

Environmental and business risk management perceptions and preferences: evidence from snowball sampling of Turkish avocado producers

Percepcija okolišnog i poslovnog rizika i preferencije prema strategijama za upravljanje rizikom - prikaz rezultata na uzorku proizvođača avokada u Turskoj primjenom tehnike snježne grude

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ABSTRACT

The booming popularity of avocado production has given a poor environmental reputation in various parts of the world. The increase in avocado production has also been observed in Turkiye, where the area under cultivation and the production volume of avocados have increased recently. The main objective of the paper is to identify the perceptions of production, environmental and business risks, to study the risk management strategies that farmers consider the most important, and display the gross margin calculation of avocado production in Turkiye. Interviews were conducted with a selected sample of fifteen farms (cases) from the Mediterranean region of Turkiye to determine risk perceptions, risk management strategies and collect data for the rapid calculation of business results of avocado producers. Interview data were analysed using descriptive statistics, and avocado calculation using gross margin. The major production risks were strong winds, fungal attack, and sunburn, while robbery, changes in agricultural policies, and lack of information and uncertain supply for export were the major business risks. The major environmental risks are depletion of water sources. Farmers' most preferable risk management strategies for sustainable avocado production in Turkiye were windbreaks, shade nets and latex coatings, farm insurance, safety and security systems, and strengthening farmer cooperatives. The main environmental risk management strategies were water management, sub-tree irrigation, and the use of technical applications for irrigation. Avocado production in Turkiye is a promising market, but only under the condition of holistic value chain management and an enabling environment that includes national producer associations, sustainable certification systems, and government control of water use and deforestation.

Keywords: avocado production, risk management, risk perception, environmental risks, risks

SAŽETAK

Rastuća popularnost proizvodnje avokada stvorila je lošu reputaciju u raznim dijelovima svijeta u pogledu okoliša. Povećanje proizvodnje avokada također je primijećeno u Turskoj, gdje su nedavno povećane površine i količina proizvodnje. Glavni cilj rada je utvrditi percepciju proizvodnih, okolišnih i poslovnih rizika i istražiti strategije za upravljanje rizicima koje poljoprivrednici smatraju važnim, te prikazati pokriće varijabilnog troška proizvodnje avokada u Turskoj. Intervjui su provedeni među 15 poljoprivrednika (slučajeva) iz Turske mediteranske regije kako bi se utvrdila percepcija rizika, strategije upravljanja rizicima i prikupili podaci za brzi izračun poslovnih rezultata proizvođača avokada. Podaci intervjua analizirani su pomoću deskriptivne statistike, a kalkulacije pomoću pokrića varijabilnog troška. Glavni rizici u proizvodnji

su jaki vjetrovi, gljivični napadi i ožegotine od sunca, dok su pljačka, promjene poljoprivredne politike i nedostatak informacija te nesigurnost opskrbe glede izvoza glavni poslovni rizici. Značajni okolišni rizici su iscrpljivanje izvora vode i krčenje šuma. Glavne strategije upravljanja rizicima poljoprivrednika za održivu proizvodnju avokada u Turskoj su vjetro zaštitni pojasi, mreže za zasjenjivanje i prevlake od lateksa, poljoprivredno osiguranje, sustavi za zaštitu i sigurnost, jačanje poljoprivrednih zadruga. Najvažnije strategije upravljanja okolišnim rizicima su upravljanje vodama, navodnjavanje podstabala, korištenje tehnoloških aplikacija za navodnjavanje. Proizvodnja avokada u Turskoj obećavajuće je tržište, ali pod uvjetima holističkog upravljanja vrijednosnim lancem i poticajnog okruženja uključujući nacionalno udruženje proizvođača, održive sheme certificiranja i vladinu kontrolu korištenja vode i krčenja šuma.

Ključne riječi: proizvodnja avokada, upravljanje rizikom, percepcija rizika, okolišni rizici, rizici

INTRODUCTION

Native to the Americas, the avocado (*Persea Americana*) is a buttery fruit with a large seed inside (Schaffer et al., 2013; Me and Arzate-Fernández, 2010). For a variety of reasons, including advertising and marketing strategies (Shepherd, 2013), policy initiatives (U.S. Customs and Border Protection, 2014), technological and agricultural improvements (Munhuwey et al., 2020), its versatility for many diets (Robbins et al., 2012), and the influence of social media (Linkfluence, 2020), avocado is gaining more attention from consumers.

Avocado production has increased significantly worldwide over the past two decades. For example, while the total area under avocado cultivation was 329,000 hectares (ha) in 2000, it increased to 807,469 hectares (ha) by 2020, a 2.45-fold increase (FAO, 2022).

Avocado cultivation trials in Türkiye were first conducted in 1970 with the support of the Food and Agriculture Organization of the United Nations (UN FAO). Recently, avocado cultivation has spread after the adaptation of varieties to the Türkiye Mediterranean coast (Bayram, 2012) (Figure 1).

The production volume of avocados in Türkiye has increased more than tenfold in the last fifteen years (TÜİK, 2022). This trend parallels the total harvested area. In 2010, it was 146 ha and reached 1264 ha by the end of 2020 (Özdal, 2021).

The leading exporters of avocados are Mexico and Peru, while the major importers are the United States of America and the European Union (e.g. Poland and France) (FAO, 2022). The Netherlands, the leading trader of avocados in Europe, is a non-producing exporter (Center for the Promotion of Imports, 2021; FAO, 2023a). Türkiye mainly imports avocados from Kenya, South Africa, and Peru during the off-season. In addition, Türkiye's exports are mainly to Russia, Ukraine, Bulgaria, and Romania (International Trade Center, 2022).

The massive production of avocados has raised environmental and socioeconomic concerns in various parts of the world. For example, in Michoacán, Mexico, avocado production has negatively impacted forests, as farmers have converted 30-40% of forests to make way for avocado orchards (Mondragón and López-Portillo,



Figure 1. Avocado production distribution in terms of quantity by cities in Türkiye (Source: Özdal, 2021)

2020). In addition, drug cartels in Mexico are involved in the avocado business and threaten and extort avocado farmers (Dehghan, 2022). Chile has experienced severe drought due to the intensive irrigation needs of avocado plantations (Facchini and Laville, 2018).

Environmental issues, climate change, competition, and volatile markets are becoming increasingly important to farmers in the EU (Meuwissen et al., 2022). The Common Agricultural Policy recognizes the importance of strengthening a resilience approach that assumes farms are able to adapt, transfer, and respond to environmental challenges. In addition to European policies (e.g., agri-environmental programs), farmers tend to adopt environmentally sustainable practices (Meuwissen et al., 2022). However, declining profit margins in the global marketplace, natural resource depletion, and complex environmental issues are affecting farmers' business. To address this, policies must be flexible enough to support farmers through various long-term sustainability transitions. The goal of such a policy would be to restore soil health, water availability, and biodiversity (Meuwissen et al., 2022).

In addition to environmental aspects, business risks and the financial situation of avocado farmers should also be considered to ensure sustainable production. Therefore, main objectives of the study are: (a) assess the perception of production, environmental and business risks of avocado producers in Turkiye, (b) estimate the gross margin of avocado crop and (c) examine the risk management strategies and resilience of avocado producers' in Turkiye.

MATERIALS AND METHODS

The study is descriptive and exploratory. A case study methodology was used. Case studies may include single or multiple cases and multiple levels of analysis. They usually combine data collection techniques such as archives, interviews, observations, and questionnaires. The data can be either qualitative or quantitative, and in some cases a combination of both (Eisenhardt, 1989). In our study, we conducted case study interviews using

the snowball system, which is not based on probability. The reason for snowball sampling is the small number of avocado producers in Turkiye and especially in the Mediterranean part (mainly Antalya and Mersin as regions with the highest number of avocado farmers), where the survey was conducted. On the other hand, the authors made efforts to collect as much information as possible from the producers. For our research, we needed a unique, informative case of avocado farmers to evaluate their farm management strategies. Farmers are generally difficult to interview and rarely have orderly bookkeeping.

The exact number of avocado producers in Turkiye is not known due to the fact that it is a relatively new crop and small percentage of avocado producers. Thus, this analysis included fifteen avocado farmers (cases) in the Mediterranean region of Turkiye, of which only five structured interviews were conducted in person to collect financial data for gross margin calculations.

Through this study, we achieve not so much generalization to a larger population, but a deeper understanding of the avocado gross margin budget and resilience of avocado production in Turkiye.

The interview questions included five different parts: a) general questions about the farm, b) questions about the risks of avocado production in terms of production, business and environment, c) questions about risk management strategies, d) questions about the resilience of avocado farmers, e) questions about gross margin analysis. The study draws heavily on the SURE-Farm project (Towards Sustainable and RE-silient EU FARMing systems) (Spiegel et al., 2019).

Part (a) contained both open-ended and closed-ended questions to obtain data on farmers' personal experiences with avocado production. Parts b, c, and d consisted of questions with a 5-point Likert scale. These parts provided quantitative data on risks, risk management strategies, and resilience of avocado farmers. The last part contained gross margin data. These data came from the five farmers who were met in person.

To calculate gross margin, variable costs were subtracted from gross revenues (Equation 1).

$$\text{Gross Margin [monetary value per ha]} = \text{Gross revenues} - \text{Variable costs} \quad (1)$$

Variable costs included planting materials, fertilizer, pesticides, irrigation, machinery, land rent, insurance, fuel, taxes, overhead, and labor. Sales price and sales volume values provided data to calculate gross revenue. The gross margin was calculated using average data from the five farmers who participated in the face-to-face interviews. Finally, to allow comparison with other countries, gross margin was calculated by dividing gross profit by gross revenue (Equation 2).

$$\text{Gross Margin Ratio [\%]} = (\text{Revenue} - \text{Cost of Goods Sold}) / \text{Revenue} \quad (2)$$

RESULTS

Qualitative Results of case study approach

The average age of interviewed avocado farmer was 53 years old ranged from 36 to 70 years. The average orchard size was 1,55 hectares having 343 avocado trees per hectare. And the average age of orchards was 9.1 years.

Avocado farmers were generally very satisfied with the profitability of avocado production. They considered the avocado to be a commercially valuable product. They rated avocado cultivation as low maintenance, with low labor and pesticide requirements. 87% of the farmers rated the impact of avocado cultivation on their income as positive.

Some farmers have converted their citrus, plum, apricot, mulberry, and olive plantations into avocado plantations. The farming method of the farmers in the sample was 20% organic and the rest conventional. The main harvest period for most farmers was between September and January. Twelve farmers sold their products through wholesale, four through e-commerce, four through the local market, and two through farm-gate sales (Figure 2). The authors emphasize that respondents could choose multiple sales channels.

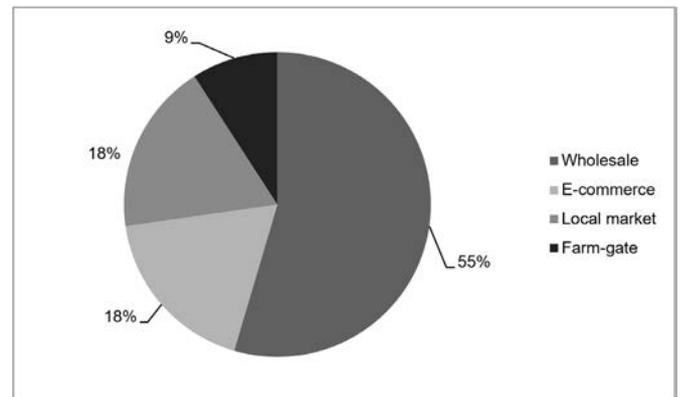


Figure 2. Avocado sales channels in Turkiye

More than half of the farmers used drill water for irrigation. Those who used water from open canals followed with 25%. A few of them used natural spring water and one used well water.

Almost all farmers used drip irrigation in their avocado plantations. Some of them also combined it with sprinkler systems. However, none of them used a technical application or program to schedule irrigation schedules. Before avocado cultivation, the land was covered by different vegetation: citrus or other fruits, including strawberries forest, limestone quarries, or empty.

Almost all farmers had other agricultural products as a secondary income. The most common alternative product was bananas, followed by citrus. In addition, some of the farmers grew other tropical fruits. These included mango, nagami kumquat, papaya, lime, passiflora, sweetsop, dragon fruit, Cape gooseberry, and carambola.

All avocado farmers believed that avocado production is very environmentally friendly.

The most frequently mentioned disease was "root rot" due to fungal pathogens. The other disease factors they had to contend with were scab, acari, thrips, lacewings, red spider mites, armored scale insects, mites, sunburn, nematodes, and rat damage.

Quantitative Results on Risk Perception and Risk Management Strategies

Quantitative outcomes include the measurement of risk perception and the application of risk management

strategies. Descriptive statistics and gross margin budgets of avocado production are presented and analyzed.

Perception of Production Risks

Table 1 shows the sources of risk in production perceived by farmers. For ease of reference, the sources of risk can be categorized as low risks from 0.00 to 1.99 to high risks from 3.40 to 5.00. Risk ratings ranged from 4.58 to 1.42 on the Likert scale from 1 to 5.

High wind was the highest source of risk to production, with an average score of 4.58, a standard deviation of 0.51, and a mode of 5. Fungal attack and sunburn followed with average scores of 3.42 and 3.25, respectively. Sunburn, diseases, and soil compaction were rated as medium to high sources of risk. Frost, hail, weeds, and wetness lasting longer than forty-eight hours were rated by farmers as medium risks. They also perceived salinity, rats, low temperatures, and birds as low to medium risk sources. Finally, farmers considered herbicide damage, physical damage during harvest, insects, and bats as low sources of risk.

Perception of business and export risks

Business and export risks were divided into five groups in terms of mean, following the distribution in Table 1 (e.g., low risks from 0.00 to 1.99; to high risks from 3.40 to 5.00). The most important risks to business and export were robbery, changes in agricultural policy, lack of information sources and the greatest risk was export uncertainty (Table 2).

Farmers rated the lack of cooperatives and packing units as medium to high risks. Most business and export risks are medium risks (certification requirements, high bargaining power of retailers and processors, access to importers, price volatility, labor problems, lack of labor, and overseas competitors). Low to medium risks were not recorded while seven risks (e.g., lack of contract farming, high bargaining power of input suppliers, availability of credit, transportation problems, interest rate changes, and market access) were rated as low risks.

Table 1. Perception of production risks

Level	Production Risks	Average	Standard deviation	Mode
High	Strong wind/breeze	4.58	0.51	5
	Fungi	3.42	1.56	4
Medium to high	Sunburn	3.25	1.36	4
	Soil compaction	3	1.6	3
	Diseases	3	1.48	3
Medium	Frost	2.5	1.31	3
	Hail	2.33	1.07	2
	Weeds	2.33	1.15	2
	Wet conditions for 48 hours or longer	2.33	1.3	2
Medium to low	Salinity	2.25	1.42	2
	Rats	2.08	1.08	2
	Low temperatures	2	1.13	2
	Birds	2	0.74	2
Low	Bats	1.92	1.51	1
	Insects	1.67	0.78	1
	Physical damage during harvest	1.42	0.79	1
	Herbicide injury	1.42	0.67	1

Table 2. Perception of business and export risks

Level	Business and Export Risks	Average	Standard deviation	Mode
High	Robbery	3.92	1.16	5
	Changes of agricultural policy	3.67	1.15	4
	Lack of information sources	3.67	1.50	4
	Supply uncertainty*	3.58	1.31	4
Medium to high	Lack of farmers' cooperatives	3.33	1.44	3
	Lack of packing units*	3.25	1.29	3
Medium	Certification requirements*	2.83	0.94	3
	High bargain power of processor-retailers	2.75	1.36	2
	Access to potential importers*	2.75	1.14	3
	Price variability	2.67	1.56	3
	Human health problem	2.67	1.37	3
	Lack of labor force	2.67	1.37	2
	Overseas competitors	2.67	1.23	2
Low to medium	/	/	/	
Low	Lack of contract growing	1.92	1.51	1
	High bargain power of input suppliers	1.83	1.03	1
	Credit availability	1.83	0.94	1
	Late collection of revenues	1.83	1.27	1
	Transportation issues	1.67	0.98	1
	Changes in interest rate	1.50	0.90	1
	Access to market	1.00	0.00	1

* The risks about export

Perception of the environmental risks

Farmers considered the depletion of water sources as the greatest environmental risk resulting from their production. This was followed by biodiversity loss, deforestation, and pesticide contamination. They considered the least environmental risk to be soil pollution and degradation (Table 3).

Risk Management Strategies and Resilience

Risk management strategies are important because they balance risk and reward in avocado production. In general risk management strategies are on-farm and risk-sharing strategies. For example, diversification (production or income), reserves, capital availability, technological innovation (irrigation, drones, autonomous

Table 3. Perception of the environmental risks

Level	Average	Standard deviation	Mode
Depletion of water sources	2.50	1.45	2
Bio-diversity loss	1.25	0.62	1
Pesticide contamination	1.25	0.62	1
Deforestation	1.25	0.62	1
Soil degradation	1.00	0.00	1
Pollution	1.00	0.00	1

tractors, seeds, etc.), contract farming, insurance, forward or future contracts, cooperatives, and mutual funds. Farm characteristics and preferences influence the farmer's choice of risk management strategy (De Mey et al., 2016; Meraner and Finger, 2019).

Risk management measures are costly and have implications for the individual farmer, the farm household, farming systems (upstream and downstream industries), and the environment (Meuwissen et al., 2022). Meuwissen et al. (2022) mentioned that the focus should be on the system level to ensure the long-term viability of the agricultural system.

The four main risk management strategies were water management, improved forecasting, safety and security systems, and irrigation under trees. These were followed by the introduction of new technologies, windbreaks,

strengthening farmer cooperatives, and the use of irrigation scheduling technology. Farmers considered production diversity, crop products, good relations with the Ministry of Agriculture, and assurance of bank credit as moderately important risk management strategies.

Off-farm income sources, fruit crop insurance, personal insurance, and training/consulting were strategies of moderate to low importance. Finally, salinity monitoring, use of inspection services, hail nets, contract farming, and orchard heaters were the least significant risk management strategies (Table 4).

Resilience as a concept represents "the capacity to ensure the provision of its desired functions in the face of often complex and accumulating economic, social, environmental, and institutional shocks and stresses" (Meuwissen et al., 2022).

Table 4. Risk management strategies among avocado producers in Turkiye

Importance	Risk Management Strategies	Average	Standard deviation	Mode
High	Water management	4.42	0.67	5
	Improved forecasts	4.25	1.14	5
	Security and safeguarding systems	4.00	1.13	4
	Under-tree irrigation	4.00	0.60	4
	Adopt new technology	3.92	0.90	4
	Wind breaks	3.92	1.16	4
	Strengthen farmers' cooperatives	3.92	1.31	4
	Using technology for irrigation scheduling	3.83	1.34	4
	Production diversity	3.50	1.00	4
Medium to high	Plant Protection products	3.25	0.97	3
	Maintaining good relationship with ministry of agriculture	3.25	1.36	4
	Assurance of bank loan	3.08	1.31	4
Medium	Off-farm income sources	2.92	1.16	3
	Orchard insurance	2.92	1.31	3
	Personal insurance	2.92	1.24	3
	Training/consultation	2.92	1.51	4
	Monitor salinity levels	2.75	1.29	3
	Getting Inspection services	2.67	1.56	3
	Anti-hail shade nets	2.50	1.45	3
Medium to low	/	/	/	/
Low	Contract farming	1.83	1.40	1
	Orchard heaters	1.33	0.65	1

Resilience capacities are robustness, adaptive capacity, and transformational capacity (Meuwissen et al., 2022). Folke (2016) stated that resilience is the ability of agricultural systems to cope with challenges and uncertainties. The resilience approach consists of five different steps: resilience of what, resilience to what, resilience for what purpose, what resilience capacities, and what enhances resilience (Meuwissen et al., 2022). The resilience questions aimed to measure agreement with the statements on a scale of 1 to 5. Positive

statements about farmers' potential for innovation and networking received the highest scores of 4.25 and 4.17, respectively. This was followed by future expectations with a value of 4. The negative statement about past experiences received a value of 3.25. Farmers rated the statements about resilience from 3.92 to 3.5. The negative statements about past experiences and the ability to cope with farming received a value of 3.08 and 2.42, respectively, while the positive statement about them received a higher value of 3.17 (Table 5).

Table 5. The resilience of avocado producers in Turkiye

Statements	Average	Standard deviation	Mode
Innovation			
I like to try out all kinds of new technologies and practices	4.25	0.97	5
Network			
I am often in contact with nearby producers regarding production activities	4.17	0.72	4
I believe I can get help from agricultural authorities, experts, and important actors in my network	3.42	1.38	4
Producers in my region tend to help each other in case of a problem	3.17	1.70	4
Future expectation			
For the following 5 years, I anticipate my orchard to be resilient to agricultural difficulties	4.00	0.85	4
Resilience in terms of adaptability			
After facing any challenge, it is easy for my farm to recover quickly	3.92	1.00	4
Resilience in terms of robustness			
In case of changes, I feel confident to adapt myself and deal with to agricultural challenges	3.92	0.67	4
A great shock will not severely influence me, since I have enough alternatives to cope with this shock on my farm	3.50	1.24	4
Resilience in terms of transferability			
In case of significant change of external conditions, I am in trouble since it is difficult to restructure my farm	3.50	1.24	4
Past experience			
Considering last 5 years my orchard has often come across negative effects of agricultural difficulties	3.25	1.60	4
Ability to cope with agricultural challenges			
I have the power to control agricultural difficulties affecting my orchard	3.17	0.94	3
In my opinion, it is challenging to cope with problems that affect my orchard	3.08	1.24	3
My orchard cannot adapt to cope with a changing environment	2.42	1.00	2

Gross Margin Calculation of avocado farmers

The average selling price of avocado producers was 0.64 United States Dollars (USD) per avocado. The average gross revenue was \$46,836.00/hectare and the average variable cost was \$3,693.00/hectare. The average annual gross margin value was \$43,143.00/hectare, with the range from 26,411.44 to 63,064.64 or standard deviation of \$16,159.40/hectare. The total gross margin per farm was \$64,431.97/hectare (standard deviation of \$35,815.44/hectare) (Figure 3).

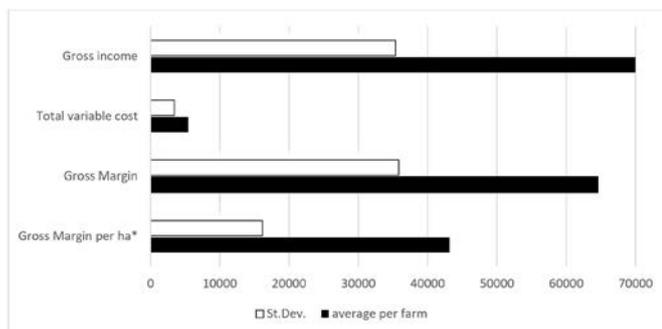


Figure 3. Gross Margin in avocado production in Turkiye

Based on the above calculation, the gross margin ratio was 92%. The highest cost item was labor, which accounted for 60% of the total cost. The second highest cost item was plant protection products, namely pesticides and fertilizers at 16%. This was followed by fuel costs, which accounted for 14%. Other costs made up a minority with a total of 10%, namely 3% for irrigation.

DISCUSSION

The value of the global avocado market is expected to increase from \$9.14 billion in 2020 to a projected \$17.91 billion in 2025 (STATISTA, 2022). Given these numbers, farmers are likely to try to take advantage of the situation and gain a competitive advantage. Farmers are switching from more traditional crops to avocado in the case analyzed. Farmers seek to focus on a narrow buyer segment (or market niche) and outcompete competitors by offering niche members tailored attributes that better meet their tastes and requirements than competitors' products (Thomas et al., 2018).

Measuring and analyzing farmer performance is difficult due to differences in economic, social,

environmental, and other factors. In addition, it is difficult to find comparable data for a new and specific production such as avocado. Currently, lack of adequate budgeting to respond to shocks, and limited availability and awareness about financial instruments may limit the capacity of companies to prepare, respond and adapt to shocks (UN FAO, 2023b). In our case, the analysis showed that the gross margin of avocado production in Turkiye is positive. Gross margin can be used to make a rapid assessment of the business results in avocado production in Turkiye. Number of the farmers in the sample is small, but the business potential of avocado production is evident. A relatively short period and a small area under avocado disable quantification of the effects of risks. Above mentioned problems with data make comparison with other countries and productions difficult. Nevertheless, the sources we consulted claim that the gross margin ratio in avocado production in Mexico and Argentina is 81% and 89% consequently (Albino, 2016; Sánchez et al, 2018). Although calculating gross margin is used as a rapid assessment method of the business success, we can guess that the reasons for positive gross margin could be higher prices due to the proximity to the EU market and the possibility to supply and export avocado indirectly through the tourism. The producers interviewed were very satisfied with the profitability of avocado production. They recognized avocado as a commercially valuable product and considered avocado cultivation to be low maintenance, requiring little labor and pesticides.

The major production risks in avocado cultivation in Turkiye were strong winds, fungi, and sunburn. On the other hand, changes in agricultural policies, and lack of information sources were the main business risks. In terms of export, insecurity of supply was perceived as the most important risk. Perceptions of risk sources and risk management were studied extensively. The results of the different studies (Smrkulj and Njavro, 2016; Gugić et al., 2008; Palinkas and Székely, 2008) depend on production, sample structure, and research design, or as Meraner and Finger (2018) concluded that risk preferences are context depending. Climate change, extreme weather events, and environmental degradation were identified as the

main risks in UN FAO research on avocado resilience with global coverage (Turkiye not included) in 2022. The economic issues with institutional capital (high market concentration and increased production costs, further exacerbated by the war in Ukraine and the high costs of key inputs such as fuels and fertilizers) follows.

Preferences toward risk management strategies has been extensively researched. Risk management strategies differ across countries, farms, farm types and farming systems (Finger et al., 2022). In this paper on risk management of avocado production farmers are mainly concerned about on-farm risk management. Different kind of production technologies are evaluated as highly important. Of business and marketing strategies, cooperation and diversification are also preferred. Finger et al. (2022) concluded that cooperation, learning and sharing of risks play a vital role in European agriculture and need to be strengthened. Cooperation is the strategy that could help increase resilience and create synergies with short supply chains and ecological production (Hanf and Gagalyuk, 2018). Collaboration among avocado producers is a way to gain bargaining power, learn, and share risks, and should be further deepened in future strategies. The actors that work in relative isolation, such as producers, midstream companies, or importers, seem to be in need of support to strengthen their resilience (FAO, 2023b). It is interesting to notice while cooperation is highly important risk management strategy, contract farming is not recognized, and it is evaluated as of low importance for interviewed farmers.

Nonetheless, a more holistic approach to agricultural risk management is now in focus. This approach is known by several names, and not just in agriculture: enterprise risk management, strategic risk management, and resilience (Njavro and Čop, 2021), and it assumes focusing on the risk management portfolios, going beyond single risk management tools (Meraner and Finger, 2018).

The SURE farm project distinguishes three resilience capacities: robustness ('bouncing back'), adaptive capacity, and transformational capacity (deep learning and change) (Meuwissen et al., 2022). Our study in Turkiye

used a similar and adapted farm resilience data collection tool. For the most part, the avocado producers studied in Turkiye are resilient to the future, adaptable and robust, and able to deal with all agricultural challenges. The producers analyzed are not as resilient to transferability as they are to other parameters and for the most part, agreed that they are able to deal with all agricultural challenges. Although they have had some bad experiences in the past, they are more confident about the future. In the case of hazelnut production in Italy, results suggest that the current situation of hazelnut farming systems is mainly based on the ability to overcome challenges, although to a lesser extent, adaptability was also found. The ability to pursue radical transformations is minimal (Severini et al., 2022).

Despite the positive gross margin, the environmental impacts of climate change and avocado should also be considered. Avocado farmers in Turkiye consider avocado production as an environmentally friendly application. However, the level of agreement with the statements that avocado production leads to environmental risks such as depletion of water sources, loss of biodiversity, pollution, soil degradation, deforestation, and pesticide contamination was strikingly low. It is therefore necessary to set different kinds of policies and actions including awareness-raising activities among farmers to mitigate the potential negative environmental effect of avocado production as well as overall resilience. The World Economic Forum (2020) mentions international certification of sustainable farming and fair trade for avocados sold in supermarkets and stores, and that trade agreements need to include environmental impact in their export clauses, and that we should rethink our dietary and lifestyle trends and reduce avocado consumption to minimize our personal contribution to environmental impact.

CONCLUSIONS

Avocado production is gaining importance in the Mediterranean part of Turkiye due to good climatic conditions. The main research questions were to evaluate the perception of production, environmental,

and business risks of avocado producers, to investigate the risk management strategies and resilience of avocado producers in Turkiye, and to identify the gross margin of avocado production.

The main findings are that avocado farmers in Turkiye perceive strong wind and fungi as production risks, robbery, agricultural policy changes, lack of information sources, and export supply insecurity as business and export risks. Looking only at environmental risks, farmers perceive the depletion of water sources as the biggest environmental risk. Other environmental risks are not as important to avocado farmers in Turkiye (e.g., biodiversity loss, deforestation, pesticide contamination, soil degradation, and pollution).

Some of the most important strategies for avocado farmers are water management, under-tree irrigation, adoption of new technologies, strengthening farmer cooperatives, and production diversity. The least important strategies are contract farming and orchard heaters.

In regards to farmers' resilience, farmers' potential for innovation and networking is the most important. The growers mostly agreed that they were resilient about the future, robustness, and adaptability of their orchards, but less in terms of transferability and experience.

A limitation of the study is the small number of avocado farmers, as there are no statistics (avocado farmers' database) on the number of avocado farmers in Turkiye (Mediterranean region). The authors applied the snowball technique by starting with interviewing the founder of the Alanya Avocado Producers Association and Anamur Avocado Producers Cooperative and also interviewing other proposed farmers. Further research should involve a larger number of farmers and recommend environmental management strategies for farmers and policy measures to mitigate the negative impacts of avocado production in Turkiye using experimental economics (Čop and Njavro, 2022) and experimental design as researched in Meraner and Finger (2019).

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