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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Analysis of Factors Affecting Corn Seed Preferences of Producers: Case of Sakarya Province, Turkey*

Üreticilerin Mısır Tohumu Tercihlerini Etkileyen Faktörlerin Analizi: Sakarya İli Örneği

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Abstract

This research was carried out in 8 districts representing approximately 91.92% of corn production in Sakarya province. In the sampling of the study, the formula developed for limited populations of the simple random sampling method was used. The main material of the research is the data obtained from the questionnaires made with 261 corn producers. Determining the factors affecting the corn seed preferences of the producers is extremely important in terms of establishing the targets of the corn breeders and the marketing strategies of the seed suppliers in the market. In order to measure the attitudes of corn producers towards corn seed preferences, factor analysis was conducted to test 88 judgments were gathered under more specific factors. It was determined that the producers in the Söğütlü district of Sakarya found the factors of consumption expectations 2.11 times more important and the factors of vegetative characteristics of the variety 10.5 times more important than the producers of other districts. According to the producers in Ferizli district, it was determined that vegetative characteristics were 16.2 times more important factors and expectations of consumption were 5.14 times more important factors compared to other district producers. The 29 propositions in the first grouping that named "The Importance Level of the Producers to Corn Breeding, Education and Corn" were collected in 9 different factor groups. The 21 propositions in the second grouping that named "The Importance Level of Environmental and Vegetal Characteristics in Variety Preference" were collected in 7 different factor groups. The 18 propositions in the third grouping that named “The Importance Level of Expectations of the Manufacturers from the Product and the Firms” were collected in 6 different factor groups. And the 20 propositions in the last grouping that named "The Corn Seed Packaging Technical Specifications and Technical Information Content Significance Level" were collected in 5 different factor groups. For manufacturers, to give a company's guarantee for seeds, to take care of producers after sales, to set up demonstrations in the target areas, to make inspections in field after planting, etc. issues are more important than to distribute promotions, to organize fairs travels and to use eye-catching packaging etc. issues.

Keywords: Seed market, Seed marketing, Market share, Purchase behavior, Producer tendencies

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Öz

Bu araştırma, Sakarya ili mısır üretiminin yaklaşık %91.92'sini temsil eden 8 ilçede gerçekleştirilmiştir. Araştırmanın örneklemesinde, sınırlı popülasyonlar için geliştirilmiş olan basit tesadüfi örnekleme yöntemi kullanılmıştır. Araştırmanın ana materyalini 261 mısır üreticisi ile yapılan anketlerden elde edilen veriler oluşturmaktadır. Üreticilerin mısır tohumu tercihlerini etkileyen faktörlerin belirlenmesi, mısır yetiştiricilerinin hedeflerinin ve tohum tedarikçilerinin pazardaki pazarlama stratejilerinin oluşturulması açısından son derece önemlidir. Mısır üreticilerinin mısır tohumu tercihlerine yönelik tutumlarını ölçmek amacıyla faktör analizi yapılarak daha spesifik faktörler altında toplanan 88 yargı test edilmiştir. Sakarya ili Söğütlü ilçesindeki üreticilerin diğer ilçelerdeki üreticilere göre tüketim beklentileri faktörlerini 2.11 kat, vejetatif özellik faktörlerini ise 10.5 kat daha önemli buldukları belirlenmiştir. Ferizli ilçesindeki üreticiler için ise diğer ilçe üreticilerine göre bitkisel özelliklerin 16.2 kat, tüketim beklentilerinin ise 5.14 kat daha önemli faktörler olduğu belirlenmiştir. Üreticilerin, mısır yetiştiriciliğine, eğitimine ve mısıra verdikleri önem düzeyi adlı birinci gruplandırmadaki 29 önerme burada 9 ayrı faktör grubunda, çevresel ve bitkisel özelliklerin çeşit tercihindeki önem düzeyi adlı ikinci gruplandırmadaki 21 önerme 7 ayrı faktör grubunda, üreticilerin üründen ve firmalardan beklentilerinin önem düzeyi adlı üçüncü gruplandırmadaki 18 önerme 6 ayrı faktör grubunda ve mısır tohumluk ambalajı teknik özellikleri ve teknik bilgi içeriği önem düzeyi adlı son gruplandırmada ise 20 önerme 5 ayrı faktör grubunda toplanmıştır. Firmalar için uygulaması kolay olduğundan sık sık yapılmakta olan promosyonlar dağıtmak, fuar ve gezi organizasyonları düzenlemek, göz alıcı ambalaj kullanmak vb. gibi hususların esasen üretici nazarında firmanın sattığı tohumluğa garanti vermesi, satış sonrası da üreticiyle ilgilenmesi, hedef bölgede demonstrasyonlar kurması, ekim sonrası tarla kontrolleri yapması vb. gibi hususlar kadar önem arz etmediği belirlenmiştir.

Anahtar Kelimeler: Tohum pazarı, Tohum pazarlaması, Pazar payı, Satın alma davranışı, Üretici eğilimleri

1. Introduction

Wild form of maize originated approximately 7000 years ago in what is now Mexico and through selections, it has become a cultivated crop. Maize, regardless of its origin, spread across the world shortly after the discovery of the American continent, is a crop with high adaptability capacity, it has biotypes with adaptation capability ranging from tropical to temperate regions and with growth periods ranging from 6 weeks to 13 months (Brown et al., 1986). Maize is a warm-weather cereal grown in almost all parts of the world, between the 58th and 40th parallels of latitude, except Antarctica, from sea level up to an altitude of 4000 m, in areas with abundant sunlight. Its entry into our country was through North Africa. The fact that this plant is called maize in our country is a sign that it entered through Egypt and Syria (Anonymous, 2021). The most suitable temperature range for maize growth is between 25-30°C, the minimum temperature requirement is 15°C and the maximum average temperature requirement is 35°C (Emeklier, 2002).

World corn production is estimated to be 1.198 million tons in 2021/2022, making it the most widely produced grain. The main maize producing countries are the United States, China, Ukraine and Brazil, in that order (USDA, 2021). In our country, maize production in the 2019/2020 marketing year was 6.5 million tons. It is estimated that consumption is around 8 million tons. Despite the very high production, the supply deficit resulting from consumption is met with high quantities of imports, while biosecurity measures and trade facilitation have changed the countries from which imports are made (Taşdan, 2020). In Turkey, corn sown area increased from 5.9 million hectares in 2010 to 6.9 million hectares in 2020, while corn production increased from 4.4 million tons in 2010 to 6.5 million tons in 2020, an increase of 47% (TUIK, 2021). As can be seen, corn production and use are very wide both in the world and in our country. This reveals the need for a detailed examination of such matters as the production and marketing of corn seed, the needs of the main and secondary sectors and the development status.

Seeds are among the most important inputs of agricultural production and their use of quality seeds is important for increasing yield and production, as well as for obtaining more resilient, less costly and more competitive products. The seed sector in our country has made great progress in the last 25 years and both the increase in domestic seed production and the development of local seed production have been addressed by the private sector through significant efforts. The share of the private sector in seed production has increased over the years. The first scientific studies on seed quality control were initiated in 1869 by Friedrick Nobbe in a laboratory established in Tharand, Germany. In our country, the first scientific studies in the field of variety development and seed production were started in the late 1920s with the establishment of the Adapazarı, Adana, Eskişehir, Samsun Seed Improvement Stations and Ankara High School of Agriculture in 1933 (Anonymous, 2017).

Sakarya Province, which was selected as the research area, was the fourth province in Turkey with the highest corn production (328 thousand tons and 7.1% share) in the year the research was conducted and the first in the Marmara Region, while in 2020 it was in the eighth place in the country with 267.886,0 hectares and 267.280,0 tons production and first in the Marmara Region (TÜİK, 2021). It is known by researchers that producers are influenced by many factors when making their choice of corn seed. Among these factors are the resistance of the variety to diseases, pests, high temperatures and drought, as well as the low grain harvesting moisture in terms of pricing, the high capacity of yield, the grain yield as well as the silage and total yield which must be satisfactory to respond to a possible change of harvest time or purpose and the high quality of all kinds. In addition to these, many environmental factors such as dealer or expert advice, neighbor or friend choices and advice and producers' socio-economic status can be counted. Karadavut and Taşkın (2014) determined that speculative conversations on the product in the written and visual media directly affect the consumers. The aim of this study is to analyze what these factors are and how effective they are in seed selection by producers, which are more important and which are less important for producers and to bring the results to the literature by also revealing any regional differences.

2. Materials and Methods

2.1. Materials

The main material of the research is composed of the data collected from the corn producers in Sakarya province. These data have been obtained from the surveys conducted between the end of 2014 and the beginning of 2015 with the corn producers in Sakarya province. It has been understood that the corn production of 8 out of 16 districts of Sakarya province constitutes 91.92% of the provincial production and thus the other 8 districts have

been excluded from the scope of the study. In the agricultural economics researches, the populations under study are generally limited populations (Çiçek and Erkan, 1996). Therefore, the formula developed for limited populations, namely the simple random sampling method, has been used in the sampling phase of the research and 247 figure has been calculated, however, surveys have been conducted for more reliability and valid 261 samples have been included in the study.

2.2. Methods

In the sampling phase of the research, the corn production areas of the 8 districts in Sakarya province and the number of corn producers in the relevant districts have been taken as the basis from the 2012 Farmer Registration System (ÇKS) records of Sakarya Province Agriculture and Forestry Directorate.

$$n = N\partial 2t2 \div (N - 1)\, d2 + \partial 2t2 \quad \text{(Eq. 1).}$$

The formula is as follows;
N: Population Size - Number of Corn Producers in 8 Districts (7.672,0)
n: Sample Size (247)
∂: Standard Deviation (22.92)
x̄: Arithmetic Mean (28.10)
t: Table Value for Confidence Level (1.96)
d: Represents the acceptable error as a percentage of the mean (28.10 * 0.10 = 2.81).

The sample size was calculated with a 95% confidence limit and 10% error margin of the population average and a 5-point Likert scale was used in the survey questions comprising evaluations of "Not at all important", "Not important", "Neither important nor unimportant", "Important" and "Very important". Data obtained from the surveys were subjected to Factor Analysis that forms the purpose of this study. A general rule stating that the number of variables to be analyzed must be one fourth or fifth of the number of observations is among the considered criteria (Atalay Oral and Akpınar, 2015). Factor Analysis is a statistical technique that brings together variables that are related to one another over a large number of data, attempting to obtain a few unrelated variables. In Factor Analysis, correlations between the observed variables are taken into consideration as the numerous variables are sought to be explained by fewer factors. Factor Analysis aims to bring together related variables in a p-variable event and to find a few new (common) unrelated variables (Tatlıdil, 2002). The validity and reliability of the data were tested by Cronbach's Alpha analysis, the suitability for Factor Analysis and the adequacy of the sample by the Kaiser-Meyer-Olkin (KMO) test. A Bartlett's test of sphericity was also applied to determine the suitability of factor analysis. Yüzbaşı (2022), in his study, performed factor analysis to determine the reasons for individuals' "zara honey" preference and used Correlation Matrix, Bartlett Test and Kaiser-Meyer-Olkin (KMO) tests to investigate the suitability of the data for factor analysis. Logistic Regression analysis was conducted to determine to what extent the factors affecting the preferences affect the preferences (Karadavut and Taşkın, 2014). Also in this study, logistic regression analysis was applied to the obtained factor scores and effort was made to identify which factors were more or less important for which producers. Since correct modelling is important in logistic regression analysis, the suitability of the model was examined to see if the Nagelkerke and Hosmer & Lemeshow values were meaningful.

3. Results and Discussion

3.1. Determinations about producers

The average age of the farmers is 55.5 (*Table 1*). In the research area, 69 producers, or approximately 26% are over the age of 60 and 16 producers, or approximately 6% are over the age of 70. When evaluated according to the requirement of "being 18 or over at the time of publication of the Regulation and not having reached the age of 41", which is one of the conditions of the application to the project called "Young Farmer Project" implemented by the Ministry of Agriculture and Forestry (Anonymous, 2019); only 9.19% of the producers in the research area are in the Young Farmer condition. Mixed farms are farms that produce in multiple directions. In mixed farms, labor has the highest marginal value among the production factors (Cinemre and Ceyhan, 1998). However, it is not possible to speak of a marginal value from a producer population with an average age of 55.5 and with a young population that is constantly migrating.

According to the World Health Organisation's (WHO) revised age range list, which updates age ranges according to changing and developing technologies, 66-79 is considered middle age while 80-100 is considered elderly (Çataloğlu, 2018). WHO's newly determined age ranges in 2018 are 0-17 Teenager, 18-65 Young, 66-79 Middle Age, 80-99 Elderly. Accordingly, 86.64% of the surveyed businesses are aged 18-65, that is young. Nonetheless, 55.5 is a relatively high average age in terms of agricultural employment.

Table 1. Age groups of the farmers

Age group	Count	%
21 to 30	1	0.38
31 to 40	23	8.81
41 to 50	64	24.52
51 to 60	89	34.1
61 to 70	69	26.44
71 and upper	15	5.75
Total	261	100

The 5488 numbered Agriculture Law dated April 18th 2006 defines agricultural production as "production of plants, animals, aquaculture products, microorganisms and energy using land, water and biological resources along with agricultural inputs" (Anonymous, 2019a). Therefore, when the income generated from production in compliance with this definition is considered Agricultural Activity Income and the remaining income is evaluated as Non-Agricultural Activity Income, approximately 97.32% of the producers residing in the research region have 56.71% of Non-Agricultural Activity income. 80.46% of the producers have social security from Bağ-Kur, 14.54% have it from SSK and 3% have no social security.

According to the statistics, 20.3% of the businesses had a gross annual income below 25.000,0 Turkish Liras and 11.49% had a gross annual income above 60.001,0 Turkish Liras in 2015. 54.79% considered themselves to be of a middle-income status, 14.56% were of low-income and 27.59% were of good standing. A statistically significant relationship was also found between the status of the businesses with and without agricultural income in the society. Examining the *Table 2*, it was found that 83% of the producers were primary school graduates and 11% were secondary school graduates. There were no higher education graduates, mainly due to the fact that young population in the region had distanced themselves from farming for both economic and socio-cultural reasons and had chosen to reside in towns or cities and work in something other than farming.

Table 2. Distribution of educational level

Education	Count	%
Literate	5	1.92
Elementary	217	83.14
Mid collage	29	11.11
High collage	10	3.83
Total	261	100

3.2. Determinations about the production area where the research was applied

Sample size of this study is the total agricultural land possession of Sakarya according to 2016 TurkStat data, which is 1.692.549,0 decares. Of this, 732.648,0 decares is cultivated with Field Crops and 1.692,0 decares is left uncultivated. The total of cultivated and unsown land is 734.340,0 decares, which is 43.4% of total agricultural land. Vegetable land is 80.637,0 decares, which is 4.8% of total. Fruit land is 866.882,0 decares, which is 51.2% of total. Ornamental land is 10.690,0 decares, which is 0.6% of total (Dellal et al., 2018). The agricultural land possession of 261 businesses in 8 districts, which have been identified as survey area, is 11903 decares in total. However, 261 businesses, which were surveyed in 2014, had produced plant products in 12.702,0 decares in 2013, including first and second products.

In this production pattern, corn holds a share of approximately 67% with 8.467,0, wheat 1.367,0 with 11%, barley 455 with 3.6%, sunflower 386 with 3% and other products 2.027,0 with about 16%; the other group is dominated by hazelnut and vetch production.

3.3. Factor analysis applied to the obtained data

Factor analysis is one of the widely used multivariate statistical techniques which reduces a large number of variables that are interrelated into a smaller set of more meaningful, easily interpretable and independent factors (Cengiz and Kılınç, 2007). Before starting factor analysis, reliability analysis is used to determine whether the data is internally consistent. Cronbach's alpha coefficient is a weighted standardized mean calculated by taking the ratio of the sum of the variances of the k items in the scale to the total variance and takes values between 0 and 1. The range of possible values of alpha coefficient and the corresponding reliability of the scale are $0.00 \leq \alpha < 0.40$ indicates that the scale is unreliable, $0.40 \leq \alpha < 0.60$ indicates that the scale is of low reliability, $0.60 \leq \alpha < 0.80$ indicates that the scale is quite reliable, $0.80 \leq \alpha < 1.00$ indicates that the scale is highly reliable (Azabağaoğlu et al., 2015). Cronbach's alpha coefficient, used to explain or question the homogeneous structure of the items in the scale, is a measure of the internal consistency of the items. Cronbach's alpha is expressed as follows; if $0 < R2 < 0.40$, it is not reliable; if $0.40 < R2 < 0.60$, it is of low reliability; if $0.60 < R2 < 0.80$, it is fairly reliable; and if $0.80 < R2 < 1.00$, it is highly reliable (Alpar, 2013).

In the factor analysis presented in *Table 3*, a high correlation is sought between the variables and the confidence in the results of the factor analysis decreases as the correlation decreases. The standard Cronbach's alpha statistic, which shows the reliability of the variables, was calculated as 0.871. This value indicates that the questionnaire items using the Likert type scale have high reliability and that the variables consist of items that are consistent with each other and measure the same characteristics.

Table 3. Reliability test

Cronbach's Alpha	Standard Cronbach's Aplha	Variables
0.841	0.871	88

At first, the suitability of the data for factor analysis and the adequacy of the sample were analyzed using the Kaiser-Meyer-Olkin (KMO) test. This test is used to measure the adequacy of the sample and concerns the size of the sample. To this end, it compares the magnitude of the observed correlation coefficients with the magnitude of the partial correlation coefficients (Nakip, 2003). In general, a KMO value greater than 0.50 indicates that the variables are suitable for factor analysis and the number is sufficient. The Kaiser-Meyer-Olkin (KMO) Test is computed by comparing the calculated simple correlation coefficients with the partial correlation coefficients. The value of the test varies between 0 and 1 (Norusis, 1994). KMO values higher than 0.90 indicate that the sample is sufficient, KMO values between 0.89 and 0.80 indicate that the sample is valuable and KMO values between 0.79 and 0.60 indicate that the sample is of moderate value. KMO values below 0.6 indicate that the sample is not sufficient (Sharma, 1996).

Another method for determining the suitability of factor analysis is to examine the entire correlation matrix. The Bartlett's Test of Sphericity is a statistical test that assesses the presence of correlations amongst the variables. It provides the statistical significance of the correlation matrix, indicating that at least some of the variables have a significant correlation. However, the researcher should note that increasing the sample size has resulted in Bartlett Test becoming more sensitive in detecting the relationships between the variables. The researcher can then assess the factorability of the general variables and individual variables by using the overall significance of the correlation matrix and the measure of adequacy of the sample with Bartlett Test. The purpose of factor analysis is always to obtain factors, hence the aim is to provide a basal statistical correlation level within the set of variables for a fundamental basis (Hair et al., 1998).

Table 4 shows that the Kaiser-Meyer-Olkin (KMO) value for the group of factors of producers' preferences for variety attributes of environmental and plant characteristics was 0.711, with a significance value of 0.000. In other words, the Kaiser-Meyer-Olkin (KMO) test was 71.1%. It can be said that the data set is suitable for factor analysis, given that the value> 0.50 and the sampling is adequate and of medium value. Bartlett test also shows significance when the significance value is examined. From this, it can be seen that there are high correlations among the variables and that the data set is suitable for factor analysis.

Table 4. KMO and Barlett's test (The level of importance of environmental and plant characteristics in variety preference)

Kaiser-Meyer-Olkin	Measure of Sampling Adequacy	0.711
	Approx. Chi-Square	1737.91
Bartlett's Test of Sphericity	Df	210
	Sig.	0.000

Table 5. Factor analysis of importance level of environmental and plant characteristics in variety preference

Factors and Variables	Factor loadings	Deviation (%)	Eigen value
Factor 1 (Vegetative Characteristics in Variety Selection)		21.735	4.564
High Temperature Tolerance	0.809		
Drought Tolerance	0.780		
Low Harvest Moisture Rate in Grain	0.575		
The Ability to Give the Same Yield in Every Soil	0.500		
Factor 2 (Purchasing Behaviors in Variety Preference)		11.588	2.433
Variety Seeking Purpose (Grain, silage, etc.)	0.725		
Opportunity to Deferred Payment	0.720		
Tried Before The Local Farmers	0.571		
Cheaper	0.540		
Convenient supply	0.497		
Factor 3 (Environmental Factors in Variety Preference)		8.260	1.735
Suitability of the Variety for Second Crop Cultivation	0.772		
Effective Advertising Campaign for Variety	0.754		
Factor 4 (Recommendations for Variety Preference)		7.053	1.481
Neighbor & Seed Dealer Recommendations	0.848		
Agriculture Province-District Professionals and Agricultural Consultant Recommendations	0.797		
Factor 5 (Usage Expectations in Variety Preference)		6.251	1.313
It it's for Fresh Consumption, Sugar Content Should be High	0.864		
Suitable for Frequent Sowing	0.644		
It it's for Silage, Animals like to Consume	0.511		
Factor 6 (Expectations of consumption in variety selection)		5.557	1.167
Be Resistant to Lying Down	0.780		
It it's for Silage, Lower Leaves couldn't Burned or Dried	0.736		
Early Vegetative Variety	0.424		
Factor 7 (Hereditary Features in Variety Preference)		5.078	1.066
High Yielding of the Variety	0.764		
High Quality Values (Protein, Starch etc.)	0.459		

The eigenvalue is a coefficient taken into account both in calculating the variance explained by factors and in determining the number of significant factors. According to this criterion, initially, factors with an eigenvalue of 1 or greater are assumed to be significant and those with an eigenvalue less than 1 are considered to be insignificant. Thus, an eigenvalue of 0.999 would lead to the factor being considered insignificant, while an eigenvalue of 1 would require the factor to be considered significant. This, however, can be seen as a drawback for Variance Contribution Criterion when sensitivity is taken into account. As can be seen in all the tables, the eigenvalues of the factors are greater than 1, thus being significant. Another criterion that can be used to determine the number of factors is Total Variance Percentage Criterion, where when the contribution of each additional factor to the total variance is less than 5%, the maximum number of factors has been reached (Cengiz and Kılınç, 2007).

Interpretation and naming of factors are done taking into account the factor loads. According to this, if the correlation of the variable with the common factor is greater than ± 0.30, it is accepted that the variable has a

meaningful relationship with the said common factor. Therefore, it can be said that the variables in the tables have a meaningful relationship with the positive factor weights of the common factors since their factor loads are greater than ± 0.30. Some researchers claim that this rate should be ± 0.40. From this point of view, again the variables in the tables have a meaningful relationship with the positive factor weights of the common factors since their factor loads are greater than ± 0.40.

In this study, the number of factors to be derived from the features grouped under headings is determined by using Variance Contribution (Eigenvalue) Criterion. In this case, factor analysis was performed on the data set grouped under the heading of the importance levels of environmental and plant characteristics in the variety preference and a total of 7 factors containing 21 recommendations were formed according to the results of the said analysis, consisting of the components seen in *Table 5*. According to the variance contribution criterion, the eigenvalue statistic greater than 1 indicates the total number of factors and there are 7 factors with eigenvalues greater than 1, which explain 65.522% of the total variance.

As seen in *Table 6*, the Kaiser-Meyer-Olkin (KMO) value for the "Level of Importance of Expectations from Products and Companies" group of factors of the producers was 0.792 (79.2%) and the significance value was 0.000. Since the value is> 0.50, the data set is suitable for factor analysis and it is seen to be significant when the Bartlett test significance value is examined. There is a high correlation between the variables.

Table 6. KMO and Barlett's test (The importance level of the expectations of farmers from product and companies)

Kaiser-Meyer-Olkin	Measure of Sampling Adequacy	0.792
	Approx. Chi-Square	4112.533
Bartlett's Test of Sphericity	df	153
	Sig.	0.000

The factor analysis of the data set collected and analyzed in the section of "Level of Importance of Producers' Expectations from Products and Companies" yields a total of eighteen recommendations made up of six factors presented in *Table 7* according to the results of the analysis. According to the variance participation criterion, the principal value statistic indicating the total number of factors greater than one, there are six factors with principal values greater than one and these factors explain 75.647% of the total variance.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the "Importance Level of Technical Characteristics and Technical Information Content of Maize Seed Packaging" group of factors was 0.816 (81.6%), with a significance level of 0.000. This value also indicates that the data set is suitable for factor analysis; when the Bartlett's test of significance was examined, it was also found to be significant. There is also a high correlation between the variables (*Table 8*).

Table 9 has been analyzed in the section "Level of Importance of Seed Packaging Technical Specifications and Technical Information Content" and the factor analysis of the data set, collected in this section, has been conducted. According to the criterion of participation in variance, there are 5 factors with eigenvalues greater than 1 and these factors explain 73.215% of the total variance.

3.4. Applying logistic regression analysis to the factor scores obtained

In this phase of the study, logistic regression analysis was applied to the factor scores obtained and the dependent variable was taken as the districts. Independent variables can be age, gender and education, etc. The logistic model can be derived from a theoretical basis using index functions or random utility models (Anderson et al., 2005). As previously mentioned, it was understood that the maize production of 8 districts out of 16 districts in Sakarya province constituted 91.92% of the total provincial production, so the other 8 districts were excluded from the scope of the research. The variable "gender" was added as a dummy variable in the analysis and each district tested was accepted as 1 and the others as 0 in the test. Correct modelling is important in logistic regression analysis. Nagelkerke and Hosmer&Lemeshow values are an important analysis for the appropriateness of the model. The Nagelkerke R square value used to explain the model was found to be significant for Söğütlü and Ferizli districts *(Table 10)*.

Table 7. Factor analysis of the importance level of the expectations of farmers from product and companies

Factors and Variables	Factor loadings	Deviation (%)	Eigen value
Factor 1 (Expectations from the Product-Seed)		29.929	5.387
Grains are not Undersized and Broken	0.974		
Not Different Sizes of Grains (Large and Small)	0.971		
Seed Cleanliness (Foreign Matter)	0.970		
The Production Date of the Seed Should be New	0.955		
Medication of Seed for Subterranean Pests	0.947		
Seed Has All Quality Certificates	0.677		
Factor 2 (Expectations from Seed Company Officers)		15.532	2.796
Company Guarantees Seed	0.832		
Company Establishes Demonstrations in the Local Areas	0.715		
Companies Support Applications After Sales	0.634		
Companies Performing Field Controls After Sowing	0.601		
Factor 3 (Promotional Expectations from the Company)		9.848	1.773
Promotional Products (Hat, Bag, Pen, etc.)	0.888		
The company's Fair, Meeting, etc. Arrangement and Taking Away to Farmers	0.886		
Factor 4 (Product Origin Expectation)		7.082	1.275
Imported Seed	0.846		
Domestically Produced Seed	0.710		
Factor 5 (Suggestion-Supply Expectations from the Company)		6.985	1.257
Company's Proposal for Varieties According to Soil and Climate	0.864		
Company Delivering the Seed at the Appropriate Time	0.856		
Factor 6 (Training-Promotion Expectations from the Company)		6.271	1.129
Visual Instructions of the Companies in Village Cafe (Video, slide, etc.)	0.760		
Company's Village Cafe Meetings	0.679		

Table 8. KMO and Barlett's test (The importance level of the content of the technical characteristics and information of the corn seed packaging)

Kaiser-Meyer-Olkin	Measure of Sampling Adequacy	0.816
Bartlett's Test of Sphericity	Approx. Chi-Square	4241.141
	df	190
	Sig.	0.000

Analysis of the data obtained from Söğütlü district revealed that the scores of the 3rd, 4th, 5th and 6th factor groups were found to be significant. The 3rd factor group, "Environmental factors in variety preference" was found to be 2.65 times (1/0.377) less important than the scores from other districts, likewise the 4th factor group, "Recommendations for variety choice" was calculated to be 2.05 times (1/0.488) less important. Factor group 5, " Usage Expectations in Variety Preference" was found to be 2.11 times and factor group 6, "Vegetative features in variety preference" 10.5 times more important than the other districts *(Table 12)*.

Table 9. Factor analysis of importance level of the content of the technical characteristics and information of the corn seed packaging

Factors and Variables	Factor loadings	Deviation (%)	Eigen value
Factor 1 (Expectations from Packaging)		28.056	5.611
Place and Date of Production Should Be Written on Seed Packaging	0.861		
Company Name and Variety Name Should Be Written	0.823		
Seed Packaging Must Be Resistant to Impact and Stacking	0.802		
The packaging must be able to maintain the germination strength of the seed for a long time	0.798		
Packaging, Water, Air and Light Proof	0.784		
Storage Conditions and Minimum Durability Period Should Be Written on the Package	0.770		
Factor 2 (Packaging Information Content Expectations)		23.845	4.769
Foreign Substance Content Information Should Be Written on the Packaging	0.850		
Yield Capacity Under Optimum Conditions Should Be Written	0.846		
Germination Power and Rate Should Write on Package	0.840		
Information on Planting Techniques Should Write on Package	0.773		
Soil and Fertilizer Requirements of the Variety Should Write on Package	0.744		
Drought Resiliency Status Information Should Write on Package	0.712		
The Frequency of Water Demand of the Variety Should Be Written	0.703		
Factor 3 (Packaging Design Expectations)		10.407	2.081
The Packaging Must Be Of Weight That Is Held By Hand Easily Transportable	0.860		
The Packaging Must Be Able to Be Opened and Closed Again in a Practical Way	0.791		
Factor 4 (Packaging Environmental Expectations)		5.492	1.098
The raw material of the packaging must be suitable for recycling	0.836		
The design quality of the packaging must be high	0.788		
Raw Material Must Be Environmentally Friendly	0.748		
Factor 5 (Packaging Quality Expectations)		5.415	1.083
Packaging Must Have All Required Quality Certificates	0.775		
The Writing on It Should Be Understandable Shape and Size	0.759		

Table 10. Model significance

	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
Söğütlü District	85.563[a]	0.310	0.615
Ferizli District	29.979[a]	0.322	0.813

In the Hosmer-Lemeshow test, it is desired that the significance value is greater than .05. The result was high in both cases *(Table11)*.

Test results from Ferizli district showed that the 1st, 2nd, 3rd, 5th, and 6th factor groups were significant. The first factor group, "Vegetative characteristics in variety selection" was calculated to be 16.2 times more important than scores obtained from other districts. Similarly, the sixth factor group, "Expectations of consumption in variety selection," was calculated to be 5.14 times and the third factor group, "Environmental Factors in Variety Preference" was calculated to be 18.8 times more important. The fifth factor group, "Usage Expectations in Variety Preference" was determined to be 32.25 times (1/0.031) less important and the second factor group, "Purchase behavior in variety preference" was 8.54 times (1/0.117) less important *(Table 13)*.

Table 11. Hosmer and Lemeshow test

	Chi-square	Df	Sig.
Söğütlü District	5.216	8	0.734
Ferizli District	0.116	8	0.998

Table 12. Model results for Söğütlü district

Söğütlü District	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I.for EXP (B)	
							Lower	Upper
Factor 1 (Vegetative characteristics in variety selection)	0.091	0.321	0.081	1	0.776	1.096	0.584	2.057
Factor 2 (Purchasing Behaviors in Variety Preference)	-0.332	0.321	1.065	1	0.302	0.718	0.382	1.347
Factor 3 (Environmental Factors in Variety Preference)	-0.975	0.349	7.794	1	0.005***	0.377	0.190	0.748
Factor 4 (Recommendations for Variety Preference)	-0.718	0.308	5.431	1	0.020**	0.488	0.267	0.892
Factor 5 (Usage Expectations in Variety Preference)	0.748	0.313	5.696	1	0.017**	2.112	1.143	3.902
Factor 6 (Expectations of consumption in variety selection)	2.353	0.457	26.456	1	0.000***	10.513	4.289	25.768
Factor 7 (Hereditary Features in Variety Preference)	0.257	0.329	0.611	1	0.435	1.293	0.678	2.466
Cinsiyet/Gender	-22.238	40192.933	0.000	1	1.000	0.000	0.000	.
Sabit/Constant	18.198	40192.933	0.000	1	1.000	79999103.267		

%95, *%99 significance level

Table 13. Model results for Ferizli district

Ferizli District	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I.for EXP (B)	
							Lower	Upper
Factor 1 (Vegetative characteristics in variety selection)	2.788	1.241	5.043	1	0.025**	16.240	1.426	185.015
Factor 2 (Purchasing Behaviors in Variety Preference)	-2.147	1.112	3.728	1	0.053*	0.117	0.013	1.033
Factor 3 (Environmental Factors in Variety Preference)	2.934	1.530	3.676	1	0.055*	18.797	0.937	377.125
Factor 4 (Recommendations for Variety Preference)	-1.112	1.055	1.111	1	0.292	0.329	0.042	2.602
Factor 5 (Usage Expectations in Variety Preference)	-3.469	1.100	9.941	1	0.002***	0.031	0.004	0.269
Factor 6 (Expectations of consumption in variety selection)	1.637	0.747	4.806	1	0.028**	5.140	1.189	22.210
Factor 7 (Hereditary Features in Variety Preference)	0.660	0.630	1.097	1	0.295	1.935	0.563	6.652
Gender	15.267	40192.962	0.000	1	1.000	4268926.264	0.000	.
Constant	-25.239	40192.962	0.000	1	0.999	0.000		

*%90, **%95, ***%99 significance level

According to the factor analysis results of the importance levels of environmental and vegetative characteristics on the variety choice of producers, it can be said that this variability between these factor groups is caused by the socio-economic structure differences which are widely felt in the region. With a similar study (Gedikli et al., 2015), factor analysis was used to determine the producers' problems related to corn and regression analysis was used to identify the factors effective on the amount of drug use and 27 factors expressing the problems encountered by

farmers in corn production were reduced to 7 main factors with factor analysis. The factor scores obtained by factor analysis were interpreted by regression analysis taking into account demographic and social variables.

In his (Kutlu, 2017) study, factor analysis and multiple linear regression analysis were used to identify the factors affecting the sustainability of local seeds. The researcher stated that 49 local varieties were identified in the research field, logistic regression analysis was used to analyze the factors affecting the sustainability of production with local seeds from the producers' point of view and the factors affecting the sustainability of local seeds were found to be awareness, marketing and pricing, gene resource and organic farming at the level of 1%, and from the consumers' point of view, consumer awareness, price, promotion and information were found to be important at the level of 1%. In their (İkikat Tümer et al., 2018) research, probit regression analysis was used to analyze the factors affecting producer satisfaction and it was found that the age of the producer, experience and producer income had a positive effect on satisfaction and that the number of family members, broiler breed, distance to the supplier company and mortality rate had a negative effect on producer satisfaction.

4. Conclusions

Producers' preferences for corn seed varieties and the extent to which these preferences are affected by various factors are highly important in terms of breeders' variety development stages and firms' marketing and post-sales strategies. It is known that the seed companies in Turkey have a very high proportion of domestic capital, which is about 90%. The markets in which these predominantly local companies operate are generally regional markets. The sector, which is mostly early life stage, also has a large number of employees with inexperience, with it being reported that about 60% of them have worked at the same firm for below 5 years. Therefore, it is inevitable to support the seed sector, which can be termed local and national, in order to be able to compete with international companies. These seed producers and seed marketers should identify other marketing channels other than their own institutions and use these channels effectively. In addition, it is of great importance that the existing public agricultural R&D resources are put into the service of the domestic and national seed sector in the form of cooperation in accordance with the legislation. Although it seems like a radical decision, it has been determined that the producers are constantly in search of new and better seeds. This situation is a great advantage for companies and creates a suitable environment for new varieties to enter the market and spread. There are some plant-based negativities related to corn varieties that negatively affect the purchase. Corn breeders and indirectly marketers should find solutions to these problems.

The average age of producers in the research area was found to be 55.5 and approximately 85% of them were found to be within the age range of 41-70. Consequently, it can be understood that the young population is distancing itself from agriculture and continuing to do so. Even though the majority of the producers are perceived to be young according to the World Health Organization age criteria, they are quite old in terms of agricultural employment. It should be facilitated for them to closely follow and access technological developments and solution programs should be implemented to ensure that the educated young human resources needed by the sector remain in this sector, policies should be implemented that make the agricultural sector attractive to this educated young human resource.

A statistically significant difference has been observed between the annual gross incomes of high school graduates and literate producers. The annual gross incomes of high school graduates are statistically significantly higher than those of literate producers. Despite the high level of education of the population in the research area, there are no university graduates among the surveyed Corn producers, the main reason for this being the economic and social reasons for the young educated population to move away from farming and the countryside and to prefer to work in a salaried job in the cities. At this point, the National Young Farmer Project implemented and concluded by the state and the subsequent Expert Hands project implemented are of great importance in keeping the educated young population in agriculture or returning them to agriculture and the countryside.

When considering the factors influencing farmers' preferences for maize seed, it appears that practices such as distributing promotions that are easy to implement and frequently used by companies, organizing fairs and trips, using attractive packaging, etc. do not have the same importance as guaranteeing the seed sold by the company, taking care of farmers after the sale, setting up demonstrations in the target area and making field checks after sowing, etc.. Therefore, it may be beneficial for companies to take this into account when determining their

marketing and post-sales strategies and tactics and combining as many of these practices as possible may lead to more satisfactory results.

In the choice of variety among producers, some plant characteristics such as plant height, stem thickness, weight, cob size and number, as well as advice from acquaintances, village headman, leading farmers, dealers and expectations in terms of consumption such as harvesting. As grain to sell, as silage to use as animal feed or to sell and vegetative characteristics suitable for either consumption or selling purposes, as well as some plant hereditary characteristics are found to cause differences in purchase behavior even if production is done in the same province. And these subjects have a determining effect in decision making concerning seed selection. For example, in Ferizli district, "plant characteristics" such as tolerance to high temperatures which may cause the lower leaves to burn, and tolerance to drought, as well as the price difference due to lower harvest moisture resulting from grain sowing, are 16.2 times more important than for other district producers. And "vegetative characteristics" such as lodging resistance, prevention of lower leaves from burning and drying early for silage varieties and early variety are 5.14 times more important. The reason for this is that in Ferizli district, producers not only produce maize but also have a significant large-scale livestock production and in addition to maize production, they have to produce silage and yield maize.

In addition to the producers in Söğütlü district being suitable for frequent planting, the "Consumption Expectations" with factors such as silage that the animals like to eat is 2.11 times, similarly with lodging resistance, silage varieties of lower leaves not burning early and early variety have 10.5 times more importance compared to other district producers which is due to their production of professional large-scale livestock.

This is because lodging, lower leaves burning, high temperature and drought can cause negative outcomes such as crumbling in the corn stem before the harvest date and the animals not being fond of consuming the silage or the harvest, or even not consuming it at all. Therefore, it is important for the private or public employed breeders and seed marketing companies conducting breeding work to consider these matters. As a result of the study, it is seen that many matters are important for the corn producers of the same province in different regions. Consequently, these matters can provide guidance to breeders and seed marketing companies in the breeding and marketing efforts they will carry out in the future.

In light of the ever-changing global and regional economic and associated sociological conditions, national and regional research on factors that influence producers' preferences should be conducted at certain intervals in order to assist breeders and marketing firms in setting their short and long-term goals.

Ethical Statement

Since it is an article produced from a master's degree study that used research data before 2020, there is no need to obtain permission from the ethics committee for this study.

Conflicts of Interest

We declare that there is no conflict of interest between us as the article authors.

Authorship Contribution Statement

Authors contribution rates to the study are equal.

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