	As a multidimensional concept involving cognitive, attitudinal, affective, conative and action disposition towards brands.
Oliver (1999); Bourdeau (2005); Maseshwari Lodorfos, and Jacobsen (2014)	As a deeply held commitment to a firm/brand.
Narayandas (2005)	Loyalty defined as increasing stages or rungs: The loyalty ladder.
Jones and Taylor (2007)	As a multidimensional concept applied to services.
Harbor (2006); Harbor, Martin, and Akridge (2008)	Assessing Agricultural Input Brand Loyalty among US Producers.
Moolla (2010); Moolla and Bisschoff (2012 a,b,c); Bisschoff and Moolla (2014)	Brand loyalty measurement of fast-moving consumer goods.
Bianchi, Drennan, and Proud (2014)	Brand loyalty in wines: brand trust, customer satisfaction, and brand loyalty.
Holland, Delgado, Widmar, and Gunderson (2014)	Measuring levels of brand loyalty of US large commercial producers.
Wiese (2014); Bisschoff and Weise (2014); Hill (2018)	Measuring brand loyalty in agribusiness.
Watson, Beck, Henderson, and Palmatier (2015)	As a mix of attitudes and behaviors that favors a firm relative to its competitors.
Ehsan, Warraich, and Sehribanoglu (2016)	Multidimensional brand loyalty in the context of a product.
Mohanty and Kumar (2017)	Measures farmer's satisfaction and brand loyalty toward fertilizer brands.
Bisschoff and Schmulian (2019)	Measuring brand loyalty for chicken brands.
Gajanova, Nadanyiova, and Moravcikova (2019)	Brand loyalty and customer segmentation.

according to the intensity or type of loyalty. Gajanova *et al.* (2019) tested the use of demographic and psychographic segmentation of customers to distinguish between more and less brand loyal customers. Marketing segmentation aid companies to define their marketing mix strategies, enabling them to target customers with specific profiles and needs in each segment.

Applying some of these ideas to agribusiness, Harbor *et al.* (2008) studied the prevalence and determinants of brand loyalty to agricultural input products. They understand brand loyalty as 'the commitment of a customer to choose to purchase a preferred branded agricultural input product or service now and in the future, despite situational changes and marketing efforts that may have the potential to cause switching' (Harbor *et al.*, 2008, p. 18). In the buying process, producers prepare themselves to buy an input and take into consideration different factors, including their perceptions, attitudes, and views; the buying process ultimately influences buying behaviors. Also, Borchers *et al.* (2012) analyzed the relationship between different types of agricultural producers and brand loyalty to crop seeds, crop protection and capital equipment products, dividing producers into balance-oriented, price-oriented, performance-oriented, and convenience-oriented.

Mohanty *et al.* (2017) examined the agriculture producers' brand loyalty to fertilizers in India, testing the relationship between customer satisfaction and brand loyalty. In this study, customer satisfaction is influenced by constructs such as perceived quality, expectations, perceived value and the firm's image. The results show that the model can be used to make benchmark studies among fertilizer companies and could also be extended to other agriculture input industries to measure producers' brand satisfaction and brand loyalty.

3. Loyalty Dimensions and Analysis Framework

The conceptual model of brand loyalty developed by Harbor (2006) and Harbor *et al.* (2008) for agricultural inputs includes a wide variety of factors − suggested by previous research − as important determinants of brand loyalty. The authors classify these factors into four dimensions: *a) producers and farms characteristics; b) producers*' beliefs and attitudes; c) product characteristics, and *d) media exposure.* Other similar studies, such as Holland *et al.* (2014), only use socio-demographic and few farm characteristics to explain agricultural producers' brand loyalty. Borchers *et al.* (2012) studied brand loyalty of different types of US agriculture producers, as a part of a segmentation study. Mohanty *et al.* (2017) only include agricultural producers' brand satisfaction as an influencer of brand loyalty.

However, Harbor *et al.* (2008) conceptual framework is more comprehensive than the above-mentioned studies, in terms of the multiplicity of variables included and its systematization. Thus, Harbor *et al.* (2008) will be used as a benchmark to characterize different brand loyalty groups among Argentine producers, including some of the variables proposed by the authors and adding some others. This paper aims at verifying whether the expected results are met in the Argentine case.

The first dimension, *demographics and farm characteristics*, includes variables such as age, income, farm size, and education. While age positively impacts on expendable input brand loyalty (Funk and Vincent, 1978), it may have no impact for the case of seed brands (Holland *et al.*, 2014). Previous studies for the US market report conflicting findings on the association between brand loyalty and incomes (Holland *et al.*, 2014; Harbor *et al.*, 2008). According to Harbor (2006) gross income positively influences loyalty until income surpasses one million dollars. However, beyond this level of sales, the probability of being loyal to brands of expendable input products falls. In general, education appears to be negatively related to brand loyalty (Holland *et al.*, 2014) and farm size (Funk and Vincent, 1978). This may be explained by the fact that the more educated and the larger the producer, the more he investigates before buying his inputs; and thus, is less brand loyal. Furthermore, this paper includes the 'residence' variable to characterize groups of loyalty. In the Argentine context, larger and wealthier producers tend to live in big cities, far away from the farm, which probably affects their buying behavior. As larger producers tend to be more disloyal to input brands, it can be expected that the farther the producer lives from the farm, the less loyal he tends to be.

Producers' attitudes and beliefs can often lead to brand loyalty. For example, past studies show that perceived brand differences encourage brand loyalty among agriculture producers (Borchers *et al.*, 2012; Harbor *et al.*, 2008, Harbor, 2006). Borchers *et al.* (2012), found that only 11% of performance-oriented producers (those who placed a large emphasis on product performance) consider seed brands more or less the same, while for balance-oriented producers (those who consider all of the input supplier's criteria to be equally important) 21.5% consider brands more or less alike. In Harbor (2006), the most loyal producers tend to be the ones who most disagree that input brands are all the same. Thus, we can expect that producers who believe in the existence of differences between expendable and branded inputs tend to be loyal to seed brands.

The third dimension proposed by Harbor *et al.* (2008) refers to the *attributes of agricultural input products*. The three key components of a product by which firms can create competitive advantages are price, product performance, and supplier relationship (Treacy and Wiersema, 1995). Agricultural input performance refers to the agronomical or technological performance of the input, which can be time-consuming and hard to assess. An alternative to ensure a good quality agronomic product would be the advice given by a supplier the producer trusts, or 'supplier relationship'. We know from previous research that quality and service (Funk and Tarte, 1976), and performance (Harbor, 2006; Funk and Vincent, 1978), impact on brand loyalty. Therefore, we can expect that the more the producer values seed performance the more likely he tends to be loyal to seed brands. We can also expect that the relationship between brand loyalty and price, as well as that between brand loyalty and the relationship with the dealer/retailer are negative, that is the more the producer values price and the relationship with the dealer/retailer, the less loyal he tends to be.

Finally, *media exposure* may prove to be an effective path for generating brand loyalty and improving relationships in agricultural markets (Harbor, 2008). Advertising and media exposure are connected to brand loyalty (Terui *et al.*, 2011; Tellis, 1988). According to Harbor (2006), media exposure positively influences brand loyalty for expendable inputs, with some few exceptions. TV and radio agriculture shows, for example, have a positive influence, as well as agriculture-oriented newspapers. At the same time, general agriculture publications do not influence brand loyalty. Dülek *et al.* (2019) also established a positive link between the use of social media and brand loyalty for products. However, while the use of social media is growing among agricultural producers and is expected to have a positive impact on how producers purchase and perceive brands in future, adoption of social media is slower in rural areas than in urban communities (Pew Research Center, 2019). Thus, we would expect that more media coverage is positively related to seed brand loyalty, although the relationship between social media and brand loyalty would not be so clear up to now.

The level of exposure may influence brand loyalty, and there may be effects based on the type of exposure. Since seed sales are of a very special and technical type (Magnier *et al.*, 2010), companies tend to approach producers through traditional farm channels (farm shows, farm magazines, TV, radio.) Personal communication (field days, meetings) are the two most prevalent ways that companies use to contact Argentine producers. We would, therefore, expect that more exposure to more common media formats (traditional and personal) would positively impact on brand loyalty. The relationship between social media and seed brand loyalty, is incipient up to now; therefore, it is hard to predict its outcome.

4. Data and Methods

Data collection
The primary source of information for this paper is "The Needs of the Argentine Agricultural Producer 2017" survey, carried out by Universidad Austral during June and July 2017. A total of 818 producers were surveyed in the country's main agricultural provinces[6]. These producers are representative of approximately 85% of the soybean production, roughly 80% of corn, and almost 90% of the wheat production in Argentine[7]. The aim of this survey is to analyze the argentine agricultural producer's purchasing behavior and comprehend their underlying preferences in such decisions. The survey is based on 58 questions, which were responded in personal interviews conducted with agricultural producers, and one of the questions directly refers to crop seed brand loyalty.

Question number 40 in the survey asked producers about their loyalty to the crop seed brands they purchase. This question is based on the loyalty ladder developed by Narayandas (2005)[8] and has also been used by

Holland *et al.* (2014). Farmers were asked to express their agreement with the following statements related to their first-choice brands (it was possible to select more than one option):

a. *I will do more business with this brand.*
b. *I endorse this brand to my neighbors.*
c. *I try products other than this brand.*
d. *I would switch to another brand for 5% savings.*
e. *I would switch to another brand for 10% savings.*
f. *I am loyal to this brand (I would not change brand if the price increases 10%).*

As previously stated, a complete definition of loyalty can relate to behavior, but should include attitudinal aspects; otherwise, it may reflect spurious loyalty (Watson *et al.*, 2015). Question 40 was designed to reflect a balance between options associated with attitudes or beliefs (*a, b, c*), and options associated with a more particular decisional aspect that reflect changes in behavior associated to changes in prices (*d, e, f*).

In interpreting the results, options *c, d,* and *e* are associated with *factors associated with disloyalty*, since they show a disposition to switch brands (even when this switching may not happen in practice). On the other hand, options *a, b* and *f* are *factors associated with loyalty,* since they imply the producers' certain involvement with the brand (by not switching even with higher prices, by recommending the brand to neighbors or seeking to do more business with it).

Some 54 individuals were excluded from the 818 in the sample due to inconsistencies in their responses. The results then derived from the answers recorded from the remaining 764 farmers. The questionnaire provided the opportunity to draw the producers' socio-demographic and purchasing behavior data, which can be used to describe the socio-demographic background of producers with different seed brand loyal profiles.

Methods
We resorted to a two-step methodology: the first step identifies groups of producers in terms of their loyalty to seed brands, using a multivariate analysis of conglomerates or cluster analysis. Then, to identify variables associated with brand loyalty, and have an initial group characterization, we use independency tests for qualitative variables.

A conglomerate is understood as a set of statistical individuals (entities, persons, objects) that have similar characteristics (Johnson and Wichern, 1998; Díaz and Morales, 2012). To partition a finite set of individuals into groups, there are two well-known and differentiated classes of algorithm: non-hierarchical methods (e.g. k-means), that begin with a number of groups defined a priori; and hierarchical methods, which begin with the calculation of the distance matrix, forming groups through agglomerative or divisive techniques.

In this study, we worked with a hierarchical agglomerative procedure, where each one of the individuals begins forming a conglomerate, or unitary groups. Nearby groups are mixed successively until all similar individuals are within the same conglomerate. In order to do that, we employ the Euclidean binary distance, since the variables selected to carry out the cluster

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[6] These provinces are Buenos Aires, Cordoba, Santa Fe and Entre Rios, in which producers obtain high yields for their crops. We are not dealing in this study with producers in marginal productive areas.
[7] Secretary of agriculture, Argentina, agricultural estimates, period 2018-2019. http://datosestimaciones.magyp.gob.ar/reportes.php?reporte=Estimaciones.
[8] With certain adaptations, as we shall see below.

Table 2.a: Cluster solution with two seed brand loyalty groups.

	Total		Cluster 1		Cluster 2			
Characteristic	N=764 Mean	Sd	N=333 Mean	Sd	N=431 Mean	Sd	t-test	
I will do more business with this brand	0.86	0.35	0.82	0.38	0.88	0.32	2.45	**
I recommend this brand to other farmers	0.52	0.50	0.85	0.36	0.27	0.44	-19.95	***
DID NOT SELECT I try different brands of this product	0.40	0.49	0.70	0.46	0.17	0.38	16.88	***
DID NOT SELECT I would change brand if the price increases 5%	0.79	0.41	1.00	0.05	0.62	0.48	15.83	***
DID NOT SELECT I would change brand if the price increases 10%	0.50	0.50	0.99	0.11	0.12	0.33	51.10	***
I am loyal to this brand (I would not change brand if the price increases 10%)	0.32	0.47	0.74	0.44	0.00	0.00	-31.12	***

Levene test for equality of variances was performed for each variable and was significant at $p < 0.01$
Note: T-mean sample comparison test with unequal variances. ***$p < 0.01$ **$p < 0.05$ *$p < 0.1$

analysis are all qualitative, with only two categories of response to each one.

The hierarchical agglomerative method of linkage by the intra-group average proposed by Sokal and Michener (1958), allows us to combine groups looking for the least possible average distance. Thanks to this method, the distance within two clusters *A* and *B* is defined as the average of the distances for all the resulting pairs of individuals in case the two groups *A* and *B* were joined; that is:

$$d_{AB} = \frac{1}{c} \sum_{i,jC} d_{ij} \qquad (1)$$

Where:
c being the total number of possible comparisons for pairs of individuals *i, j* of the new cluster *C*, constructed through the union of the individuals in group *A* and *B*.

As we are in the presence of an agglomerative method, in the first step of the algorithm, two of the closest individuals are joined; that is, two individuals *i, j* such that their binary Euclidean distance d_{ij} calculated through (1) is equal to the origin, or at least a very small value. In each step of the process we can group together either individual cases, previously formed conglomerates, or an individual case with a previously formed conglomerate. Therefore, individuals are grouped into increasingly larger and more heterogeneous conglomerates until the last step, in which all the sample is grouped into a single global conglomerate.

Once the groups of individuals have been established based on their brand loyalty to seeds, we use an independency test to check the statistical relationship of brand loyalty to each of the variables that can influence the producer's behavior, following the framework proposed in Harbor et al. (2008).

5. Results

We start by presenting the tentative identification of the number of clusters. Furthermore, we show and analyze the proposed clusters and their validation, based on the producers' disposition to seed brand loyalty. Next, we check a group of variables based on their association with brand loyalty to draw an initial characterization of producers in different clusters.

Identification of loyalty groups

As explained in the methodology section, the identification of groups of loyalty is based on a hierarchical agglomerative process. Since hierarchical methods do not define *a priori* the number of clusters, it is essential to determine when to stop the agglomeration process and the number of clusters to be finally obtained. According to the positive conglomerate coefficient values, we work with two and three clusters. We also check whether the groups obtained are significant, not only statistically but also commercially. For further details, see Annex A.1.

Tables 2.a and 2.b show the results in two and three clusters, respectively. In the first case, we have the first cluster with 333 individuals, where 82% of producers would continue doing business with the seed brand they presently buy; they recommend that brand to their neighbors (85% of answers), and would stay with the brand even with a 10% price increase (74% of answers). Only 30% of the producers included in this group indicate that they would try different products, none of them would change brand even with a 5% increase in price, and 99% of them would stay with the brand even if prices increase 10%. Thus, we can say that this is the cluster that includes the group of producers who show loyalty.

On the other hand, the second cluster includes 431 individuals. They also indicate their willingness to doing more business with the brand they are currently buying (88% of answers). However, most producers in this category claim that they would try different products (83% of answers) and change the brand if prices increase 10% (88% of answers) or even 5% (38% of answers). Finally, none of them say that they would continue buying the product if prices rise more than 10%. Therefore, we can say this cluster reveals the group of producers who do not show loyalty.

As shown in Table 2.a, t-test for mean sample comparison (considering unequal variances) indicates differences for each variable between both groups that are statistically significant (see Annex A.2 for more details regarding t-test).

Table 2.b: Cluster solution with three seed brand loyalty groups.

Characteristic	Total N=764 Mean	Sd	Cluster 1 N=333 Mean	Sd	Cluster 2 N=269 Mean	Sd	Cluster 3 N=162 Mean	Sd	F-value	
I will do more business with this brand	0.86	0.35	0.82	0.38	0.92	0.27	0.82	0.38	7.4	**
I recommend this brand to other farmers	0.52	0.50	0.85	0.36	0.30	0.46	0.21	0.41	192.4	***
DID NOT SELECT I try different brands of this product	0.40	0.49	0.70	0.46	0.23	0.42	0.07	0.25	161.1	***
DID NOT SELECT I would change brand if the price increases 5%	0.79	0.41	1.00	0.05	1.00	0.00	0.00	0.00	48,555.6	***
DID NOT SELECT I would change brand if the price increases 10%	0.50	0.50	0.99	0.11	0.20	0.40	0.00	0.00	1,182.1	***
I am loyal to this brand (I would not change brand if the price increases 10%)	0.32	0.47	0.74	0.44	0.00	0.00	0.00	0.00	626.3	***

Note: ANOVA test for differences in multiple means. ***$p < 0.01$ **$p < 0.05$ *$p < 0.1$

We consider a scenario with 3 clusters (as shown in Table 2.b) and check changes in the above analysis. We have a loyal group (cluster 1) with the same number of individuals and results as in the two-cluster solution. As explained before, this group includes producers who are loyal to the seed brand.

Cluster 2 in the analysis above (disloyal cluster), consists of two sub-clusters. Sub-cluster 1 includes 162 individuals. Every single producer in this group claims that they would change brands if prices increase 5% or 10% whereas 93% said that they would try different brands. As we can see, compared to the disloyal cluster in the two-cluster solution, this group shows a deeper and more emphatic disloyalty, almost no loyalty to the seed brands and would not tolerate any price increase.

The second sub-cluster consists of 269 agricultural producers and seems to be an 'intermediate' group. 92% of producers answered that they would continue doing business with the brand they are currently buying, and none of them would switch brands if prices increase 5%. Nonetheless, 80% of the agricultural producers in this group would switch brand in case of a 10% increase, and none of them would stay attached to the brand if prices increase more than 10%. 77% of these producers try different seed brands, and 30% of them recommend the brand to their neighbors. As we can see, this group likes and is satisfied with the brand they presently use. They show a certain degree of loyalty and would tolerate a small/moderate increase in price. However, this loyalty would not last forever: they are willing to change brand if prices increase significantly. This means that they like the brand but are not willing to 'marry' the brand.

As shown in Table 2.b, analysis of variance (ANOVA) test for differences in multiple means is significant so we confirm there are statistically significant differences between means in the three groups (see Annex A.2 for more details).

This three-cluster solution is more refined, in the sense that it shows the two 'empirical' groups conformed in the previous solution, the 'disloyal' and the 'loyal' clusters (with a much more emphatic disloyalty group). This solution also includes an intermediate group whose members share loyalty and disloyalty traits. Summarizing, the 'two clusters' solution, with one loyal and another disloyal group, was transformed into a 'three cluster' segmentation of agriculture producers: one 'loyal group', as before, and two new ones: a 'pure disloyal group' and an 'intermediate group' with a blend of loyal and disloyal traits. As there are significant differences in the responses of the agriculture producers in each cluster, we have a new way of segmenting argentine agriculture producers according to their brand loyalty to seeds. Therefore, we can now take this outcome to advance in the characterization of each loyalty group considering different types of variables.

Characterization of loyalty groups

The second stage of our analysis includes a first exploration of the characteristics of those individuals in the clusters identified. We provide an initial description of the producers' profile for each brand loyalty group. This is an ex-post, non-conditional analysis, aimed at exploring relationships between a group of selected variables and brand loyalty. We identified variables based on their relevance to explain brand loyalty. Besides, we test whether there exists a significant relationship between each variable and brand loyalty. The variables are 11, divided into 4 dimensions, following the framework developed by Harbor *et al.* (2008).

We can observe the results in Table 3. The results corresponding to the *first dimension (the farm and the producer's characteristics)* show that loyal producers tend to be younger (higher share of producers under 44) and rent a larger proportion of their land, than the other two clusters. Disloyal producers manage larger farms and sale volumes than those in the intermediate and loyal clusters (higher share of large producers, and sales above U$D 1,000,000). Disloyal producers also show higher levels of education than those in the other two clusters and live farther from the farm (higher share of producers who live more than 50 kilometers away).

The results corresponding to the *second dimension (producers' beliefs and attitudes)* include the belief that there are differences between expendable and branded

Table 3: Independence Chi-Square test for selected variables

			Cluster 1 Loyal N=333	Cluster 2 Intermediate N=269	Cluster 3 Disloyal N=162	Pearson Chi-Square		Log-Likelihood		Df
Dimension 1=Farm and Farmer Characteristics										
Education	High School or Less	% of total	36.0	29.4	19.1	14.90	***	15.55	***	2
	More than High School	% of total	64.0	70.6	80.9					
Age	≤44	% of total	60.7	36.4	30.2	66.56	***	65.15	***	4
	45-54	% of total	21.9	32.3	48.1					
	≥55	% of total	17.4	31.2	21.6					
Residence	In the facilities	% of total	8.1	5.2	2.5	10.15	**	10.69	**	4
	Less than 50 kilometers away	% of total	59.5	65.4	58.6					
	More than 50 kilometers away	% of total	32.4	29.4	38.9					
Size	Mid-size	% of total	63.1	70.3	63.0	7.93	*	7.65		4
	Commercial	% of total	26.4	21.2	21.6					
	Large	% of total	10.5	8.6	15.4					
% of rented land	Less than 50%	% of total	46.2	71.7	58.6	39.74	***	40.44	***	2
	50% or more	% of total	53.8	28.3	41.4					
Gross Sales (U$D)	≤499,999	% of total	49.2	50.9	34.0	24.24	***	24.50	***	4
	500,000- 999,999	% of total	24.6	31.2	29.0					
	≥1,000,000	% of total	26.1	17.8	37.0					
Dimension 2= Farmer beliefs/attitudes										
Diff. between expendable and branded-products	Strongly Disagree - Disagree	% of total	14.7	58.7	61.7	161.49	***	172.96	***	4
	Partially Disagree	% of total	16.8	10.8	8.6					
	Partially Agree - Agree - Strongly Agree	% of total	68.5	30.5	29.6					
Dimension 3= Product Characteristics										
Price	Least Important/Neutral	% of total	81.1	68.0	60.5	26.43	***	26.72	***	2
	Most Important	% of total	18.9	32.0	39.5					
Performance	Least Important/Neutral	% of total	31.5	53.2	64.8	56.65	***	57.63	***	2
	Most Important	% of total	68.5	46.8	35.2					
Relationship	Least Important/Neutral	% of total	88.0	79.2	75.3	14.56	***	14.83	***	2
	Most Important	% of total	12.0	20.8	24.7					
Dimension 4= Media Exposure										
Media Sources	Traditional	% of total	53.5	48.3	33.3	95.13	***	97.33	***	4
	Personal Communication	% of total	31.5	14.1	13.0					
	Social Media	% of total	15.0	37.5	53.7					
Mean Valoration by Cluster (value min = 0, value max = 6)			3.69	3.25	3.11	F-value = 3,25	***			
Mean Valoration by Cluster without Social Media (value min = 0, value max = 6)			3.94	3.54	3.23	F-value = 3,34	***			

Note: ANOVA test for difference in multiple means. ***$p<0.01$ **$p<0.05$ *$p<0.1$

Table 4: Dimensions of Brand Loyalty. Conceptual model versus results

Dimension	Variable	Conceptual model proposed by Harbor et al. (2008)	Results for Argentine Farmer
Farm and farmers' characteristics	Sales	(+/-)	(-)
	Age	(+)	(-)
	Education	(-)	(-)
	Farm Size	(-)	(-)
	Location	(+/-)	n.a.
	Search activity	(-)	n.a.
	Residence (distance to farm)	n.a.	(-)
	% of rented land	n.a.	(+)
Farmers beliefs and attitudes	Value of time	(+)	n.a.
	Positive attitude to innovations	(+)	n.a.
	Perception of brand differences	(+)	(+)
Product characteristics	Price	(-)	(-)
	Performance	(+)	(+)
	Relationship	n.a.	(-)
Media exposure	Exposure to media sources	(+)	(+)
	Traditional media & personal comunication	n.a.	(+)

products. The differences are clear and confirm the result previously expected: most loyal producers tend to consider that there are significant differences, while most neutral and disloyal producers do not.

In the *third dimension (product characteristics),* we include three variables that reflect three different dimensions of the seed product: price, performance and relationship with the dealer/supplier. These variables were converted into three dummy variables that separate those producers who selected one dimension as the most important (#1), from those who rank such dimension in second (#2) or third (#3) place. There is a relevant relationship between these variables and brand loyalty.

Loyal producers are more performance-oriented than their colleagues in the disloyal and intermediate cluster. Some 68.5% of loyal producers indicate performance as the most important product dimension, compared to 35.2% in the disloyal category and 46.8% in the intermediate one. Producers in the loyal group do not rank price and relationship first in importance among product dimensions; 81.1% consider price and 88% mention relationship as the least important/neutral factor. Loyal producers are more focused on product performance, and they care much less about price and relationship than their colleagues in the other two clusters.

Finally, the *fourth dimension (media exposure)* includes the level and the type of media exposure. The mean exposure value for loyal producers is higher and significantly different from intermediate and disloyal producers.

Concerning the type of exposure, we classified the sources of information into three groups: traditional (farm shows, farm magazines, agricultural TV or radio shows), social media (social networks and YouTube), and personal communication (field days or meetings with retailers). The results show a meaningful relationship between preferred media sources and brand loyalty. Loyal producers prefer, first of all, traditional sources (53.5%) followed by personal communication (31.5%). While disloyal producers rank social media in the first place (53.7%) and traditional communication second (33.3%), more intermediate producers give priority to traditional means (48.3%) followed by social media (37.5%).

In summary, this section focuses on producing an initial description of those producers grouped in different brand loyalty clusters. There is a statistically significant relationship between brand loyalty and the 11 variables that explain seed brand loyalty. Producers in different brand loyalty clusters have different profiles based on their farm and farming characteristics, beliefs and attitudes, preferences for product characteristics, and media exposure. As previously stated, it is important to note that the results drawn from this analysis are descriptive and do not predict class membership. Annex 3.A synthesizes the different profiles of loyal, intermediate, and disloyal producers.

Conclusions

Companies in the crop seed markets face increasing competition, market restructuring and consolidation, and high innovation costs, which puts pressure on these firms to find ways to attract customers and differentiate their products from competitors. Brand loyalty is a concept that gains crucial relevance for firms selling crop seeds, as a means of developing brands which agricultural producers can perceive and associate with as high quality, valuable and reliable products; and in this way, help firms become more competitive and profitable.

This paper intended to identify and characterize different groups of producers based on their loyalty to crop seed brands sold in formal markets in Argentina. The specific objectives were to identify the agriculture produces who are loyal to crop seed brands, characterize them, and provide some insights to agricultural input providers who aim to gain a more in-depth knowledge of argentine producers and design marketing strategies to sell their products.

This identification and characterization may be helpful to understand producers' purchasing behavior, especially for companies and organizations selling agricultural inputs such as seed crops. The argentine crop seed markets are characterized by poor patent protection and a weak legal enforcement regime, as well as strong competition as Argentina is a relevant crop producer, which makes it difficult for firms to make profits (Correa, 2020; Craviotto, 2018). At the same time, Argentine

producers tend to be more brand loyal than US producers (Feeney and Berardi, 2013). Thus, it is meaningful for seed companies to understand their buyers' buying behavior and set strategies to retain them as loyal customers in such a complex market. Such understanding and strategies would minimize companies' commercial risks.

Thanks to cluster analysis, we identify and describe the main characteristics of those producers *who are loyal* to seed brands. Our first finding is that approximately 44% of Argentine producers consider themselves loyal to the crop seed brands they buy. These producers are willing to buy the brand regularly, despite price increase. They declare that they would continue purchasing the brand if prices increase 5% (or even 10%), and most of them would continue buying the brand even if there is a price rise of more than 10%. However, loyal producers exhibit not only behavioral loyalty to the seed brand they purchase but also attitudinal loyalty or commitment to the brand. Many loyal producers would recommend the brand and would not try different brands.

By contrast, only 21% of Argentine producers consider themselves *disloyal*, meaning that they are willing to try other products and would change seed brand if price increased 5% or more. Nevertheless, most *disloyal* producers state that they would continue buying their preferred brand but would try other products. Furthermore, in most cases, they would not recommend this brand to other producers. These disloyal producers do not show behavioral or attitudinal loyalty to seed brands.

We also identified a third segment of producers, which we called *intermediate*, as they combine some characteristics of loyal and disloyal producers. They want to do more business with the brand and are willing to tolerate slight price increase, but they would not buy the brand if prices rise more than 10%. Intermediate producers claim they would try other products and, in most cases, would not recommend this brand to other producers. Intermediate producers display some degree of behavioral and attitudinal loyalty, however, limited: they like the brand and would like to continue using it under the present conditions, but they would not 'marry' to the brand.

The 'two clusters' solution, with one loyal and another disloyal group, was transformed into a 'three cluster' division of agriculture producers with one 'loyal group', and two new ones: a 'pure disloyal' and an 'intermediate group'. Thus, this paper presents a new way of segmenting argentine agriculture producers according to their brand loyalty to crop seeds sold in formal markets.

To draw an initial characterization of these groups based on their brand loyalty, we used the conceptual framework proposed in Harbor *et al.* (2008). This conceptual framework is more comprehensive than most studies reviewed, in terms of the multiplicity of variables included and its systematization. It associates brand loyalty with different variables grouped into four different dimensions. Out of the 11 variables we used to test brand loyalty, 8 are common with this conceptual model: sales, age, education, farm size, brand differences, price, performance, and media exposure.

Our results match those in Harbor *et al.* (2008) for 7 of the 8 variables. Age is the only variable where our results differ from those expected, based on the model. In our study, younger producers (under 44 years) tend to be loyal to seed brands, while in Harbor *et al.* (2008) US producers over 54 and under 35 are disloyal, and those in between (35-54) tend to be loyal.

This paper has included some variables that are absent in the benchmark model, such as residence, rented land, relationship with the dealer/retailer and type of exposure to media communication (traditional and personal communication).

Our results show that traditional media and personal communication have a positive association with brand loyalty, while the association with social media is negative. Harbor *et al.* (2008) did not establish such a relationship since, at that time, social media and the Internet was not as extended as nowadays. Besides, loyal farmers tend to rent a larger proportion of the land they farm when compared to disloyal farmers. The relationship with the supplier appears as negatively related to brand loyalty. Regarding the producer's residence, it was found that the farther a producer lives from his farm, the more likely he is disloyal to seed brands.

Table 4 summarizes the main differences and similarities shown by our results between the two studies for the US and Argentine producers.

Our results have strong business implications, as they establish a clear profile of producers who are loyal to a brand in the heart of the Argentine Humid Pampa, the main agricultural area of the country. Our findings can help ag input companies determine where to focus their attention and resources. A loyal producer is a very special type of customer: young, technically focused, operates in a small/medium scale, value product performance, and prefer traditional and personal channels of communication. Seed companies should be aware of these characteristics, not only to retain their current customers but also to set marketing strategies that may attract potential customers.

Personal interviews we made with seed industry experts in Argentina tend to confirm the profile of a typical loyal producer[9]. First, industry experts claim that a rather large segment of producers traditionally tends to be loyal to seed brands. They also confirm that loyal producers tend not to be large ones. Loyal producers are usually mid-size or commercial; they value product performance and are not highly sensitive to price. Price discounts and fidelity programs work in the short-term, but producers would stick to the brand that shows the best performance in the long-term.

This analysis of seed brand loyalty among Argentine producers expands the work done by Harbor *et al.* (2008), Borchers *et al.* (2012) and Holland *et al.* (2014), and, to our knowledge, is the first to deal with crop seed brand loyalty in Argentine, with a novel way of segmenting and characterizing agricultural producers. This paper is, therefore, a contribution to the literature on agriculture marketing. This paper, however, has a limitation: the results apply only to the Humid Pampa, the main agricultural area of Argentina, are descriptive and do not predict class membership. This work could be expanded to other products, such as agricultural machinery and expendable inputs. Furthermore, it may be interesting to perform a comparative analysis between brand loyalty and dealer/distributor loyalty.

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[9] Three personal interviews with managers of seed companies of around one hour each.

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Annex A1.

The Software Package for Social Sciences (SPSS) 15.0 produced the results presented in the Annex, which correspond to the positive conglomerate coefficients. For summary purposes, we only present the coefficients calculated last that differ from the origin, as we can see in the Table A.1.

The third column reflects the distance between the coefficient of the i-1-th element of the cluster and that of the i-th element. We can see that except for the first coefficient, the others are mathematically negligible in magnitude. Therefore, it is very reasonable to consider a total of two clusters in principle. However, since the distances that follow are very small, due to the successive closeness between the values of the respective conglomeration coefficients, it is statistically convenient to consider at least one more group.

A.1: Conglomerate Coefficients.

Clusters (i)	Agglomeration Coefficient (c_i)	Distances ($d_i = c_{i-1} - c_i$)
1	1.464	
2	1.124	0.340
3	1.027	0.097
4	0.945	0.082
5	0.835	0.110
6	0.723	0.112
7	0.721	0.002
8	0.666	0.055
9	0.609	0.057
10	0.496	0.113
11	0.485	0.011
12	0.480	0.005
13	0.459	0.021
14	0.456	0.003
15	0.409	0.047
16	0.408	0.001
17	0.334	0.074
18	0.300	0.034
19	0.274	0.026
20	0.191	0.083
21	0.186	0.005
22	0.169	0.017
23	0.166	0.003
24	0.143	0.023
25	0.129	0.014
26	0.100	0.029
27	0.085	0.015
28	0.070	0.015
29	0.026	0.044

Annex A.2.

A.2.1: Validation for cluster solution with two brand loyalty groups.

		Levene Test for Equality of Variances		T- test for mean difference	
		F	**p-value**	**t**	**p-value**
I will do more business with this brand	Equal Variances	25.3	0.000	2.5	0.012
	Unequal Variances			2.5	0.014
I recommend this brand to other farmers	Equal Variances	63.6	0.000	-19.4	0.000
	Unequal Variances			-19.9	0.000
DID NOT SELECT I try different brands of this product	Equal Variances	73.3	0.000	17.3	0.000
	Unequal Variances			16.9	0.000
DID NOT SELECT I would change brand if the price increases 5%	Equal Variances	4255.7	0.000	14.0	0.000
	Unequal Variances			15.8	0.000
DID NOT SELECT I would change brand if the price increases 10%	Equal Variances	174.7	0.000	46.1	0.000
	Unequal Variances			51.1	0.000
I am loyal to this brand (I would not change brand if the price increases 10%)	Equal Variances	1364.3	0.000	-35.4	0.000
	Unequal Variances			-31.1	0.000

A.2.2. Validation for cluster solution with three brand loyalty groups.

ANOVA		Sum of squares	df	Quadratic Mean	F	p-value
I will do more business with this brand	Inter-group	1.8	2	0.9	7.43	0.001
	Intra-group	92.4	761	0.1		
	Total	94.2	763			
I recommend this brand to other farmers	Inter-group	64.0	2	32.0	192.39	0.000
	Intra-group	126.7	761	0.2		
	Total	190.7	763			
DID NOT SELECT I try different brands of this product	Inter-group	54.6	2	27.3	161.14	0.000
	Intra-group	128.9	761	0.2		
	Total	183.4	763			
DID NOT SELECT I would change brand if the price increases 5%	Inter-group	127.2	2	63.6	48555.62	0.000
	Intra-group	1.0	761	0.0		
	Total	128.2	763			
DID NOT SELECT I would change brand if the price increases 10%	Inter-group	144.5	2	72.2	1182.09	0.000
	Intra-group	46.5	761	0.1		
	Total	191.0	763			
I am loyal to this brand (I would not change brand if the price increases 10%)	Inter-group	104.2	2	52.1	626.28	0.000
	Intra-group	63.3	761	0.1		
	Total	167.5	763			

Annex 3.A.

A.3: Producers' profiles based on their seed brand loyalty. 4 Loyalty dimensions.

	Loyal	Intermediate	Disloyal
Farm and the producer's characteristics	Mostly under 44 years old. Lower sales than disloyal. Highest share of rented land among the three clusters.	Oldest producers' segment. Smallest average size and sales. Produces more on owns more land than the other two clusters.	Mostly aged 44-54. Highest share of producers with high school or moreLargest cluster in size and sales. On average, live farther from farm than the other two clusters.
Producers' beliefs and attitudes	Perceive differences between branded and expendable products.	Less perception of differences between branded and expendable products.	Less perception of differences between branded and expendable products.
Product characteristics	More focused on performance than on price, relationship oriented.	Less focused on performance and more on price, relationship centered.	Less focused on performance and more on price, relationship centered.
Media exposure	They place a higher value on information from media sources. Ranking of media sources: First, traditional sources and second, personal communication.	Ranking of media sources: First, traditional sources and second, social media.	Ranking of media sources: First, social media and second, traditional media.