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Factors affecting decisions of farmers to produce geographical indication dry beans: a case from Turkey

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Geographical indications (GIs) are defined as labels that show the relationship of a product with a certain region. They are of great importance in terms of distinguishing these products from the similar ones in terms of the quality that the characteristic features of the region bring to the product, making them stand out commercially, contributing to the rural development and preserving the cultural heritage. Dry beans cultivated by the farmers in the Gümüşhane province is newly recognized as a GI product that is unique in both taste and quality. This study is intended to identify the factors affecting the farmers' decision to produce GI-labelled dry beans. The survey was conducted in January–March 2021. A sampling size of the participants consisted of 50 farmers who cultivated GI-labelled dry beans and 50 non-GI dry beans. A binary logistic regression analysis approach was employed to identify the factors affecting the likelihood of the farmers cultivating the GI dry beans. The results of the model indicate that the young farmers with the low educational level, the low property land size, the low yield per decare, and the large farmland, the high annual agricultural income and specializing in the dry beans production are more likely to engage in the production of GI dry beans. For the farms involving the GI product, agricultural associations can be advised with the farmers with the wider agricultural acreage and the high annual agricultural income, and that specialize in the production of such products. The participation of the farmers in the agriculture enterprises involving the GI dry beans will depend on them seeing positive widespread effects, which requires a long-term commitment.

KEYWORDS

dry beans, GI labels, rural development, local production, Turkey

1 Introduction

Practices such as organic agriculture, good agricultural practices, cultivation of geographical indication (GI) products and agro-ecological agriculture have become essential for the sustainability of small farms and healthy food production (Giovannucci et al., 2010; Kuşat, 2012; Mancini, 2013; Latruffe et al., 2016; Narin and İnanöz, 2016; McDermott and Wyatt, 2017; Tello and González de Molina, 2017; Migliorini et al., 2018; Fernandez-Ferrin et al., 2019; Uebersax et al., 2022; Boga and Paül, 2023; Cholo et al., 2023). The GI is a sign used on products with a distinctive quality, reputation or other distinguishing characteristic that corresponds to a specific region (Turkish Patent and Trademark Office (TPO), 2022). The main features of geographical indication products are their characteristic features that link them to the region in which they are produced. The presence of a GI label on a product suggests, albeit partially, that in the changing global market conditions, the product is produced according to specific standards, thereby increasing the competitiveness, recognition and originality of the product and the revenues of the producer. Such local products are thus protected and secured within the geographical indication system.

The geographical indications are location-based signs (e.g., Champagne, Roquefort, etc.) that convey the geographical origin, as well as the cultural and historical identity, of agricultural products (Bowen and Zapata, 2009), and are issued by specific institutions around the globe. The earliest and most advanced the GI protection systems were established in Europe (France, Italy, Spain), however, developing countries have recently started to pay more attention to the GI labels as a tool for the promotion of the rural development and the protection of the local products and the traditions. Outside the Europe, a GI labeling system was used for the first time in Mexico in 1974 (Bowen and Zapata, 2009), while Brazil and Peru, more recently in 1996, passed a law on GI labeling systems, followed by South Korea and India in 1999, Colombia in 2000 and Chile in 2005. As noted by John et al. (2020), geographical indications are based on the French concept of "terroir," which refers to an essential link between the geographical and human environment in which a product is produced. The GI was officially defined as an intellectual property right by the World Trade Organization in 1994. While the GI registrations are widely used in the European Union countries to protect the industrial rights of wine and alcoholic beverage producers, they have more frequently been used in recent years to protect the characteristic features of the other food products, such as ham and cheese.

Especially in an environment of global competition, investing in knowledge is as crucial as investing in physical capital, which constitutes the underpins the economy. In this regard, the GIs that give information about local products are playing an increasingly important role in both national and international economies. Although the GIs are important in any economy, they can be considered particularly important in developing countries, especially those with a heavy reliance on agriculture. Increasing the production shares of local food products and supporting them with the GI labels in the regions of Turkey that are unsuitable for industry but are open to agricultural development can bring substantial benefits to the local economy. The production of local products by small farms without relying on intensive technological applications and the protection of agricultural lands are not only necessary for sustainable agriculture, but also highly effective in convincing consumers to consume healthier and more natural products (Kupke and Page, 2015).

The earliest application of a geographical indication system in Turkey was initiated with Decree Law No. 555 in 1995, when the authority to register products was delegated to the Turkish Patent Institute, which has registered 352 products in the geographical indication class to date as of 2022, only eight products in Turkey had been registered as GI products by the European Union (Turkish Patent and Trademark Office (TPO), 2022).

Dry bean is a traditional crop in Turkey, but is imported due to such reasons as the lack of improved varieties, the decrease in production areas over the years, and the inadequacy of efforts to increase production, but is located in a privileged geography in terms of local seed resources. The cultivation of certain agricultural products for thousands of years although they lack a local gene origin, has attributed them a distinctive position in the cuisine, agricultural economy, employment and rural development of Turkey.

Many practices have been put in place to protect heirloom seed heritage in Turkey. The fact that producers use seeds with different genotypes instead of the local heirloom seeds is increasing the risk of loss of seed heritage. One of the primary reasons for the decline in the use of local seeds is that the yield of the new improved seeds is higher. While it is more practical for the small-scale farmers to use the local seeds (seeds left over from the previous year) in the next production period, it is becoming more commonplace for the large-scale farmers to use new improved seeds. Other factors contributing to the loss of local seed resources include market price fluctuations, agricultural policies and the lack of an organizational culture. In Turkey, there are beans varieties that are produced from the local seeds that can be distinguished from the other dry beans by their geographical indication, which indicates the characteristics of the region in which they are produced. Examples of these include Ispir beans, Çameli beans and Akkuş sugar beans. One of the registered dry beans products is Kelkit sugar (dry) beans, for which the Kelkit Dry (Sugar) Beans Producers Association applied the geographical indication application with the Turkish Patent Institute (TPI) in 2018. The process of the registration was subsequently initiated by the TPI and the Kelkit dry beans was registered as a product protected under Industrial Property Law in January 2020. Prior to the application, the extensive studies were carried out into the characterization of the dry beans genotypes, and sample plantings were done in the districts in which it was produced. Kelkit sugar beans was registered highlighting its distinctive features over other sugar beans, with the description of the population product cultivated in the Kelkit, Şiran and Köse districts of Gümüşhane province, the seeds of which are white with pink spots. In recent years, the farmers in the region have been cultivating sugar beans using the seeds procured from the neighboring provinces, which have a higher yield, rather than the local Kelkit sugar beans seeds known locally as "pink eye," however, sugar beans grown from the seeds procured from the neighboring provinces have different characteristics to those grown from the local seeds, which are elliptical and pinkish in color (Anonymous, 2020). There have been numerous studies of foreign origin analyzing the importance of geographical indications for the rural development and their effect on increasing farmer income (Jena et al., 2012, 2017; Mesic et al., 2017; Ardana, 2019; Sitorus et al., 2020; Poetschki et al., 2021; Wang et al., 2021; Crescenzi et al., 2022). Although there have been domestic studies into the contribution of the GI products to the rural economy investigating their impact on sustainability (Özsoy, 2015; Arslan-Pauli, 2016; Pektaş et al., 2018; Arıkan and Taşçioğlu, 2019; Doğanlı, 2020; Everest et al., 2022) and analyzing the economic impact of the dry beans production (Direk et al., 2002; Çiftçi et al., 2012; Önder et al., 2012; Berk and Güngör, 2016; Efeoğlu et al., 2016; Kan et al., 2019; Küzeci et al., 2019; Ayçiçek and Karakaya, 2022), there have been no field studies to date analyzing the effects of the GI agricultural products on the farmers. In this regard, it is believed this study will fill a significant gap in the literature.

The present study analyzes the factors affecting the decisions of the farmers related to the production of the GI dry beans. The first part of the study presents an analysis of the descriptive statistics of the farmers while the second part presents the results of a logistic regression model that has been developed to identify the factors affecting farmers' decisions to produce the GI dry beans.

2 Materials and methods

2.1 Data collection

Primary and secondary data was used in this research. The primary data were obtained from face-to-face interviews in Gümüşhane, Turkey. The survey was conducted in the Kelkit, Şiran and Köse districts of the Gümüşhane province. Due to the small number of the farmers producing GI dry beans, the full count method was employed in the study. The sample size was the number of non-GI farmers (50) as well as the number of the farmers producing the GI Kelkit Sugar Beans (50) and these farmers (GI-farmers) were also members of the Kelkit Sugar Beans Producers Association. The face-to-face interviews with a total of 100 farmers were held in January, February and March 2021. The survey used in this research consists of 3 parts. The first part is about the socio-economic and structural characteristics of the GI and the non GI farmers. The second part covers questions about the farmers' dry beans production status and marketing channels. The third section includes the questions measuring the perceptions of all the farmers included in the research regarding the production and the marketing decisions. Semi-structured questions were used in the survey. Secondary data for the study were obtained from databases and institutional reports. Google Scholar and Web of Science (WoS) were used as the databases. In addition, online and printed reports prepared by institutions (Turkish Patent Institute, Gümüşhane Provincial Directorate of Agriculture) were also used.

2.2 Analysis of the factors affecting farmers' decisions to produce GI dry beans

A binary logistic regression analysis approach was employed to identify the factors affecting the likelihood of the farmers. Logistic regression approaches determine the cause and effect relationship with explanatory variables in cases where the response variable is observed in binary, ternary and multiple categories. It is a regression method in which the expected values of the dependent variable are obtained in the form of probabilities, depending on the explanatory variables. The logistic function has a range of 0–1, which is the main factor making it the function of choice (Karagöz, 2016). The logistic regression model is expressed by the following Equation 1 (Gujarati, 2001):

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2 X_i + u_i \tag{1}$$

In the above logit function Equation 1, the *p* value indicates the probability of the farmer using GI dry beans. In other words, it estimates the probability of the farmers producing the GI dry beans. $P_i = 1$ refers to the GI-farmers, while $P_i = 0$ refers to tge non-GI farmers. In the model, β_1 is the constant term. β_2 represents the slope and measures the change in L for a unit change in X.

The variables included in the binary logistic regression model are presented in Table 1. The dependent variable in the model indicates the probability of the farmers producing the GI dry beans. The explanatory variables in the model are education level, age, farmland size, number of family members engaged in agriculture, land ownership (property land), share of dry beans in the total cultivated land, yield per decare, annual agricultural income, gross profit per decare, receiving consultancy services from a specialist institution or person, and level of specialization in dry beans production.

TABLE 1 Variable description.

Variables	Description	Category
Dependent variable		
GIprodc.	1 = if farmers produce GI-registered dry beans, 0 = otherwise	dummy
Explanatory variables		
edu	1 = if farmers have a high school degree or higher; 0 = otherwise	dummy
age	Age of farmers	continuous
fexp	Farmer experience	continuous
nfm	Number of family members	continuous
fsize	Farm size (decares)	continuous
lownsize	Land ownership size (decares)	continuous
beanshare	Share for beans in cultivated land (%)	continuous
yield	Yield per decare	continuous
gfincome	1 = if annual gross income more than 75,000TRY; 0 = otherwise	dummy
gmargd	Gross margin of beans production per decare (TRY)	continuous
advise	1 = if the farmers receive special agricultural consultancy services, 0 = otherwise	dummy
spec	1 = if the farms that provide at least two-thirds (67%) of the total agricultural production value from beans production branch, 0 = otherwise	dummy

The factors affecting farmers' decisions to produce the GI dry beans, for which a binary logistic regression analysis method was used. A series of tests were conducted to measure the goodness of fit of the logistic regression model that was developed to identify the factors affecting the interviewed farmers' decisions to produce GI dry beans. The result of the Omnibus Test concerning the model coefficients indicates that whether the independent variables in the model contribute to the prediction of the dependent variable. It is a likelihood-ratio chi-square test of the current model versus the null (in this case, intercept) model. The significance value of less than 0.05 indicates that the current model outperforms the null model (IBM, SPSS Software, 2021). The goodness of fit of the model was measured using the Hosmer-Lemeshow Test. Hosmer and Lemeshow goodness of fit test is used to indicate a good fitting model when its value is greater than 0.05 since it fails to reject the null hypothesis, implying that the model's estimates fit the data at an acceptable level (Sinthupundaja et al., 2017). The explanatory power of the independent variables to explain the dependent variable in the model was measured with the Cox & Snell R^2 value and the Nagelkerke R^2 value. Cox and Snell's R^2 is based on the log likelihood for the model compared to the log likelihood for a baseline model. However, with categorical outcomes, it has a theoretical maximum value of less than 1, even for a "perfect" model. Nagelkerke's R^2 is an adjusted version of the Cox & Snell R-square that adjusts the scale of the statistic to cover the full range from 0 to 1 (IBM, SPSS Software, 2023).

In line with the goal of the research, the following hypotheses are put forward regarding the factors that may play a role in the production of dry beans by farmers in the study area:

> *H1*: There is a significant relationship between the level of education and the probability of the farmers producing the GI dry beans.
>
> *H2*: Young farmers are more likely to produce the GI dry beans.
>
> *H3*: There is a positive and significant relationship between the farmland size and the probability of the farmers producing the GI dry beans.
>
> *H4*: The probability of producing the GI dry beans is higher in the farms with a large number of family members engaged in agriculture
>
> *H5*: There is a significant relationship between the size of the property land and the probability of the producing the GI dry beans.
>
> *H6*: The probability of producing the GI dry beans is higher in farms with a large share of the dry beans in the total cultivated land.
>
> *H7*: The probability of producing the GI dry beans is higher in the farms achieving a high yield per decare.
>
> *H8*: There is a positive and significant relationship between the annual agricultural income and the probability of the farmers producing the GI dry beans.
>
> *H9*: The probability of producing the GI dry beans is higher in the farms earning a high gross profit per decare.
>
> *H10*: The farmers who receive the consultancy services from a specialist institution or a person are more likely to produce the GI dry beans.
>
> *H11*: The probability of producing the GI dry beans is higher in farms with a high level of specialization in the dry beans production.

3 Results and discussion

3.1 Descriptive statistics

This part presents an analysis of the descriptive statistics related to the potential factors affecting the decisions of the interviewed farmers to produce GI dry beans. Table 2 shows the descriptive statistics of the variables used in the logistic regression model.

Among the interviewed farmers, 49% produce GI dry beans. 56% of the farmers have a high school diploma or a higher education level. The age range of the farmers is 22–65 years, with an average age of 47.37 years. The agricultural experience of the farmers varies between 5 and 50 years, with an average of 23.54 years. The number of family members engaged in agriculture in the interviewed farms varies between 1 and 6, with an average of 2.17. The farmland size of the farms varies considerably, varying between 2 and 1,021 decares (0.2–102.10 hectares), with an average of 100.01 decares (10 hectares). The average size of the property land is 17.13 decares (1.71 hectares). The share of dry beans in the total cultivated land varies between 1.40 and 100%, with an average of 30.96%. The average dry beans yield per decare is 162.24 kg, varying between 33.33 and 400 kg in different enterprises. The annual agricultural income of the interviewed farmers is generally low. Only 22% of the farmers generate an annual income equal to or above 75,000 TRY. The gross profit per decare in dry beans production is 2,262.58 TRY. Among the interviewed farms, some make a loss of 1,281.75 TRY per decare, while others make a profit of 10,236.25 TRY per decare. Among the interviewed farmers, the percentage of those who had received consultancy services from a specialist institution or person is 42%. The percentage of the farms that earn at least two-thirds (67%) of their total agricultural output value (plant+animal) from the dry beans production is 36%. This suggests that a significant portion of the farms are unable to specialize in the dry beans production.

3.2 Factors affecting farmers' decisions to produce GI-labelled dry beans

This section presents an analysis of the factors affecting the farmers' decisions to produce the GI dry beans, for which a binary

TABLE 2 Descriptive statistics of variables.

Variables	Mean	Minimum	Maximum	Std. Dev.
Dependent variable				
GIprodc.	0.49	0.00	1.00	0.503
Explanatory variables				
edu*	0.56	0.00	1.00	0.499
age	47.37	22.00	65.00	10.223
fexp	23.54	5.00	50.00	11.881
nfm	2.17	1.00	6.00	1.134
fsize	100.01	2.00	1021.00	122.551
lownsize	17.13	0.00	140.00	29.028
beanshare	30.96	1.40	100.00	28.709
yield	162.24	33.33	400.00	67.049
gfincome**	0.22	0.00	1.00	0.418
gmargd	2262.58	−1281.75	10236.25	1918.571
advise***	0.42	0.00	1.00	0.497
spec****	0.36	0.00	1.00	0.483

* The farmers with less than a high school degree is coded as 0, establishing it as the reference category for edu. ** The farmers with gross farm income equal to or less than 75 thousand TL are coded as 0, establishing it as the reference category for gfincome. *** The farmers who do not receive special agricultural consultancy services are coded as 0, establishing it as the reference category for advise. **** The farms that do not provide at least two-thirds (67%) of the total agricultural production value from sugar beans production branch are coded as 0, establishing it as the reference category for spec.

logistic regression analysis method was used. The result of the Omnibus Test concerning the model coefficients indicated that the independent variables in the model contributed to the prediction of the dependent variable. The Chi-square value of the model was statistically significant ($p < 0.05$) (Table 3).

The goodness of fit of the model was measured using the Hosmer-Lemeshow Test, and the Sign = 0.519 > 0.05 result suggested that the condition of goodness of fit was met (Table 4) and also this model was analyzed further using the classification table, which showed that 71.4% of the interviewed farmers who produced GI dry beans and 70% of those who did not were estimated accurately. Overall, the accurate estimation rate was approximately 71% (Table 5).

The explanatory power of the independent variables to explain the dependent variable in the model was 0.286 (28.6%) according to the Cox & Snell R^2 value, and 0.382 (38.2%) according to the Nagelkerke R^2 value (Table 6). Since pseudo R^2 values tend to take much smaller values than R^2 in multiple regression, a value of 0.20–0.40 can be considered very high (Karagöz, 2016). Based on the calculated values, it can be said that the relationship between the dependent and independent variables was strong.

The parameter estimations of the binary logistic regression analysis model that was developed to identify the factors affecting the interviewed farmers' decision to produce the GI dry beans are presented in Table 7. The model results indicated that the education level, the age, the farmland size, the property land, the yield per decare, the agricultural income and the specialization in the dry beans production had a statistically significant relationship with the probability of the farmers producing the GI dry beans. The hypothesis test results according to the logistic regression model were given in Table 8.

The results suggest that there is a significant relationship exists between the level of education and the probability of farmers producing the GI dry beans. In the logistic model, the farmer group with the education level below high school was treated as the reference category. An evaluation based on the exponentiated logistic regression coefficient (Exp (β) or odds ratio) suggested that the farmers with a high school diploma or a higher level of education were 0.101 times less likely to produce the GI dry beans than the other farmers (non-GI farmers). In other words, the farmers with the high school diploma/the higher level of education were 9.9 times $(1 \div \exp(\beta) = 1 \div 0.101 = 9.901)$ more likely to produce the GI dry beans than the non-GI farmers. This result suggests that the farmers with the high level of education are less likely to produce the GI beans than those with the low level of the education. This can be considered at first glance to go against the assumption, although the production of the GI dry beans in the study area does not have a long history, dating only to 2020, meaning that it has not had the chance to become widespread. The farmers with the higher levels of education may be following a wait-and-see approach, giving themselves time to evaluate the outcomes of the production of the GI dry beans as it becomes widespread in the region. This can be suggested as a reason why the farmers with the higher levels of education are cautious about participating in projects related to the GI dry beans production. In the regression analysis conducted by Jena et al. (2012) in their study measuring the effect of GI rice production on farmers, the level of education was not found to be a statistically significant contributor to the probability of farmers growing GI rice.

The results of the model suggest that a significant relationship exists between the farmer's age and likelihood of the GI dry beans production. Accordingly, each one-year increment in the age of the farmers reduced the probability of producing the GI dry beans by 10.9% $(1 - \exp(\beta) x\, 100 = (1 - 0.891) x 100 = 10.9)$. Considering this result, it can be said that the older farmers are less likely to produce the GI beans than the younger ones. The older farmers, who usually display a more contented attitude than their younger counterparts, tend to resist change. In addition, the older farmers may be more cautious about implementing such new approaches as the geographical indication in their businesses. It can also be said that the older farmers are more committed to traditional production methods than younger ones. In their study, Jena et al. (2012) reported that as the age of the farmer increased, the probability of producing GI rice decreased (−0.0439).

According to the model results, a positive and significant relationship exists between the farmland size and the probability of farmers producing the GI dry beans. That said, the larger farmland size does not imply a significantly higher probability of producing the GI dry beans. Indeed, each increment of 1 decare in the farmland size increases the probability of producing GI dry beans by 0.4% $(\exp(\beta) - 1) x\, 100 = (1.004 - 1) x 100 = 0.4)$. This suggests that the larger size of the farmland do not necessarily equate to a significantly higher probability of the producing the GI dry beans. The farmers with the larger size of the farmland are willing to engage in the production of the GI crops on their lands, but as the production of the GI crops is not widespread in the study area, the farmers are reluctant to take on too much risk. As a result, the farmers with the large-scale farms tend to produce the GI dry beans on only a small proportion of

TABLE 3 The results of the omnibus tests for model coefficients.

		Chi-square	df	Sig. (p)
Step 1	Step	33.411	12	0.001
	Block	33.411	12	0.001
	Model	33.411	12	0.001

* denotes significance at the 5% level.

TABLE 4 The results of the Hosmer–Lemeshow test for model.

Step	Chi-square	df	Sig. (p)
1	7.165	8	0.519

TABLE 5 The classification table results of model.

	Observed	Predicted		Percentage of correct classification
		Non-GI producers	GI producers	
Step 1	Non-GI producers	35	15	70.0
	GI producers	14	35	71.4
Overall percentage of correctly classified cases				70.7

TABLE 6 The model summary.

Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	103.822[a]	0.286	0.382

[a]Estimation terminated at iteration number 5 because parameter estimates changed by less than 0.001.

TABLE 7 The logistic regression model predictions for GI farmers' decisions.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
edu (1)	−2.294	0.721	10.119	1	*0.001	0.101
age	−0.116	0.047	6.176	1	**0.013	0.891
fexp	0.054	0.035	2.312	1	0.128	1.055
nfm	0.111	0.232	0.231	1	0.631	1.118
fsize	0.004	0.002	2.899	1	***0.089	1.004
lownersize	−0.022	0.010	4.720	1	**0.030	0.978
beanshare	0.019	0.012	2.300	1	0.129	1.019
yield	−0.018	0.008	5.195	1	**0.023	0.982
gfincome(1)	1.560	0.743	4.409	1	**0.036	4.757
gmargd	0.000	0.000	0.149	1	0.699	1.000
advise(1)	0.662	0.510	1.683	1	0.195	1.938
spec(1)	1.519	0.812	3.498	1	***0.061	4.570
Constant	6.039	2.185	7.642	1	**0.006	419.670

*, **, and *** denote significance at the 1, 5, and 10% levels, respectively.

their land. A study conducted by Arıkan and Taşçioğlu (2019) found that farmers growing GI oranges tended to have larger farms than other orange producers. While the average agricultural land size of farmers growing GI oranges was 47.14 da, the average land size of the growing non-GI oranges was 41.20 da.

The results of the logistic regression model indicate that a significant relationship exists between the property land and the probability of producing the GI dry beans. Accordingly, each 1 decare increment increase in the size of land owned by the farmers reduces the probability of producing the GI dry beans by 2.2% $(1-\exp(\beta))x\,100=(1-0.978)x100=2.2)$. This result suggests that the farmers with the large size of the property land less likely to produce the GI beans. The farmers that own the larger size of the farmland are more inclined to maintain the traditional production practices on their land as they own all or most of the land they cultivate. Furthermore, those with the larger size of the property land may be more concerned about the risk of generating low income associated with a sudden switch to the GI dry beans production model that has been newly introduced in the study area. On the other hand, the farmers with the smaller farmland tend to be more willing to implement the new production models on the farmlands they rent in pursuit of greater profit by constantly renting lands and applying different production patterns and methods. In this context, the commitment of the farmers with the smaller farmlands to the traditional production models is out of the question. A study conducted by Ayçiçek and Karakaya (2022) of enterprises producing dry beans using traditional methods in the province of Bingöl found that 95.8% of the enterprises rented their lands, and only 4.2% of enterprises cultivated their own land.

TABLE 8 The results of hypotheses testing.

Hypotheses	Explanation	Result
H1	There is a significant relationship between the level of education and the probability of the farmers producing the GI dry beans.	Accepted
H2	Young farmers are more likely to produce the GI dry beans.	Accepted
H3	There is a positive and significant relationship between the farmland size and the probability of the farmers producing the GI dry beans.	Accepted
H4	The probability of producing the GI dry beans is higher in the farms with a large number of family members engaged in agriculture	*H04* is accepted. The null hypothesis states that there is no statistical relationship between the two variables.
H5	There is a significant relationship between the size of the property land and the probability of the producing the GI dry beans.	Accepted
H6	The probability of producing the GI dry beans is higher in farms with a large share of the dry beans in the total cultivated land.	*H06* is accepted. The null hypothesis states that there is no statistical relationship between the two variables.
H7	The probability of producing the GI dry beans is higher in the farms achieving a high yield per decare.	Declined
H8	There is a positive and significant relationship between the annual agricultural income and the probability of the farmers producing the GI dry beans.	Accepted
H9	The probability of producing the GI dry beans is higher in the farms earning a high gross profit per decare.	*H09* is accepted. The null hypothesis states that there is no statistical relationship between the two variables.
H10	The farmers who receive the consultancy services from a specialist institution or a person are more likely to produce the GI dry beans.	*H10* is accepted. The null hypothesis states that there is no statistical relationship between the two variables.
H11	The probability of producing the GI dry beans is higher in farms with a high level of specialization in the dry beans production.	Accepted

The results of the logistic regression model suggest that a significant relationship exists between the dry beans yield per decare and the probability of producing the GI dry beans. An evaluation based on the exponentiated logistic regression coefficient (Exp (β) or odds ratio) indicates that each 1 kilogram increment increase in dry beans yield per decare reduces the probability of producing GI dry beans by 1.8% $(1-\exp(\beta))x100=(1-0.982)x100=1.8)$. This result suggests that the farmers who achieve a higher yield per decare in the dry beans production are less likely to produce the GI dry beans than those who achieve lower yields. This may be due to the differences in the yield between those who have participated in the GI dry beans (Kelkit dry beans) production program and those who have not. According to the results, the dry beans yield per decare achieved by the farms that participated in the program and those that did not were 142.98 kg and 181.12 kg, respectively. Although the yield difference between the farms was not very high, it is sufficient to affect the production decisions of the farmers. The cultivation of the dry beans with the GI seeds and the preparation of the soil, planting, fertilization and use of pesticides in a controlled manner and in accordance with the program's requirements, can lead to low yields at the outset. On the other hand, the farmers who do not participate in the GI production use the seeds provided from the other regions intensively, as well as main inputs such as fertilizers and pesticides in their production activities. This results in those who do not participate in the GI dry beans production achieving slightly the higher yields. It is anticipated that the yield obtained by the farmers will increase as they adapt to the production conditions in the future. A similar study conducted by Wang et al. (2021) found the yield per hectare of the farmers producing GI rice (3.52 t/ha) to be lower than that of those producing traditional rice (3.96 t/ha).

The model results suggest that a significant relationship exists between the annual agricultural income (or annual gross agricultural income) and the probability of producing the GI dry beans. In the logistic model, the farmer group with an annual gross agricultural income of 75,000 TRY and below represents the reference category. An evaluation based on the exponentiated logistic regression coefficient (Exp (β) or odds ratio) suggests that the farmers with the annual gross agricultural income of 75,000 TRY and above are 4.757 times more likely to produce the GI dry beans than the farmers in the reference group. This result indicates that the farmers with the high annual gross agricultural income are more likely to produce the GI beans than those with the low annual gross agricultural income. The production of the GI dry beans is new to the region, and the farmers with the lower annual gross agricultural incomes tend to be unwilling to take risks in this regard, and act more cautiously. The low-income farmers are worried that their annual gross agricultural income will decrease further if they participate to the GI dry beans production. On the other hand, the farmers with the higher annual gross agricultural income may be better able to tolerate a loss of income in the production of the GI dry beans. This concurs with the findings of Jena et al. (2017) related to certified coffee production, with the gross production income of certified coffee producers (C$ 39,133.98) found to be higher than that of non-certified coffee producers (C$ 36,700.91).

The results of the logistic regression model in the present study show that a significant relationship exists between the level of specialization in the dry beans production and the probability of producing the GI dry beans. The farms that earn at least two-thirds (67%) of their total agricultural output value (plant+animal) from the dry beans production represent the reference category. An evaluation based on the exponentiated logistic regression coefficient (Exp (β) or odds ratio) suggests that the farms that make at least two-thirds (67%) of their total agricultural output value (plant+animal) from the dry beans production are 4.5 times more likely to produce the GI dry beans than those in the reference group. This result suggests that the probability of producing the GI dry beans is higher in the farms that specialize in the dry beans production than for those that do not. The farms that specialize in the production of the dry beans can be expected to display a more determined attitude than those that do not, despite having no previous experience in the production of the GI dry beans. Indeed, specialized farms may benefit from certain advantages, such as the better use of land, better marketing, better management, less equipment and labor utilization, preservation of costly and efficient agricultural machinery, and productive and skillful workforce (Baskar and Nandhini, 2019). It can be understood that increasing the production of the GI products depends on the specialization of the farmers in the production of the crops in question (Mesic et al., 2017). According to the finding in the study by Jena et al. (2017) investigating the effect of certified coffee production on the income of farmers, 98% of the agricultural income of farmers comes from coffee production.

4 Conclusion

The results of this study suggest that a significant relationship exists between the probability of the farmers producing the GI dry beans and the certain demographic and the structural factors. These factors include the education level, the age, the property land, the yield per decare, the farmland size, the agricultural income and the specialization in the dry beans production. The findings indicate that young farmers with the low education level, the low property land, the low yield per decare, the large size of the farmland, the high annual agricultural income and the specializing in dry the beans production are more likely to engage in the production of GI dry beans.

It is further suggested that a positive relationship exists between the agricultural land size, the annual agricultural income, the specialization in agricultural production, and the probability of producing the GI dry beans. In agricultural production initiatives promoting the use of the GI products, cooperation with the farmers who have the large farmland size and the high annual agricultural income, and those specializing in the production of such products, can be considered. The findings of the present study also reveal a significant but negative relationship between the education level, the age, the property land and the yield per decare, and the probability of the producing the GI dry beans. Among these, the relationships identified for the education level, the property land and the yield per decare can, at first glance, be interpreted as going against the initial assumption, although this result can be expected to change as the production of the GI products becomes more widespread in the region. The participation of the farmers in agricultural production involving the GI products depends on them seeing positive widespread effects, which requires taking a long-term view. As mentioned before, Kelkit dry beans were registered as the GI product by the TPI in January 2020. The data of this research belongs to the 2020 and 2021 production period. Therefore, it will be possible to encounter more different results in the long term in the analysis of the factors affecting the GI production of the farmers included in the research than short run term. We cannot disregard this issue in the research, and this can be included as a research limit of this paper. But, further research on this matter can be done, to see the relationship between the effective factors and the GI production especially in the future. Another limitation of this study is the sample size. The fact that the number of the farmers producing the GI dry beans at the time of the survey was very limited, this ignored the need to analyze the factors affecting the GI production in a larger sample.

The identification of the factors that affect the participation of the farmers in agricultural production projects involving the GI products in different regions and for the different products can be considered important in terms of the potential contribution to the formulation of common strategies.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Gumushane University Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

ND: Writing – original draft, Project administration. HA: Formal analysis, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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