Perception of Risk in Farm Activities: A Comparison of Matrix Analysis with Results from Multifactorial Linear Regression

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Abstract: - Risk is ubiquitous, and entrepreneurs face it daily. In this study "risk" refers to the negative impacts on businesses. The research was conducted in the Korçë District, Albania, to gauge farmers' perceptions of risk factors. The study aims to identify these factors, assess their severity, and propose strategies for their management. The objectives include understanding and analyzing risks in production, marketing, financing, law enforcement, and human resources management. Through a combination of matrix analysis and the multi-factorial linear regression method, the study concluded that farmers' perceptions did not align with the regression results. The research findings indicated that farmers need to address several key challenges: hail, frost, low prices, difficulties in accessing the market, understanding and implementing laws, meeting financial obligations, lack of funding resources, low profits, and labor shortages. This research contributes valuable insights into agricultural risk management, benefitting local farmers, scientific researchers, and policymakers at both regional and national levels.

Key-Words: - Farm, Perception, Risk, Matrix, Analysis, Assessment, Aggressiveness, Albania.

Received: June 13, 2024. Revised: December 11, 2024. Accepted: February 6, 2025. Published: March 6, 2025.

1 Introduction

The sustainable development of the Albanian economy is directly linked to agriculture. However, the development of this sector faces numerous risks. Beyond the risks in production, marketing, financing, compliance with legal provisions, and human resource issues, agriculture in Albania is grappling with problems such as land ownership issues, access to markets for agricultural products, low levels of technology use, lack of cooperation among farmers, insufficient investments, fewer subsidies compared to regional countries, [1], [2], [3], small farm sizes, low profitability, agricultural emigration and migration, youth abandonment of agriculture, high informality, and gender inequality, [4], [5].

In agricultural entrepreneurship, the ultimate goal is to achieve expected profits. It is crucial to thoroughly research key risks to develop effective risk management strategies on farms. This study will focus on the classification of risks in agricultural entrepreneurship, with a specific focus on an apple production farm, to identify and address the most significant risk factors.

Risk classification is fundamental in the risk management process in agricultural entrepreneurship. There is no bad categorization and sub-categorization of risks. All classifications are useful. Professionals should use the risk classification system according to entrepreneurial circumstances, [6]. Thus, field researchers agree, categorizing farm risk into five main categories: production risk, market risk, financial risk, legal (institutional) risk, and human resources risk, [7]. In this context, analyzing risk in an apple production farm is crucial for understanding the challenges and

opportunities to enhance the performance and sustainability of this enterprise.

The study focuses on apple production in Korçë, Albania (Figure 1). Albania has the highest apple consumption per capita annually (24.6 kg). Following closely is Serbia with 23.1 kg per capita, while Macedonia has the lowest consumption at 7.3 kg per capita, [8]. In Kosovo, apples are also a traditional and extensively cultivated crop due to favorable climatic conditions. Domestic apple production covers 53% of internal demand, with consumption at 16 kg per capita, [9]. In 2021, the apple cultivation area in Kosovo increased by 3,083 hectares, which is 0.5% higher than in 2020, while production decreased by 1.8%, [10]. In Albania, domestic supply is dominated by domestic production. The percentage of imports relative to supply or domestic consumption has nearly halved, while the percentage of exports compared to total production has significantly increased, [11], [12], [13], [14].

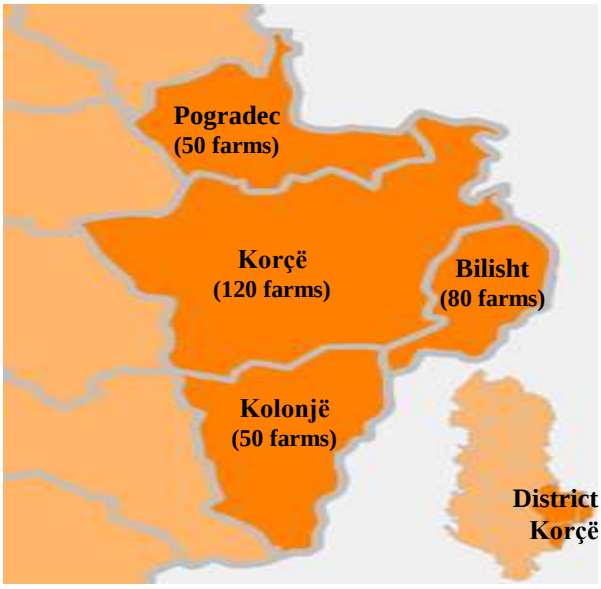

Fig. 1: Korçë District and the farms included in the study

The Korçë district is one of the twelve districts of Albania, situated in the southeastern part of the country. It borders Greece to the south and North Macedonia to the east. This district is known as one of the most important agricultural regions in Albania, recognized for its production of apples, vegetables, and various other agricultural products. The economy of Korçë primarily depends on agriculture, livestock farming, tourism, and handicrafts.

The study is unique in the field of risk in apple production farms. Initially, the research presents the diversity of risks across five key risk sources: production, market, finance, legal, and human resources. It then proposes and tests a multi-factorial regression model for the five risk events for each key risk source. The study aims to familiarize farmers with the five main risks of the farm and recommend management practices. The study objectives include: identifying risks, selecting the most significant risks and analyzing them, as well as providing useful information and advising farmers.

Previous studies have focused on descriptive analyses of farmers' perceptions regarding different risk groups, analysis of variance, and simple regression analysis, [15], [16], [17], [18], [19]. The added value of this study, compared to others, is the analysis of 25 variables (risk events). For each key risk source, 5 variables (risk events) are analyzed using a composite linear regression model.

The study has several limitations. First, it is confined to the Korça region and does not represent the entire country. Second, it relies on primary data collected from farmers' perceptions, which may contain inaccuracies due to oversight by respondents. Third, the research focuses only on the 25 most significant risk factors in apple production, omitting the analysis of many other potential risks. In total, there are 82 risk factors identified in apple production farms (n=82). For further details, please refer to Figure 4.

2 Literature Review

Smallholder farmers in many developing countries face numerous challenges, including access to inputs, agricultural technology, and modern markets, [20], [21], [22]. They are also exposed to risks such as low agricultural productivity, crop damage, and product quality that barely meets market demands. These risks result from insufficient knowledge of best farm management practices, limited access to advanced farm management technologies, high transaction costs to access input markets, frequent pest and disease outbreaks, and weather uncertainties, [23], [24], [25].

Apple cultivation requires significant energy inputs to produce high-quality fruit for commercial purposes. In apple orchards, most agricultural works are performed manually, as farmers in the West Azerbaijan province of Iran do not use machinery for soil maintenance, [26]. However, efforts have been made to mechanize and improve work methods to reduce the risks associated with work-related diseases. Studies on risk prevention in agriculture are generally categorized into six areas: health and safety, labor market and employment, sustainable

agriculture, organization, policies and agricultural reforms, and family farming, [27].

From a study on apple production in China in 2022, compared to smallholder farmers, cooperatives significantly reduce resource use and environmental impacts by 12.50 - 22.16%, and their net profit is 21.23% higher than that of smallholder farmers. Additionally, cooperatives show higher net profits while using lower production factors and having less environmental impact than smallholder farmers. Moreover, labor costs are the most significant contributor to total costs. Due to knowledge limitations, smallholder farmers typically hold the misconception that "more production factors lead to more yield". Consequently, they use a large amount of agricultural chemicals such as chemical fertilizers and pesticides in the apple production process, [28].

Another study was conducted in Antalya province, Turkey, where apple farms have an average size of 2.8 hectares. The average size of the farming family was 3.3 persons. The average age of farmers was 56 years, and the average farming experience was 30.9 years. Results showed that 1.1% of farmers had no formal education, 63.3% had completed primary school, 6.7% had completed secondary school, and 14.4% had completed vocational school, while 14.4% had university degrees. Apple cultivation (60.8%) was the predominant crop in the area, followed by wheat (17.2%) and barley (14.8%). Various issues were identified in apple production in this region, such as lack of certified seedlings, inadequate credit availability, disproportionate increase in exports compared to production growth, inefficiency in local and foreign market organizations, low yields, high input costs, low product prices, and inadequate storage capacities. This study found that the production cost per hectare for apple production was $11,193, the net return values for apple production were $5,370 per hectare, and the Profit/Cost ratio was 1.48, [29].

The size of fruit farms in California, USA, is classified as very small to medium-sized, ranging from 1.0 to 69.9 hectares, with average sales values of $59,319 and a total number of farms amounting to 24,742. Key issues highlighted by the California Fresh Fruit Association (2020) include water reduction, groundwater requirements, immigration policies, compliance with labor laws, invasive pests, and food safety compliance. Major ongoing challenges faced by the fruit industry in California include compliance issues related to groundwater (17.3% decrease in acreage), water supply availability (>2.4% decrease in acreage), immigration policies (22% increase in labor costs), changing labor standards (17% increase in labor costs), food safety compliance (1.32% cost of compliance decreased from revenue), and invasive pest issues (20.0% loss in farm value), [30].

From a study conducted in India in 2016, small farmers (1.0-2.0 hectares) and marginal farmers (less than 1 hectare) are unable to reap the benefits of the globalized market due to a lack of access to credit. Consequently, they find it difficult to meet quality, quantity, and timely delivery standards, manage investment risks, and raise funds, [31]. Small farmers do not always adapt to the constantly changing market, the increasing consumer preference for processed and value-added food products, the diminishing direct marketing impact (due to supermarket chain competition), [32], the preference for centralized procurement, and the rise of supermarket chains, [33]. Another risk faced by small farmers is the preference for larger suppliers, thereby benefiting large farms. It has been observed that large food processors also favor larger suppliers, neglecting the interests of small and marginal farmers, [34]. Another risk is their inability to achieve security and quality standards due to capital constraints, product certification, and shortcomings in understanding consumer preferences. This further reduces the quantities sold by small farmers. Lack of access to transportation, storage, poor market information access, and absence of linkages with organized markets constrain farmers' prospects and business opportunities. Lack of access to credit, technical assistance, and consultancy results in lower quality and quantity of production and increased cultivation costs. Relatively high transaction costs, weak entrepreneurial skills, low exposure to agribusiness, and presence in weak market and business networks lead to poor investment, production, and marketing decisions. Small farmers have a relatively higher need for finances but are in a high-risk position, hence financial agencies show less interest in lending to them, [31].

In Greece and Southern Europe, small farms show a slow adoption of new technologies, subsidies from the European Union, and a lack of technology for fruits and vegetables, [35]. For example, the development of mobile applications for agriculture compared to other business sectors is limited, [36]. Regarding the use of mobile applications in agriculture, 95% of farmers have responded that they do not use any mobile applications for their agricultural activities. The main reason is that they lack information about the

availability of applications and their usefulness in supporting daily agricultural practices.

Apple orchards in Greece are managed traditionally, which can lead to underutilization or overutilization of inputs in certain parts of the orchard, causing economic and environmental problems such as increased production costs and environmental pollution from agrochemicals, [37]. Farmers perceive weather (54%), financial management (30%), calculating optimal quantities of agrochemicals for spraying, fertilization, and seeds (8%), pests and diseases (5%), and agricultural management in practice (cultivation techniques, plant varieties, etc.) (3%) as risks in their business. Regarding how they address these issues, 32% stated consulting with their family and friends, 30% rely on media for information, 20% use the internet (social networks, websites, blogs, etc.), 12% consult with their agronomist, and 6% rely on their knowledge and experience, [38]. Annual apple consumption per capita in Greece is among the lowest in the region at 5.3 kg, compared to Albania at 34.5 kg, Romania at 26.2 kg, Serbia at 15.3 kg, Bosnia at 9.6 kg, Macedonia at 9.6 kg, Montenegro at 9.5 kg, Bulgaria at 5.4 kg, [39].

Research questions of the study:
- What is the risk structure in terms of production, market, financing, legal, and human resources?
- Which risk factors are most aggressive?
- What is the employment structure in apple production farms, solely on-farm employment or combined with other options?
- Are there signed contracts for the sale of production?
- Is the primary destination of production the market?
- Do farmers use tools for risk control?

Hypothesis:
There is a significant relationship between the entrepreneurship of apple production farms and risk factors such as diseases, pests, hailstorms, frosts, failures in agrotechnical operations, low sales prices, market presence challenges, product quality (standards), issues in sales contracts, competitiveness, lack of financing resources, production input costs, low-profit margins, higher family needs, lack of financial data maintenance, tax-related issues, neglect of debt payments, quality standard violations, certification issues, lack of consultation with experts, labor force shortages in the job market, managerial incapacity, technological incompetence, family workforce migration from the farm, and poor interpersonal relationships with neighbors.

3 Materials and Methods

3.1 Selection of the Sample

The design of the study map is based on the administrative division of Korçë County (Figure 1). To enable the selection of a representative sample, we have considered three indicators: (i) the population size in districts, (ii) farm size, and (iii) farm access to markets. The number of interviewed farmers by district is presented in Table 1.

Table 1. Farmers interviewed according to the districts of Korçë district

Korça district	Number of farms	%
Korça	120	40 %
Kolonja	50	16.6 %
Devolli	80	26.8 %
Pogradeci	50	16.6 %
Total	**300**	**100%**

Source: Authors' results, 2024

To ensure sample representation, we have applied the following formulas (1) and (2), [40], [41], [42], [43], [44].

$$n_0 = \frac{Z^2 pq}{e^2} \quad (1)$$

In this formula:
- Z is the confidence coefficient, which, for a confidence level of 95%, takes the value of 1.96.
- p and q represent the proportions of the two groups being studied, where p is 0.5 and q is 0.5, assuming that there is no prior information about their proportions.
- e represents the allowable error (margin of error), which in this case is 0.05.

By substituting these values into the formula, the calculation results in:

$$n_0 = \frac{1.96^2 * 0.5 * 0.5}{0.05^2} = 385\ farmers$$

The number of farms primarily producing apples in the district of Korçë is 1,500. Formula (2) is a formula for adjusting the sample size, which takes into account the total population size (N) and the initially calculated sample size (n_0).

In this case, n_0 is 385, and N is 1,500.

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \quad (2)$$

By substituting these values into the formula, the calculation results in:

$$n = \frac{385}{1 + \frac{(385-1)}{1\,500}} = 300\ farmers$$

Table 2 presents the measurement method of probability and consequence of the risk event. Farmers' perceptions of the 5 main risks and the 25 risk events studied were assessed on a Likert scale ranging from 1 (very low) to 5 (very high).

Table 2. Psychometric assessment according to the Likert scale

	Rating according to the Likert scale with:	
	Words	**Numbers**
The level of risk (probability*consequence) for the event "xi" is perceived:	Very low	**(1)**
	Low	**(2)**
	Average	**(3)**
	High	**(4)**
	Very high	**(5)**

Source: Adapted for study from, [16], [19], [40], [44], [45], [46], [47, [48], [49]

3.2 Definition of Variables for the Five Main Risks and Questionnaire Development

Based on the literature and specific circumstances of apple farms in the Korçë district, we identified nearly all risks for each main risk, [50], [51], [52], [53]. Risk identification techniques in apple production farms included listing, dynamism, empiricism, and brainstorming. After listing all risks for each main risk, a preliminary survey of farmers was conducted to identify the five most significant risks for each main risk. Selection indicators for the initial study of farmers were (i) farm size, (ii) educational level of the farmer, and (iii) farmer experience. The number of respondents was limited to 30 farmers.

The survey is organised into three sections. In the first section, farmers were asked about their age, gender, education, farm income, etc. In the second section, farmers were asked whether they use risk control measures. In the third section, farmers were asked how they perceive suggested risk sources (where probability and consequence were measured to calculate the risk factor for the 25 variables studied, grouped according to five main risks).

3.3 Measuring the Reliability of the Questionnaire

To evaluate the reliability of the questionnaire, we used the widely recognised Cronbach's Alpha coefficient. Cronbach's Alpha is a measure of reliability for a questionnaire or test. Essentially, this coefficient assesses how effectively a set of questions or variables measure the same underlying construct or general concept. A higher Cronbach's Alpha value indicates greater internal consistency among the questions.

The formula for calculating Cronbach's Alpha is:

$$a = \left(\frac{k}{k-1}\right)\left(\frac{S_y^2 - \sum S_i^2}{S_y^2}\right) \quad (3)$$

Where,

- k = 25 indicates that there are 25 variables corresponding to 25 questions.
- $S_y^2 = 94.98$ represents the overall variance of the data, which measures the general distribution of the results across all questions.
- $\sum S_i^2 = 26.48$ signifies the sum of the variances for each question, illustrating the distribution of responses for each specific question.

$$a = \left(\frac{25}{25-1}\right)\left(\frac{94.98 - 26.48}{94.98}\right) = 0.8$$

A Cronbach's Alpha equal to 0.8 indicates that the questionnaire has good reliability and is relatively consistent in measuring risk factors in apple production farms.

3.4 Interviewing and Data Processing Methodology

The questionnaires were administered in the field. The team interviewed 300 farmers. The survey was random and face-to-face with each farmer. After collecting the questionnaire data, they were entered into a database and further analyzed using the professional software Envious. During the data entry process, the accuracy and completeness of the data were verified. The study employed (i) descriptive analysis, (ii) qualitative analysis, and (iii) quantitative analysis (multiple linear regression).

3.5 Descriptive Analysis

Statistical description is the initial step of data analysis. This analysis is based on primary numerical data collected from surveys.

Interpretation and explanation are presented using corresponding tables and graphs.

3.6 Developing a Qualitative Risk Matrix

The process of qualitative risk analysis uses the Risk Matrix, which enables a comprehensible representation of the levels and aggressiveness of the 25 risk factors included in the study, [18], [19], [54], [55]. The qualitative risk matrix provides a clear view of risk levels in business, [55]. There are two types of qualitative risk matrices: one categorizes risks into five or more levels, from very low (or 1) to very high (or 5), and the other compares the aggressiveness of risk to animals like mice, rabbits, sharks, and lions, [56]. Figure 2 presents a combined qualitative matrix. This matrix is a highly effective tool for clarifying the aggressiveness or level of risk events for farmers, [6], [18], [19].

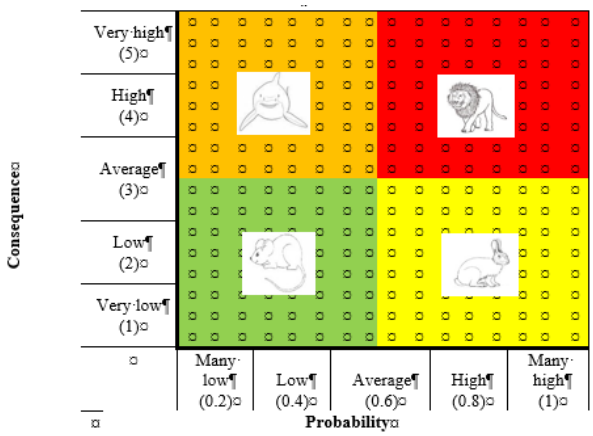

Fig. 2: Qualitative risk matrix
Source: [18], [19]

3.7 Multifactorial Regression Analysis

Multiple factorial regression analysis reveals trends that may not be apparent in descriptive and matrix-based analyses. This model has also been utilized by other researchers [57], [58], [59], [60]. The equation for multiple factorial linear regression is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon \qquad (4)$$

Where:
- ***Y*** is the farm's enterprise,
- ***β*** is the constant coefficient (indicating where the function intercepts the Y-axis),
- ***(β1…βk)*** are the independent coefficients (indicating the slope of the linear function),
- ***(X1 … Xk)*** are the independent variables (the risk events studied),
- ***ε*** is the error margin.

To eliminate statistically insignificant risk factors, the regression equation was tested in three stages.

In the first test, the regression equation identified diseases, agronomic operations, production standards, expert consultation, and interpersonal relationships among farmers as statistically insignificant. During this test, five risk factors were excluded. For more details, refer to Table 4 in the Appendix.

In the second test, the regression equation assessed low-profit margins as insignificant, excluding only this risk factor. For more details, see Table 5 in the Appendix.

In the third test, no risk factors were identified as statistically insignificant. Thus, out of 25 risk factors, 19 were found to be significant. For more details, refer to Table 6 in the Appendix.

4 Problem Solution

4.1 Selection of the Sample

A sample of 300 farms is distributed across four districts of the Korçë region. The percentage distribution in each district is as follows:

Korçë (40%): The Korçë district has the highest specific weight in the study. This indicates that Korçë is the most important in apple cultivation.

Devoll (26.8%): The Devoll district is second in importance in apple cultivation.

Kolonja and Pogradec each (16.6%): The Kolonja and Pogradec districts are third in importance in apple cultivation.

This geographical distribution of data is important for understanding the representation of the study sample. This analysis of data distribution provides a strong foundation for conducting more in-depth analyses in academic research. For more details, refer to Figure 3 and Table 1.

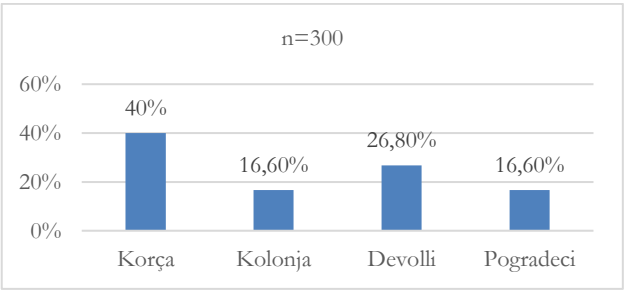

Fig. 3: Distribution of interviewed farms according to counties
Source: Authors' results, 2024

4.2 Risk Map of the Five Main Risks

82 risk events were identified in apple farms in Korça district.

Table 3. Risk structure in apple production farms in Korçë district

The five main risks	Number	%
Production risk	39	48%
Market risk	15	18%
Financial risk	8	10%
Legal risk	10	12%
Human risk	10	12%
Total	**82**	**100%**

Source: Authors' results, 2024

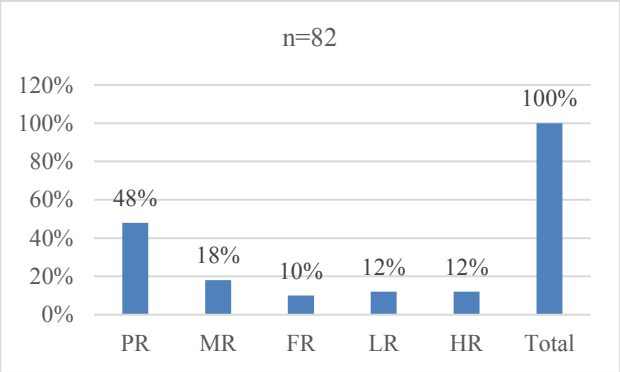

Fig. 4: Risk structure
Source: Authors' results, 2024

As seen from Table 3 and Figure 4, production risk holds the highest weight, followed by market risk. Legal risk and human resources risk have equal percentages, while financial risk has a lower rate than the other four risks.

4.3 Situation and Social Demographic Data

The first section of the questionnaire focuses on the socio-demographic data of apple producers in the Korçë district. Below, we present a comprehensive statistical analysis for each measured or assessed socio-demographic variable.

Primary employment: The data in Figure 5 are crucial for understanding the concentration of the workforce on apple production farms.

In the above graph, it is reflected that the majority of farmers (81%), or 244 farmers, work solely on their farms. This indicates a high level of independence and commitment to apple production, suggesting an economic structure based on small and medium-sized agricultural businesses. Meanwhile, a small portion of workers (11%), or 11 farmers, work in their other businesses not directly related to farms, while a smaller percentage (2%), or 6 farmers, work in the private non-agricultural sector, and another portion (3%), or 8 farmers, in the public non-agricultural sector.

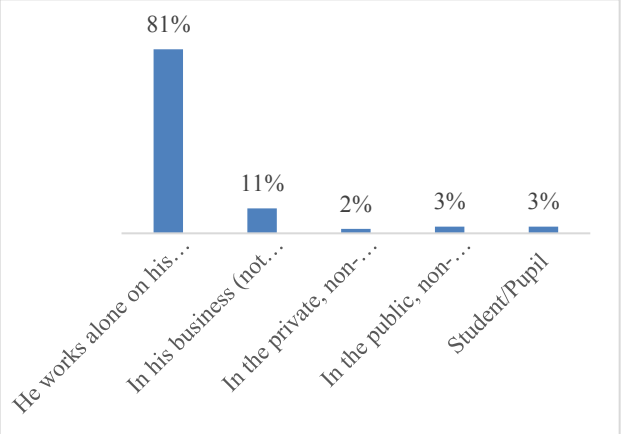

Fig. 5: The main employment of framers
Source: Authors' results, 2024

These data provide a clear picture that apple producers in the Korçë district have a strong concentration of employment in just one sector, primarily on their farms, which may be specialized in apple production. This can influence the dynamics of the local economy and the social structure of the community, making apple production a key factor for the development and prosperity of the Korçë district.

Educational attainment: The data from Figure 6 provide an important overview of the educational level of farmers in this specific sector of the local economy.

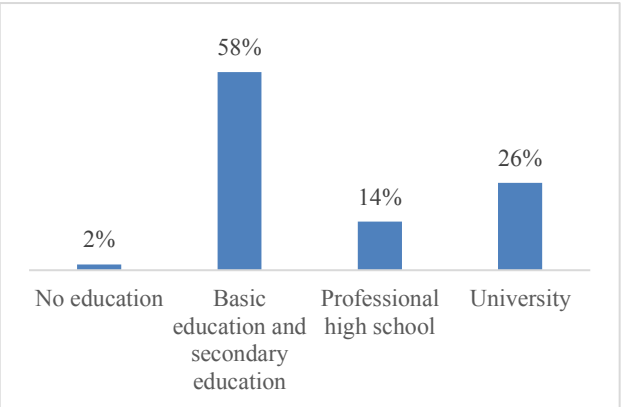

Fig. 6: Level of education of farmers
Source: Authors' results, 2024

From the presented data, in the above graph, we observe:

Basic and secondary education is predominant. The majority of workers (58%), or 175 farmers, have completed basic and secondary education, while only (2%), or 5 farmers, are without education. This indicates the need for further

development of their skills to meet the challenges and demands of a changing market.

In comparison to those with basic education, the number of farmers who have completed vocational high school is (14%), or 43 farmers, while those with university degrees are (26%), or 77 farmers, which is lower. This may pose challenges in terms of specialized skills and the necessary knowledge to adapt to more advanced production technologies and methods.

The data suggest a crucial need for investment in education and training for workers in the apple production sector in the Korçë district. This includes offering specialized training programs and promoting a culture of skills enhancement in workplaces. Local and central authorities can play a key role in promoting the economic development of this sector by ensuring policies and programs that encourage education and skills development for workers, as well as investments in infrastructure and technology that can enhance the efficiency and competitiveness of Apple production in this region.

How many of the productions are marketed? Figure 7 illustrates how farmers market their productions. According to the data, 4% or 11 farmers partially market their productions. A larger percentage, 62% or 182 farmers, fully market their productions. Meanwhile, 34% or 102 farmers report that the marketing of their productions depends on the production level each year.

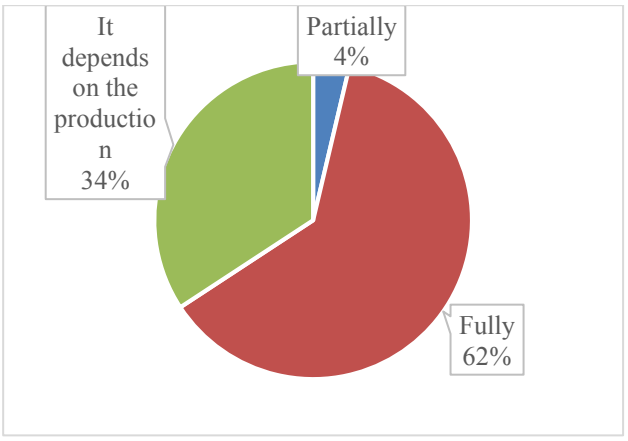

Fig. 7: Addressing products in the market
Source: Authors' results, 2024

These data indicate diversity in farmers' approaches to marketing their produce. The vast majority of farmers have a sustainable and complete approach to the market, bringing their productions entirely. A small proportion of farmers have a limited approach, bringing only a portion of their productions to market, while a significant group links this approach to the quantity and quality of their production for each specific year.

This diversity may reflect various variables such as production scale, storage capacities, market demands, or even individual business strategies of farmers. These findings suggest the need for tailored policies and support to enhance farmers' market capacities, taking into account their diverse situations and needs.

How to sell: Figure 8 illustrates how farmers sell their produce.

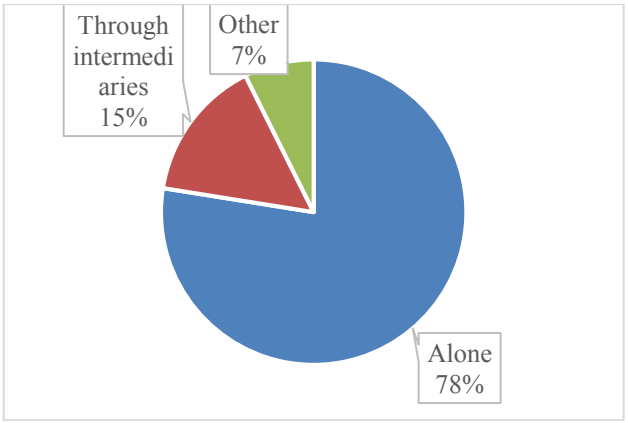

Fig. 8: Method of selling production
Source: Authors' results, 2024

According to the data; (78%) of 231 farmers have sold their produce themselves. This indicates that a large majority of sales have been directly to consumers or clients without using other intermediaries. This may suggest a direct link between the producer and the consumer in the sales process, focusing on direct business-consumer relationships; (15%) of 45 farmers have conducted sales through intermediaries. This indicates that a smaller portion of sales have been made through agents or other intermediation channels. This can be interpreted as a business strategy to expand the customer base using different sales channels, and (7%) or 22 farmers have chosen to include themselves in the "Other" category.

Cold storage of production: Figure 9 presents data regarding the availability of a refrigerator to store produce after harvesting. It is noted that 14% of respondents, or 41 farmers, confirmed having a refrigerator to store produce after harvesting. This suggests that a small portion of individuals in this district have infrastructure to store their products after harvesting in a controlled and sustainable manner; while 86% of respondents, or 255 farmers, responded that they do not have a refrigerator to store produce after harvesting.

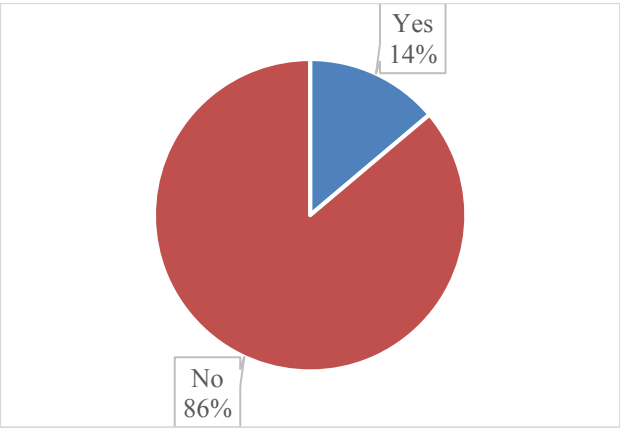

Fig. 9: Cold storage of production
Source: Authors' results, 2024

This indicates that the majority of farmers in this district do not have a dedicated refrigerator for storing their products after harvesting, which may affect how they manage and preserve their agricultural products.

This analysis shows that labor market shortages and the departure of family workers from farms pose high-level risks. Managerial incapacity and lack of technological skills have a lower impact, while weak interpersonal relationships with neighbors are at a low-risk level. This information can assist in planning strategies for managing human risks on your farm.

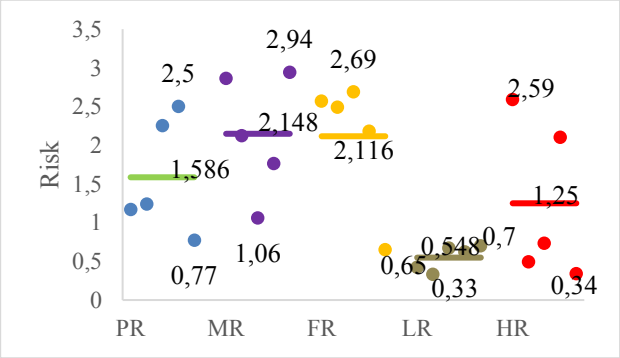

Fig.10: Matrix of factors according to the five main risks
Source: Authors' results, 2024

Risk matrix for apple farmers in the Korçë district (Figure 10), which identifies and ranks five key risks. Financial resources and market risk emerge as the highest risk factors for this group, with respective assessments of FRF=2.16 and FRT=2.148. Production is considered a moderate risk factor (FRP=1.586), followed by human resources (FRH=1.25). Legal and institutional issues appear as factors posing a low risk for farmers in this sector.

Based on Figure 11, we observe the distribution of risk factors according to aggressiveness in apple production farms in the Korçë district. The analysis has identified three levels of aggressiveness: mouse aggressiveness (M), rabbit aggressiveness (R), and lion aggressiveness (L).

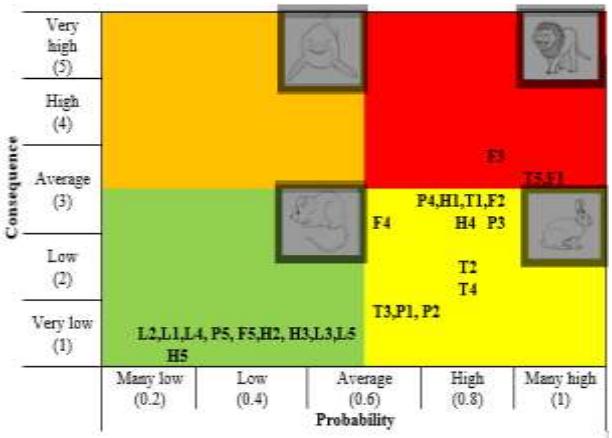

Fig. 11: Risk matrix in apple farms in Korça
Source: Authors' results, 2024

Mouse aggressiveness (M) includes 10 risk factors, representing 40% of all risk factors. These factors are not highly critical and are often self-managed by farmers without significant consequences.

Rabbit aggressiveness (R) encompasses 12 risk factors, representing 48% of all risk factors. These factors cause concern among farmers, but if they occur, the consequences are relatively minor and manageable.

Lion aggressiveness (L) includes 3 risk factors, representing 12% of all risk factors. These are factors that farmers need to take seriously as they impact the objectives and sustainability of the farm enterprise. It is emphasized that these three factors are located in the lower part of the risk matrix, indicating their importance and urgency.

4.4 Multifactorial Linear Regression Analysis

Farmers' perception of risk aggressiveness levels often reflects a deep subjective sense, such as complaining about low prices when selling their produce and high prices when purchasing production factors. Despite this, to achieve a comprehensive and objective understanding of risk factors, we have employed multiple linear regression equations. This method has helped us accurately assess the impact of each identified factor on the risk level. Through this focused analysis, it is possible to improve risk management strategies,

ensuring a more effective and sustainable approach to agricultural operations in the Korçë district.

The regression equation is:
Y=0.529283+0.162793·RP1+0.092392·RP3+0.106951·RP4+0.138665·RT1+0.055615·RT2+0.092200·RT3+0.104331·RT4+0.159819·RT5+0.100340·RF1+0.083739·RF2+0.127560·RF4+0.133338·RF5+0.130207·RL1+0.159929·RL2+0.164160·RL4+0.047378·RH1+0.136998·RH2+0.119520·RH3+0.149285·RH4

This equation represents the influence of each independent variable (RP1, RP3, RP4, RT1, RT2, RT3, RT4, RT5, RF1, RF2, RF4, RF5, RL1, RL2, RL4, RH1, RH2, RH3, RH4). Out of 25 variables considered in the study, only 19 have an impact. The relationship of the independent variables (19 risk factors) with the enterprise is approximately 85.88%. Table 4, Table 5 and Table 6 (Appendix) reflect the significance of the influences of these 19 variables and the statistically insignificant variables, which means they have been excluded from the multiple linear regression analysis (a total of 6 variables).

Referring to the data presented in Table 6 (Appendix), we make the following observations:

- R-squared (0.858820): This statistic indicates that approximately 85.88% of the variation in the dependent variable is explained by the independent variables in the model. This high value suggests a strong fit for the model.

- Adjusted R-squared (0.849240): This adjusted version of R-squared accounts for the number of variables in the model. With a value of 0.849, it indicates that 84.92% of the variation is explained when taking into consideration the number of variables used, reflecting the model's robustness.

- Standard Error of Regression (0.313934): This value represents the dispersion of the residuals (the differences between predicted and actual values). A smaller standard error indicates that the model fits the data well.

- Sum of Squared Residuals (27.59533): This measure assesses the distance between actual data points and the predicted values. A smaller value implies a better fit for the model.

- Log-Likelihood (-67.76119): This statistical indicator is used to compare different models; a higher log-likelihood value suggests a better model.

- Akaike Information Criterion (0.585075), Schwarz Criterion (0.831993), Hannan-Quinn Criterion (0.683892): These criteria are used for model selection. Models with lower values for these criteria are preferred, as they balance model fit with simplicity.

- F-statistic (89.64633): This statistic tests the overall significance of the model. A high value indicates that the model significantly explains the variation in the dependent variable.

- Prob(F-statistic) (0.000000): This value corresponds to the F-statistic probability. A value of 0 indicates that the model is highly statistically significant at a very high confidence level.

- Durbin-Watson Statistic (2.020864): This statistic tests for autocorrelation between residuals. A value close to 2 suggests no significant autocorrelation, indicating that the residuals are independent.

In conclusion, the model is statistically significant in explaining the dependent variable. The fit is good, and no significant issues with autocorrelation have been observed.

5 Conclusions and Recommendations

Knowledge of risk management has an important role in the farmer's decision-making, [61]. This analysis has made a measured and documented effort to understand five key risks in apple production farms in the Korçë district. Through deep analysis and interpretation of survey data, we have reached several important conclusions that directly impact the development and sustainability of this crucial sector of the Albanian economy.

Production Risk: Diseases and pests have a low impact on production, confirmed by the low average perceived risk and low coefficient in regression analysis. Hail and frost are identified as high risks both in the risk matrix and regression analysis. These risks have a considerable impact and high coefficients in regression (e.g., RP3 Hail has a coefficient of 0.092392).

Market Risk: Low prices in sales and market absence challenges represent significant challenges, with a high perceived impact and significant coefficients in regression (e.g., RT1 Low prices in sales have a coefficient of 0.138665). Product quality is a low-risk factor, consistent with regression results where its coefficient is 0.092200.

Financial Risk: Lack of financial resources and low-profit margins are identified as high risks in both matrix analyses and have high coefficients in regression (e.g., RF1 Lack of financial resources has a coefficient of 0.100340). Lack of financial data maintenance poses a low risk, consistent with the lowest coefficient in regression (0.133338).

Legal Risk: Issues with legal requirements and neglect of tax payments are identified as high risks

in regression analysis (e.g., RL4 Issues with legal requirements have the highest coefficient of 0.164160). Breach of quality standards is a moderate risk and has a relatively low coefficient in regression (0.067789).

Human Resources Risk: Labor force shortage and departure of family labor from farms are identified as high risks in matrix analysis and have high coefficients in regression (e.g., RH4 Departure of the workforce has a coefficient of 0.149285).

Some variables such as pests and failures in agrotechnical operations are not statistically significant in regression analysis, but they still constitute a part of risk perception, suggesting the need for more focus on aspects where perception and statistical analysis align to improve risk management.

Recommendations for addressing risks in apple production farms include a series of coordinated measures and approaches aimed at enhancing sustainability and competitiveness in the agricultural sector.

Farmers should unite in cooperatives to share risks related to production, market, finance, legal, and human resources. Cooperatives aid in improving bargaining power, accessing markets and financial resources, managing human resources, and enhancing resilience to climate challenges.

The Ministry of Agriculture and Rural Development should offer subsidies and training for new production technologies, establish programs for disease and pest prevention, develop strategies to diversify export markets, improve logistical infrastructure, and promote a national brand for Albanian apples. Simplifying legal procedures and creating legal assistance services are necessary for compliance with laws. Essential for human resources is the creation of training and education programs.

The central government should support apple farms in Korçë by improving agricultural techniques, diversifying varieties, easing access to finance, enhancing logistics and supply chains, organizing training on legislation and financial management, and developing human capacities.

Municipalities (Korçë, Devoll, Pogradec, and Kolonjë), the Regional Directorate of Agriculture in Korçë, and Korçë County should enhance cooperation with the central government and develop an integrated strategy. This strategy should include advanced technology for production, supporting the market with appropriate infrastructure, promoting local brands, providing loans and subsidies, and improving the legal framework and farmer training.

The Agricultural University of Tirana should expand cooperation with the National Agency for Research and Innovation to apply for financing and innovative projects addressing key agricultural production and market challenges. This involves developing advanced technologies, improving food safety systems, assisting farmers in adopting sustainable practices, and conducting market studies.

This research concludes that the model effectively explains the dependent variable and demonstrates a good fit, showing no signs of autocorrelation among the variables. The model's application aligns with previous studies, [5], [43], [44], [62]. Furthermore, all research questions have been addressed in this study, and the results are consistent with earlier findings, [5], [43], [44], [63].

The hypothesis was partially confirmed, with 16 out of the 25 variables examined in the study showing significance. These results are further supported by previous research, [5], [43], [44]. The study provides important recommendations, although we acknowledge some limitations.

First, the data were obtained from farmers' perceptions, which can often be biased and inaccurate, [64]. Prior studies indicate that a deviation of 10-15% in research results can occur due to inaccuracies in self-reporting by farmers, [65]. Second, this study focuses solely on Albania, and the unique circumstances there may limit the generalizability of the findings to other countries.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this paper, the authors used ChatGPT to facilitate a clear and comprehensible presentation of the paper in English. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostëriting Policy)

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

This study was conducted within the project of the National Agency of Scientific Research andInnovation (NASRI) and Agricultural University ofTirana. We would like to thank the NationalAgency of Scientific Research and Innovation fortheir financing and contributions to this research.

Conflict of Interest

The authors have no conflicts of interest to declare.

APPENDIX

Table. 4. First testing of 25 variables

Dependent Variable: FARM ENTERPRISE
Method: Least Squares
Date: 06/09/24 Time: 15:53
Sample: 1 300
Included observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(Y)	0.524827	0.097523	5.381590	0.0000
P1 Diseases	0.091686	0.042364	2.164227	0.0313
P2 Pests **(insignificant)**	0.041967	0.042452	0.988567	0.3237
P3 Drought	0.078899	0.015996	4.932441	0.0000
P4 Floods	0.108116	0.015469	6.989059	0.0000
P5 Failures in agrotechnical operations **(insignificant)**	0.045553	0.028846	1.579179	0.1154
M1 Low prices in sales	0.134475	0.020807	6.463062	0.0000
M2 Inability to attend markets	0.061833	0.025244	2.449411	0.0149
M3 Product quality (standards)	0.084521	0.025630	3.297716	0.0011
M4 Issues in sales agreements	0.100289	0.023315	4.301539	0.0000
M5 Competitiveness	0.137979	0.020306	6.794907	0.0000
F1 Lack of financing resources	0.097441	0.021384	4.556789	0.0000
F2 Cost of production factors	0.080335	0.024362	3.297580	0.0011
F3 Low profit margins	0.041627	0.020081	2.072994	0.0391
F4 Higher demand for family needs	0.122262	0.018981	6.441368	0.0000
F5 Lack of financial data maintenance	0.114794	0.031382	3.657946	0.0003
L1 Taxation and tax-related issues	0.110379	0.044019	2.507504	0.0127
L2 Neglect of debt payments	0.129274	0.050928	2.538366	0.0117
L3 Violation of quality standards (chemicals, etc.) **(insignificant)**	0.067789	0.037636	1.801161	0.0728
L4 Legal issues (property certificates, etc.)	0.134639	0.033152	4.061193	0.0001
L5 Failure to consult experts (insignificant)	0.071040	0.040517	1.753322	0.0807
H1 Labor shortage in the job market	0.040357	0.018623	2.167088	0.0311
H2 Managerial incapacity	0.106216	0.035583	2.984984	0.0031
H3 Inability to use technology	0.107686	0.033461	3.218245	0.0014
H4 Departure of family workforce from farms	0.146343	0.017497	8.364037	0.0000
H.5 Poor interpersonal relations with neighbors **(insignificant)**	0.070797	0.044866	1.577953	0.1157

R-squared	0.865843	Mean dependent var	4.069000
Adjusted R-squared	0.853603	S.D. dependent var	0.808528
S.E. of regression	0.309358	Akaike info criterion	0.574045
Sum squared resid	26.22249	Schëarz criterion	0.895040
Log likelihood	-60.10682	Hannan-Quinn criter.	0.702508
F-statistic	70.73552	Durbin-Ëatson stat	2.034632
Prob(F-statistic)	0.000000		0.000000

Table. 5. The second test in the regression equation

Dependent Variable: FARM ENTERPRISE
Method: Least Squares
Date: 06/09/24 Time: 16:07
Sample: 1 300
Included observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(Y)	0.499408	0.096520	5.174111	0.0000
P1 Diseases	0.161406	0.030675	5.261797	0.0000
P3 Hail	0.093131	0.015460	6.023838	0.0000
P4 Frost	0.108838	0.015528	7.009263	0.0000
M1 Low selling prices	0.131975	0.020205	6.531796	0.0000
M2 Impossibility of market presence	0.050845	0.024234	2.098132	0.0368
M3 Production quality (standards)	0.092495	0.025120	3.682070	0.0003
M.4 Problems in sales and purchase agreements	0.100424	0.023435	4.285191	0.0000
M.2.5 Competitiveness	0.154651	0.019746	7.831933	0.0000
F1 Lack of funding sources	0.098950	0.021449	4.613269	0.0000
F2 Cost of production factors	0.081225	0.024228	3.352589	0.0009
F3 Low profit rates **(insignificant)**	0.026401	0.019088	1.383113	0.1677
F4 Higher demands for family needs	0.125101	0.018747	6.673049	0.0000
F5 Lack of keeping financial records	0.138537	0.028964	4.782995	0.0000
L1 Problems in relation to taxes and duties	0.135267	0.043727	3.093460	0.0022
L2 Negligence for payment of obligations	0.163662	0.048630	3.365493	0.0009
L4 Problems with legal requirements (ownership certificate...	0.165253	0.028483	5.801865	0.0000
H1 Lack of manpower in the labor market	0.053543	0.018319	2.922831	0.0038
H2 Leadership/managerial incompetence	0.130050	0.033987	3.826455	0.0002
H3 Inability to use technology	0.127680	0.032032	3.985979	0.0001
H4 Removal of the family labor force from the farm	0.146755	0.016714	8.780328	0.0000

R-squared	0.859781	Mean dependent var	4.069000
Adjusted R-squared	0.849730	S.D. dependent var	0.808528
S.E. of regression	0.313424	Akaike info criterion	0.584908
Sum squared resid	27.40741	Schëarz criterion	0.844173
Log likelihood	-66.73620	Hannan-Quinn criter.	0.688666
F-statistic	85.53736	Durbin-Ëatson stat	2.033575
Prob(F-statistic)	0.000000		

Table. 6. The third test in the regression equation

Dependent Variable: FARM ENTERPRISE
Method: Least Squares
Date: 06/09/24 Time: 16:04
Sample: 1 300
Included observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(Y)	0.529283	0.094226	5.617189	0.0000
P1 Diseases	0.162793	0.030709	5.301225	0.0000
P3 Hail	0.092392	0.015476	5.969930	0.0000
P4 Frost	0.106951	0.015493	6.903216	0.0000
M1 Low selling prices	0.138665	0.019650	7.056897	0.0000
M2 Impossibility of market presence	0.055615	0.024026	2.314773	0.0213
M3 Production quality (standards)	0.092200	0.025160	3.664485	0.0003
M4 Problems in sales and purchase agreements	0.104331	0.023302	4.477354	0.0000
M.5 Competitiveness	0.159819	0.019421	8.229152	0.0000
F1 Lack of funding sources	0.100340	0.021460	4.675619	0.0000
F2 Cost of factors of production	0.083739	0.024199	3.460486	0.0006
F4 Higher demands for family needs	0.127560	0.018693	6.823872	0.0000
F5 Lack of keeping financial records	0.133338	0.028766	4.635225	0.0000
L1 Problems in relation to taxes and duties	0.130207	0.043644	2.983364	0.0031
L2 Negligence in payment of obligations	0.159929	0.048634	3.288442	0.0011
L4 Problems with legal requirements (property certificate...	0.164160	0.028518	5.756317	0.0000
H1 Lack of manpower in the labor market	0.047378	0.017797	2.662104	0.0082
H2 Leadership/managerial incompetence	0.136998	0.033668	4.069033	0.0001
H3 Inability to use technology	0.119520	0.031536	3.789995	0.0002
H4 Removal of the family labor force from the farm	0.149285	0.016641	8.971053	0.0000

R-squared	0.858820	Mean dependent var	4.069000
Adjusted R-squared	0.849240	S.D. dependent var	0.808528
S.E. of regression	0.313934	Akaike info criterion	0.585075
Sum squared resid	27.59533	Schëarz criterion	0.831993
Log likelihood	-67.76119	Hannan-Quinn criter.	0.683892
F-statistic	89.64633	Durbin-Ëatson stat	2.020864
Prob(F-statistic)	0.000000		