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## Article

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RESEARCH

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# Is quality certification in fruit and vegetable production a market-driven choice in Greece?

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## Abstract

This study examines whether the implementation of a quality management system (QMS) and the choice of a certain quality assurance scheme (QAS) were decided as responses by fruit and vegetable producers to market conditions, separating certification decisions into two components. A survey study is conducted and two discrete choice models are estimated: ordered logit for the implementation of QMS and binary probit for the choice of QAS. It is found that the buyers' demand for certification and the efforts of farmers to differentiate their products from others in an area that may present local quality problems lead farm businesses to accelerate QMS implementation. Regarding the choice of a private QAS, it is a market-driven decision. The conclusion is that certifications are characterised by a market-driven approach and the increased interest in certified products can lead to the diffusion of certification. Because the absence of information provision and the controls exerted by public authorities have an impact on QMS implementation, the diffusion of certification depends also on public policy measures, indicating the crucial role of a public policy mix properly designed to promote certification.

**Keywords:** Market; Certification; Decisions; Standards; Quality systems; Policy

## Background

Enterprises that implement quality management systems (QMSs) and pursue quality assurance schemes (QAS) gain some benefits connected with factors of the internal and external business environment (Chow-Chua et al. 2003; Karipidis et al. 2009; Lee et al. 2009; To et al. 2012). Therefore, they invest in quality plans by choosing the appropriate QAS, in correspondence with the challenges and threats posed in the external environment by market conditions and public policy measures. Because agricultural production and marketing generate a large number of hazards for consumers and the natural environment, the expansion of QMS implementation is a crucial issue for public authorities, which are interested in the consumers' health, the quality of life and the agricultural competitiveness. If farm and food businesses are not willing to implement a QMS, the public authorities encourage them properly or oblige them to meet the minimum quality requirements (Segerson 1999; Larsson et al. 2013).

If the farm and food businesses implement a QMS and choose the proper QAS as a strategic choice – namely, in correspondence with the conditions prevalent in the market – the gradually increased interest in certified products in the market can

motivate businesses to implement a QMS on a gradually increasing basis, leading to a multiplication of certification efforts in agriculture and food and to a diffusion of certification. However, in the case of unfavourable market conditions and of a State-induced implementation of QMS, the conditions cannot be considered favourable for the diffusion of certification, since farm and food businesses' decisions are determined by public intervention. Thus, it is not easy for businesses to respond effectively to the course of events in the market, as this may be done indirectly, which may lead the agricultural competitiveness to weaken and market opportunities to be lost. In such a case, the diffusion of certification depends more on a continuation or amplification of the State's proper interventions (Segerson 1999; Hattam et al. 2012; Larsson et al. 2013).

Since the quality of the finished food depends substantially on the quality of the primary agricultural products, some studies have dealt with the adoption and implementation of QMS decisions in agriculture and each of them identified a number of determinants of such decisions (Karipidis et al. 2009; Asfaw et al. 2010a, b; Masakure et al. 2011; Muriithi et al. 2011; Kersting and Wollni 2012; Karipidis and Tselempis 2014; Soltani et al. 2014; Veldstra et al. 2014). These studies analyse the adoption/non-adoption and implementation/non-implementation decisions focusing mostly on factors of the internal business environment, adding also, in some cases, one or more factors from the market and/or policy.

The present paper goes beyond these issues. It focuses on certified farm businesses and explores the impact of factors of the external business environment on farmers' decisions, combining the management decision model proposed by Johnson and Scholes (1999) with the idea of Veldstra et al. (2014), who separate organic production decisions into two components. More specifically, the aim of this study is to investigate whether the implementation of a QMS and the pursuit of certain QAS are chosen by farm businesses as responses to market conditions, and thus can be considered part of a 'market-driven' approach. We separate the certified farmers' decisions into two components: QMS implementation and QAS selection. In addition to this, the study incorporates the public policy factors that can contribute, directly or indirectly, to quality improvements in order to identify their impact and thus help public authorities to know the effectiveness of the different quality-related policy measures. The study focuses on fruit and vegetable producers as the first players in the supply chain, because these enterprises are characterised by intensive use of agrochemicals generating a high risk for consumers' health and the natural environment, making the implementation of a QMS a more crucial choice than for other farm enterprises. The fact that Mediterranean fruit and vegetable production constitutes a significant trading sector of the European food market, which imposes certain quality certification requirements (Kalaitzis et al. 2007), makes certification also a significant strategic choice for farm businesses.

The remainder of the paper is structured as follows. The next section presents the research hypotheses, followed by a presentation of the discrete choice model and the specialisation of two discrete choice models (for the implementation of the QMS and for the choice of QAS). The third section presents the models' estimation, results for each model and discussion. The conclusions and suggestions for future research are offered in the last section.

## Methods

### Research hypotheses

In order to study farmers' certification decisions, we adopt the view of Johnson and Scholes (1999), who define strategy as 'the direction and scope of activity so as to achieve competitive advantage, ultimately meeting the needs of markets and fulfilling stakeholder expectations'. There are three stages in every strategic decision: (1) strategic analysis, (2) strategic choice and (3) strategic implementation. In the first stage, strategic analysis, the farm business investigates its competitive standing based on the criteria of expectations, goals and influence from interest groups. It assesses opportunities and threats, and the strengths and weaknesses of its resources and capabilities. In the second stage, strategic choice, the farm business defines the main strategic issues that it has to address and seeks to satisfy its basic priorities. In the third stage, strategic implementation, the business implements and assesses the results.

Viewing the farmer as the administrative manager of the farm business who produces and trades the farm's products, we assume that, in the first stage, he/she assesses the influence of specific factors in the outer environment, such as the conditions in the market. In the second stage, based on the information acquired in the previous stage, the farmer decides to implement a specific QMS in two steps. Step 1 involves making the decision to implement a QMS and to become certified, and Step 2 involves selecting the proper QAS to pursue. Thus, the certification decision is separated into two components, analogous to the idea of Veldstra et al. (2014). The implementation of QMS decisions is expected to be influenced by market factors, which can lead to the expansion of quality certification in alignment with the demand. Thus, the following research hypothesis will be examined:

**H1:** The farmer's decision to implement a QMS is affected by demand-related factors.

Third-party certification reflects a broader, gradual shift from public to private governance (Hatanaka et al. 2005; Kalaitzis et al. 2007). There exist several QAS nowadays that are suitable for fruit and vegetable production certification, such as the national standard 'AGRO 2.2' in Greece and the 'Organic Certification' standard in the European Union (EU), both of which are considered public/official; others include 'GlobalGAP', 'Quality and Safety' and 'Tesco Nature's Choice', which are considered private standards, as they arose as a result of cooperation between production and marketing enterprises. The public standards were developed by public institutions so as to create a shared framework of quality and environmental rules, requirements and certifications. The private standards -firm specific or collective- were developed, and are being promoted, by private organisations, mainly retail chains or collective unions of retailers, so as to ensure that the basic requirements of quality and environmental responsibility are met in alignment with the retailers' interests. Because the role of private standards as drivers of change in the agri-food system is widely recognised and policy-makers are gradually acknowledging their potential role in both domestic and international markets, especially in the case of small and medium-sized agri-food producers and processors (Hatanaka et al. 2005; Henson and Reardon 2005), it is expected that the choice of a private standard is affected by market factors. Thus, a second hypothesis is formulated:

**H2:** The choice of a private standard is derived from demand-related factors.

If the hypothesis is not accepted, the role of private standards as drivers of change in fruit and vegetable supply system is not ascertained and farm businesses' certification

decisions are not in alignment with the demand. This could make necessary a revision of quality certification-related policy taking into account the role of private standards in the development of certification.

Public policy in EU countries includes a large number of quality-related measures aiming to promote proper farming practices. It is expected that these measures have an impact on farmers' decisions to implement a QMS, directly or indirectly, which can imply that the public policy is effective. Thus, a third hypothesis is formulated:

**H3:** The farmer's decision to implement a QMS is affected by public policy factors.

If the hypothesis is not accepted, it is not ascertained that there is an impact of public policy factors on farmers' certification decisions, and a revision of the policy mix may be needed.

### The discrete choice framework

We assume that the typical farm business operates within a competitive environment and offers its product at a quantity of  $q$  and a quality of  $Q$ , obtaining a price of  $p$ . Thus, the profit function in relation to the product quality offered may be defined as follows:

$$\max \pi = pq - c(q, Q) \quad \text{with } p = P(Q) \quad (1)$$

The farm business's profit function helps us to connect price and cost to quality.

As QMS implementation is interwoven with a multitude of organisational, process and technological changes/innovations, we resort to methodological tools used in the case of innovation adoption. The discrete choice model can be used to examine how decisions are influenced by the conditions under which they are realised. There has been extensive use of the discrete choice model proposed by McFadden (1974) in order to locate the factors affecting farmers' choices regarding the adoption of innovations, new methods or new technologies (D'Souza et al. 1993; Burton et al. 1999; Wynn et al. 2001).

In the present paper, the farmers' certification decisions are based on aspirations to increase their business's profits by boosting its competitiveness. As stated above, we separate this decision into two components: (1) the implementation of a QMS and (2) the choice of a QAS. The implementation of the QMS decision can be measured against whether the farmer implements the QMS at an early stage before others or at a later stage (timing of the implementation of QMS) by using the proper scale of measurement or by including the farmer in one of five categories, between innovators and laggards (Rogers 2003). The choice of a QAS can be measured by a binary variable (private or public standard). Therefore, the model assumes the following form:

$$y_i = a_i \chi_i + u_{ij} \quad (2)$$

According to this model, the farmer has chosen alternative  $i$ , which leads to an improvement of the farm business's competitive position via the quality certification. This decision can be affected by factors ( $\chi_i$ ) in the external business environment.

### QMS implementation and QAS choice models

Previous studies investigating the factors of the internal business environment that have an impact on farmers' certification-related decisions also identified some market and public policy factors (Karipidis et al. 2009; Asfaw et al. 2010a, b; Masakure et al. 2011; Muriithi et al. 2011; Kersting and Wollni 2012; Karipidis and Tselempis 2014; Soltani

et al. 2014; Veldstra et al. 2014). We select thirteen factors of the external business environment identified in these studies and we also add three factors that we identified in some in-depth interviews with producers as crucial in order to examine the research hypotheses. These sixteen factors are presented in Table 1 accompanied by the related studies we found, grouped into two categories (market and policy) and eleven subcategories on the basis of the analysis that follows. The profit function we present above helps us to calculate the possible positive or negative impact of each factor on the farmer's decision. An analysis of each factor's influence on the implementation decision follows.

As is observed in Table 1, market conditions include eleven factors. The customers' requirement for certification, or for products to meet certain quality standards, is expected to influence the farmer's decision positively, as such certification or assurance of meeting standards would render the products more appealing. Demand, and especially the perception that buyers are interested in certified products, makes the farmer more eager to implement a QMS, since the marketing of products is bound to become easier and more secure, thus leading eventually to a reduction in marketing costs and an increase in revenue. The same applies to the expectation that certified products will attain higher prices. Appropriate, reliable and adequate information coming from the marketers/buyers of the products, or from suppliers to farming enterprises, may affect the decision positively, as such information helps farmers to balance their expenses and profits, and make the most efficient quality-related decision. On the contrary, uncertainty about the prices of certified products may affect the decision either negatively, because of uncertainty regarding profit increase, or positively, in case the farmer is

**Table 1 Factors that can affect the farmer's decision to implement QMS**

	<b>Factors</b>	<b>Reference</b>
<b>MARKET conditions</b>	Customers are interested in certified products	Karipidis et al. 2009
	Buyers demand for implementation of QMS	Asfaw et al. 2010a; Kersting and Wollni 2012
	Buyers demand minimum quality requirements	
	Expectations of easier selling	Kersting and Wollni 2012
	Requirement of the cooperative	Asfaw et al. 2010b; Narrod et al. 2009
	Expectations of average price raise	Soltani et al. 2014
	Advice – buyers' recommendations	Kersting and Wollni 2012
	Advice – suppliers' recommendations	-
	Local quality defects or problems	D'Souza et al. 1993
	Price uncertainty	-
	Impelling – Penalisation and control exerted on behalf of the buyers	-
<b>PUBLIC POLICY measures</b>	Participation in an agricultural development program	D'Souza et al. 1993
	Participation in a good practice implementation program	Dimara et al. 2004
	Expectation of subsidizing QMS implementation	Segerson 1999; Masakure et al. 2011
	Absence of provision of appropriate information/technical support	Asfaw et al. 2010b; Veldstra et al. 2014; Muriithi et al. 2011
	Penalisation and control exerted by the authorities	Reardon et al. 2003



implementing QMS to render the product more competitive and to reduce price uncertainty. The exertion of control and imposition of fines on behalf of buyers impel farmers to implement a QMS so as to avoid penalisation.

We select five measures from the EU public policy, which are presented in Table 1. Participation in agricultural development and/or good agricultural practice programmes is expected to affect the farmer's decision positively if, through such programmes, the farmer is motivated to apply innovations and changes that facilitate the implementation of a QMS, or becomes more receptive to changes. However, such programmes may also exert a negative influence if the farmer has satisfactory gains from programme subsidies, or negative bureaucratic experiences, or does not consider the implementation of a QMS to be beneficial. The pursuit or expectation of relevant subsidies for certification may exert a positive influence, as it leads to a reduction of implementation and certification costs, and finally to general cost reductions. Insufficient information and technical support render farm business owners less eager to implement quality systems, as they are unable to assess whether the implementation and certification expenses will be counterbalanced by corresponding benefits. In addition, they may lack the necessary knowledge and information for implementation and certification of the quality system. The exertion of control and the imposition of fines by public authorities compel farmers to implement a QMS in order to avoid penalisation.

The implementation of a QMS model takes the ordered logit form, enabling us to analyse the farmer's decision to implement a QMS in comparison with decisions made by other farmers. We use a five point scale to measure farmers' choices reflecting how early they implemented the quality system that is the timing of the implementation of QMS. The dependent variable assumes the value of 5 if the farmer has implemented the QMS innovatively; in the case of a laggard, the value assumed is 1. The model's binary probit form is used to study the farmer's decision to choose the QAS under which quality will be certified. The dependent variable assumes the value of 0 when the farmer chooses a public QAS, and the value of 1 when the QAS is privately designed. In the case that a farm business adopts both public and private standard, we can take in account the stricter certification. Thus, model (2) becomes

$$y_i = a_k^m X_k^m + a_i^p X_i^p + u_{ik} \quad (3)$$

Where  $X_k^m$  represents the market factors ( $k = 1, \dots, 11$ ) that may affect the farmer's decision and  $X_i^p$  represents the public policy factors ( $i = 1, \dots, 5$ ). Table 2 illustrates the types of variables representing the sixteen factors, the expected positive or negative sign, the measuring scale and the value range.

### Data collection

Based on the previous studies cited in Table 1, a survey was developed in the summer of 2011 and a small-scale pre-test with some in-depth interviews was conducted in the winter of the same year. All the necessary modifications were made to take into account the comments and suggestions received, which primarily concerned the difficulty in answering the questionnaire (including its size), the clarity of the questions and their order. The final questionnaire was delivered to participants in the spring and summer of 2012. The questionnaires were completed by conducting interviews with 250 fruit and vegetable producers, who are dispersed all over the region of Central Macedonia–North Greece,

**Table 2 Independent variables of the model, signs, measurements, and observed values**

Category	Factors/Independent variables	Expect. sign	Values	Type of variable	Aver.	Min.	Max.
<b>MARKET conditions</b>	Customers are interested in certified products	+	1 – 5	Discrete	3,30	1	5
	Buyers demand for implementation of QMS	+	1 – 5	Discrete	2,85	1	5
	Buyers demand minimum quality requirements	+	0 – 5	Discrete	2,23	0	5
	Expectations of easier selling	+	1 – 5	Discrete	3,23	1	5
	Requirement of the cooperative	+	1 – 5	Discrete	2,18	1	5
	Expectations of average price raise	+	1 – 5	Discrete	3,08	1	5
	Advice – buyers' recommendations	+	1 – 5	Discrete	2,58	1	5
	Advice – suppliers' recommendations	+	1 – 5	Discrete	1,66	1	5
	Local quality defects or problems	+	0 – 1	Binary	1,13	0	1
	Price uncertainty	±	1 – 4	Discrete	3,48	1	4
	Impelling – Penalisation and control exerted on behalf of the buyers	+	0 – 3	Discrete	0,78	0	3
<b>PUBLIC POLICY measures</b>	Participation in an agricultural development program	±	0 – 6	Discrete	0,16	0	3
	Participation in a good practice implementation program	±	No = 0, Yes = 1	Binary	0,22	0	1
	Expectation of subsidizing QMS implementation	+	1 – 5	Discrete	1,23	1	4
	Absence of provision of appropriate information/technical support	–	1 – 4	Discrete	2,89	1	4
	Penalisation and control exerted by the authorities	+	0 – 3	Discrete	0,43	0	3

which is the main fruit and vegetable producing region in Greece. The respondents were randomly selected from a database held by the regional services of the Ministry of Agricultural Development and Food, which includes farm businesses implementing a QMS under different QAS. After discarding a number of problematic questionnaires, we were able to use a total of 231 in our analysis.

The mean scores and minimum/maximum values of the sample for each factor examined are presented in the three right-hand columns of Table 2. Regarding the size of the farm businesses in the sample, we observe that the annual income from agriculture for 84% of the farms varies between 10,000 and 30,000 euros and the mean cultivated area of each farm business is 5.2 hectares, which is about equal to the mean size of farm businesses all over Greece. Thus, probable ambiguities about the representativeness of the sample could be eliminated.

## Results and discussion

Empirical investigation of the two models is based on data drawn from the 231 questionnaires. Estimations regarding the decision to implement a QMS model and the decision to choose a QAS model were conducted using the Eviews program; we used the Huber/White option to compute robust (quasi-maximum likelihood) estimators in the sense that consistent estimates of parameters are produced, even if the distribution is incorrectly specified. The results are presented in Table 3. In both cases, it is determined that the null hypothesis is rejected, and that all of the independent variables



**Table 3 Estimation results of implementation of QMS model and QAS choice model**

	Factors/Independent variables	QMS model			QAS model		
		a	Z – stat.	Probab.	a	Z – stat.	Probab.
<b>MARKET conditions</b>	Customers are interested in certified products	0.20503	0.92341	0.356	0.62568	2.29794	0.022*
	Buyers demand for implementation of QMS	0.31941	2.21292	0.027*	0.69488	4.05913	0.000*
	Buyers demand minimum quality requirements	–0.05617	–0.28999	0.772	0.23613	1.15968	0.246
	Expectations of easier selling	0.56587	1.30760	0.191	–0.19296	–1.16466	0.244
	Requirement of the cooperative	0.12642	0.33699	0.736	–0.37869	–3.54569	0.000*
	Expectations of average price raise	0.25506	1.43017	0.153	0.06377	0.28178	0.778
	Advice – buyers' recommendations	0.13059	0.99648	0.319	0.25639	1.81742	0.069*
	Advice – suppliers' recommendations	–0.21173	–1.12343	0.261	0.10951	0.59328	0.553
	Local quality defects or problems	1.279.09	3.91830	0.000*	–0.07027	–0.21323	0.831
	Price uncertainty	0.19413	0.65858	0.510	0.074357	0.24441	0.807
<b>PUBLIC POLICY measures</b>	Penalisation and control exerted on behalf of buyers	0.52475	1.44713	0.148	0.238206	0.65971	0.509
	Participation in an agricultural development program	0.07741	0.24585	0.806	0.541880	1.06638	0.286
	Participation in a good practice program	0.05890	0.12450	0.901	–1.087.743	–2.05962	0.039*
	Expectation of subsidizing QMS implementation	0.22905	0.75491	0.450	–0.689528	–1.88346	0.060*
	Absence of appropriate information / technical support	–0.52085	–2.16704	0.030*	0.200168	0.92000	0.358
	Penalisation and control exerted by the authorities	1.526.75	3.81816	0.000*	0.117162	0.29331	0.770
		LR statistic (16 df): 1.197.488			LR statistic (16 df): 1.868.241		
		Probability (LR stat): 0.000000			Probability (LR stat): 0.0000		
		LR index (Pseudo R-2): 0.197033			McFadden R-2: 0.614447		

\* Significance level: 0.1.

affect the variability of the dependent variable. The interpretative capacity of the two models is pseudo- $R^2$ : 0.197 for the implementation model and McFadden  $R^2$ : 0.614 for the QAS model.

#### **Impact of demand-related factors on QMS implementation**

As can be seen from Table 3, four of the sixteen independent variables substantially participate in the formation of the dependent variable's variability, at a significance level of 0.10. Therefore, one may deduce that four of the factors examined affect the farmer's decision to implement a QMS; namely, to implement the QMS at an early stage. Two of the factors pertain to the market and affect the farmer's decision positively. More specifically, the demand for certification, which will eventually lead to a reduction in costs and an increase in revenues, renders it more probable that she/he implements a QMS at an early stage. The same applies when there exist local quality-related problems, in which the farmer tries to differentiate her/his products from local ones in order to improve the image of the products and make them more attractive to potential customers, reduce marketing uncertainty and eventually increase revenues. Thus, the first hypothesis ( $H_1$ ), namely that the farmer's decision to implement a QMS is affected by demand-related factors, is verified.

#### **Impact of demand-related factors on QAS choice**

As shown in Table 3, six of the sixteen independent variables participate substantially in the formation of the dependent variable's variability, at a significance level of 0.10: four market factors and two policy factors. Therefore, one may deduce that the four market factors mentioned therein affect the farmer's choice between a public and a privately designed QAS. Three of these factors increase the probability that the farmer chooses a privately defined standard: customers' interest, demand for certified products and buyers' recommendations. The fourth factor that renders the choice of a privately designed standard less probable is the requirement imposed by a cooperative to choose a public standard, because it may be connected with a collective (group) certification by gaining subsidies.

Of the public policy factors, participation in a good-practice programme decreases the probability of choosing a privately designed QAS and increases the probability of choosing a public standard. This fact may be attributed to the farmer's estimation that, by choosing a public QAS, she/he secures the requirements pertaining to the QMS implementation immediately, thus rendering implementation less difficult and less expensive. Roughly the same can be said for the aspiration to receive subsidies connected with public standards, which contributes to cost reduction of the implementation of a QMS based on a state-developed QAS, therefore rendering the choice of such a standard more likely. The above results verify the second hypothesis ( $H_2$ ), that the choice of a privately designed standard is affected by demand-related factors.

#### **Impact of public policy factors on QMS implementation**

As shown in Table 3, two public policy factors affect farmers' QMS decisions. One of them was found to affect the decision negatively, while the other affects it positively. Specifically, failure to supply the appropriate information and technical support affects QMS implementation negatively, as it reduces the probability that the farmer

implements the QMS at an early stage, while increasing the probability that the farmer implements it at a late stage. As previously mentioned, this could be attributed to the farmer's inability to assess the positive consequences of QMS implementation. On the other hand, the exertion of control and the imposition of fines cause farmers to accelerate the certification, as they tend to implement a QMS earlier. These results confirm the third hypothesis ( $H_3$ ), that the farmer's decisions to implement a QMS are affected by public policy factors.

### Discussion

The above results regarding the market and policy factors affecting the implementation of QMS decisions of fruit and vegetable producers confirm, complement and extend results of previous studies on the topic. More specifically, the findings concerning the impact of the demand for certified products and of the control exerted by the authorities confirm the related results of Asfaw et al. (2010b) and Masakure et al. (2011) indicating the role of lower transaction costs and regulatory enforcement in the supply chain with reference to certification decisions. The findings concerning the role of information and the provision of technical assistance to farmers in their certification-related actions confirm the results of Muriithi et al. (2011) and Kersting and Wollni (2012). Because the implementation of a QMS is one way in which farmers manage the quality of fruits and vegetables they offer by acting proactively, our findings imply an alignment of agricultural certification with demand, being in accordance with Lineback et al.'s (2009) suggestion that business operators should act proactively in taking responsibility for food quality and safety issues.

The results regarding the impact of the two public policy factors indicate the crucial role in certification decisions of information provision and of the fines imposed by authorities on fruit and vegetable producers who do not meet the specific quality requirements. This, in combination with the conclusions of Kalaitzis et al. (2007) concerning the difficulties of some Mediterranean exporting firms in having access to European retailer chains that impose quality certification requirements, indicates the necessity of public policy interventions in order to promote QMS. These results could be generalised in the case of fruit and vegetable enterprises in Greece, but a more efficient public policy can be achieved if a more focused policy mix and implementation pathway is scheduled for different products and regions taking into account economic development, industrial structure and institutional capacity (Guo et al. 2012).

### Conclusions

The present study examines whether the implementation of a QMS and the choice of a QAS were decided as responses by fruit and vegetable producers to market conditions. By empirically investigating a model of the timing to implement a QMS and a QAS selection model, three hypotheses are examined and verified: that (1) farmers' decisions are affected by the conditions prevalent in the market; (2) the choice of a private standard is affected by market factors; and (3) the QMS implementation decisions are affected by public policy.

It is found that the buyers' demand for certification and the efforts of farmers to differentiate their products from others in an area that may present local quality problems are factors that lead farm businesses to implement a QMS at an early stage, which

implies that some demand-related factors accelerate the quality certifications. Regarding the choice of a private QAS, it seems that it tends to be a market-driven choice for farmers, implying a shift from public to private governance in fruit and vegetable certification. In reference to the public policy factors, one may deduce that policy factors are interwoven with information provision, controlling, penalising and subsidising, either directly or indirectly, even if the subsidies do not correspond with demand. In conclusion, it should be argued that certification in fruit and vegetable production is characterised by a market-driven approach that can lead to faster adoption of certification in correspondence with demand, but it is also simultaneously directed by public policy, even without being consistent with demand in some cases.

The results yield useful propositions for public authorities, farmers, certifiers and marketers. For example, in order to achieve the goals of improving competitiveness and quality of life, public policy must take into account the necessity of providing proper information to farmers and lowering the probable negative consequences of subsidies, which might lead producers away from the market's needs. The latter should be achieved by extending the provision of subsidies in the case of privately designed QAS, if it does not conflict with public policy objectives. If producers wish to maximise profits resulting from QMS implementation, they need to be wary of subsidies that may ultimately prove harmful. On the other hand, both certifiers and marketers/buyers of fruits and vegetables may contribute to make certification more attractive to farmers: the former by reducing the cost of certification and reinforcing its credibility in order to be more in demand in the market, and the latter by either rewarding farmers with better prices or becoming part of the farmers' clientele.

The findings of the present study can be considered as generalised for certification decisions in fruit and vegetable production in Greece, but it could not be argued that they reflect the situation in all crop production. Thus, a future study could further explore certification decisions in different crops such as cotton, cereals and so on. Furthermore, because it is not known whether or not market factors outperform policy factors, it would be useful to examine if there is a balance between the market and policy factors affecting farmers' certification decisions.

#### **Competing interests**

The authors declare that they have no competing interests.

#### **Authors' contributions**

TD collected the bulk of the data, undertook literature review and specialisation of the model, KP conceptualised the study, undertook the data analysis drafted the results and conclusion sections and finalised the text, PA collected some of the data and undertook the data analysis, SA read and approved the final manuscript. All authors read and approved the final manuscript.

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