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EXPLORING THE ROLE OF FIVE KEY RISKS FOR APPLE FARMERS: AN EXPLANATORY AND INFERENTIAL ANALYSIS

Arif Murrja, Gentjan Çera

Abstract

This study investigates the impact of the five main risks (production, market, financial, legal compliance, and human resources) along with risk analysis, farmer experience, and farm size on farm income. The research is based on primary data collection consisting of 300 valid questionnaires. The respondents were randomly selected, and the interviews were conducted face-to-face. Explanatory (principal component analysis) and inferential statistical (regression analysis) approaches are employed to test the formulated hypotheses. The results showed that risk analysis, experience, and farm size significantly affect farm income. Additionally, legal risk and production risk were significant and influenced farm income, whereas financial risk, market risk, and human resources risk did not. The findings of the research assist farmers, field researchers, policymakers at local and central levels, and other stakeholders such as clients, suppliers, and consumers. This guides farmers in effective risk management and helps government institutions in drafting supportive policies for the sustainable development of agriculture.

Key words: *Risk, income, regression analysis, explained variance, efficiency, farm, farmer's experience.*

JEL Classification: *M12, Q11, R11*

1. Introduction

Agriculture is one of the primary sectors, not only in terms of its size but also its importance. In developing and underdeveloped countries, this sector is the largest employer and the main producer of food (ITU and FAO 2020). The rapid growth of the global population is facing the depletion of land, water, and labour resources, as well as climate change (Brown 2012; FAO 2020; P. B. Thompson 2017). According to Řezník et al. (2017), agriculture is not only confronted with water pollution, soil degradation, and climate change but also with the loss of biodiversity. Furthermore, the world is currently facing an energy crisis, and agriculture has the potential to produce alternative energy sources (Aluwani 2023).

In Albania, agriculture is also a significant economic sector. Approximately 46% of the population resides in

Arif Murrja, PhD
Associate Professor
Faculty of Economics and Agribusiness,
Agricultural University of Tirana
Pajsi Vodica St., Tirana 1029
Country: Albania
E-mail: amurrja@ubt.edu.al
ORCID: 0000-0002-6794-8782

Gentjan Çera, PhD
Lecturer and researcher
Faculty of Economics and Agribusiness,
Agricultural University of Tirana
Country: Albania
E-mail: gcera@ubt.edu.al
ORCID: 0000-0002-9324-181XDOI: 10.2478/

rural areas. Agriculture contributes 19.6% to the Gross Domestic Product of the country and accounts for 40% of employment (INSTAT 2023). Entrepreneurship in agriculture is associated with a high level of risk (Jankelova, Masar, and Moricova 2017; Jankelová et al. 2020). Farmers face complex and intricate risks that require careful management (Duong et al. 2019). This study focuses on analyzing risk factors and their impact on farm income focusing on apple farms in Albania.

Over the past 30 years since the end of the communist era, Albania has faced a challenging business climate. According to Batraneca (2024) and Çera at al. (2019), there is a need for greater fiscal transparency, reduced informality, and more targeted policies for specific economic sectors. Compared to other countries in the Western Balkans, Albania still has untapped potential to enhance its competitiveness and attract investment.

From the perspective of our study, the World Bank (2017) highlights that apple production is a vital sector in the horticulture of the Western Balkans. While Albania has experienced an increase in apple production in recent years, it still trails behind countries like Serbia and North Macedonia regarding productivity and quality standards. Although Albania enjoys favourable climatic conditions, the lack of technology and investment restricts its export competitiveness. In contrast, Serbia and North Macedonia have successfully leveraged investments in modern technology and EU policy support, leading to higher production standards and greater export volumes (World Bank 2017).

The focus of our study is the Korçë district, located in southeastern Albania, which has a comparative advantage in apple production. Research indicates that apple production in this region is rapidly growing (Osmani and Kambo 2019). Apples account for 62.97% of the district's total fruit production. According to Osmani and Kambo (2019), traditional farming practices, soil fertility, and favourable climatic conditions have established Korçë as the leading apple producer in the country. Apple cultivation provides Korçës farmers with approximately 58.7% of their household income (Gërdoçi et al. 2016), and they are eager to invest in this sector (Maloku, Çera, Poleshi, et al. 2021; Maloku, Çera, Metzker, et al. 2021; Osmani and Kambo 2019; Tomorri et al. 2024).

Risk management scholars in agriculture have identified five major risks: production, market, financial, legal, and human resources (Hardaker 2015; Harwood et al. 1999; Hassan et al. 2023; Komarek, De Pinto, and Smith 2020; N. M. Thompson, Bir, and Widmar 2019). However, Komarek et al. (2020) note that many studies do not sufficiently reflect farmers' concerns regarding these risks. Therefore, it is important to have a comprehensive analysis of these five key risks to understand how risk factors affect farm activity.

The main objective of this study is to analyze the risk factors in apple farms according to the five major risks (production, market, financial, legal, and human resources) and to inform farmers in the Korça region about the levels or intensities of risk events. The study objectives are: to identify risks, select the most significant risks, analyse them, and provide useful information to farmers (Murrja et al. 2022).

The study uses a contextual framework that includes literature, primary data from a survey of 300 farmers, and previous studies in Albania. The main part of the study involves analyzing 25 risk variables using Principal Component Analysis. This aspect of the study ensures a thorough and detailed analysis of risk factors for apple production farms.

The results of this study serve apple farmers in countries sharing similarities with Albania context and risk management researchers in agriculture. The study is particularly important in the context of risk analysis in apple production farms. By identifying and analyzing key risks in this sector, valuable information is provided to farmers. This study enriches the literature, particularly in the field of risk management, offering additional knowledge from a transitioning and developing country like Albania (Lushi et al. 2023).

2. Literature review

2.1. Main farm risks

The term "risk" is highly complex and researchers use it from various perspectives. Risk is uncertainty (Hardaker 2015; Rejda and McNamara 2014), involving losses, undesirable events, and negative impacts (OECD 2009), but also potentially positive outcomes (Hopkin 2018; Rejda and McNamara 2014). It is considered adversity and is integral to entrepreneurship (Hopkin 2018). Broadly, the risk is the combination of probability with consequence (Hopkin 2018; Ndregjoni, Murrja, and Prendi 2023). In literature, a unified definition is lacking (Hopkin 2018; Jankelova, Masar, and Moricova 2017). In our research, the terms "risk" and "risk factors" are used to focus on the negative impacts of events related to production, market, finance, laws, and human resources (Noumir, Langemeier, and Mallory 2023). These negative impacts are measured as the combination of probability and consequence, referred to as risk factors (Fletcher 2015; Hopkin 2018; Ndregjoni, Murrja, and Prendi 2023).

Table 1. Description of the five main farm risks and authors who have done quantitative research.

Description of the five main streams	Studies of risk events. Sources:
1. Production Risk Production risks in agriculture arise from uncertain processes of planting, growth, harvesting, and gathering for agricultural crops, as well as breeding, handling, and gathering of livestock and poultry. The primary sources of production risk include adverse weather, pests, diseases, biological production cycles, machinery and equipment breakdowns, infrastructure, environment, technology, globalization, farm size, agricultural land segmentation, on-farm and off-farm infrastructure, limited labour force, and free trade agreements (Girdžiūtė 2012; 2012; Harwood et al. 1999; Hassan et al. 2023; Kahan 2008; Komarek, De Pinto, and Smith 2020; OECD 2009).	(Angelucci and Conforti 2010; Çerpja and Murrja 2024; Eggertsson 1998; Hayran and Gül 2015a; Iqbal 2018; Jankelova, Masar, and Moricova 2017; Karadas and Birinci 2018; Kwak et al. 2024; Lobos et al. 2018; Meuwissen et al. 2001; Murrja, Kurtaj, et al. 2023; Nelson, Klodd, and Hutchison 2023; Seamon et al. 2023; Shang et al. 2024; Skreli and Imami 2019; Spornberger et al. 2013; Sulewski and Kłoczko-Gajewska 2014; Ullah et al. 2016)
2. Market Risk Agricultural producers and livestock breeders do not control the market. Production quantities and changes in supply and demand can cause significant and unpredictable fluctuations in prices. Consumer incomes and preferences, economic downturns, government taxes, energy policies, and exchange rates-all influence demand for goods and, consequently, agricultural production prices. The production process is time-consuming, and returns are not immediate. Low prices, competitiveness, contract shortages, inaccuracies in income and expense recording are additional risks affecting farm marketing activities. Failure to anticipate these market risks makes managing agricultural marketing risk very challenging (Harwood et al. 1999; Hassan et al. 2023; Kahan 2008; Komarek, De Pinto, and Smith 2020; OECD 2009).	(Angelucci and Conforti 2010; Çerpja and Murrja 2024; Gërdoçi, Skreli, and Imami 2016; Harwood et al. 1999; Iqbal 2018; Jankelova, Masar, and Moricova 2017; Karadas and Birinci 2018; Lobos et al. 2018; Markelova et al. 2009; Melyukhina 2011; Meuwissen et al. 2001; Skreli and Imami 2019; N. M. Thompson, Bir, and Widmar 2019)
3. Financial Risk Farmers face financial risk, which is associated with the method of financing and the financial condition of the farm. Farm operations require liquid funds to finance operations, pay suppliers, repay loans, and meet other financial obligations. Financial risk occurs when money is borrowed to finance a farm business. This risk can be caused by uncertainty about future interest rates, the willingness and ability of a lender to continue providing funds when needed, and the farmer's ability to generate sufficient income to repay the loan (Harwood et al. 1999; Hassan et al. 2023; Kahan 2008; Komarek, De Pinto, and Smith 2020; OECD 2009).	(Angelucci and Conforti 2010; Durga et al. 2024; Flaten et al. 2005; Iqbal 2018; Jankelova, Masar, and Moricova 2017; Kurtaj, Çerpja, and Murrja 2024; Lefore, Closas, and Schmitter 2021; Melyukhina 2011; Meuwissen et al. 2001; Murrja et al. 2022; Okoye, Okolie, and Odesola 2022; Skreli and Imami 2019; N. M. Thompson, Bir, and Widmar 2019)
4. Legal Risk Legal risks are another type of risk related to compliance with a series of legal frameworks. Production practices must comply with the laws. Many marketing and financial decisions are subject to contract law, and failure to meet the terms of any agreement can have serious legal implications. Farmers are also required to meet legal obligations regarding reporting and tax payment, labour laws and wages, food safety requirements, workplace safety requirements, and others. Institutional risks are also associated with unforeseen changes in policies and regulations affecting agriculture (Harwood et al. 1999; Hassan et al. 2023; Kahan 2008; Komarek, De Pinto, and Smith 2020).	(Jankelova, Masar, and Moricova 2017; Markić, Požega, and Crnković 2022; Melyukhina 2011; Meuwissen et al. 2001; Ndregjoni, Murrja, and Prendi 2023; Skreli and Imami 2019; N. M. Thompson, Bir, and Widmar 2019)
5. Human Resource Risk The last, but no less important, type of risk is human resource risk. Human resource risk events are specific to farm members and involve issues such as incapacity to work, poor health, family divorces, poor interpersonal relationships within and outside the farm, and family members leaving the farm. Although not as conspicuous as other types of risks, human resource risks cannot be overlooked and must be recognized and managed for the farm enterprise to be successful (Girdžiūtė 2012; Harwood et al. 1999; Hassan et al. 2023; Kahan 2008; Komarek, De Pinto, and Smith 2020; OECD 2009).	(Barneo-Alcántara et al. 2021; Chen et al. 2017; Earl et al. 1996; Iqbal 2018; Jankelova, Masar, and Moricova 2017; Melyukhina 2011; Meuwissen et al. 2001; Skreli and Imami 2019; N. M. Thompson, Bir, and Widmar 2019; Ullah et al. 2016)

Source: Adapted for our study from Hassan et al. (2023), Okoye et al. (2022), Khan et al. (2015).

Enterprise Risk Management supports businesses in identifying, assessing, and managing risks at the enterprise level (Anton and Nucu 2020; Berry-Stölzle and Xu 2018; Rahmawati et al. 2024). One of the conditions for effective risk management is timely recognition of farm risks related to production, marketing, financing, compliance with laws, and human resources management According to Abdullah (2024), knowledge of risk management is very important in the successful decision-making of the farm owner. Table 1 presents the definitions of the five main ones and the quantitative research of the authors for different risk events as part of the five main risks.

2.2. Hypothesis development

The risk management process is complex and very complicated (De Oliveira et al. 2017; Duong et al. 2019; Hopkin 2018). This process involves several stages (setting objectives, risk identification, risk analysis, risk treatment, recording and reporting, monitoring, and risk control) (BSI 2018; De Oliveira et al. 2017; Hopkin 2018; IEC/FDIS31010 2009). Risk analysis is one of the critical steps in the farm risk management process that aims to assess the negative impact of external and internal factors on the farm's income (Dmitrijeva et al. 2020; Jankelova, Masar, and Moricova 2017). The Orange Book (2023) recommends a more streamlined risk management process (identification, treatment, monitoring and reporting). This analysis guides farmers in making the right decisions.

Farm owners apply various techniques or tools to manage negative risks. These techniques include self-financing, prevention or reduction, diversification, contracts, insurance, expert consultation, subsidy utilisation, and avoidance (Hopkin 2018; Iqbal 2018; Jankelova, Masar, and Moricova 2017; Meuwissen et al. 2001; Murrja, Kurtaj, et al. 2023; Sulewski and Kłoczko-Gajewska 2014). Other techniques involve membership in farmer unions and participation in clusters or cooperatives (Hayran and Gül 2015b; Iqbal 2018; Joffre, Poortvliet, and Klerkx 2019).

All the studies cited in this research represent a significant effort to identify and analyse risks in agricultural enterprises. In conditions of constant change, understanding risks and responding effectively to them helps farmers succeed in their businesses.

Based on the above, the following hypothesis is proposed:

H1: Risk analysis significantly affects farm income.

Hardaker et al. (2015; 2004), assess risk analysis methodology as very important in increasing farm income. The success of farmers is directly linked to risk analysis (Dmitrijeva et al. 2020; Jankelova, Masar, and Moricova 2017). According to Haden et al. (2012), risk analysis is an integral aspect of farm management that directly impacts agricultural income. About two decades ago, Barrett et al. (2004) showed that risk analysis guides farmers in making sound financial decisions, which increase farm income. Additionally, they found that farmers who analyze risks are better able to maximise profits and minimise losses. Even earlier, Meuwissen et al. (2001) argued that risk analysis in agriculture ensures the sustainable development of farms. They noted that a farmer's experience and the size of the farm are advantageous in identifying and managing risks, which results in higher income. Thus, it can be assumed that:

H2: Farm income is positively influenced by the farmer's experience (H2a) and farm size (H2b).

The farm owner's experience and the farm size are two significant factors that positively impact farm income (Bird and Fafchamps 2004; Huffman and Evenson 2001; Kimhi 1994; Saha, Shumway, and Talpaz 1994). According to Kimhi (1994), farm income continues to increase when the transfer of activities is gradually made from parents to children. Additionally, Figurek et al. (2023) emphasize that the transfer of experience through generational rotation is a highly functional process. In their study, they find that productivity and farm size are considered the most important factors, followed by the volume of farm assets, type of farm, geographical location, diversification strategies, enterprise diversity, land leasing, expenses, and inheritance privileges. Huffman and Evenson (2001) finds that farm size and partial engagement in agriculture affect farm income. Moreover, according to him, farm size also impacts the structure of farm activities. Barrett et al. (2004) identify the farmer's experience as one of the key factors influencing farm income.

The farm owner faces many challenges, such as production risk, market risk, financial risk, legal risk, and human resource risk. Production and market uncertainties, the inability to secure financing sources, negligence in implementing legal provisions, and limited human resources directly impact the farm's income.

These arguments lead to the following hypothesis:

H3: Production risk (PR), market risk (MR), financial risk (FR), legal risk (LR), and human resource risk (HR) significantly impact farm income.

The first studies on the five major risks in agriculture were conducted in the United States (Harwood

et al. 1999). Later, studies continued in the European Union countries, the United Kingdom, New Zealand, Australia, and OECD countries (Jankelova, Masar, and Moricova 2017; Melyukhina 2011; OECD 2009; Schaffnit-Chatterjee 2010; Sciabarrasi 2024). The classification system of the five major risks in agricultural businesses is universally accepted and applied worldwide. The impact of production, market, financial, legal, and human resource risks is highly significant. Their importance varies according to the type of farm and different countries around the world. The same farm enterprise has different risk exposures. This exposure depends on the climatic, economic, and political circumstances of each region or country. Previous studies have shown that the impact of these risks is significant (Harwood et al. 1999; Melyukhina 2011; Meuwissen, Huirne, and Hardaker 2001).

3. Methods and procedures

3.1. Data

The research aims to explore the role of the main risks for the farmers' activity focused on orchards (apple production). The research is conducted in an area of Albania, Korca. The reason it covers only the Korça region is that it accounts for 62.97% of the national (INSTAT 2023) production. A questionnaire is developed based on the literature review and the research objectives. It consists of the following main sections: information for the area where the farm is located; general information for the farm family; farm profile; use of tools to control the risks faced in daily activities; and 25 risk indicators grouped into five main risks (law, market, production, financial, and human risks).

The questionnaire is tested in the field and validated by research experts (pilot phase). Based on the feedback collected during this phase, the questionnaire was improved. The feedback contributed to: (i) question clarity: Ambiguous questions were rephrased for better understanding; (ii) relevance: irrelevant questions were removed, and new questions were added to cover missing areas; (iii) comprehensiveness: the structure of the questionnaire was refined to ensure it comprehensively covered all necessary topics. Data collection started in February 2024 and ended in the first week of March 2024. The data is collected through enumerators supervised by the research team. The mode of data collection was through structured surveys conducted in-person.

Overall, 300 valid questionnaires were collected. After data cleaning, 4 observations were removed. All the following procedures and analyses are done based on this sample size. Considering the population of the farmers, the authors believe that this sample size is satisfactory in generalizing the findings. Moreover, based on G*Power software that calculates the sample size, effect size, power etc., including the case of linear multiple regression (Faul et al. 2009; 2007). For an effect size = 0.075, alpha level = 0.05, power = 0.9 and number of predictors = 8, the sample size should be 263. As a matter of fact, the sample size in this research is bigger than the proposed size by the software. This comparison leads to the conclusion that the sample size of 296 observations can be considered as an appropriate sample size.

Table 2 provides a detailed overview of the profile structure of the data sample collected in the study focused on apple farmers in the Korça region.

Table 2. The profile of the sample

Variable	Category	Mean	Count	Share
How many years have you been working in an orchard?		18.33		
What is the area of the orchard in hectares?		2.97		
Family size (number of family members)		4.52		
Main occupation	Work on the farm only		244	81%
	Work for my business (not farm)		34	11%
	Other		22	8%
Most of your agricultural production is for:	Own consumption		5	2%
	Trade		294	98%
How much of your production is marketable?	Partially		11	4%
	Fully		185	62%
	It depends on the production		102	34%

Source: Own research

In terms of experience, on average, farmers have worked in orchards for about 18.33 years, indicating a high level of expertise in this field. The average orchard size is 2.97 hectares, suggesting that most farmers own considerably large farms for apple production. The families of these farmers consist of an average of 4.52 members, reflecting a typical medium-sized family structure.

Regarding primary occupation, the vast majority of farmers, around 81%, work solely on their farms. Only 11% of farmers work for businesses unrelated to farming, while 8% are engaged in other activities. This indicates a high concentration of resources and efforts in agricultural production.

Concerning the production destination, only 2% of farmers primarily produce for personal consumption, whereas 98% of their production is intended for trade. This underscores the economic importance of apple production for these farmers and their contribution to the domestic market.

Regarding marketability, 62% of farmers report that their production is fully marketable, while 34% state that it depends on the production of the specific year. Only 4% of farmers have production that is partially marketable, indicating that most of the production is of high quality and suitable for the market.

3.2. Variables

The measurement of the variables used in this research is summarized in Table 3. Farm size is the first listed variable, which is measured on a scale variable. The question in the questionnaire is "What is the area of the orchard in hectares?", and the respondent was asked to report the number of hectares. The second variable is the farm's experience, which is measured in the number of years that the farmer works in apple production, meaning that it is a scale variable. Risk analysis is the third variable presented in this table. It is measured as a dummy variable. The question in the questionnaire reads "Do you do risk analysis for the activities on your farm?" and its options to be selected were either [1] Yes, or [0] No. Farm income is the dependent variable and it is measured as the share of family income originating from farm activities over total family income.

Five key risks are identified in this research: law, market, production, financial, and human risks. Five indicators/items are developed for each type of risk. For each indicator, the respondent was asked to report the probability of occurrence of that specific indicator/risk and then the consequence that can be caused to the farm activity if that occurs. Thus, we can calculate the indicator risk as follows:

$$Risk\ factor = Probability\ of\ Occurrence * Consequence$$

Where the probability of occurrence is measured as [0%-20%] very low, [20%-40%] low, [40%-60] moderate, [60%-80%] high, [80%-100%] very high, while the consequence is measured as a Liker scale ([1] very low to [5] very high). With this math computation, the nature of the indicator risk variable is scale.

Once the indicator risks are calculated, factor analysis is employed to generate the five key risks. This step is provided with more details in the next sub-section.

3.3. Procedures

To meet the aim of this paper, a set of statistical techniques is followed. Firstly, to reduce the number of indicators, factor analysis was performed (Fabrigar and Wegener 2011). Principal component analysis was

Table 3. The measurement of variables

Variable	Type of variable	Measurement
Farm size	Scale	What is the area of the orchard in hectares?
Experience	Scale	How many years have you been working in an orchard?
Risk analysis	Dummy	Do you do risk analysis for the activities on your farm? [1] Yes, [0] No.
Farm income	Scale	What percentage of the income comes from the orchard?
Law, market, production, financial, and human risks	Scale	Emerged from factor analysis: Law risk (5 items); Market risk (3 items); Production risk (3 items); Financial risk (3 items); Human risk (2 items). Each item is calculated as production of the probability of occurrence ([0%-20%] very low,…, [80%-100%] very high) with the consequence ([1] very low,…, [5] very high)

Source: own research

selected as the extracted method, while varimax with Kaiser normalization was chosen as the rotation method. The output of the factor analysis for law and market risks is summarized in Table 4, while the output for the other risks is summarized in Table 5.

To satisfy all the requirements of running a factor analysis, 9 indicators/items were removed from the analysis, which are indicated in Table 4 and Table 5. Hence, the Kaiser-Meyer-Olkin statistic was reported to be higher than the critical value of 0.70 and Barlett's test of sphericity is found to be statistically significant, demonstrating that principal component analysis is appropriate.

Table 4. Rotated matrix: law and market risks

		Component	
Code	Item	Law risk	Marker risk
MR1	Low prices		Removed
MR2	Impossibility of presence in the market		0.790
MR3	Production quality (standards)		Removed
MR4	Problems in sales and purchase agreements		0.676
MR5	Competitiveness		0.754
LR1	Problems in relation to taxes and duties	0.703	
LR2	Negligence for electricity and water payments	0.578	
LR3	Violation of quality standards (chemicals, etc.)	0.708	
LR4	Problems with legal requirements (property certificate...)	0.797	
LR5	Failure to consult with experts	0.709	
	Eigenvalue	2.715	1.629
	Variance explained	32.4%	21.9%
	Cronbach's alpha	0.751	0.624

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. LR, law risk; MR, market risk.

Table 5. Rotated matrix: production, financial, and human risks

		Component		
Code	Item	Production risk	Financial risk	Human risk
PR1	Diseases	0.728		
PR2	Pests	0.918		
PR3	Hail	Removed		
PR4	Flood	Removed		
PR5	Failures in agrotechnical operations	0.809		
FR1	Lack of funding sources		0.751	
FR2	Cost of factors of production		0.873	
FR3	Low profit rates		0.679	
FR4	Higher demands for family needs		Removed	
FR5	Lack of financial record keeping		Removed	
HR1	Labor shortage in the labor market			0.895
HR2	Leadership/managerial incompetence			Removed
HR3	Inability to use technology			Removed
HR4	Removal of the family labor force from the farm			0.727
HR5	Bad interpersonal relations with neighbours			Removed
	Eigenvalue	2.858	1.406	1.209
	Variance explained	27.3%	23.3%	17.9%
	Cronbach's alpha	0.784	0.681	0.664

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. PR, production risk; FR, financial risk; HR, human risk.

All indicator/item loadings are reported to be higher than the standard value of 0.40, indicating the convergent validity related to constructs is reached (Stevens and Pituch 2015). Furthermore, accepted scale reliability was reported for the emerged factors, because the statistic of Cronbach's alpha was reported higher than the conservative threshold of 0.60. According to Hair et al. (2010), in explanatory research, where the scales are not consolidated enough in the literature, similar to the current research, values of Cronbach's alpha ranging from 0.60 to 0.70 are considered acceptable.

Upon the creation of variables (five key risks) that emerged from the factor analysis, the regression analysis followed up. The purpose of running a regression analysis was to test the importance of five risks in determining farm income. As mentioned earlier, the dependent variable is measured as a scale type of variable, giving the possibility to perform a regression analysis based on the ordinary least square method (Harrell 2015). The variables that emerged from the factor analysis are normally distributed, leading to the satisfaction of the assumption of normality of variables included in the regression. In order to better understand the influence of the five key risk variables a stepwise approach of regression analysis was performed in IBM SPSS, version 26 (George and Mallery 2019). Hence, a regression with four steps is run, where firstly control variables are included, and then the emerging variables from the principal component analysis. The general mathematical form of the regressions is below:

$$farm\_revenue = \beta_0 + \beta_1 \exp + \beta_2 farm\_size + e \quad (1)$$

$$farm\_revenue = \beta_0 + \beta_1 \exp + \beta_2 farm\_size + \beta_3 risk\_analysis + e \quad (2)$$

$$farm\_revenue = \beta_0 + \beta_1 \exp + \beta_2 farm\_size + \beta_3 risk\_analysis + \beta_4 LR + \beta_5 MR + e \quad (3)$$

$$farm\_revenue = \beta_0 + \beta_1 \exp + \beta_2 farm\_size + \beta_3 risk\_analysis + \beta_4 LR + \beta_5 MR + \beta_6 PR + \beta_7 FR + \beta_8 HR + e \quad (4)$$

Where *farm_revenue* stands for the farm's revenue from the orchard; exp, owner/manager's experience; *farm_size* is farm size in ha (orchard only); *risk_analysis* is risk analysis as a tool to control the risk; LR, law risk; MR, market risk; PR, production risk; FR, financial risk; HR, human risk; e, error term.

All the analyses are done by using IBM SPSS version 26, as indicated in the guidelines provided by Pallant (2016) and George & Mallery (2019).

4. Results

The regression analysis is performed in this research paper to investigate the influence of five key risks that farmers face in their activities. To have a better picture of the effects of these factors on farm's revenue four models are performed.

The first model considers control variables only. For this reason, in this paper, this model is named as a baseline model. The other three models include additional independent variables and are compared to the baseline model. Table 6 summarizes the main statistics regarding the fitness of each model. The baseline model explains 23% of the variance in the farm's revenue. The second model, which includes the risk analysis variable as an additional independent variable, increased the variance explained by 4%. This increase is statistically significant. The third model explains 31% of the variance in the dependent variable, which represents almost an 8% improvement compared to the

Table 6. Model summary

Model	R	R Square	Adjusted R Square	Std. error of the estimate	Change Statistics				
					R Square	F	df1	df2	Sig. F
1	0.482a	0.232	0.227	0.21248	0.232	44.332	2	293	.000
2	0.520b	0.270	0.263	0.20752	0.038	15.168	1	292	.000
3	0.555c	0.308	0.296	0.20282	0.037	7.8450	2	290	.000
4	0.628d	0.394	0.377	0.19071	0.087	13.674	3	287	.000

Note: N = 296; a. Predictors: constant, exp, farm_size; b. Predictors: constant, exp, farm_size, risk_analysis; c. Predictors: constant, exp, farm_size, risk_analysis, LR, MR; d. Predictors: constant, exp, farm_size, risk_analysis, LR, MR, PR, FR, HR.

Table 7. Regression results

Variable	Model 1			Model 2			Model 3			Model 4		
	Beta	*t*	*p*	*Beta*	*t*	*p*	*Beta*	*t*	*p*	*Beta*	*t*	*p*
constant		14.48	0.000		12.80	0.000		13.57	0.000		15.52	0.000
exp	0.465	9.049	0.000	0.506	9.873	0.000	0.442	8.347	0.000	0.287	5.073	0.000
farm_size	0.098	1.907	0.057	0.097	1.939	0.053	0.119	2.375	0.018	0.157	3.289	0.001
risk_analysis				0.199	3.895	0.000	0.246	4.785	0.000	0.256	5.238	0.000
LR							-0.172	-3.335	0.001	-0.126	-2.520	0.012
MR							0.125	2.373	0.018	0.048	0.729	0.467
PR										-0.231	-4.631	0.000
FR										0.176	1.260	0.210
HR										0.214	1.510	0.130

Note: N = 296; Dependent variable: farm's revenue from the orchard; exp, owner/manager's experience; farm_size, farm size in ha (orchard only); risk_analysis, risk analysis as a tool to control the risk; LR, law risk; MR, market risk; PR, production risk; FR, financial risk; HR, human risk; Beta, standardized coefficients; t, t-statistic; p, p-value.

baseline model. The addition of the three remaining independent variables in model 4 leads to a better explanation of the variance of farm revenue, from 31% to almost 40%, which is statistically significant.

The regression output is summarized in Table 7 for each model. The baseline model shows that both control variables are statistically significant in determining farm revenue. Hence, having experience in working with apple production on the farm increases the farm's revenue ($\beta = 0.465$, $t = 9.049$, $p < 0.001$). In the same way, the larger the size of the farm, the higher the farm's revenue ($\beta = 0.098$, $t = 1.907$, $p < 0.10$). The second model finds that risk analysis is statistically significant in predicting the farm's revenue. Thus, in case a farmer does risk analysis for the farm activities, the farm's revenue increases ($\beta = 0.199$, $t = 1.371$, $p < 0.001$).

Model 3 tests the influence of law and market risks on a farm's revenue, beside the control variables. The results of the analysis show that law risk negatively affects the farm's revenue ($\beta = -0.172$, $t = -3.335$, $p < 0.01$). However, the regression does confirm the influence of market risk on the farm's revenue ($\beta = 0.125$, $t = 2.373$, $p < 0.05$).

The remaining risk variables are added in Model 4. So, this model tests the effect of law, market, production, financial, and human risks on a farm's revenue, besides the control variables. The results of the analysis demonstrate that law risk ($\beta = -0.126$, $t = -2.520$, $p < 0.01$) and production risk negatively influence the farm's revenue ($\beta = -0.231$, $t = -4.631$, $p < 0.01$). Conversely, the regression does not find evidence of the influence of market, financial, and human risks on the farm's revenue.

The post-estimation tests are essential for validating the assumptions and robustness of the linear regression models. To check whether the residual is normally distributed or not the Q-Q plot and Kolmogorov-Smirnov test are performed. Both indicated that the residual is normally distributed. In addition to the scatter plot of standardized residuals vs standardized predicted values, the homoscedasticity is tested by performing Breusch-Pagan test in SPSS (Analyse, General Linear Model, Univariate…, Option: Breusch-Pagan test). Its result showed that the variance of the errors does not depend on the values of the independent variables ($\chi^2 = 1.397$, $p = 0.237$). Multicollinearity is tested by examining the variance inflation factor (VIF) for the independent variables included in the model (see Table 7). All VIF values resulted below the conservative threshold of the number 10 (for model 4, the minimum, mean, and maximum values of VIF were 1.006, 1.231, and 2.164, respectively), indicating the absence of multicollinearity in the models. According to Durbin-Watson test (ranges from 1.83 to 2.11), no autocorrelation was present in the data.

5. Discussion

Based on the findings of the present study, we proceed with the discussions as follows:

Firstly, we note that risk analysis is a very important tool in farm management. This tool has a significant impact on farm income. The results confirm hypothesis H1 and also validate the sensitivity of risk analysis to farm income. The relationship and impact

of risk analysis on farm income are in line with previous studies (C. B. Barrett, Reardon, and Webb 2001; Haden et al. 2012; Just and Pope 2001; Maddison 2007; Meuwissen, Huirne, and Hardaker 2001), which suggest that risk analysis is one of the most important tools in farm business management for making timely decisions. Just and Pope (2001) state that farmers who conduct risk analysis have a higher probability of achieving high profits. In the context of OECD countries, hypothesis H1 is validated in terms of risk management and strategies within the general context of the agricultural sector (OECD 2009; 2000).

Secondly, hypothesis H2 is validated. Farmer experience and farm size have a positive impact on farm income. Our study's findings are corroborated by previous research (K. Barrett, Reardon, and Webb 2004; Figurek, Morphi, and Thrassou 2023; Huffman and Evenson 2001; Kimhi 1994). According to Kimhi (1994) and Figurek et al. (2023), experience retention occurs through the gradual transfer of farm activities from parents to children. Huffman and Evenson (2001) and Figurek et al. (2023) note that, in addition to the positive impact of farm size on business income, farm size is also associated with other important components such as structure, geographic location, diversification strategies, and type of enterprise. In the context of several countries, the results of hypothesis H2 regarding the role of experience and farm size are confirmed by previous studies conducted in OECD countries (OECD 2009; 2000).

Thirdly, Hypothesis H3 is partially confirmed regarding the impact of the five main risks (production risk, market risk, financial risk, legal risk, and human resource risk) on farm income. Among these risks, legal risk and production risk significantly affect farm income, whereas market risk, financial risk, and human resource risk do not have a substantial impact. These findings are consistent with previous research (Hardaker et al. 2004; Jankelova, Masar, and Moricova 2017; Melyukhina 2011; Meuwissen, Huirne, and Hardaker 2001). The influence of legal variables-such as issues related to taxes and obligations, negligence in electricity and water payments, violations of quality standards (e.g., chemicals), problems with legal requirements (e.g., property certificates, licensing of activities), and failure to consult with experts-aligns with the findings of prior studies (Ndregjoni, Murrja, and Prendi 2023). According to Ndregjoni et al. (2023), farmers often neglect and do not consult with field professionals (economists, legal experts, and agricultural specialists). Karadas and Birinci ((2018) found that the professional incompetence of farmers was a major cause of low profits. Regarding the impact of production variables, it is observed that diseases, pests, and failures in agrotechnical operations have an impact, whereas hail and flooding do not. These findings are partially confirmed by previous studies (Murrja, Ndreca, et al. 2023; Murrja, Kurtaj, et al. 2023). This is explained by the fact that risk exposure is not uniform across different regions and enterprises (Figurek, Morphi, and Thrassou 2023). For example, according to Eggertsson (1998), the main concerns for farmers are primarily related to weather variability and human diseases, whereas Harword et al. (1999) found that agricultural producers are concerned about the risk of price volatility and input quality. Another study identifies marketing and production risks as the most significant (Angelucci and Conforti 2010). Thompson et al. (2019), conclude that production, market, and financial risks are more concerning than human and legal risks.

From the discussion of the findings of the current study, we conclude that risk analysis, farmer experience, farm size, and effective management of the five major risks have an impact on the income and success of apple farmers in the Korça region. The results of the regression analysis for predicting risk and the importance of risk analysis in farming are supported by recent studies in agriculture (Kalogiannidis et al. 2023; Valaskova et al. 2018). These findings suggest that farmers should be attentive to achieving sustainable agricultural development in this region. To succeed in business, systematic risk management is suggested (HM Treasury 2023) and its adaptation according to business circumstances (Hopkin 2018).

6. Conclusion

This study offers valuable recommendations for farmers and policymakers at both local and central levels. According to the best literature reviews on farm risk management (agricultural risk), risk research should focus on five main risks (production, market, finance, legal, and human resources) (Komarek, De Pinto, and Smith 2020). This classification system is comprehensive, universally accepted, and applied worldwide (Harwood et al. 1999; Melyukhina 2011; OECD 2009; Schaffnit-Chatterjee 2010; Sciabarrasi 2024; Thomas 2018). However, studies based on these five main risks are limited in number (Komarek, De Pinto, and Smith 2020).

Firstly, the findings of this study enrich the literature and encourage researchers to study the five main risks (Harwood et al. 1999) or big risks(Sciabarrasi 2024) or general risks on farms (Hardaker et al. 2004). The synonymous use of terms clearly indicates the role of these five risks in agriculture.

Secondly, the study provides clear evidence of the role of risk analysis on farms. The positive impact of risk analysis on farm businesses in a developing country like Albania is in sync with previous studies, spanning decades, from developed countries (C. B. Barrett, Reardon, and Webb 2001; Haden et al. 2012; Hardaker et al. 2004; Just and Pope 2001; Maddison 2007; Meuwissen, Huirne, and Hardaker 2001).

Thirdly, the study highlights the undeniable role and importance of farmers' experience and farm size. The study's evidence aligns with research from many decades ago (Kimhi 1994) and recent times (Figurek, Morphi, and Thrassou 2023).

Fourthly, the study offers consultancy for farmers in Albania. Based on the results and discussions mentioned above, we suggest: (i) farmers should not neglect legal risks and should consult with economists, lawyers, and attorneys, and (ii) farmers should advance in the use of modern technology to mitigate or avoid the risk of changing climatic conditions and agrotechnical processes. These recommendations align with contemporary studies (Alem 2021; Řezník et al. 2017). However, desires for integration are often accompanied by inefficiency.

Fifthly, the study offers consultancy for government institutions, specifically for the Ministry of Agriculture and Rural Development in Albania. From the above, we suggest: training and informing farmers, certifying production quality (investing in laboratories), creating production brands, raising farmer awareness about the advantages of cooperatives, and monitoring subsidies and allocating them based on performance.

However, the study is accompanied by several limitations. Firstly, the data were collected from farmers' perceptions. Studies have demonstrated that data obtained from interviewees are often distorted and inaccurate (Tourangeau and Yan 2007). Carletto et al. (2015) found that the deviation in research results due to the inaccuracy of farmers' self-reporting ranges from 10-15%. Secondly, the study covers only Albania, and due to dissimilar circumstances, this limits the generalizability of its findings to other countries.

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