Table olive farmers' sources of risk and risk management strategies

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Abstract

Like in all Mediterranean countries, Table olive farming has an important tradition and production potential in western Turkey, and thus it is critical to assess the risk sources and risk management strategies that farmers perceive. This study identifies perceptions of risk sources and managements strategies in the region, clarifying their relative importance, as farmers perceive them, using a survey conducted among 121 selected purposefully farmers. Sociodemographics of farmers and households were identified using basic descriptive statistics, such as arithmetic means and percentages. According to factor loadings, financial and marketing risk sources are most prominent among farmers, and human-induced and production technology issues represent the most important risk management strategies. In table olive production, it will be beneficial to develop strategies such as increasing the number of trees, improving agricultural activities, increasing the awareness level of farmers on issues such as climate change and the use of new technologies.

Keywords: *Olive production, Uncertainties, Sustainability, Rural development, Food security.*

1. Introduction

Due to the nature of agricultural production, managing risk and uncertainty is integral to generating income. Climate change, financial crises, price fluctuations, and uncertainty have become common agendas during plant and animal production, and more generally, during agricultural production. The Covid-19 epidemic, which emerged worldwide during 2020 and remains in effect, further emphasized the importance of agricultural production, with sustainability in agricultural production moving closer to the center of the agenda. Risks have negative implications, especially lower earnings and income, and as a result, dramatic consequences, such as financial collapse, food insecurity, and human health problems, can occur. Anticipating high returns should represent a positive reward for taking risks, and farmers bear many such risks (van Winsen *et al.*, 2013; Wauters *et al.*, 2014; Komarek *et al.*, 2020), including production, price and market, financial, human capital (i.e., personal or idiosyncratic), and institutional risks (Komarek *et al.*, 2020; USDA, 2021a). Environmental risks also belong with these others (Velandia *et al.*, 2009; Adnan *et al.*, 2020).

Duong *et al.* (2019) conducted a literature search for farmers' perceptions of agricultural risks within the framework of the PRISMA protocol, finding that the most important risk sources are air-related issues, biosecurity, human capital, market, financial, corporate, and technology risks. However, the risk management strategies that

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farmers use most are crop and animal diversification, monitoring and prevention of pests and diseases, own off-farm work, agricultural insurance, off-farm investments, debt reduction, adoption of new technologies, development of agricultural production opportunities at minimum cost, expansion studies, cooperatives with other farmers, cooperation with the government and improvement activities, and education and training.

Komarek *et al.* (2020) identify the top five risk sources in agriculture. First in agricultural production are risks to both crop and animal production that arise from biological processes because there exists a relationship between diseases and pests, in conjunction with weather and climatic conditions (e.g., temperature and oil), and among other efficiency limiting and reducing factors, excessive heavy metals and salinity in soil represent salient production risk factors. Second are market risks, especially uncertainties regarding prices, costs, and market access. Unexpected changes to weather and their effects on agricultural income, shocks to energy prices, and asymmetry concerning access to information cause significant volatility in agricultural commodity prices. Developments to international trade, liberalization, and/or protectionism are among other important sources of market risk. Such risk factors also affect market access both positively and negatively in more than one geographical location, and thus processes during which many risks occur at various times, such as increases to prices, weather events, and difficulties encountered when accessing a market, also develop (Holden and Shiferaw, 2004; Harvey *et al.*, 2014; Lazzaroni and Wagner, 2016). Third are risks from changes to policies and regulations implemented by public and/or other non-governmental organizations that operate in the agricultural sector. Legal regulations and social norms are salient to farmers when asked about change, and farmers can be involved variously in support mechanisms by concentrating more on market-oriented production (Harwood *et al.*, 1999). Fourth are personal risks that affect human health directly and mechanisms that affect a farm. Injuries caused by agricultural machinery and diseases, and/or deaths from various causes and the negative effects of pesticides and pests on humans and animals, appear within this scope (Antle and Pingali, 1994; Lopes Soares and Firpo de Souza Porto, 2009; Masuku and Sithole, 2009; Arana *et al.*, 2010; Tukana and Gummow, 2017). Health risks represent prominent causes of changes to agricultural production and thus income (Dercon *et al.*, 2005). Family events (e.g., marriage and divorce), health problems, death, and customary and legal rules also affect agricultural production, and thus, the interaction of personal and organizational risks are also very important (Meinzen-Dick *et al.*, 2014). Fifth are a farm's cash flow, budgeting, income-expense balancing, and fixed and variable financial liabilities within the scope of financial risk (Gabriel and Baker, 1980; de Mey *et al.*, 2016). Fluctuations to interest rates and regulations regarding credit use and conditions also fall under financial risk factors.

Farmers have preferences when managing potential risks, and they commonly use a combination of strategies. Precise analyses regulate only one risk source, and others deal with multiple risk sources, with some strategies more common than others (USDA, 2021b). First, by using business diversification and product modeling, income distributions from different crop and animal productions can be balanced, with optimization achieved when one decreases and another increases. Second, financial leverage ensures optimum use of loans. Greater debt is riskier than some equity. Many factors affect critical instruments, such as optimum leverage, farm profitability, credit cost, risk sensitivity, and tolerance, and the degree of income uncertainty. Third, vertical integration is effective at managing ideal inputs and outputs. A firm with a vertical working system achieves effective time management by holding ownership and control of goods during two or more stages of production and/or marketing. Fourth, contracts reduce risks by securing market prices, and hence sales and other exchange factors, in advance. Contracts that define the price, quality, and volume of a product to be produced and delivered are called marketing or advanced contracts, and those that determine which stakeholders will provide inputs to be used and production processes are called production contracts.

Duong *et al.* (2019) argue that primary risk topics that research assesses include perceptions of agricultural risk sources (Flaten *et al.*, 2005; Morton, 2007; Waage and Mumford, 2008; Bergfjord, 2009; Müller *et al.*, 2011; Morera *et al.*, 2014; Hardaker *et al.*, 2015), risk management strategies (Aldy *et al.*, 1998; Messerli *et al.*, 2006; Atreya, 2007; Lin, 2011; Gillespie and Mishra, 2011; Jin *et al.*, 2015; Ruiz *et al.*, 2015; Gautam *et al.*, 2017), links between perceived risk sources and risk management strategies (Alamerie *et al.*, 2014; Patrick and Ullerich, 1996; Fielke and Bardsley, 2014; Gebreegziabher and Tadesse, 2014; Chang and Tsai, 2015), socioeconomics that affect farmers' risk perceptions and management (Sjöberg, 2000; Hall *et al.*, 2003; Akcaoz and Ozkan, 2005; Flaten *et al.*, 2005; Legesse and Drake, 2005; Stockil and Ortmann, 1997; Botterill and Mazur, 2004; Borges and Machado, 2012; Kisaka-Lwayo and Obi, 2012; Ríos-González *et al.*, 2013; Wheeler and von Braun, 2013; Ullah *et al.*, 2015; Kabir *et al.*, 2016; Kiama *et al.*, 2016; Lu *et al.*, 2017), and barriers to management of agricultural risks (Legesse and Drake, 2005; Mannon, 2005; Panneerselvam *et al.*, 2011; Ilbery *et al.*, 2013; Toma *et al.*, 2013; Gebreegziabher and Tadesse, 2014; Harvey *et al.*, 2014; Awan *et al.*, 2015; Baruwa *et al.*, 2015; Mardero *et al.*, 2015; Ullah *et al.*, 2015; Woods *et al.*, 2017).

On the topic of table olives, few studies assess the risk sources that producers perceive and the risk management strategies available to them. Fleskens (2008) argues that olive plantations in the Mediterranean are generally in sloping and mountainous areas. Increased use of mechanization during table olive cultivation, and both chemical inputs and drip irrigation systems, are leading developments, especially in recent years. Twenty-eight olive plantation systems were created, with regional typologies developed for six study areas, analyzed using cluster analysis, including Tras-os-Montes (Portugal), Cordoba and Granada / Jaen (both in Spain), Haffouz (Tunisia), Basilicata/Salerno (Italy), and Western Crete (Greece). Six olive growing systems were established, including very extensive, conventional comprehensive, semi-intensive low input, semi-intensive high input, dense, and organic. Stroosnijder *et al.* (2008) presented the OLIVERA project, which analyzes the future of olive production systems on sloping land in the Mediterranean basin. The study suggests that existing production systems (known as SMOPS for Inclined and Mountain Olive Production Systems) are being threatened, with sources of risk falling into three categories – environmental (e.g., erosion hazards), social (i.e., youth migration), and economic (e.g., high labor costs). Thus, an unsustainable phenomenon is evident. During the project, an expanded survey was conducted at five facilities in Portugal, Spain, Italy, and Greece, demonstrating the diversity and multifunctionality of SMOPS. Four systems require greater attention in the future – traditional, organic, semi-dense, and intensive. Çukur *et al.* (2011) argue that the most important risk source during olive cultivation is seasonality, with other sources including yield loss, climatic conditions, diseases, and pests. Increasing internal controls, providing technical support for continuity of production, developing olive production systems, and using new techniques and tools are suggested as risk strategies for these risk sources. Northcote and Alonso (2011) outline parameters that underlie diversification of farm activities among olive farmers located in Western Australia. Gomez-Limon *et al.* (2012) analyze the eco-efficiency assessment of olive farms in the Andalusia region of Spain, and Pergola *et al.* (2013) investigate alternative production management for olive groves. Villanueva *et al.* (2014) assess the supply of agricultural public goods in the context of irrigated olive groves in Southern Spain, and Palese *et al.* (2013) argue that for traditional olive cultivation to survive, approaches that increase olive farmers' income should be used, and the multi-functional role of this production system should be accepted; thus, policy tools are inevitable. They propose a sustainable innovation management model that includes recycling of urban wastewater, distribution through drip irrigation systems, and use of soil management techniques based on recycling polygenic carbon resources (e.g., cover crops and pruning material) in olive orchards. Allahyari *et al.* (2017) investigate farmers' technical knowledge on integrated pest management (IPM) during olive production. Arenas-Castro *et al.* (2020) predict climatic changes that might reduce the suitability and production of olive varieties in Southern Spain, with results suggesting that climate change will reduce areas available for important olive varieties, and drier and warmer climatic conditions in summer and autumn will be drivers of change. Gkisakis *et al.* (2020) develop a decision support tool to evaluate the environmental performance of olive production based on energy use and greenhouse gas emissions, an important tool developed to ensure sustainable olive cultivation. Orlandi *et al.* (2020) apply statistical models to determine the most appropriate meteorological variables for olive fruit production in post-pollination periods. Olive pollen time series from 1999 to 2012 were analyzed across 16 Italian provinces, with findings suggesting that although the minimum and maximum temperatures in the spring and summer (i.e., March to August) correlated negatively with olive production, precipitation always had a positive correlation.

On the other hand, although it is defined that there are many production-based studies such as the components that affect the yield and periodicity in the production of both table and olive oil, no evaluation has been made on these literatures with the thought that the focus of the study will be moved away. According to the literature review, it is clarified that a certain number of studies have been carried out to determine risk sources and risk management strategies in olive production. On the other hand, no study is found that reveals the sources of risk in table olive production and the risk management strategies for them in detail and comprehensively. It is thought that this study makes up for this deficiency in the literature, albeit to a certain extent. The current study assesses similarities between the risk sources and risk management strategies that farmers perceive during production of table olives. After the Introduction, the materials and methods used in the study are discussed, followed by results, a discussion of findings, and a conclusion.

2. Materials and methods

2.1. *Study area*

Manisa, Turkey's most important olive producing region, is located in the upper level and has achieved significant specialization in table olive farming (Ozturk *et al.*, 2021). Table olive cultivation in the region represents an important culture and lifestyle. When olive cultivation data from Manisa are examined based on district, the highest production is from Akhisar (Çolak and Çulha, 2020). According to the latest data, 12 table olive varieties were registered and/or applied for PDO (protected designations of origin) and PGI (protected geographical indication) in Turkey (TURKPATENT, 2021), including Akhisar Domat Zeytini, Akhisar Uslu Zeytini, Antalya Tavşan Yüreği Zeytini, Aydın Memecik Zeytini, Aydın Yamalak Sarısı Zeytini, Edremit Körfezi Yeşil Çizik Zeytini, Gemlik Zeytini, Hatay Halhalı Zeytini, Milas Yağlı Zeytini, Samanlı Zeytini, Tarsus Sarıulak Zeytini, and Yarımada Hurma Zeytini. Two varieties of table olives have geographical indication records in the Akhisar region, which is one of Turkey's most important centers of table olive production. Besides being an important source of income, table olive production has become a cultural heritage, tradition, and habit in the region.

2.2. *Data collection*

A survey was administered among 121 olive farmers, and when selecting farmers to participate, attention was paid to a high degree of experience with table olive farming. It is predicted that the preliminary observations and evaluations made in the research area, the survey to be made with 121 table olive producers and the objective results to be obtained from them will produce as objective and realistic findings as possible for the whole region. Thus, this number is thought to have the ability to represent most of the producers in the region. Besides continuous and discrete data, answers and data obtained from the survey questions were collected using yes-no options. Descriptive statistics, such as arithmetic means and percentages, were used during analysis and evaluation of the data. The literature review suggests that no consensus exists regarding the most appropriate methods for determining risk sources and risk management strategies on farms. However, extant studies suggest that rating methods that use Likert-type scales can be applied with precision. Most such studies have farmers rate sources of risk and risk management strategies using a five-point scale (i.e., 1= not important at all; 5=very important) (Aditto *et al.*, 2012). In the current study, a 5-point, Likert-type scale was used to assess risk sources and risk management strategies that producers on table olive farms perceive (i.e., 1=not effective at all; 2=ineffective; 3=unstable; 4=effective; 5=very effective).

2.3. *Analytical approach*

This study uses factor analysis to assess similarities between the risk sources and risk management strategies that farmers perceive. Such risk sources and risk management strategies are discussed and explained in detail. The main reason for presenting this methodology in the study is to reveal the sources of risk and risk management strategies in table olive cultivation, which is the basic setup of the study, in detail and comprehensively. While the method used offers a user-friendly approach, it also offers the opportunity to produce solutions for the strategies created for the future.

2.4. *Determining the risk sources and risk management strategies that table olive farmers perceive*

Principal component analysis (PCA) was used to determine the risk sources and risk management strategies that farmers perceive and reduce them to a smaller number. During evaluation, risk sources and risk management strategies were considered separately using scores from data collected using Likert-type scales. PCA is a type of analysis that reduces many variables to a limited number of groups. Converting groups into new variables maximizes relationships between variables in the groups and minimizes relationships between groups, with the new variables called factors. Factor analysis enables finding new variables that are independent, fewer, more meaningful, and based briefly on many relationships (Lattin *et al.*, 2003; Field, 2009; Karagöz, 2016). During PCA and as part of the Kaiser Normalization transaction, varimax rotation was used to reduce the number of factors in the data (Lattin *et al.*, 2003; Field, 2009; Zhang *et al.*, 2019).

3. Results and discussion

3.1. *Socioeconomics of farmers and/or household members*

Responses that resulted in continuous data included farmers' socioeconomic characteristics (Table 1). Characteristics of farmers whose answers represented discrete data appear in Table 2. The average farmer's age was 54.03, which accords with extant studies (Giourga *et al.*, 2008). Duarte *et al.* (2008) explores what the traditional olive production system means and its definition in OLIVERA (i.e., Tras-os-Montes - Portugal, Cordoba and Granada / Jaen - Spain, Basilicata / Salerno - Italy, and West Crete - Greece). Twenty-four sloping and mountainous olive production systems (SMOPS) were defined during the OLIVERO project, which suggested that farmers of traditional SMOPS are older, about 50 years old. The average number of people living in a household was 3.38, and the average number of people engaged in agriculture in the household

Table 1 - Socioeconomic characteristics of farmers and/or households.

Variable	*Description*	*Mean*	*SD*	*Min*	*Max*
AGE	Year	54.03	11.69	27	80
HM	Household members	3.38	1.32	1	9
IHWA	People in household who work in agriculture	1.76	0.97	1	5
AE	Agricultural experience	33.12	14.99	1	70
OFE	Olive farming experience	36.07	49.11	3	55
SOFL	Size of olive-farming land	56.40	53.98	5	300

Table 2 - Socioeconomics of farmers indicative discrete data.

Variable	*Description*	*Frequency*	*Percent*
ED	Education		
	1: Literate	0	0.0
	2: Primary school graduate	67	55.3
	3: Middle school graduate	22	18.2
	4: Lycee graduate	25	20.7
	5: High school graduate	1	0.8
	6: Undergraduate and graduate	6	5.0
NAI	Non-agricultural income		
	0: No	72	59.5
	1: Yes	49	40.5
FRK	Farmers' recordkeeping		
	0: No	56	46.3
	1: Yes	65	53.7
MFC	Membership in a cooperative		
	0: No	31	25.6
	1: Yes	90	74.4

was 1.76. Agricultural production experience of farmers was 33.12 years, and experience with olive farming was 36.07 years. The average size of land on which olive farming was conducted was 56.40 decares (1 decare=1000 m^2), varying from 5 to 300 decares. Studying olive oil farmers in the western region of Turkey, Artukoglu (2002) reports similar results. Similar results were also found in Greece (Giourga *et al.*, 2008), and Berg *et al.* (2018) also reports similar findings.

Sixty-seven of the farmers (55.3%) were primary school graduates, 22 (18.2%) were secondary school graduates, and 25 (20.7%) were high school graduates. Six (5%) were undergraduate and graduate degree holders. The education of most of the farmers was thus low. These results accord with many studies conducted in Mediterranean countries (Artukoglu, 2002; Ligvani and Artukoğlu, 2015; Rodríguez Sousa *et al.*, 2020). Forty-nine (40.5%) of the olive farmers had non-farm income, and 72 (59.5%) explored non-farm income, similar to results from Giourga *et al.* (2008), EC (2012). Non-agricultural income earning status on farms was positive in terms of rising farm incomes but was negative in terms of decreasing concentration on olive production. During farm management, good recordkeeping provides optimal management, including for tax purposes. Using financial records and appropriate methodologies offers ideal assistive tools in achieving business profitability. Recordkeeping and optimal interpretation of data help identify the weakest links of a farm business's operation, and allows corrective actions (Arzeno, 2004). Sixty-five (53.7%) of the farmers kept records of their agricultural activities, and 56 (46.3%) did not have any agricultural registration system. Keeping records of agricultural production is important in terms of ensuring sustainability during agricultural production. Although not at a desired level, these figures are important and sufficient.

Recordkeeping in farm management is very important. Ninety (74.4%) olive farmers were members of a cooperative, and the remaining 31 (25.6%) were not. Most olive producers are members of a cooperative, making positive contributions to innovation, support mechanisms, and agricultural activities. Cooperative membership is high; in SMOPS CO1, it is 88% (Metzidakis, 2004), and in Granada/Jaen 90% (Duarte, 2005a; Fleskens, 2007). Of farmers surveyed in Basilicata/Salerno, nearly all were members of a cooperative, and the most important reason for membership was qualifying for CAP subsidies (Duarte, 2005b; Fleskens, 2007).

3.2. *Risk sources and risk management strategies perceived by table olive farmers*

3.2.1. *Sources of risk*

Twenty-seven risk sources were considered in olive farming, and expressions belonging to a risk source were created from items scored using a Likert-type scale. The arithmetic means, ranks, and standard deviations of the expressions appear in Table 3. During factor analysis, a high correlation between variables is ideal, calculated using the Barlett test and evaluated using the degree of significance ($p<0.01$). High correlations between variables were evident, and thus data came from multiple normal distributions. Results were adequate since the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and chi-square (χ^2) were 0.656 and 1495.103, respectively. Therefore, the sample size was sufficient to determine risk sources in the study. Common variance (i.e., communality) represents the variance a variable shares with other variables. Variables with factor loadings of 0.5 or greater were included during analysis, and the remainder were excluded. Since factor loadings for all items were greater than 0.5, all were included during analysis (Hair, 2006).

Explained total variance and eigenvalues before and after rotation were examined, identifying 8 factors from evaluation results. Cumulative variance explained by the eigenvalues was 68.74% of total variance. In a scree plot shown in Figure 1, the 8 factors were chosen because there were 8 factors with eigenvalues of one and

Table 3 - Identification of risk sources.

Item	*Mean*	*SD*	*Rank by mean*
Drought	4.55	0.82	5
Excessive rainfall	3.95	1.96	17
Hail	4.53	0.84	7
Storm	3.55	1.28	18
Frost	4.33	1.15	13
Earthquake	1.59	1.05	25
Theft	2.51	1.49	24
Bird and wildlife damage	1.50	0.90	26
Certified nursery supply	2.83	1.49	23
Pests (diseases and insects)	4.20	1.08	14
Unconscious use of inputs (chemical pesticides and fertilizer)	4.13	1.14	15
Unconscious use of water	3.97	1.23	16
Breakdown and malfunction of agricultural machines	3.09	1.40	22
Insufficient family workforce/young generation abandoning agriculture	4.71	0.65	1
Inability to use information technologies	4.27	1.00	13
Difficulties with finding foreign labor	3.54	1.41	19
Agricultural work accidents	3.22	1.33	21
Market uncertainty and instability	4.70	0.69	2
Low selling price	4.70	0.67	2
Increase in input prices	4.67	0.69	3
Logistics	3.35	1.47	20
Distrust between farmer and buyer	4.45	0.93	10
Economic crisis expectation	4.54	0.82	6
Borrowing	4.49	0.88	8
Failure to repay debts	4.48	0.86	9
Uncertainty of future interest rates	4.59	0.73	4
Volatility in exchange rates	4.40	0.86	11

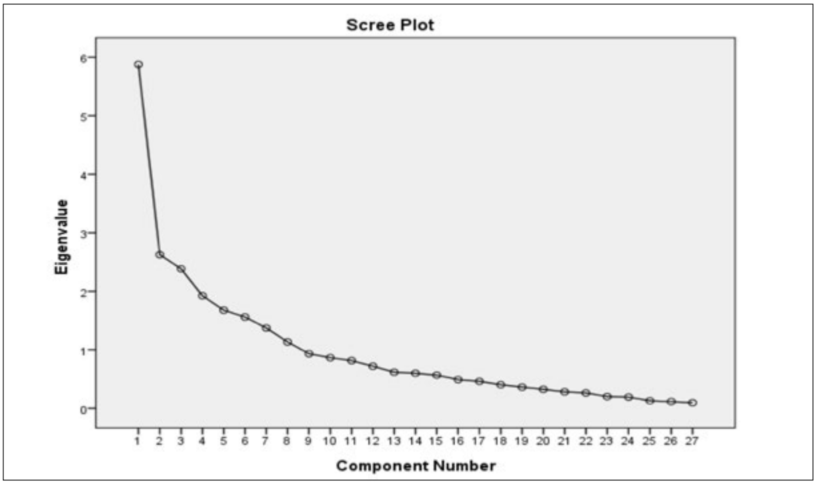

Figure 1 - Scree plot of risk source factors.

Table 4 - Varimax-rotated factor loadings of risk sources.

Item	*Factors*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Commu-nality*
Uncertainty of future interest rates	0.814								0.709
Borrowing	0.806								0.691
Volatility in exchange rates	0.803								0.724
Economic crisis expectation	0.801								0.681
Failure to repay debts	0.796								0.738
Insufficient family workforce/young generation abandoning agriculture	0.488								0.633
Low selling price		0.860							0.765
Increase in input prices		0.814							0.734
Market uncertainty and instability		0.796							0.758
Unconscious use of inputs			0.873						0.830
Unconscious use of water			0.815						0.788
Pests			0.794						0.709
Excessive rainfall				0.776					0.792
Storm				0.709					0.634
Inability of the farmers to use IT				0.539					0.614
Breakdown and malfunction of agricultural machines				0.535					0.589
Drought				0.532					0.620
Hail					0.810				0.747
Earthquake					0.648				0.674
Frost					0.610				0.677
Logistics						0.780			0.721
Distrust between farmer and buyer						0.653			0.565
Agricultural work accidents						0.540			0.612
Theft							0.715		0.579
Certified nursery supply							0.614		0.538
Bird and wildlife damage							0.601		0.786
Difficulties with finding foreign labor								0.775	0.650

greater (λ≥1). The rotated component matrix and communalities appear in Table 4.

According to the factor loadings, general financial risk sources comprise the first group. In this group and unlike sources of financial risk, in the human-induced risk category there was only the insufficiency of the family workforce and abandonment of agriculture by the younger generation. The second group comprised general marketing risk sources, and the third comprised diseases and insects (pests) and unbalanced input and water use. Other risk sources included excessive rainfall, storms, a farmer's inability to use information technologies, and breakdown and malfunction of agricultural machines during work. Drought comprised a fourth group. Drought, hail, and frost comprised the fifth group, and logistics, distrust between farmers and buyers, and agricultural work accidents comprised the sixth. The seventh group included theft, certified nursery supplies, and bird and wildlife damage, and difficulties with finding foreign labor comprised the eighth group. These findings accord with extant studies from Patrick *et al.* (1985), Martin (1996), Flaten *et al.* (2005), and Aditto *et al.* (2012). Such studies suggest that fluctuations to product and input prices represent the most important risk sources that farmers perceive, especially when integrated with marketing risks.

Boggess *et al.* (1985) assess farmers' risk awareness regarding crop and livestock production systems in Northern Florida and Southern Alabama, finding that farmers define risk as the likelihood of an adverse outcome. Concerning plant production, precipitation variability, pests and diseases, and product price variability represent primary risk sources. Regarding animal husbandry, animal diseases are perceived to be the most important risk sources during animal production, in addition to animal and animal product prices, and weather variability. Patrick *et al.* (1985) assess risk perceptions and farmers' attitudes toward risk, conducted among farmers of mixed crops and livestock in the United States. Findings suggest that unexpected circumstances, such as weather conditions, output prices, and input costs, represent major sources of risk during both crop and livestock production.

Martin (1996) used a nationwide postal survey to examine the risk sources and risk management strategies of New Zealand farmers, assessing whether farmers perceive marketing risk (e.g., volatility in input and output prices) to be a major risk source. In contrast, production risks, such as precipitation and operating within the scope of agricultural control activities, were assessed from a variety of perspectives, depending on geographic region, type of farm activity, and crop. Pellegrino (1999) examines Argentinian rice farmers' perceptions of risk sources and risk management responses, finding that across small, medium, and large farms, farmers' awareness of risk sources varies. A farm's size thus determines such perceptions, with small farm owners having greater production risk awareness than those in the other two groups.

Meuwissen *et al.* (2001) found that price and production risks represent the most important risk sources in livestock farms that operate in the Netherlands, and agricultural insurance was reported as the most important risk management tool. Flaten *et al.* (2005) examine the risk perceptions and reactions of farmers in traditional and organic dairy farms that operate in Norway, finding that institutional and marketing risks, including government support policies, represent the most important risk sources in organic dairy farming. Hall *et al.* (2003) found that drought and meat price volatility represent major risk sources among cattle farmers in Texas and Nebraska. Nicol *et al.* (2007) found that large-scale South African sugar cane farmers perceive that land reform regulations, labor legislation, and crop price volatility are major risk factors. Çobanoğlu *et al.* (2015) defined major risk resources in earthen pond fish farming in Turkey, finding that the most important sources of risk are production and operational, market and price, financial, political and social, and personal risks.

Chand *et al.* (2018) conducted a survey to assess farmers' perceptions of risk sources in animal husbandry, finding that increasing feed costs, extreme weather conditions, and delays in veterinary services represent primary risk sources. Iqbal *et al.* (2018) examined farmers' perceptions of risk sources in cotton production in Pakistan, finding that frequent changes to agricultural policies, farm equipment prices, and inefficiencies in farm cooperatives are primary constraints. Karadas and Birinci (2018) conducted a factor analysis to assess risk sources in bee farming that create financial risks, finding concern in the presence of biotic stressors and theft in Turkey. Thompson *et al.* (2019) used a best-worst choice experiment among farmers to assess the importance of types of risk in large commercial U.S. farms, finding that production, market, and financial risks are of greater concern than are personal or legal risks. Komarek *et al.* (2020) identified 3,283 peer-reviewed studies published between 1974 and 2019 that address one or more of the five types of risks in agriculture (i.e., production, market, corporate, personal, and financial), with results suggesting that 66% of the studies focus solely on production risks, and only 15% on more than one type. Only 18 studies considered all five types of risks, assessing either how farmers perceive the significance of each risk or focusing on conceptual issues, rather than assessing how exposure to all risks quantitatively affects farm indicators, such as yields and income.

3.2.2. *Risk management strategies*

Twenty-three risk management strategies are considered in this study, with statements related to such strategies assessed using scores obtained from Likert-type scale. Arithmetic means, ranks, and standard deviations of the statements appear in Table 5. Using factor analysis, high correlations between variables were examined, assessed using the Barlett test and its degree of significance ($p<0.01$). High correlations between variables were evident, and thus data came from multiple normal distributions, an adequate result since the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and chi-square (χ^2) were 0.678 and 1046.299, respectively. The sample size was thus sufficient to define the risk management strategies in the study. Common vari-

Table 5 - Defining risk management strategies.

Item	*Mean*	*SD*	*Rank by mean*
Taking out agricultural insurance	3.97	1.28	12
Renting assets such as land, machinery, and equipment	2.71	1.32	19
Repair or renewal of agricultural machinery after a period	3.62	1.23	15
Using certified nurseries	3.16	1.46	16
Determining input use levels in appropriate amounts (chemical pesticides and fertilizers)	4.34	0.93	5
Efficient use of irrigation systems	4.40	0.89	4
State encouragement of young farmers to agricultural production, and agricultural training and demonstration studies	4.26	1.24	7
Accessing information using IT	4.40	0.89	4
Working with an educated workforce that is expert in its field, has appropriate skills and experience	4.41	0.97	3
Ensuring worker safety	3.92	1.07	13
Sales spread throughout the year	4.23	1.08	8
Personal storage (pool)	4.11	1.09	10
Licensed warehouse system	3.69	1.20	14
Cooperative and farmer organization	4.26	1.15	7
Direct selling (without brokerage firm)	4.40	0.99	4
Contractual agricultural production	3.62	1.38	15
Debt reduction	4.45	0.86	2
Insurance against financial losses	4.19	1.01	9
Planning expenses	4.54	0.68	1
Regulation of investments	4.33	0.91	6
Keeping financial records	4.07	1.13	11
Out-of-business investment	3.07	1.43	17
Work outside agriculture	2.88	1.44	18

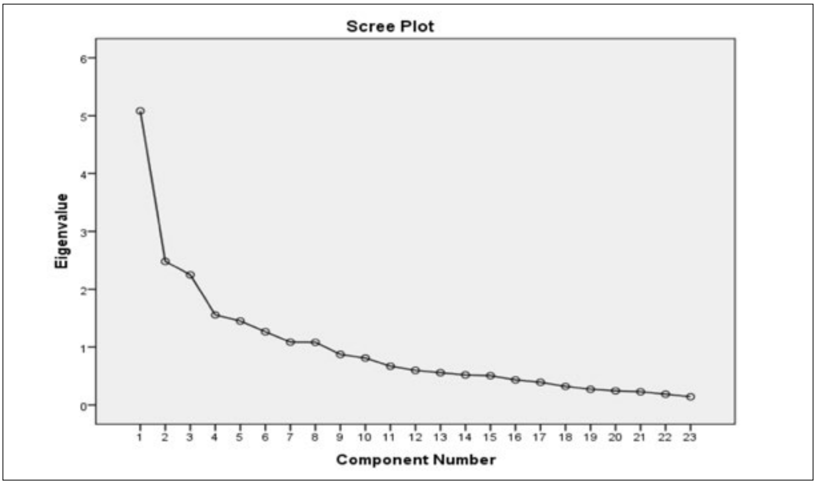

Figure 2 - Scree plot of risk management strategy factors.

ance (communality) represents the variance that a variable shares with other variables. Those with a factor loading of 0.5 or greater were retained, and those less than 0.5 were excluded. Since all factor loadings were greater than 0.5, they were all retained for analysis (Hair, 2006).

Explained total variance and eigenvalues before and after rotation suggested 8 factors from evaluation outcomes. Cumulative variance explained by the eigenvalues was 70.66% of the total variance. From a scree plot (Figure 2), the 8 factors were selected because there were 8 factors with eigenvalues of one and more ($\lambda \geq 1$). The rotated component matrix and communalities appear in Table 6.

Several inferences are warranted based on the factor loading results. Statements such as accessing information using information technology, state encouragement of young farmers to agricultural production and agricultural training and demonstration studies, working with an educated workforce that is expert in its field, has appropriate skills and experience, ensuring the safety of workers comprised the first factor, and efficient use of irrigation systems, determining the input use levels in appropriate amounts, repair or renewal of agricultural machinery after a certain period, and using certified nurseries comprised the second. The first factor includes strategies recommended for human-induced risks in general, and the second includes recommended strategies for risks related to production technology. The third factor included debt reduction, insurance against financial losses, and renting assets such as land, machinery, and equipment, and the fourth included keeping financial records, planning expenses, and regulation of investments. Among the third and fourth factors, there were risk management strategies related to production technology and strategies recommended for financial risks. The fifth factor included work outside agriculture and out-of-business investment expressions, and the sixth included sales spread throughout the year and personal storage (i.e., pools). These two groups comprised strategies for financial and marketing risks. The seventh factor group comprised licensed warehouse system, taking out agricultural insurance, and cooperative and farmer organization, and the eighth group comprised direct selling (i.e., without a brokerage firm) and contractual agricultural production. These last two groups comprised strategies for marketing risks.

Results from this study corroborate results from extant studies. Boggess *et al.* (1985) and Patrick *et al.* (1985) propose expressions such as improving investments, access to the most ideal and up-to-date market information, and entrepreneur differentiation as risk management strategies in the United States. Meuwissen *et al.* (2001) argue that management of production costs and improvement to insurance schedules are the most appropriate risk management strategies among livestock farmers. Flaten *et al.* (2005) recommend risk management strategies for farmers on organic and conventional cattle dairy farms in Norway, including improving farm cash flow,

Table 6 - Varimax-rotated factor loadings of risk management strategies.

Item	*Factors*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Commu-nality*
Accessing information using IT	0.819								0.755
State encouragement of young farmers to agricultural production, and agricultural training and demonstration studies	0.697								0.667
Working with an educated workforce that is expert in its field, has appropriate skills and experience	0.696								0.602
Ensuring worker safety	0.574								0.631
Efficient use of irrigation systems		0.837							0.750
Determining input use levels in appropriate amounts (chemical pesticides and fertilizers)		0.828							0.777
Repair or renewal of agricultural machinery after a period		0.631							0.696
Using certified nurseries		0.561							0.608
Debt reduction			0.776						0.719
Insurance against financial losses			0.766						0.764
Renting assets such as land, machinery, and equipment			0.420						0.537
Keeping financial records				0.823					0.717
Planning expenses				0.725					0.736
Regulation of investments				0.685					0.774
Work outside agriculture					0.873				0.813
Out-of-business investment					0.855				0.764
Sales spread throughout the year						0.813			0.760
Personal storage (pool)						0.707			0.615
Licensed warehouse system							0.820		0.762
Taking out agricultural insurance							0.656		0.669
Cooperative and farmer organization							0.582		0.722
Direct selling (without brokerage firm)								0.726	0.747
Contractual agricultural production								0.725	0.767

preventing diseases, buying farm insurance, and improving production costs. Martin (1996) offers an ideal risk management strategy for farmers in New Zealand to reduce risk, arguing that it might vary significantly depending on the nature of the product, market structure and conditions, farmer characteristics, and dynamic risk regulation rules.

Kisaka-Lwayo and Obi (2012) introduce major traditional risk management strategies that are primarily at the first levels, including product diversification, precautionary savings, and participation in social networks. Using a comprehensive literature review, Duong *et al.* (2019) identify statements that represent what farmers perceive to be the most important risk management strategies, including diversification of plants and animals produced (i.e., differentiation in product patterns), monitoring and prevention of diseases and pests, development of off-farm business opportunities, farm insurance, debt reduction, adoption of new technologies, lowest cost production, improvement of extension services, working with other farmers, increasing cooperation opportunities, creating opportunities for good cooperation with the government, and increasing education and adaptation.

Lubben (2020) offers extension risk management education (ERME) so that producers can develop various risk management strategies against excessively increasing prices of agricultural products and highly variable effects of Covid-19 in the United States. After a comprehensive survey conducted among producers, four topics emerged, including focusing on marketing (i.e., hedging), farm programs, crop insurance, and price levels. Most participants reported that price, profitability, and cost control will be the most important issues over the next 10 years. Important and dynamic recommendations should thus be created by focusing on the negative effects that Covid-19 created and/or might cause on agricultural production. In the United States and with Farm Income Protection (WFRP) as a new policy, a risk management safety net has been created for all goods under a single insurance tool, and the system is available in all territories across the country. The insurance scheme covers all insured income of up to $8.5 million, including farms with private or organic produce (e.g., both crop and livestock production) and local, regional, farm-protected, private, and direct farms capable of marketing their products (USDA, 2021c).

Boháčiková *et al.* (2021) report that in Slovakia, agricultural production is managed by commercial insurance, which does not cover all risks and losses adequately. In case of catastrophic damage and special events, private support from the state budget and insurance premium support for vineyards are available. Most farmers try to compensate for income losses with direct payments, and thus the study suggests that Slovak agriculture has much to learn about establishing risk management at the national and farm levels. Loriz-Hoffmann (2021) introduced the Common Agricultural Policy (CAP) principal framework and financial instrument, including risk management tools, in which the Paris Climate Agreement, the Sustainable Development Goals, and political priorities of the Commission are discussed. Economic, environmental, climatic, and social components included in specific purposes can be viewed as a kind of risk management strategy. As an economic factor, it ensures sustainable farm income and security within the Union, encourages market orientation and competitiveness, gives importance to research, technology, and digitalization, and improves the position of farmers in the value chain. Regarding environmental and climatic conditions, it contributes to climate change adaptation, accelerates sustainable development of soil, water, and air, manages natural resources, contributes to biodiversity protection, improves ecosystem services, and protects habitats. As a social principle, it makes rural areas attractive to young farmers, establishes jobs in rural areas, and develops rural areas, including bio-economies and sustainable forestry.

4. Conclusions

Manisa is the top producer of table olives across Turkey's Akhisar district, and its farmers variously perceive resources and risk management strategies. This study assesses factors that contribute to decisions regarding agricultural insurance, which represents an important risk management strategy tool. Findings suggest that farmers' recordkeeping, memberships in cooperatives, and the size of an olive farm affect the probability of buying agricultural insurance. According to factor loadings, financial risk sources represent the first factor group. Unlike sources of financial risk, in the human-induced risk category, only one factor exists—an insufficient family workforce and agricultural abandonment by the younger generation. The second group comprises sources of marketing risk, including risks related to production technology as risk management strategies.

The risk factors that farmers perceive and their risk management strategies overlap, but the rapid spread of Covid-19 worldwide during the first quarter of 2020 led to significant changes to producer behaviors and expectations. It is thus not difficult to predict that rapid and continuous increases to agricultural inputs and product prices will represent bottlenecks for both farmers and consumers soon. To allow farmers to continue to grow table olives and meet consumer expectations, especially worldwide, requires development of risk management strategies in Turkey.

The Akhisar region and the Mediterranean Basin have cultural and historical habits related to table olive farming. As with other types of agriculture, table olive farming has versatile dimensions such as multifunctionality, sustainability, and geographical indication, providing farmers with sustainable income. Farmers use the most appropriate risk management strategies by prioritizing them against the risk sources that they perceive (e.g., risks related to production technology, human-induced risks, marketing risks, and financial risks). That process will likely become much more difficult and complex soon, and it would thus be beneficial for future research to analyze possible changes in-depth, especially regarding the effects of Covid-19.

The role of TARSİM (insurance of agriculture) should be increased in the production of table olives in the research region and throughout Turkey, the risk sources perceived by the producers and their risk management strategies. The full package includes many insurance products such as flood and flood, fire and landslide, storm, and the risk of frost is optional. Income protection insurance, which was used for the first time by TARSİM in 2021-2022, is very important. Although it is currently used as a pilot study in only one province and wheat, it is considered that the development of this insurance product to include table olives in the following processes will play an important role in the formation of agricultural policies and shaping agricultural supports.

In TARSİM, the government support for the premium generated in crop insurance is 50%, and in case of the occurrence of adverse risk sources such as drought and climate change, the government support provided to the premium can increase to 2/3. It can be stated that this solution tool also offers an important innovative approach.

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