

Innovations in Wine Sector: Evidence from Bulgaria Based on Fuzzy AHP Approach

Petyo Boshnakov¹, Vesselina Dimitrova² and Georgi Marinov³

^{1) 2) 3)} *University of Economics - Varna, Varna, Bulgaria.*

E-mail: pboshnakov@ue-varna.bg; E-mail: vesselina.dimitrova@ue-varna.bg

E-mail: gmarinov@ue-varna.bg

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Abstract

Up to date wine production is challenged to adopt various innovations. Current literature systematically identifies better strategies, technological improvements and emerging market opportunities with respect to sustainable viticulture. Some lack of knowledge and practice is related with the impact on the local community for leveraging on all positive impacts of wine conventional and eco-innovations. The present paper assesses the perceptions about the relative importance of three types of innovations in the wine sector in Bulgaria - conventional, ecological and social. The tool for analysis is analytical hierarchical process (AHP) methodology and Fuzzy version of AHP. We select an equal number of managers and technological specialists from the wine industry in Bulgaria whose assessment of these three types of innovation in wine-making is decisive for both market competition and consumer behavior. The results of the study show that priority is given to conventional and eco-innovations compared to social innovations in the wine sector. At the same time, the direct involvement of wine experts in different types of innovations is emerging. Conventional or marketing innovations are better developed by sales managers, and eco-innovation as a part of sustainable production is important for technologists. The analysis is vitally important for small and middle-sized wine producers in Bulgaria who want to join worldwide wine innovation performance.

Keywords

wine sector, conventional innovations, eco-innovations, social innovations, fuzzy AHP

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Introduction

Wine industry in recent decades faces a multitude of innovations, many of them concern different aspects of production and marketing of wine. Innovations can play an important role in all cycles of wine production based on interdisciplinary approaches, empirical knowledge transfer or promotion of relevant technological solutions. Innovations in the wine industry can also generate sustainable managerial adaptation and good social decisions. The diffusion of wine innovations in Europe is becoming an important tool for small and middle-sized companies for identifying their commercialization performance and agro-organizational knowledge (Vergamini et al., 2019). For example, precise viticulture and remote observation of vineyards allow real-time monitoring of accurate weather data, vine conditions (grape surveys, phenological stage determination and plant diseases) and key cellar conditions with technology developed on the basis of the Internet of Things (IoT) (Deloitte, 2019). This approach has a consequential effect on resource efficiency as well as environmental protection by reducing the carbon footprint, reducing water and electricity use and recycling vine and wine waste (Forbes et al., 2013). At the same time, local consumers remain in a search for authentic wine as a part of innovative wine production. All these facts show that there is a need for understanding and rating of different innovations as technological, ecological and social innovations for wine producers in order to track some dynamics in the sector (Costa et al., 2022). There will be a first mover advantage for those wine producers that upskill today and develop innovative expertise.

The aim of the present study is to check the degree to which managers and technological specialists are familiar with the different types of innovations and how they assess their importance, making a subsequent evaluation of the importance of certain types of innovations. In this paper, we will first explain some conceptual frameworks related to innovations in the wine industry. Then, we will present our method of empirical study which uses a questionnaire for managers and technological specialists in Bulgarian wine-producing companies as a base for a fuzzy analytical hierarchical process (fuzzy AHP) assessment. The discussion of results will be presented into three dimensions - conventional, ecological and social, highlighting the assessment of each item. Finally, we summarize our findings for small and middle-sized wine companies in the country.

1. Literature review

Innovation is a technological-based process for production and market development, which can be studied or monitored through various methods and variables. Innovation has always been well accepted by winemakers as an approach towards successful and differentiated marketing. The results of a survey of 522 Canadian winemakers show that innovation has only positive effects on business performance through improved products, efficient use of resources and implementation of new environmental practices in the wine sector (Frigon, Doloreux and Shearmur, 2020). As noted by Calle et al. (2022) innovation is a key determinant for productivity growth in agricultural activity. The authors present a survey of winemakers in 70% of Spain's regions and underline that a successful wine strategy is driven not so much by its process motivation (e.g. being part of corporate social responsibility policy) as by its product motivation (e.g. improved quality for biological or organic wines).

By implementing the company's business strategy for competitive advantage, winemakers test various marketing tools to introduce innovations: from conventional or technological to eco-innovation, and even social innovation. Social innovation represents a dynamic part of technologies, business models and creative ideas, as well as a supporting micro-level initiative for social entrepreneurship without limitation of the sector, type or importance of actors (Choi and Majumdar, 2015). In the case of wine production, social innovation is a conductive lens and perspective change to analyze how sustainability objectives and wine-knowledge creation can be achieved for social and urban inclusion in wine regions (Costales, 2022). Social innovation is a transformation driver between conventional or technological innovations (related especially to fertilizers and pesticides for intensive agriculture) and sustainability innovations. In this sense, social innovation can provide fast and appropriate trade solutions for winemakers (Ziegler et al., 2022).

In order to study in detail the ability of wineries towards orientation purchasing of their clients, today winemakers want to include in the circle of innovations an increasing number of green or eco-innovations. Despite the growing interest in this topic, the scientific research is relatively limited, mainly due to the consideration related to scarce winemaking resources and to the traditional managerial approach in the sector, mainly at national level (Cusin and Passebois-Ducros, 2015). However, in recent years the logic of studying innovations in winemaking has considered possible correlations between consumer preferences for wine and the adoption of eco-certification, bottle recycling, reuse of washing water, emission monitoring or other environmentally friendly actions (Calle et al, 2022). Pereira and Vence (2012) identify two groups of factors that are important in the analysis of green innovation: a) conventional factors - characteristics of winemakers, technological competences and business logic, and b) management capacity and trade approach in implementing environmentally friendly strategies. Confusing results compared to the conventional factors could create difficulties in implementing ecological wine-policy actions for green innovations.

According to Fiore et al. (2017) innovations in wine production are extremely important for SMEs in the sector due to the dynamics of global competition and the existence of legal regulations for wine quality (for example, EU Regulation 2019/34 and Regulation 2019/33 regarding applications for protection of designations of origin, geographical indications and traditional terms in the wine sector). According to the same authors, SMEs wineries in the Puglia region (Italy) perceive green innovation as a normal part of their technological-based innovations, and those who have more R&D contributions can enjoy more sustainable agricultural and wine-making practices. Spadoni et al. (2019) also prove that the winemaker's potential for innovation might boost the ability of the entire production system to combine technologies, product differentiation and regional traditions. Thus, the wine sector can also employ digital innovations and encourage the creation of startups.

2. Methodology

To assess the relative importance of innovations in the wine sector in Bulgaria, we use the analytical hierarchical process (AHP) methodology. AHP is a widely used tool for managing qualitative and quantitative multi-criteria elements, it is a technique developed by Saaty (1980) and later widely applied and enriched in the literature, see Taherdoost (2017) for a review.

The AHP starts with a composition of a decision hierarchy, in the form of a tree, a unidirectional graph, with several levels. The decision-making elements are brought in this hierarchical structure, whereby the original complex problem is decomposed into the hierarchy. In the standard methodology, the top level is called the "goal", divided into "criteria" (the second level), which are further divided in "alternatives" (the third level) etc., and as a result from the pairwise comparisons are obtained "crisp" values about the importance of the elements of the hierarchy.

In a second step wine experts make pairwise comparisons of the items at each level, in order to obtain an evaluation of the hierarchy. For this purpose, a questionnaire is made, and the opinion of the experts is collected by asking about the relative difference of the items measured by a scale. The experts are assessing the relative importance of the respective items from the point of view of the upward level. All pairwise comparisons are arranged in a square matrix, called a pairwise comparison matrix (PCM).

In the next step the consistency of the results is validated, by applying to the PCM measures such as "consistency index" (CI) and "consistency ratio" (CR), proposed by Saaty (1980) or some of the wide variety of alternative measures, which were proposed later in the literature, for a good review see Mazurek (2017). In order to obtain plausible results, the pairwise comparisons have to be reciprocal, the values below and above the diagonal of the matrix have to be reciprocal, and the results have to be consistent.

Finally, the relative importance of the respective items is calculated, and relative weights are obtained.

One of the problems of the crisp AHP versions is the difficulty wine experts encounter in comparing all the items in a level at once. As it often occurs, for the experts it can be very difficult, if not impossible, to match the pairwise comparisons to the whole group of items. To relax the possible evaluations, and to allow for more room for existing uncertainty in the decisions, fuzzy variants of the AHP have been proposed. In the fuzzy version of AHP, instead of giving a "crisp" value about the difference among the items in the pairwise comparison, experts describe the difference between the items in narrative values. Further these narrative values are replaced by triads of values, the "low" (l), "middle" (m) and "high" (h) values. Values given by different experts are averaged, to obtain the final l-m-h triads, and the fuzzy AHP comparison matrix consists of these triads, instead of single values. To finalize the AHP process, the fuzzy AHP matrix is converted back to a "crisp" AHP matrix and the respective weights of the items are calculated.

In our study we apply the fuzzy version of AHP, following the methodology in Calabrese et al. (2013), who use the fuzzy comparison scale within the span from "JUST EQUAL" (1,1,1), followed by "EQUALLY important" (2/3,1,3/2), "WEAKLY MORE" (1,3/2,2), "MODERATELY MORE" (3/2,2,5/2) and "STRONGLY MORE" (2,5/2,3) to "EXTREMELY MORE" (5/2,3,7/2), the opposite comparisons are calculated as reciprocal values. We use a sparse version of this assessment scale, with 3 levels to choose from, in both directions, however, we keep the original span of the values, thus we have a scale of (5/2,3,7/2), (3/2,2,5/2), (1,1,1), (2/5,1/2,2/3), (2/7,1/3,2/5).

Our hierarchy is presented in Table no. 1.

Table no. 1. Innovations in the wine industry - a decision hierarchy

CONVENTIONAL INNOVATIONS	ECO-INNOVATIONS	SOCIAL INNOVATIONS
v <u>Product innovation:</u> Significant improved products onto the market, QR code/website/newsletter, wine club, training course, green activities promotion, IT technologies	v <u>Reduction of material use:</u> Resource efficiency per unit of output, organic certification	v <u>Recognizing wine innovations of indigenous people and local community</u>
v <u>Grape-growing techniques and technologies:</u> Use of organic, chemical and innovative substances	v <u>Replacing material:</u> less greenhouse gas intensive alternatives, emission monitoring	v <u>Recognizing locally developed wine innovations and experimentation</u>
v <u>Grape-transformation techniques and technologies:</u> Selective cryoextraction, wine bio-informational research	v <u>Recycling:</u> Reduction of consumption through recycling water, waste, materials	v <u>Piloting and testing local policy wine innovations</u>

Source: The authors, based on Frigon, Doloreux and Shearmur., 2020.

In fact, we use three different hierarchies, for each type of innovation, where the top levels are "CONVENTIONAL", "ECO", and "SOCIAL" innovations, the second levels are represented in the columns, with the respective item underlined, and the third level is in the respective cell, the items after the underlined text.

The proposed innovations in Table 1 are the most common innovations among wine-producing countries such as Italy, Spain, France, Australia et al. It is noteworthy to add that the widest scope is conventional or rather marketing innovation compared to the scope of social innovation, for example. Eco-innovation includes good practices with circularity application for the purposes of the whole wine production cycle.

3. Results and discussion

An important aspect of the discussion of results is the fact that the experts working in the wine sector in Bulgaria are divided into two categories: managers or sales directors and technologists, technical specialists responsible for the production process and organoleptic characteristics of wines. The choice to study these two groups is justified by the expected different attitudes to perceive the innovations according to the specifics of the activities of each of the experts.

In our survey, the first group of people engaged with marketing, sales or management will be marked as ("m"), and the second group, which is made of technical specialists, engaged with production and technology will be marked as ("t"). We represent the respective weights next to the description of the item in Table no. 2, Table no. 3 and Table no. 4.

Besides the pairwise comparisons, in our survey we also asked about the degree of familiarity of the experts with the items studied. Although in general the experts are either fully familiar, or at least well informed about the innovations we study, some minor lacks of knowledge do exist, mainly among the specialists from the group which is not directly responsible for the respective innovation.

Table no. 2. Conventional innovations

Product innovation (m) - 0.30	Grape-growing techniques and technologies (m) - 0.27	Grape-transformation techniques and technologies (m) - 0.44	Product innovation (t) - 0.30	Grape-growing techniques and technologies (t) - 0.36	Grape-transformation techniques and technologies (t) - 0.34
Significant improved products onto the market (0.1)	Use of organic substances (0.18)	Selective cryoextraction (0.45)	Significant improved products onto the market (0.12)	Use of organic substances (0.19)	Selective cryoextraction (0.61)
QR code/ website/ newsletter (0.13)	Use of chemical substances (0.42)	wine bio-informational research (0.55)	QR code/ website/ newsletter (0.14)	Use of chemical substances (0.40)	wine bio-informational research (0.39)
wine club (0.18)	Use of innovative substances (0.39)		wine club (0.15)	Use of innovative substances (0.41)	
training course (0.19)			training course (0.17)		
green activities promotion (0.21)			green activities promotion (0.17)		
IT technologies (0.16)			IT technologies (0.26)		

Source: The authors.

For conventional innovations (see Table no. 2), both groups of experts seem to be relatively unanimous in their opinions about the importance of the different items. Weights for product innovation and grape-growing techniques and technologies coincide to a large extent, with exception of the opinions about IT technologies, which can be attributed to their different role in marketing/management on the one hand and

production on the other hand, the base areas of expertise of the experts. The orientation of managers towards green and IT initiatives may also outline some new directions in wine sales.

The differences in the assessments about the grape-transformation techniques and technologies seem to reflect the certain lack of information about some technical details of the production process under the managers, which was discovered explicitly in their answers. More specifically, the role of the cryo techniques is more difficult to be explained to the general public than the organic culture of the grapes. Since communication to the general public is mainly a marketing task, the differences in the views of the experts are a plausible outcome.

The obtained weights can be used as a basis for an index, for measuring the relative performance of wineries in the field of conventional innovations.

Table no. 3. Eco-innovations

Reduction of material use (m) - 0.38	Replacing material (m) - 0.28	Recycling (m) - 0.34	Reduction of material use (t) - 0.30	Replacing material (t) - 0.36	Recycling (t) - 0.34
Resource efficiency per unit of output (0.44)	Less greenhouse gas intensive alternatives (0.42)	Reduction of consumption through recycling water, (0.32)	Resource efficiency per unit of output (0.37)	Less greenhouse gas intensive alternatives (0.40)	Reduction of consumption through recycling water, (0.18)
Organic certification (0.56)	Emission monitoring (0.58)	Reduction of consumption through waste, (0.33)	Organic certification (0.63)	Emission monitoring (0.60)	Reduction of consumption through waste, (0.45)
		Reduction of consumption of materials (0.35)			Reduction of consumption of materials (0.37)

Source: The authors.

Eco-innovations are assessed in a similar way by both groups of wine experts, the structure of weights practically coincides. However, the knowledge of technological specialists has a leading role in determining the importance of eco-innovation in water recycling and waste generation. The small disparity in the assessments of recycling, with technical specialists attributing less weight to waste water than to alternatives is likely to be linked to the widespread standardization of these technologies, which can be seen as classical today, and to the shifting of the agenda towards waste and use of materials, where newer technologies appear, and there is a multitude of innovations.

Table no. 4. Social innovations

Recognizing wine innovations of indigenous people and local community (m) - 0.36	Recognizing locally developed wine innovations and experimentation (m) - 0.32	Piloting and testing local policy wine innovations (m) - 0.32	Recognizing wine innovations of indigenous people and local community (t) - 0.29	Recognizing locally developed wine innovations and experimentation (t) - 0.28	Piloting and testing local policy wine innovations (m) - 0.43

Source: The authors.

Social innovations are likely to be more strongly driven by local influence in the future, and for the moment they are used primarily as a base for some pilot projects, at least in Bulgaria. Through piloting and testing local policy wine innovation, small and middle-sized wineries can successfully experiment production, and monitor quality at the local level the general social effects of wine production on local communities. The divergence in the assessments of the two groups reveals a possible lack of information about the importance of social innovations and their influence on the market, therefore further studies in the area can be very useful for the sector.

Conclusions

The ongoing drive for competitive advantage and sustainability in the economy has influenced many sectors, including the wine industry. In our study, we explore the degree of awareness of the decision makers in the wine sector about several types of innovations - conventional innovations, eco-innovations, and social innovations. The results of the study show that priority is given to conventional and eco-innovations compared to social innovations in the wine sector. At the same time, the direct involvement of wine experts in different types of innovations is emerging. Conventional or marketing innovations are better developed by sales managers, and eco-innovation as a part of sustainable production is important for technologists, social innovations need further research and promotion. The obtained weights in the hierarchies can be used for assessment of the achievements of the sector as a whole, which is an area of possible further research. The analysis is vitally important for small and middle-sized wine producers in Bulgaria who want to join worldwide wine innovation performance.

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