

NOVATERRA PROJECT

DELIVERABLE 5.3

Report on results of consumer willingness to pay and purchase intention for products from sustainable agriculture management

Lead beneficiary: IRTA(CREDA)

Deliverable type: Report

Dissemination level: Confidential

Document Information



Document Modifications

Doc Version	Date	Editor	Modification	Remarks

Project Information

Project title	Integrated Novel Strategies for Reducing the Use and Impact of Pesticides, towards Sustainable Mediterranean Vineyards and Olive Groves
Project Acronym	NOVATERRA
Call identifier	SFS-04-2019-2020 - Integrated health approaches and alternatives to pesticide use
Grant Agreement no.	101000554
Start date - End date – Project Duration	01 October 2020 – 30 September 2024 (48 months)
Website address	https://www.novaterraproject.eu/
Project Coordinator	Institut de Recerca i Tecnologia Agroalimentàries, IRTA Dra Felicidad de Herralde Traveria

Report information

Deliverable no.	D 5.3
Deliverable name	Reports on results of consumer willingness to pay and purchase intention for products from sustainable agriculture management
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Work Package and Task	WP5, Task 5.2, Subtask 5.2.3
WP Leader	IRTA
Dissemination level and Nature¹	PU R
Date of publication	

¹ **Dissemination level:** PU = Public, PP = Restricted to other programme participants, RE = Restricted to a group specified by the consortium, CO = Confidential, only for members of the consortium

Nature of the deliverable: R = Report, P = Prototype, D = Demonstrator, O = Other





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1.1 Executive Summary

This deliverable aims to investigate the complex relationship between consumer preferences and behaviours regarding sustainable wines and olive oils, with a specific focus on products made using alternative methods to controversial plant protection products (pesticides). **The study seeks to identify key characteristics, attitudes, perceptions, and personality traits influencing sustainable consumption decisions in the wine and olive oil sectors.** Additionally, it aims to analyse **consumer purchase intentions and the premium they are willing to pay for sustainable wine and olive oil** produced with pesticide-reducing innovations developed **within the NOVATERRA project.**

To achieve these objectives, a comprehensive **survey experiment involving 5,092 wine and olive consumers was conducted across five Euro-Mediterranean countries (France, Greece, Italy, Portugal, and Spain).** The survey aimed to uncover consumer attitudes, perceptions, opinions, motivations, values, and ethical considerations driving preferences for sustainable conventional wines and olive oil from alternative pesticide-reducing innovations. It also explored consumer perceptions of the impact of vineyard and olive grove activities on communities to **gain a deeper understanding of consumer perspectives in these economically significant sectors, particularly in the Mediterranean regions.** In addition to demographic insights and personality traits, the deliverable estimates **the premium consumers associate with sustainable wines and olive oils,** particularly those produced from alternative pesticide-reducing innovations, using two robust stated preference methods: choice experiment for wine and contingent valuation for olive oil.

The results of the **simulated market for wine using the Discrete Choice Experiment method (DCE)** indicate a promising **positive attitude and willingness to pay a premium** for sustainable wines produced from alternative pesticide-reducing methods across all case study countries. Moreover, consumer preferences and the premium placed on sustainable wine attributes varied among the five case study countries and were influenced by various factors, including certification bodies. Differences in willingness to pay premiums among countries show **heterogeneity in consumer desires to contribute to pesticide reduction through purchase decisions.** The **relevance of certification bodies** in signalling sustainability compliance to consumers was highlighted, particularly certification by the European Commission. Similarly, the results for **olive oil using the Contingent Valuation (CVM) method,** revealed **positive consumers' willingness to pay intentions for sustainable olive oil** derived from pesticide-reducing innovations, with heterogeneity observed across countries in terms of estimated premium willingness to pay.

These findings provide **useful insights for discussions regarding sustainable pesticide use in the vineyard and olive grove sectors** from the **consumers' perspective.** Key factors influencing consumer preferences in the sustainable wine and olive oil markets include consumers' sociodemographic characteristics, environmental attitudes, certification, and perceptions, among others.

Overall, the results suggest a **highly promising preference for sustainable conventional wine and olive oil (produced from limited pesticide use)** compared with conventional products, indicating a potential market if pesticide reduction levels can be effectively communicated to consumers. Recommendations are made to **harmonise sustainable production efforts** with minimal pesticide use in the vineyard and olive grove sectors, including emphasising transparent and informative food and beverage labelling schemes, leveraging the premium consumers are willing to pay for reduced pesticide use products, tailoring marketing strategies to align with consumer preferences, and understanding factors influencing consumer decisions to contribute to a more reduced and sustainable pesticide use in the vineyard and olive grove sectors.





1.2 Introduction and Background

This deliverable presents the outcomes of subtask 5.2.3 within the NOVATERRA project, focusing on evaluating consumers' willingness to pay for products such as wine and olive oil derived from alternative methods to controversial plant protection in vineyards and olive groves.

The European Commission's Green Deal endeavours to make Europe the leading climate-neutral continent by 2050. Central to this initiative is the Farm to Fork (F2F) strategy, which aims to reduce reliance on pesticides and antimicrobials, minimize excess fertilization, promote organic farming, enhance animal welfare, and reverse biodiversity loss. Various research endeavours across food sectors are underway to meet the targets of the F2F strategy's objectives by 2030. The NOVATERRA project, dedicated to developing integrated strategies for sustainable Mediterranean vineyards and olive groves, aligns closely with the F2F strategy's objectives. While the majority of targets and policies target producers, it believed that consumers play a vital role in promoting sustainable production through their consumption behaviours.

In this context, the subtask seeks to understand consumers' purchase intentions regarding wine and olive oil products derived from alternative pesticide-reducing innovations. Its primary goal is to evaluate consumers' willingness to pay (WTP) for sustainable wines and olive oil produced using alternatives to contentious plant protection products in vineyards and olive groves. Specifically, the subtask aims to estimate the value of consumers' willingness to pay for products from alternative pesticide-reducing innovations, identify the factors driving consumers' WTP, and assess how consumers' attitudes influence their receptivity to products from sustainable vineyards and olive groves.

The analysis of WTP for products derived from alternatives to contentious plant protection was performed through a joint survey utilizing two different methods: a discrete choice experiment (DCE) for wine, considering its multiple attributes, and a contingent valuation (CVM) for olive oil. The survey involved 5,092 consumers who had purchased both products within three months prior to the survey. The survey was conducted using the platform of Qualtrics, a reputable survey market company with an extensive database of food consumers. The rest of this deliverable report is segmented into section the objectives in section 1.2, method in section 2, the results, implication and conclusion in section 3 while cited references, relevant information are presented in the last parts.





1.3 Scope and objectives

The detrimental impacts of intensive and unsustainable food production practices on humanity, society, and the environment have been highlighted in recent research (Li & Kallas, 2021; Reynolds et al., 2015). Although many initiatives have focused on producers and processors along the food value chain in an attempt to promote sustainability, it is crucial to recognize the significant influence that consumers possess. Consumers possess substantial sway over the movement towards sustainable production in diverse food systems by virtue of their purchasing decisions and consumption patterns.

In light of this impact, the United Nations underscores the significance of sustainable production and consumption in furthering the objectives of sustainable development. Despite an observable trend among consumers to choose healthier and more environmentally friendly foods (Aschemann-Witzel et al., 2021; Petrescu et al., 2020) achieving a comprehensive shift requires the implementation of effective policy measures. However, developing such measures depends heavily on accurate information about consumer preferences, purchase intentions, and the underlying factors that shape their decisions.

Estimating consumers' willingness to pay (WTP) is a critical step in gaining valuable insights into their preferences, attitudes, and opinions about sustainable food products (Lizin et al., 2022). WTP estimates reveal the price premium, or the maximum amount that consumers are willing to pay for a specific product. Understanding consumers' WTP allows policymakers and stakeholders to create socially acceptable policy interventions that promote sustainable food production (Vecchio & Annunziata, 2015).

Under the **NOVATERRA project**, the main objective is to find alternative methods that maintain current yields and quality of grapes and olives while eliminating or significantly reducing the use of contentious plant protection products, commonly known as pesticides. It is our conviction that consumers can make a meaningful contribution towards attaining this objective by endorsing products that incorporate sustainable innovations through their purchasing choices.

Hence **this subtask aims to determine the willingness of wine and olive oil consumers to pay for sustainable products derived from alternative pesticide-reducing innovations in both sectors.** The deliverable focuses on achieving the following objectives:

- (a) Identifying the **characteristics, attitudes, perceptions, and personality traits of consumers towards sustainable wine and olive oil.**
- (b) Estimating the **premium associated with sustainable wines and olive oils derived from alternative pesticide-reducing innovations.**
- (c) Identifying the **key factors influencing consumers' willingness to pay and preferences for sustainable wines and olive oils from alternative innovations.**





2. Method

To achieve the objectives of the deliverable, the study followed **two experimental survey methods called the discrete choice experiment (DCE) and the contingent valuation (CVM)** described under subtask 5.2.3. Below are the summaries of the steps followed:

1. A total of **5, 092 consumers (at least 1000 from each of the five countries) who had purchased both wine and olive oil three months before the survey were selected from a panel of consumer databases provided by Qualtrics**, an experienced management/research company with expertise in survey data collection. The selected sample was stratified by sex and age. Participants were also eligible according to the **responsibility of purchase decision for the two products**. Those who were not directly involved in purchase decisions were dropped from the survey.
2. In the first part of the survey, information about **their purchase habits including their last purchase** was solicited. Information gathered includes the **price, type, attributes, place of purchase (online or physical shop), and level of satisfaction with their last purchase**.
3. In the second part, participants were provided information on **alternative innovations designed to reduce the use of contentious plant protective products (pesticides)** in the vineyard and olive grove sectors.
4. In the third part, participants were asked to read a cheap talk script and take a solemn oath, which enjoins them to be honest in their choices and selections during the experiment (Carlsson et al., 2005; De-Magistris & Pascucci, 2014).

*The fourth part covers **discrete choice experiment (DCE)***

5. For the DCE for wine, all consumers who had purchased conventional wines were presented with three 750ml standard red wine options (i.e. two hypothetical wines in addition to their last purchased wine, which served as the reference). The two hypothetical wines are assumed to be produced from alternative innovation, which limits the use of pesticides. The hypothetical wines therefore have slightly higher price (5%, 20%, 35% or 50%) compared to the reference conventional wines and were either certified by a certification agency (Independent, Collective/participatory, EU/governmental) or not (Delmas & Lessem, 2017; Parga Dans et al., 2019).
6. Participants were then presented with eight choice sets each comprising three options (two hypothetical ones and the reference). At each of the eight choice occasions, participants were to select one of the three options considering the *price, level of pesticide avoided in grape cultivation, and the type of certification*.

*The fifth part covers the **contingent valuation method (CVM)***

7. For the CVM olive oil, participants were presented with open-ended and closed-ended multiple payments. Thus, participants were given the option to choose between multiple payments options of how much more they are willing to pay for a 1 Litre of olive oil produced from alternative innovations that reduce pesticide use in olive groves. The options include “zero amount” and other ranges between 1-2 €, 2-3 € until > 9 €. Following the selection of a particular range, participants are asked to specify the exact value of their willingness to pay.





8. In both the choice and the contingent valuation experiments, all the factors that influence choice such as taste and other product attributes are held constant with the exception of pesticide level, certification and price. Thus, the last products purchased that served as the reference for the experiment has the same attribute as the hypothetical options except price, pesticide, and certification.
9. The sixth part addressed the consumers' perception of pesticide use in vineyard and olive grove, opinions regarding the impact of vineyard/olive grove expansion and mechanization on human settlements, the receptivity to new wine/olive products
10. The final section deals with the sociodemographic characteristics of the participants





2.1 Measuring consumers' WTP for sustainable wines: The Discrete Choice Experiment (DCE) method

The Discrete Choice Experiment (DCE) was used to derive consumers' willingness to pay and expected purchase intention towards sustainable wines produced from alternative innovation to contentious plant protection products. The DCE aims to identify the consumers' trade-offs in their choice decisions regarding sustainable attributes of wines. Considering the many attributes of wines, the DCE method is adopted to identify the consumers' trade-offs between other relevant wine attributes and the main sustainable attribute in this subtask. The use of the Discrete Choice Experiment (DCE) is grounded in Lancaster's choice theory, assuming consumers are rational and consistently seek to maximize their utility. Initially applied by Louviere (1984) to estimate the proportion of consumers willing to try new food products in a fast-food setting, the DCE has evolved into a primary stated preference method for discerning the crucial attributes influencing preferences in the food sector. This method entails constructing a hypothetical market scenario through questionnaires, simulating a purchasing decision among different alternatives that vary in quality attributes and price (Contini et al., 2019)

In this context, examining consumers' preferences and willingness to pay through surveys may be susceptible to the well-known hypothetical bias. As explained by Loomis (2014), this bias in surveys reflects the age-old adage "There is a difference between what is said and what is done". The hypothetical bias is characterized by the variance between what a respondent claims they would purchase in a survey or interview and their actual behaviour in a real market. To mitigate the impact of the hypothetical bias on results, Loomis (2014) suggests employing various ex-ante and ex-post approaches in surveys. One ex-ante strategy involves incorporating a cheap talk script before respondents answer the DCE questions, as also proposed by Carlsson et al. (2005). Participants were informed about previous studies highlighting a disparity between survey responses and real-life actions. They were also made aware that respondents often overestimate their willingness to pay (WTP) in hypothetical purchase situations, neglecting their food budget constraints. Consequently, participants were encouraged to thoughtfully assess each purchase situation accordingly and be honest with their choices.

In addition to the ex-ante remedies, we adopted the reference-dependent survey approach, which minimizes attribute selection and starting point biases. The reference-dependent approach involves premising the choice sets on a specific reference which is similar to what is referred to in some literature as the pivot design (Hess & Rose, 2009). To determine the reference points of all consumers, we initially gathered information from participants about the attributes of their most recent red wine purchase (referred to as the reference wine). These attributes include alcoholic content, brand, geographic indication, packaging, price, taste, vintage, and others. The reference-dependent choice design utilized details from the reference wine to formulate the hypothetical choice sets.

The collection of information on the reference wine and the design of the hypothetical choice options were dynamically linked with the help of the 'piped text' feature in Qualtrics, a survey tool enabling the customization of questions and choices for each respondent within a dynamic framework (Weber, 2021).

2.1.1 The experimental design

We adopted a design similar to the one suggested by Contini et al. (2019). In this design, each participant specifies their regular purchase price and subsequently engages in the choice experiment featuring a price vector aligned with their stated prices. Thus, the choice scenarios are linked to the individual stated prices of participants. The choice scenarios involve selecting between three alternative red wines of which two are unlabelled hypothetical wines varying in three attributes (i.e. volume of





pesticide levels reduced in grape cultivation, certification and prices) and the third is the reference wine (i.e. participants' last purchase wine). The reference alternative was designated as "NONE (I prefer my last purchase)".

Since the hypothetical alternative wines offered were sustainable i.e. produced from low levels of pesticide use through alternative innovation of contentious PPPs, their price levels were obtained by adjusting upwards the price of the reference wine by 5%, 20%, 35% or 50%. The levels of pesticide reduction attribute was obtained from engagement with partners of this project who had developed alternative innovations for pesticide reduction in vineyards. Data from the innovations showed winegrowers could reduce pesticide use by up to 40 percent of what is currently applied in conventional vineyards. The actual level of reduction however depends on the level of adoption and commitment by the grower. Hence, we included four levels of pesticide reduction (-10%, -20%, -30% and -40%) corresponding to different levels of adoption by winegrowers. Finally, a four-level certification attribute is included based on the existing certification bodies for sustainable food products in the EU (Bazoche et al., 2014; Cuéllar-Padilla & Ganuza-Fernandez, 2018). This is important because, to analyse the values consumer puts on pesticide reduction, it is important to know whether different certifications and corresponding signals are identified by consumers. The four levels of certification included were the base level is denoted as no certification (NC), commonly associated with conventional wines. The second level involves certification by an independent third party (IC) vested with regulatory authority to uphold specific production standards. The third certification level is the participatory guaranteed body (PC), which certifies locally based on the collaborative involvement of all stakeholders. The final level is National/European certification (EC), wherein ecolabels are issued for sustainable initiatives.

Table 1. below summarize the three attributes used in the experiment and their levels. Besides the three attributes included in the experiment, participants were to assume that all other attributes of their usually preferred or purchased wines remain the same.

Table 1. Attributes definition and levels used in choice experiment

Attribute	Definition	Base	Level1	Level2	Level3
Pesticide Reduction	The percentage of spray volume of pesticides that is reduced by conventional winegrowers using pesticide-reducing innovations.	-10%	-20%	-30%	-40%
Certification	Regulatory bodies that are capable of issuing certificates to signal compliance with accepted sustainable practices.	No-certification (NC)	Independent /Third party certification (IC)	Participatory guaranteed certification (PC)	EU/National certification (EC)
Price	Price variation in percentage based on respondents' stated reference prices in Euros (€) for a 750ml bottle of red wine for regular home consumption.	+5%	+20%	+35%	+50%





2.1.2 Creating the simulated purchase situations

A very important step in applying the DCE is to create comprehensive and efficient purchase scenarios. This is concerned with: i. how to combine the different attribute levels (in our case the pesticide reduction, certification and price level), how to create the alternatives (products), ii. how many alternatives to put in each choice set (purchasing situation), and iii. how to deal with the dominant and unrealistic alternatives if existed. In this context, the DCE involves the use of statistical design theory to construct choice scenarios. The orthogonal design method is important from the point of view of isolating the effects of individual attributes on choice and is one of the most used design methods in DCE literature. The orthogonal designs use a mathematical constraint requiring that all attribute levels are statistically independent of one another which implies zero correlations between the same attribute in different alternatives. It also ensures that the attribute levels are well spread over all choice tasks in a balanced way, guaranteeing the same occurrence of all levels among all alternatives in the design and that attribute level combinations do not exhibit a certain pattern.

However, recently, the D-optimal design has been proposed to increase the statistical performance by minimizing the standard errors in parameter estimates (Bliemer & Rose, 2023). To construct D-efficient designs, the analyst is required to assume prior parameter estimates in a Bayesian-like fashion. For this task, we assumed the prior of the price attribute to be zero. The *Ngene software* is employed to create the D-optimal efficient design (Metrics, 2014). Accordingly, the design generated 16 choice sets made of two blocks by ensuring the orthogonality of all attributes across the products. To reduce the cognitive burden on participants, each participant was presented with 8 choice sets. The participants received a description of the main attributes of sustainable wines produced from alternative innovations. After that, they were asked to select, in each choice set, the wine alternative that they would purchase in a real market situation.

A summary of the **choice design** and a **sample choice card** can be found in the **Note box1** in the annex section of this document.

2.1.3 The econometric modelling: The willingness to pay estimation

The DCE relies on Lancaster's Theory of Value (Lancaster, 1966) and on the Random Utility Theory (RUT) of Thurstone (1994). According to this theory, individuals choose among the alternatives in a choice situation according to a utility function with two main components: a systematic (observable) component and a random error term (non-observable):

$$U_{jn} = V_{jn} + \varepsilon_{jn} \quad (1)$$

Where:

- U_{jn} is the utility of alternative j to subject n ,
- V_{jn} is the systematic component of the utility and
- ε_{jn} is a stochastic term.

Assuming linearity, the utility function for alternative j can be expressed as:

$$V_{jn} = \beta_s ASC_j + \beta_j X_j + \beta_i Z_i + \alpha_j P_{jn} \quad (2)$$





where:

- j are the alternative wines from different alternative innovations
- P_{jn} is the price of alternative j selected by the consumer n ,
- β_s is the coefficient of the Alternative Specific Constant for the sustainable hypothetical wines relative to the reference alternative i.e. NONE (I prefer my last purchase). Hence, in our case study, the β_s represents the marginal utility of the sustainable wine alternatives.
- β_j represents a vector of the coefficients of the attributes of wines of alternative j
- β_i is a vector of coefficients of the personal characteristics of individual i varying over individuals in the population
- α_j are the coefficients representing the effect of the j th wine price on its utility

To predict the participants' preferences for an alternative (i.e., a wine obtained from sustainable cultivation), we need to define the "probability of choice" that individual n chooses the alternative i rather than the alternative j (for any i and j within choice sets, T). McFadden (1974) developed the base model for the DCE often referred to as the multinomial logit (MNL) model. According to this model, the probability that a consumer n chooses production system j is

$$\text{Probability}\{j \text{ is chosen}\} = \frac{e^{\mu V_{jn}}}{\sum_{k=1}^J e^{\mu V_{kn}}} \quad \forall k \in T \quad (3)$$

Where:

μ is a scale parameter that is inversely related to the variance of the error term.

For the MNL, the scale parameter is fixed to one for estimation reasons. Furthermore, in this model specification, the condition of Independent and Identically Distributed (IID) error term must be met according to a Gumbel distribution. Such a distribution in the error term allows for the verification of a restrictive property within the MNL which is the Independence of Irrelevant Alternatives (IIA) property. This restriction implies that the ratio of the probabilities of choosing any pair of alternatives i and j $\left[\frac{P(i/T)}{P(j/T)} \right]$ is not dependent on the systematic utility of any other alternative within the set of alternatives which is seldom ensured. As a consequence, the MNL imposes a very strict structure on cross-price elasticities avoiding the possibility to analyse substitutability between the wine alternatives (Hensher et al., 2005).

To relax this assumption and allow for substitutability of alternatives, the Random Parameter Logit (RPL) model is used (McFadden et al., 1977). In the RPL, the parameters are assumed to be random and independent across individuals and identically distributed within the population. This assumption simplifies the modelling process and is often made for mathematical tractability.

Thus, the RPL model extends the MNL model by allowing for unobserved heterogeneity through random coefficients on attributes (Ben-Akiva et al., 1997) and hence relaxes the IIA assumption. In our case studies, the random parameters were assigned on the Alternative Specific Constant (ASC) since this estimate encompasses all attributes of the sustainable wine alternative in a holistic way.





In most applications, the multivariate normal distribution is used i.e. $N(\mu, \Sigma)$. In our case, we considered the ASC and all attributes normally distributed in the population. The price coefficients were considered fixed (i.e. non-random) to ensure that the estimated total Willingness to Pay distribution is finite. The total Willingness to Pay (WTP) for the sustainable wine alternative relative to the conventional reference is calculated as the negative ratio of the ASC coefficient to the price coefficient

$$WTP \text{ for sustainable wine products} = \frac{\partial U_{jn} / \partial ASC_j}{\partial U_{jn} / \partial P_{jn}} = - \left(\frac{\beta_s}{\alpha_j} \right) \quad (4)$$

This calculation relies on the estimation of the Marginal Rate of Substitution (MRS) of any two coefficients. Since one of the coefficients is a monetary one (i.e. the price), it is possible to determine the WTP. Finally, the Wald test (Delta method) was applied to calculate the significance and confidence intervals of the WTPs. We used the NLOGIT 6.0 software and 500 random draws to estimate the coefficients (Chiew, 2015).





2.2 Measuring consumers' WTP for sustainable olive oil: The Contingent Valuation Method (CVM)

The Contingent Valuation Method (CVM) was used to estimate the consumers' expected WTP for olive oils produced from alternative innovations. The Contingent Valuation (CV) method is a simple and direct elicitation method to evaluate consumers' willingness to pay for a product.

Respondents were asked in a direct question, to state how much extra they are willing to pay for the olive oils produced from alternative innovations that reduce pesticide use in the olive groves given the average price of the current conventional olive oils. The CVM is preferred as a suitable monetary valuation technique for olive oil because i. the proposed sustainable olive oil (i.e. produced from alternative solutions to contentious PPP) is not available on the market and ii. Olive oil does not have several separable attributes and hence can be evaluated holistically.

The initial step in implementing the Contingent Valuation Method (CVM) involves creating a hypothetical market for the proposed sustainable olive oil. This is achieved by clearly defining the aim and purpose of the value question. Various formats for eliciting Willingness to Pay (WTP) have been utilised in CVM, as noted in studies by Chen et al. (2020) and Zhang et al. (2020). However, no single format has demonstrated clear superiority, as its effectiveness depends on the specific research context. For this case study, the "payment card" format was employed due to its advantages. This format combines the benefits of open-ended formats, capturing specific WTP information, and closed-ended formats, minimizing the cognitive burden on participants (Kallas & Gil, 2012). Simultaneously, it addresses the drawbacks of open-ended formats, reduces protest answers, and mitigates issues associated with dichotomous choice methods and iterative bidding processes, such as susceptibility to the anchoring effect (Kallas et al., 2012; Lo & Jim, 2015). This approach is widely adopted in current literature and gives more robust WTP estimates compared to the dichotomous choice approach (Ready et al., 2001).

Our multiple payment card method involves two-step WTP elicitation questions that are dynamically linked together. In the first question, consumers are asked to select among different ranges of prices that match their extra willingness to pay a premium. In the second question, they are asked to specify the exact amount given the previous range selected. The price ranges in the first step in the multiple payment cards were left open to allow participants unrestricted choice. Thus, 10 premium price ranges were presented, including zero (indicating unwillingness to pay more). The option of not being willing to pay extra (zero) aligns with demand theory and enhances the realism of the price premium selection task. This approach prevents respondents from feeling compelled to choose among options, a situation that could introduce bias into preferences (Weinrich & Elshiewy, 2019). To establish the additional amount respondents are willing to pay, we first asked for the price of their previous purchase which is the conventional olive oil produced under the current conventional practices without alternative pesticide-reducing innovations. We used the previous purchase price as the starting point for assessing the additional amount they were willing to pay. This starting point price is referred to as the reference price. To incorporate the reference price for each respondent, we employed a dynamic survey approach where previous information gathered from all consumers regarding their most recent purchase price for conventional olive oil is again revealed to them before asking how much extra they will pay. Thus, the previous price, serving as the reference point, was incorporated into the question asking about the additional amount they are willing to pay for a 1 Litre bottle of olive oil. Table 2 below displays the summary of how the CVM question was asked using the payment card method.





To reduce the “hypothetical bias”, which is the difference between what respondents indicate they would purchase in a survey (intention) and what they would actually do in the real market (behaviour), a cheap talk script and solemn oath are used at the beginning of the questionnaire as proposed in Carlsson, Frykblom, & Lagerkvist (2005). Consumers tend to overestimate their WTP in a hypothetical situation as they are inclined to overlook the cost since they are not actually paying and give more importance to other beliefs not related to the cost (Ajzen et al., 2004). A cheap talk script and solemn oaths play the role of creating attitudes and intentions in a hypothetical situation that mimic those in a real situation (Ajzen et al., 2004).

Table 2. The payment card format used and the contingent question

<i>Preliminary question</i>	<i>Indicate how much in € that you usually pay for a 1 Litre bottle of conventional olive oil purchased for regular consumption. Answer: XXX</i>										
<i>Experiment² question</i>	<i>You indicated that you usually pay XXX € for a 1 Litre bottle of olive oil for your regular consumption. How much <u>extra</u> are you willing to pay for the 1Litre bottle olive oil produced from alternative innovations that reduce pesticide use by up to 40% compared to the current practice?</i>										
Olive oil from alternative innovation	Nothing extra (0)	0>-1€	1-2€	2-3€	3-4€	4-5€	5-6€	6-7€	7-8€	8-9€	>9€
Specific WTP	You indicated that you are willing to pay 1-2€ extra. Please state the specific extra amount you are willing to pay.										

For participants who opted not to pay any premium, an additional follow-up question was introduced. This was aimed at distinguishing between genuine zeros (indicating a true lack of willingness to pay) and protest responses, where consumers express interest but are unwilling to pay for various reasons (Pennington et al., 2017). Within the reasons for opting out, a response such as "I cannot pay extra due to budget constraints" was considered a genuine zero. Another follow-up question was included to assess whether the stated willingness to pay (WTP) would have differed had the survey been conducted before the current inflation situation.

² The experiment question follows detail description of alternative innovations adopted to reduce pesticide use.



2.2.1 Econometric modelling: The mean WTP estimation and factors

The means WTP is estimated using by finding the average of the consumers' stated premiums from the closed ended format questions.

To identify the factors influencing the willingness to pay a premium and to estimate the likelihood of being open to paying extra, we employ the two-stage Heckman sample selection model. When examining consumers' spending behaviour on a novel and unfamiliar product, it is anticipated that a significant portion of respondents may not express a willingness to purchase the product (Umanath, 2018). The sample selection model operates as a two-step regression model, specifically suitable for datasets with a considerable number of zero observations. It is chosen over the Tobit model to mitigate selection bias. The Tobit model utilizes a single equation to explain both participation and expenditure decisions, often leading to sample selection bias. In contrast, the sample selection model (J.Heckman, 1979), also known as the type 2 Tobit model (Quah & Tan, 2009), employs two distinct equations. The first equation is a probit regression model predicting the decision of whether to make a purchase (in this study, whether to pay extra or not). Hence it is sometimes referred to as the participation equation). The participation equation helps to identify the factors that influence the likelihood of being included in the sample and can be written as.

$$P_r(D_i = 1 | X_i) = \Phi(Z_i\gamma) \quad (5)$$

where D_i is a binary indicator for whether an individual is willing to pay extra or not, X_i is a vector of observed characteristics of the individual, Φ is the cumulative distribution function of the standard normal distribution, and γ is a vector of parameters. From the estimation of the first stage equation, the Inverse Mills ratio (λ), which is the ratio of the standard normal density function to the cumulative distribution function is calculated. The Inverse Mills Ratio (IMR) serves as the link between the first and the second equations.

The second equation is a linear regression model indicating the amount to spend when the decision to pay extra is affirmative (Lyu & Noh, 2017). The second equation which is the main equation of interest is estimated while including the IMR as a covariate to correct for sample selection bias as follows:

$$Y_i = \beta X_i + \alpha \lambda_i + \varepsilon_i \quad (6)$$

where Y_i is the outcome variable of interest, X_i is a vector of covariates, β is the vector of coefficients for the covariates, α is the coefficient for the inverse Mills ratio, and ε_i is the error term.





2.2.2 Protest responses

The zero bid option where consumers choose not to pay extra for products from alternative solutions may be a true response or a protest response. A true response is when the consumer is truly not interested in sustainable olive oil. A protest response is when the consumer is actually interested in the product but, there is a reason why he/she is not willing to pay for it (Frey & Pirscher, 2019; Strazzera et al., 2003). Protest replies are not related to illogical answers, and replies from respondents that did not understand the question or refuse to answer it (Frey & Pirscher, 2019). Further questions can reveal the motivations behind the consumer's protest behaviour (Strazzera et al., 2003). For example, respondents can protest because they think it is unfair for them to pay extra as they think the government or farmer should deal with the cost of sustainability, or they already pay enough for the product etc. (Frey & Pirscher, 2019; Lo & Jim, 2015). Therefore, we identified these protest responses to allow for correct policy decisions since they can significantly affect the estimated WTP in the study.

Hence, the participants who objected to paying extra premium were asked the reason behind their decision with the following possible answers to choose from.

- *Prices are already too high*
- *My income is not enough*
- *Pesticide reduction is not important to me*
- *Is the obligation of farmers to produce more sustainably*
- *I do not believe in new alternative innovations*
- *The Government must pay for the innovation*
- *I am just not interested in paying more*
- *Other reasons (specify)*





2.3 Receptive consumer behaviour

The Food Neophobia Scale (FNS), a self-administered questionnaire has been used to measure an individual's willingness to try new foods and their level of food neophobia, which is the fear or loathing of novel or unfamiliar foods (De Kock et al., 2022; Pliner & Hobden, 1992). Numerous studies have verified the reliability and internal consistency of the FNS, confirming its ability to predict consumers' reactions to new food products (Raudenbush & Frank, 1999; Ritchey et al., 2003). Since its inception, the FNS has been widely utilized in various case studies across multiple countries. Research indicates that individuals with high levels of food neophobia tend to avoid new foods, both in terms of preference (e.g., purchase intention) and acceptance (e.g., eating intention), see e.g. (Fernández-Ruiz et al., 2013; Labrecque et al., 2006).

Consequently, assessing the neophobia score among consumers in this study would provide some bases to understand their potential acceptance of sustainable products derived from alternative methods that reduce pesticide usage in vineyards and olive groves. However, it's important to note that the products (wine and olive oil) obtained from alternative pesticide-reducing methods are not entirely new but rather sustainable versions of conventional wine and olive oil, produced with reduced or optimal pesticide application. Therefore, using the exact terminology and concept of food neophobia to gauge consumer willingness to accept these products might be overly stringent, as the food neophobia scale typically measures subjects' openness to trying entirely new products. Consequently, we adopted the term "receptiveness" instead of neophobia to analyse the behaviour of consumers towards unfamiliar products.

According to the literature on consumer receptiveness and typologies of market (Lee & Geistfeld, 1999), it is possible to define receptiveness in terms of consumer's involvement in choosing and using a products (Lorenzon & Pilotti, 2008). Therefore we define receptive behaviour as consumers' openness or willingness to experience or accept unfamiliar products.

Consumers' receptiveness was assessed using the wine neophobia scale (WNS)-an adapted food neophobia scale, which apply to wine following Rabadán (2021) and Ristic et al. (2016). The original scale consists of 7-point Likert scale from "strongly disagree" to "strongly agree". In this subtask, we used a 9-point scale because findings indicate that having more scale points reduces the skewness, minimizes the kurtosis and produces results closer to normal than the lower scales (Leung, 2011). Peryam & Girardot (1998) also argued that the data obtained from the 9-point scale can be handled by parametric methods as it accomplishes the statistical assumption of normality and allows estimating levels of preference. Our 9-point Likert scale contained the following categories: "disagree very strongly", "disagree strongly", "disagree moderately", "disagree slightly", "neutral", "agree slightly", "agree moderately", "agree strongly" and "agree very strongly".

The scales were translated from its original English version to the different languages and their comprehension were tested in a pilot sample of 20 consumers in each country. The original version of the scale (English) and the translated versions are presented in Table 3.

Following, Rabadán (2021), the individual score on the WNS for each consumer was calculated as the sum of the 8 items after reversing the negative items (items 1, 2, 4, 5, and 8). Consumers with higher scores on the scale demonstrate a lower degree of receptivity, suggesting a reduced inclination to accept unfamiliar wine products. Conversely, those with lower scores are categorized as more receptive, indicating a stronger inclination to try new wine products.

Table 3. Items from the 8 WNS item

English	France	Greece	Italy
1. I like going to places serving wines from different countries(R)	1. (R) J'aime aller dans des endroits servant des vins de différents pays (R)	1. Μου αρέσει να πηγαίνω σε μέρη που σερβίρουν κρασιά από διαφορετικές χώρες (R)	1. Mi piace andare in posti che servono vini di diversi Paesi (R)
2. I will drink almost any wine (R)	2. Je boirai presque n'importe quel vin (R)	2. Πίνω σχεδόν οποιοδήποτε κρασί (R)	2. Bevo qualsiasi tipo di vino (R)
3. I am afraid to drink wines I have never had before	3. J'ai peur de boire des vins que je n'ai jamais bu	3. Φοβάμαι να πω κρασιά που δεν έχω ξαναπιεί	3. Ho paura di bere vini che non ho mai bevuto prima
4. At social gatherings, I will try a new wine (R)	4. Lors de réunions sociales, j'essaierai un nouveau vin (R)	4. Σε κοινωνικές συγκεντρώσεις, θα δοκιμάσω ένα νέο κρασί (R)	4. In occasione di incontri sociali, proverò un nuovo vino (R)
5. I like wines from different countries (R)	5. J'aime les vins de différents pays (R)	5. Μου αρέσουν τα κρασιά από διαφορετικές χώρες (R)	5. Mi piacciono i vini di diversi paesi (R)
6. If I do not know what wine it is, I won't try it	6. Si je ne sais pas de quel vin il s'agit, je ne l'essayerai pas	6. Αν δεν ξέρω τι κρασί είναι, δεν θα το δοκιμάσω.	6. Se non so di che vino si tratta, non lo assaggio
7. I do not trust new wines	7. Je ne fais pas confiance aux nouveaux vins	7. Δεν εμπιστεύομαι κρασιά που δεν έχω δοκιμάσει στο παρελθόν	7. Non mi fido dei vini nuovi
8. I am constantly trying new and different wines (R)	8. J'essaie constamment des vins nouveaux et différents (R)	8. Δοκιμάζω συνεχώς νέα και διαφορετικά κρασιά (R)	8. Provo costantemente vini nuovi e diversi (R)
	Portugal	Spain	
	1. Eu gosto de frequentar locais que servem vinhos de diferentes países (R)	1. Me gusta ir a sitios donde sirven vinos de distintos países (R)	
	2. Eu bebo praticamente qualquer vinho (R)	2. Beberé cualquier tipo vino (R)	
	3. Eu receio beber vinhos que nunca provei antes.	3. Me da miedo beber vinos que no he probado nunca	
	4. Nos eventos sociais, eu provarei um novo vinho (R)	4. En las reuniones sociales, estoy dispuesto a probar vinos nuevos (R)	
	5. Eu gosto de vinhos de diferentes países (R)	5. Me gustan los vinos de diferentes países (R)	
	6. Se eu não souber que vinho é, não o provarei.	6. Si no sé qué vino es, no lo pruebo	
	7. Eu não confio em vinhos novos.	7. No me fío de los vinos nuevos	
	8. Eu estou constantemente a provar vinhos novos e diferentes (R)	8. Pruebo constantemente vinos nuevos y diferentes (R)	



2.4 Data Collection

This subtask of the project was carried out **using primary data collected through a survey among a panel of consumers in the Euro-Mediterranean region**. The questionnaire was designed to gather information on the purchase habits, socio-demographic characteristics, perception, opinions, and attitude among others of the participants. Participation was restricted to consumers over 18 years of age who were mainly involved in purchasing decisions regarding wine and olive oil their households. All participants had history of previously purchasing both wine and olive oil three months prior to the survey.

The questionnaire was **pre-launched using a pilot sample of 50 consumers in each case study country**. The data collection was done using the Qualtrics platform with the participants drawn from their European consumer panel database.

Following the DoA, the data were collected according to consumers’ recruitment conditions of subtask 5.2.3.3 (details can be consulted in the deliverable D5.3 page 38). Participation was subject to agreement to the General Data Protection Regulation of the European Union. All participants had the option to decline participation after reading the introductory statement which spelt out the aims and objectives of the survey. The questionnaires were translated into the respective national languages with the help of the project partners. At least 1000 consumers that were stratified by gender and age were surveyed in each of the case study country. The breakdown of participants in the five Euro-Mediterranean countries is presented in the Table 4 below.

Table 4. Data breakdown by country and sample

	France	Greece	Italy	Portugal	Spain	TOTAL
<i>Sample size (n)</i>	1013	1018	1021	1022	1018	5092
<i>Duration (days)</i>	30	30	30	30	30	
<i>End date</i>	April 1, 2023					

The full survey questions can be accessed in English, French, Greek, Italian, Portuguese and Spanish from [Survey Link](#)





3. Results

3. 1 Socio-economic and demographic characteristics of the samples

In this section, we summarized the **main socio-economic and demographic variables** of the participants in each country. Information regarding the questionnaires and their respective sections can be found in the link provided under data.

3.1.1 Gender

As can be seen in 2, **the gender variable** was distributed almost in equal proportion between male and female according to the population distribution in all countries. The female population was slightly higher than the male population in all the five countries.

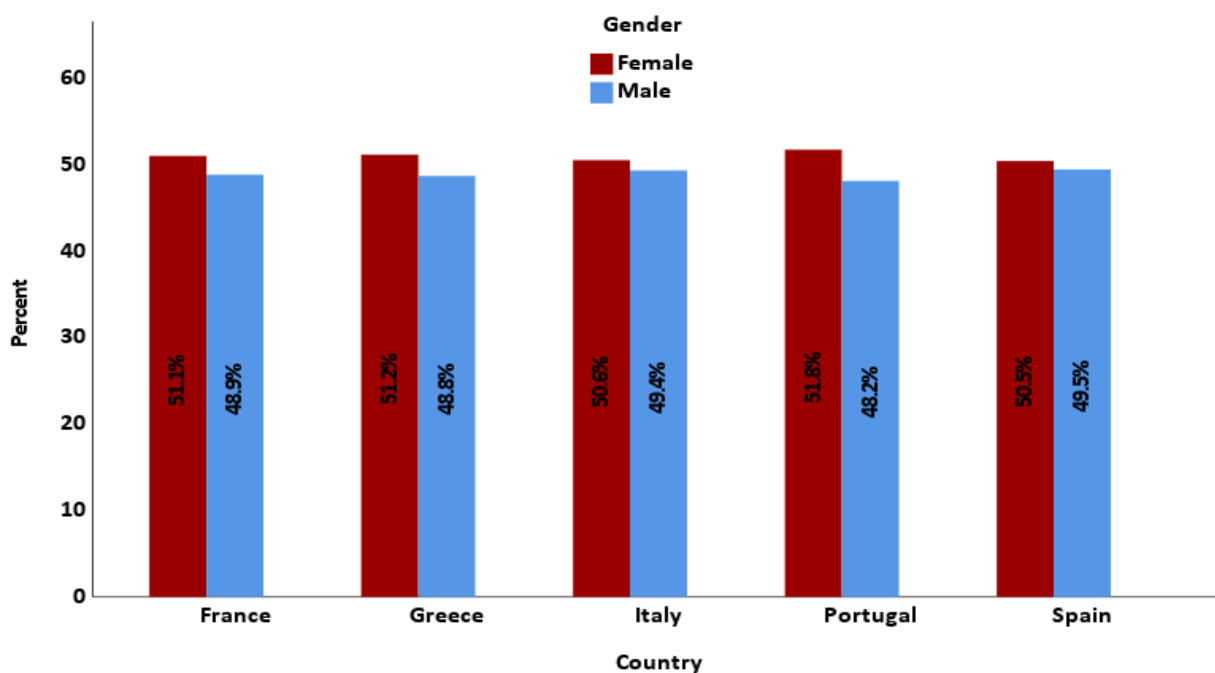


Figure 1: Gender distribution of the consumers by country



3.1.2 Age categories

Concerning the age variable, the findings illustrated in Figure 3 depict a proportional distribution of all **age categories** based on the populations of respective countries. Therefore, a comparable age distribution is observed across countries with representation from all age bracket.

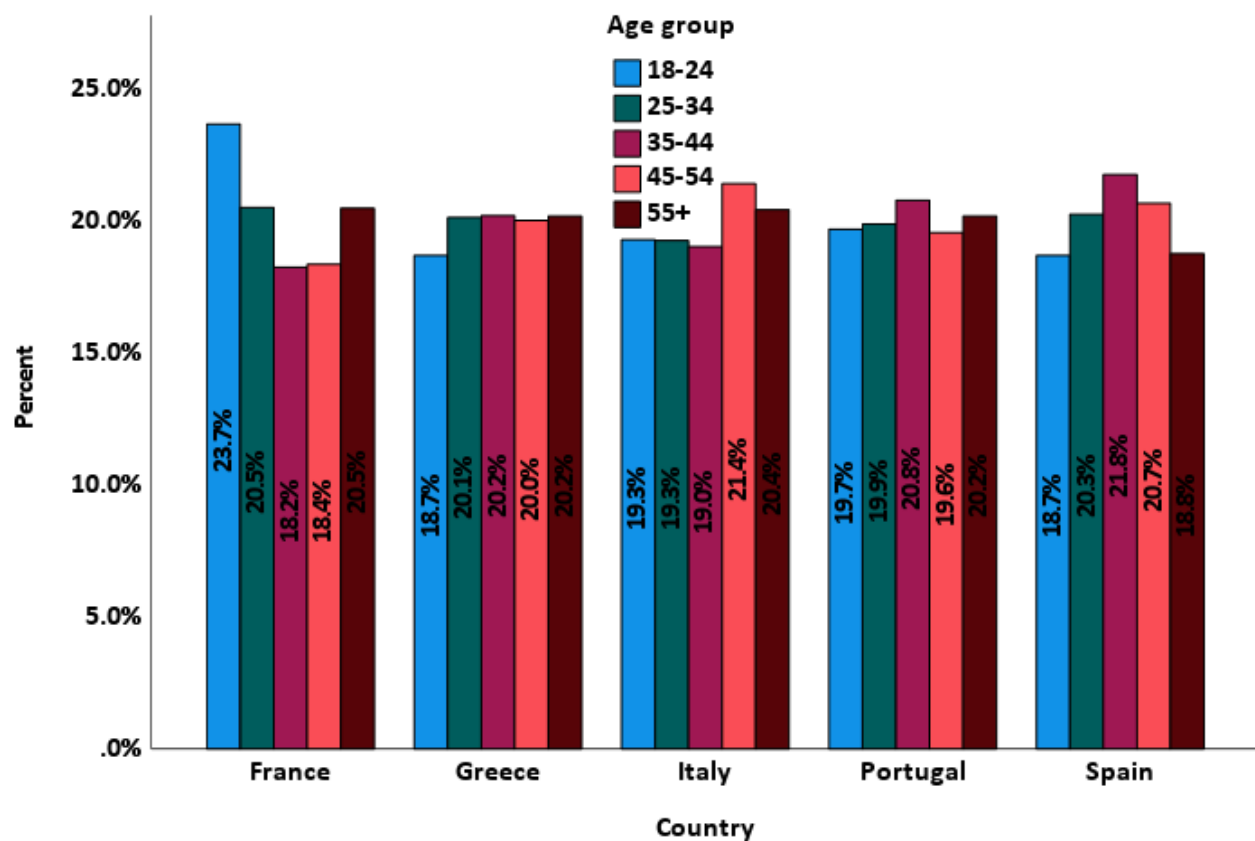


Figure 2: Age distribution among respondents in each country



3.1.3 Education

In regards to the participants' educational backgrounds, a majority held secondary or post-secondary education, indicating a high level of literacy among the respondents. The **educational profile** of the participants thus accurately reflects the situation in the case study countries, with a negligible number of individuals having only primary education

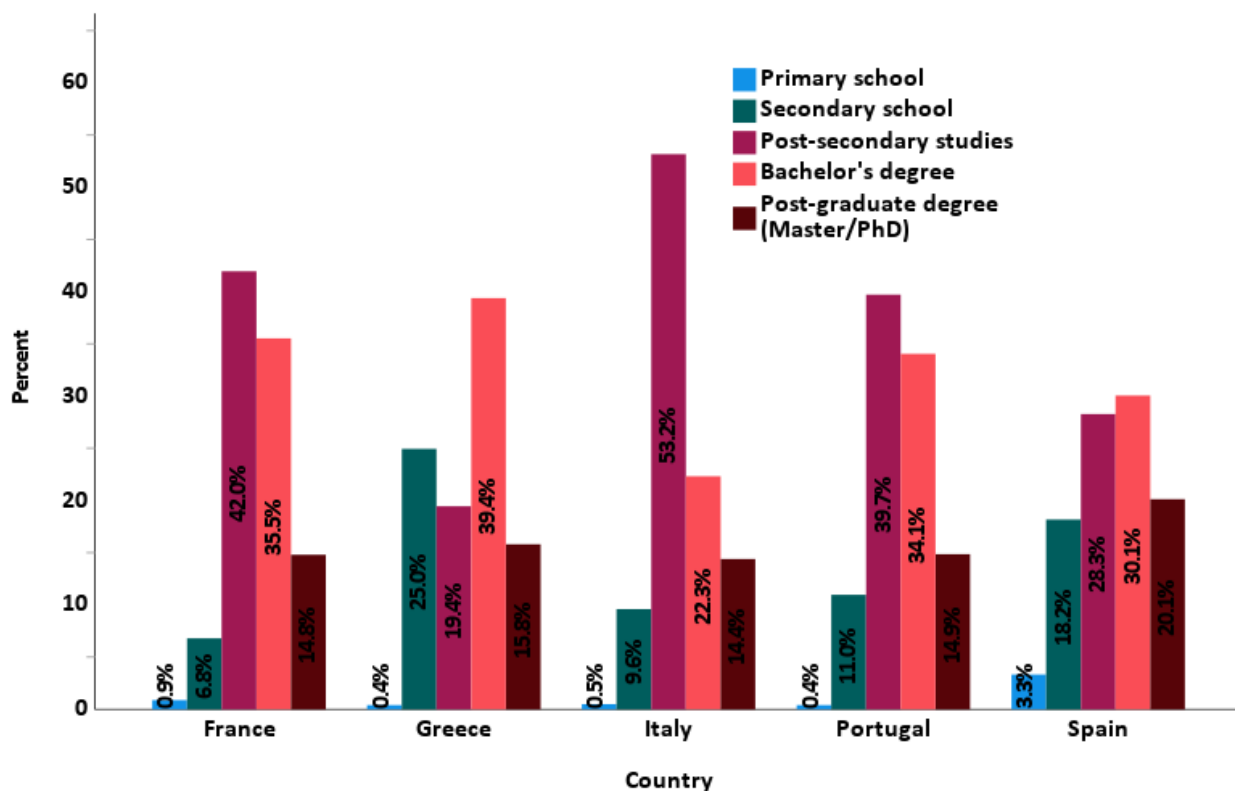


Figure 3: Respondents' distribution by educational level attained

3.1.4 Employment status

More than 60% of participants in all case study countries were earning income either as employees or employers. **Employment distribution** was consistent across the five countries, with the majority being full-time employees. Approximately 10% of the sample consisted of retired workers in all case study countries, except for France, where the number of retired workers approached 20%. Those who indicated an "other" employment status specified activities such as homeworking and housekeeping as their primary economic pursuits.

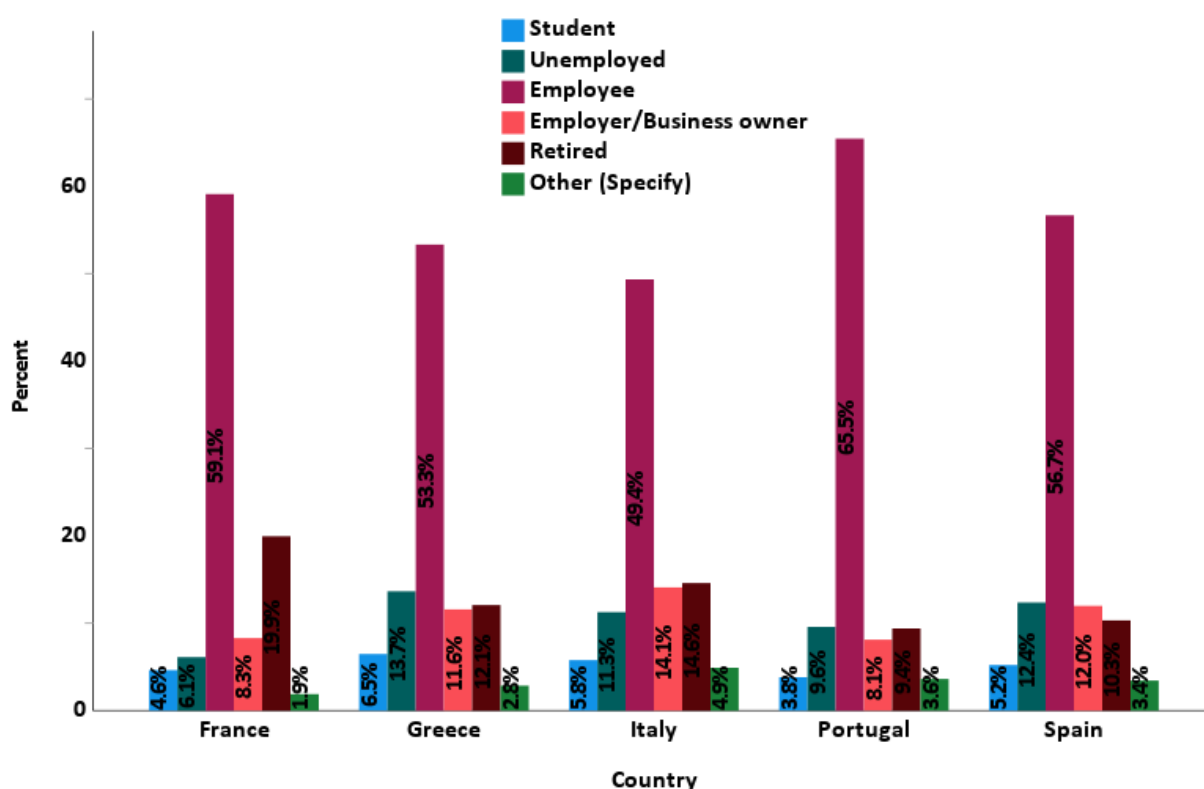


Figure 4: Employment status of respondents



3.1.5 Income situation

Participants were queried about **their net household income** to assess the financial circumstances of the sample. In France, Italy, and Spain, the majority falls within the 1000-2000€ net income range. However, in Greece and Portugal, the majority of participants earn less than 1000€ net income. Overall, France has the highest number of participants in higher income brackets compared to the other countries, followed by Italy, Spain, Greece, and Portugal in that sequence.

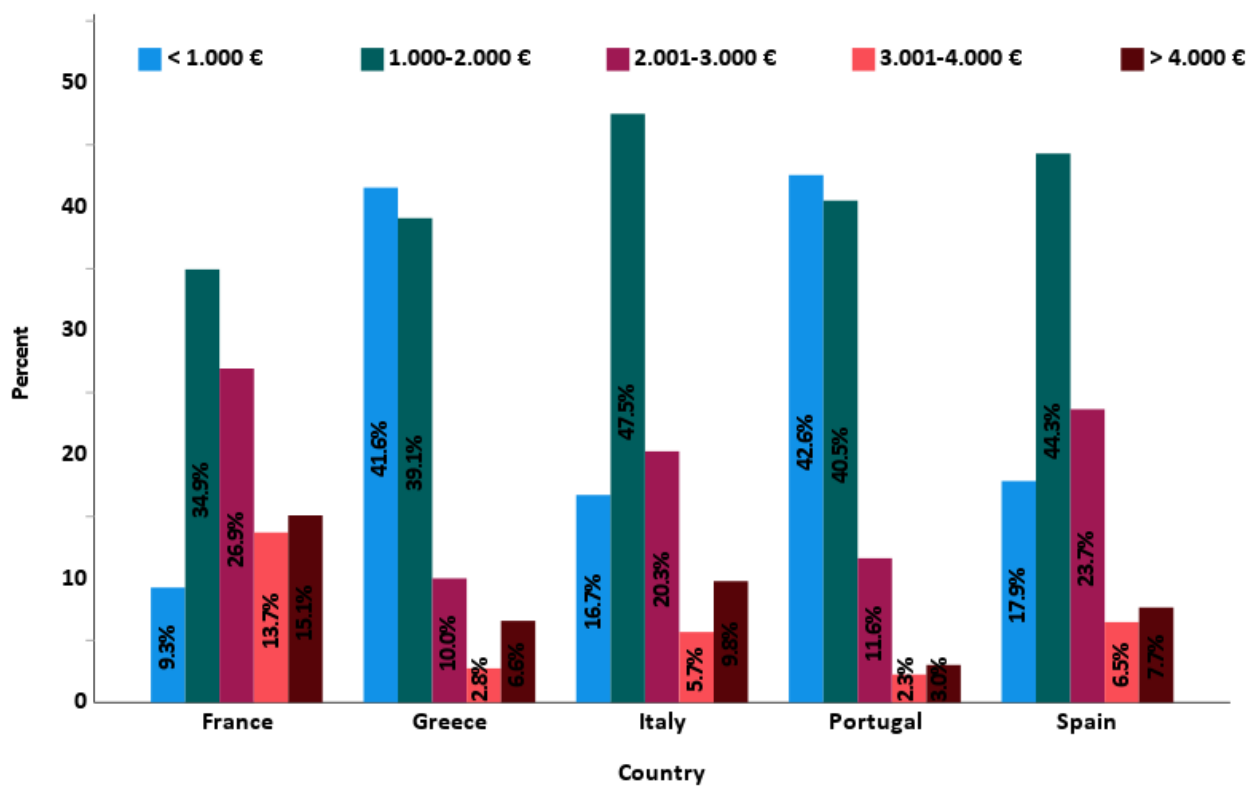


Figure 5: Net monthly household income of respondents in each country



3.1.6 Nature of dwellings of participants

Figure 6 displays the **nature of participants residence** for the various countries. In Greece, Portugal, and Spain, the majority of participants live in urban areas, whereas in France and to a lesser extent in Italy, most participants reside in less populated areas. The figure presents a significant representation of various dwelling types, offering a balanced perspective for analyzing views on sustainable wine and olive production in the Euro-Mediterranean region.

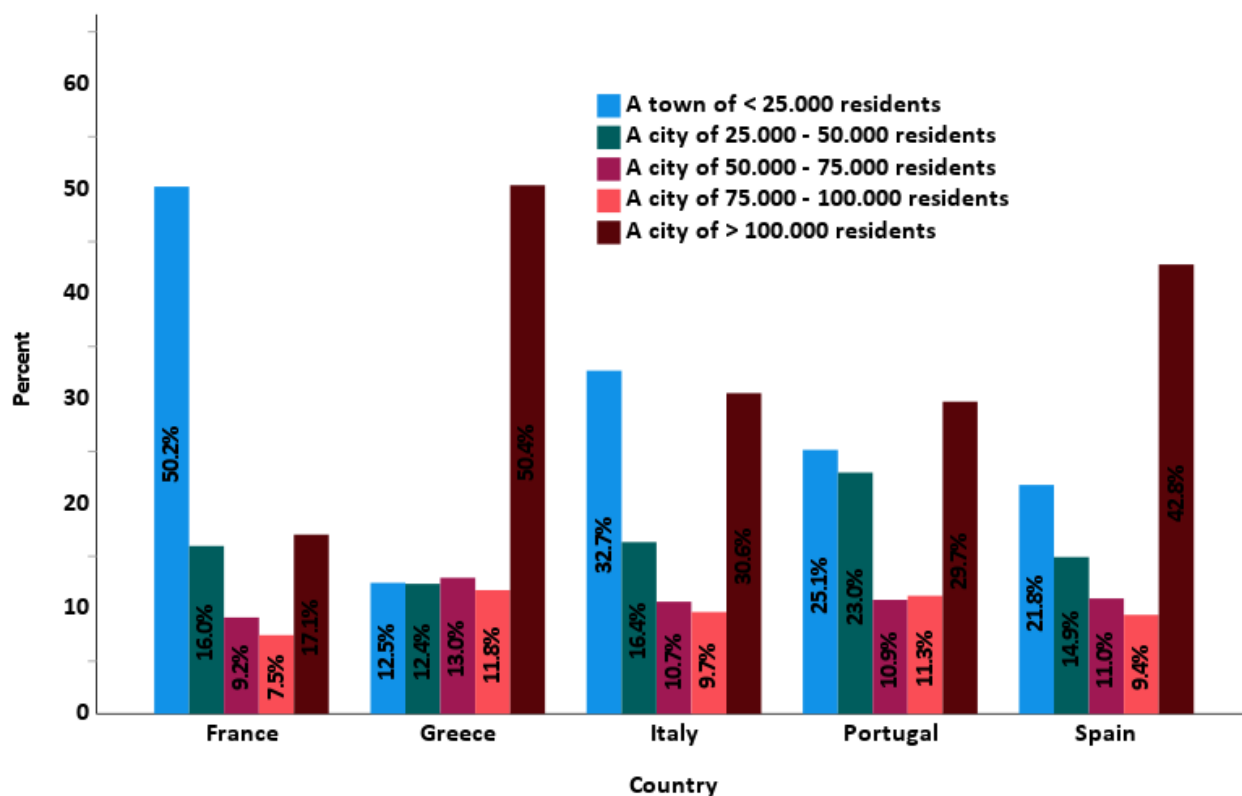


Figure 6. Type of dwellings of respondents



3.2 Consumers' behaviour, purchase patterns and knowledge

3.2.1 Purchase frequency of wine consumers

Wine consumers were surveyed about the **frequency of their purchases**, and the responses are depicted in Figure 7. The data indicates variations in purchase frequency among participants across all countries. Notably, those who buy wine more frequently, such as once a week, make up one-third of the participants in each country, indicating a presence of regular wine buyers in the dataset. The "once a week" purchase frequency was most commonly chosen in Italy, Portugal, and Spain, while "once a month" was the most frequently selected option in France and Greece.

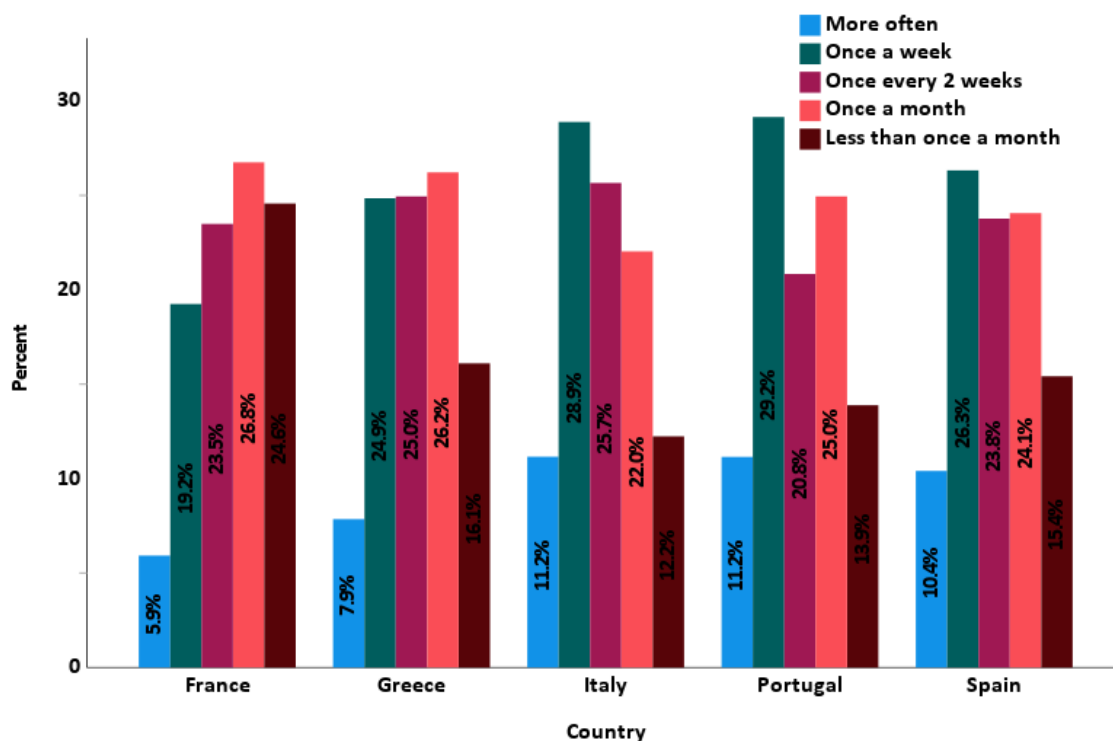


Figure 7. Purchase frequency of wine consumers



3.2.2 Purchase frequency of olive oil consumers

In the case of olive oil consumers, the data reveals a lower **purchase frequency** compared to wine, which is expected because olive oil is typically stored for long-term use as opposed to wine. The most common purchase frequencies for olive oil among participants are "less than once a month" and "once a month" in all countries, except in Spain where "once every two weeks" is the second most common frequency. The purchasing pattern for both wines and olive oil is largely consistent across the five Euro-Mediterranean countries.

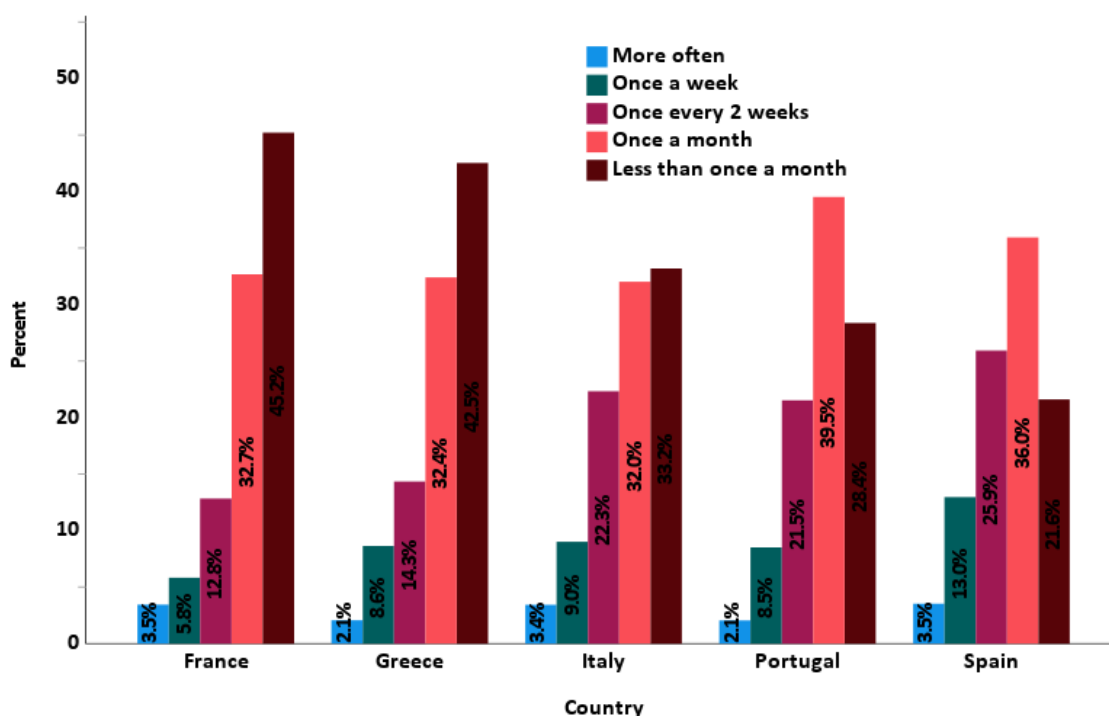


Figure 8. Purchase frequency for olive oil



3.2.3 Purchase responsibility

To determine the willingness to pay for a product, it is crucial that the respondents involved in the experiment play a **role in the purchase decision-making process**. Hence, we asked participants to specify their level of involvement in the purchase decisions for both wine and olive oil within their households. In all the countries examined in the case studies, the majority of participants were exclusively engaged in these purchase decisions. Those who indicated a lack of involvement in the purchase decisions were excluded from the survey to ensure that participants had the relevant experience and responsibility to accurately assess their willingness to pay more in both the wine and olive experiments.

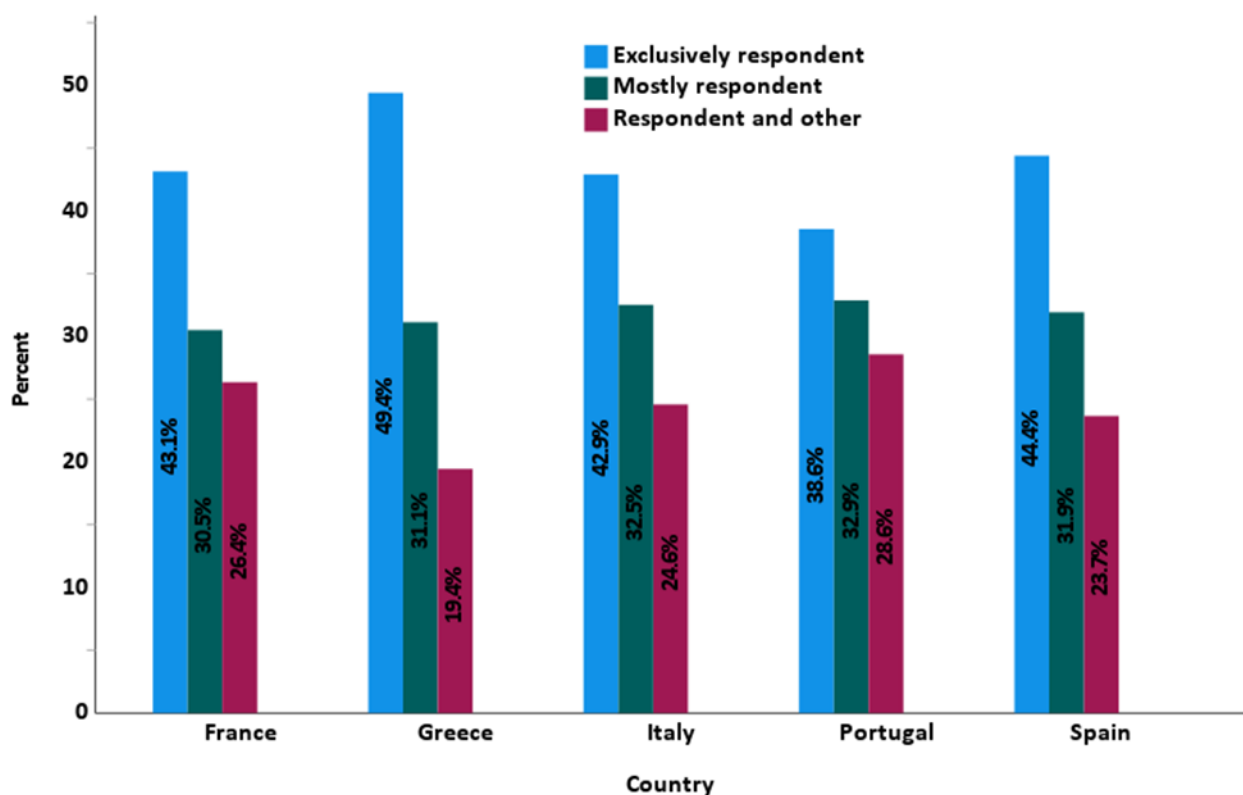


Figure 9. Purchase responsibility

3.2.4 Purchase outlets for wine and olive oil

Consumers of wine and olive oil were surveyed about their **regular purchase venues** to identify the popular places where they typically buy these products. The results, illustrated in Fig. 10a, reveal that super and hypermarkets emerge as the most popular purchase locations for wine consumers across all countries. Specialized wine shops come next, followed by direct purchases from wineries—except in Italy, where buying directly from wineries slightly surpasses purchases from specialized shops.

Similarly, for olive oil consumers in Fig 10b, supermarkets and hypermarkets happen to be the primary outlets, with direct purchases from producers following closely. Notably, direct purchases from olive oil producers are higher for all countries compared to direct purchases from wine producers, particularly notable in Greece and Italy.

It's worth highlighting that the proportion of consumers usually engaged in online purchases ranges from 10% to 40% depending on the by country.



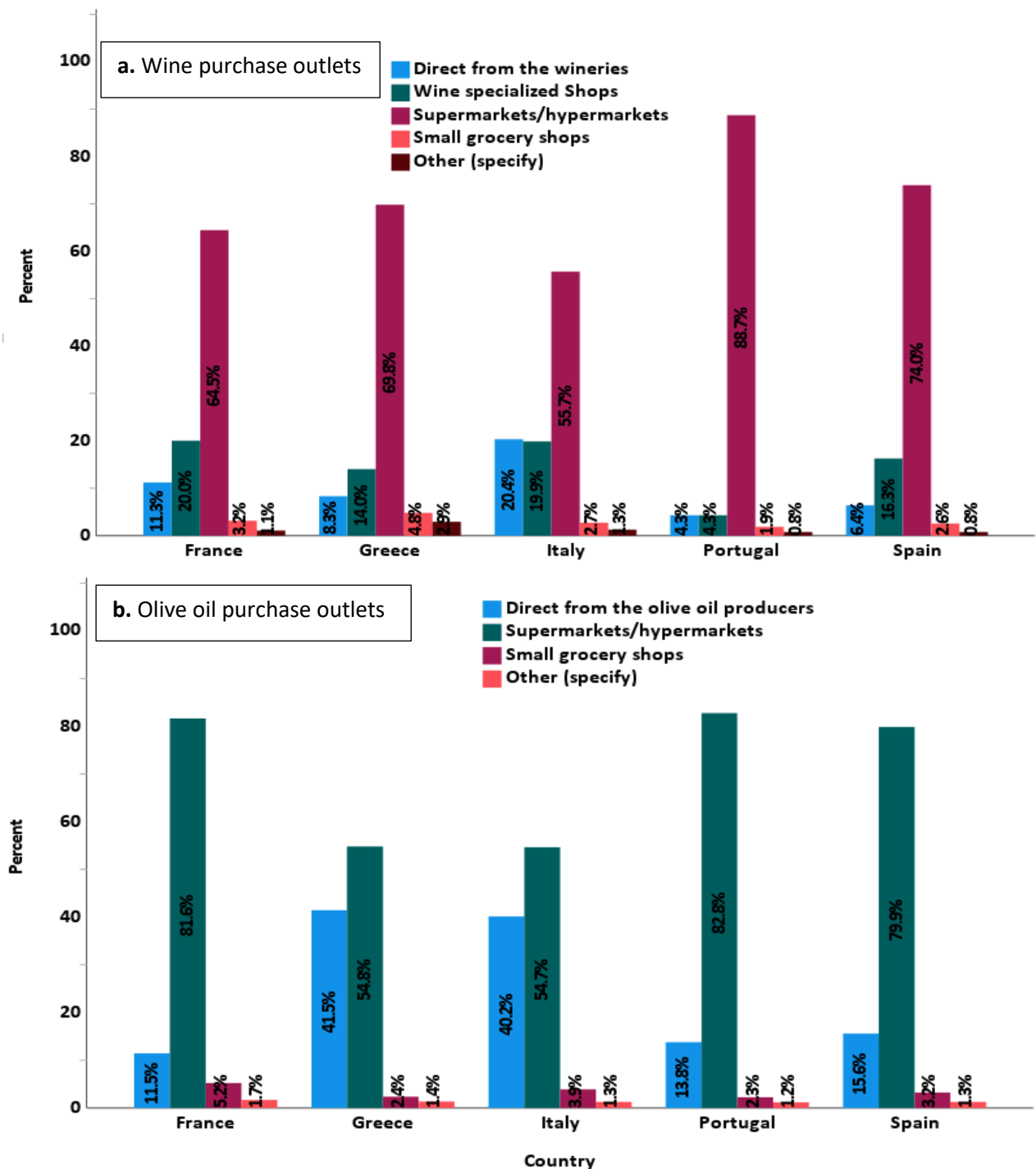


Figure 10. Popular purchase locations of wine and olive oils





3.2.4 Wine preference among participants

It is believed that Consumers can influence sustainable agricultural practices through purchase behaviour (Paul & Rana, 2012). Hence, we queried survey participants about the type of wine they typically buy for regular home consumption. As evident in Figure 11, conventional wines are the most favored for regular home consumption, followed by organic wines, across all the surveyed countries. The findings indicate that, when it comes to regular home consumption, the majority of wine consumers prefer conventional wine over other sustainability-labelled options such as organic and biodynamic wines.

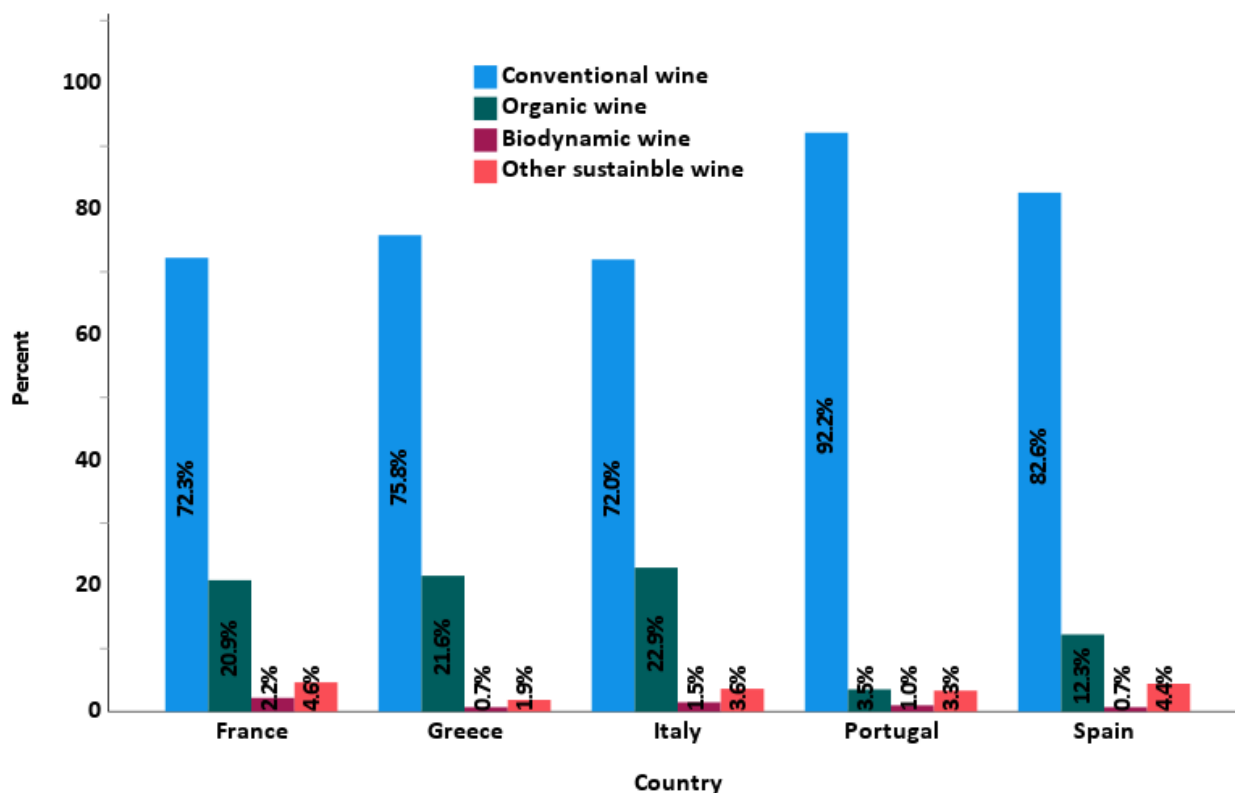


Figure 11. Type of wine purchased for regular consumption

3.2.4 Olive oil preference among participants

Among olive oil consumers, the preference for organic options was comparable in France and Italy, as illustrated in Figure 12. However, there is a substantial difference in Greece, Portugal, and Spain, where the number of consumers favouring conventional olive oil is more than double that of organic consumers. The preferences for both products, as depicted in Figures 10 and 11, indicate a significant number of consumers opting for conventional alternatives over organic ones for regular home consumption in the Mediterranean region.

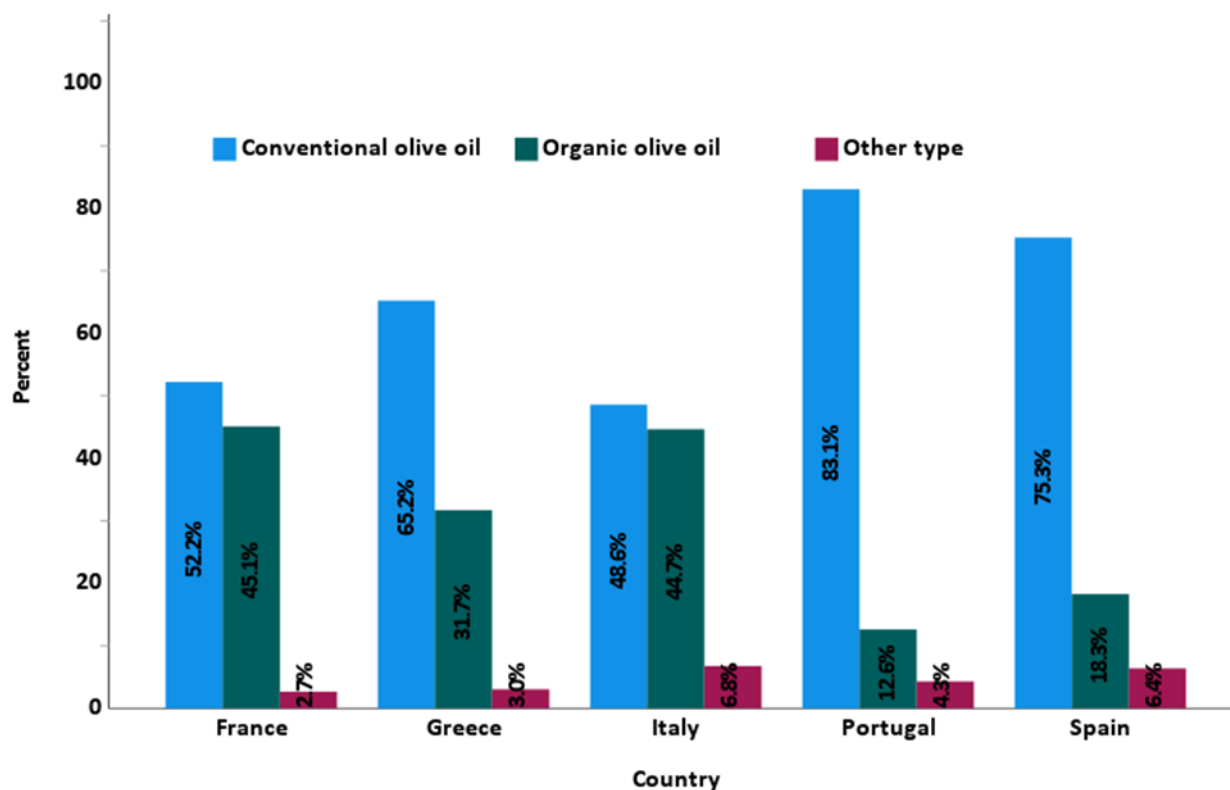


Figure 12. Type of olive oil purchased for regular home consumption

3.2.5 Knowledge of plant protection product activities

Participants were asked about their **perception regarding the current application rates of plant protection products** for managing pests and diseases in vineyards and olive groves. This is based on the belief that consumers' perceptions of pesticide risks influence their Willingness to Pay (WTP), as suggested by Misra et al. (1991). Again, Combris et al. (2012) observed that information about pesticide use enhances WTP for organic products. Therefore, we specifically inquired about participants' subjective knowledge concerning pesticide use in winegrowing and olive groves.

Figure 13 illustrates the outcomes, revealing that a majority of consumers lack substantial knowledge about the application of pesticides in treating pests and diseases in vineyards and olive groves. Only less than 30% of respondents across all countries demonstrated an average to high level of knowledge regarding pesticide use in these settings.

To delve deeper into consumer perceptions, we posed further questions to those with moderate to high levels of knowledge regarding their opinions of the rate of pesticide use. Respondents were presented with five options: "Excessive," "Moderate," "Low," "Sustainable," and "I don't know," to express their opinions on the current state of pesticide use. Interestingly, individuals with knowledge of pesticide use predominantly perceive that the current rates are sustainable, followed by those who were unsure (choosing "I don't know"). Across all countries, less than 10% of participants believed that pesticide use is excessive. This contrasts with the stance of the EU and many environmental sustainability advocates who are concerned about the rate of pesticide use in agricultural production.



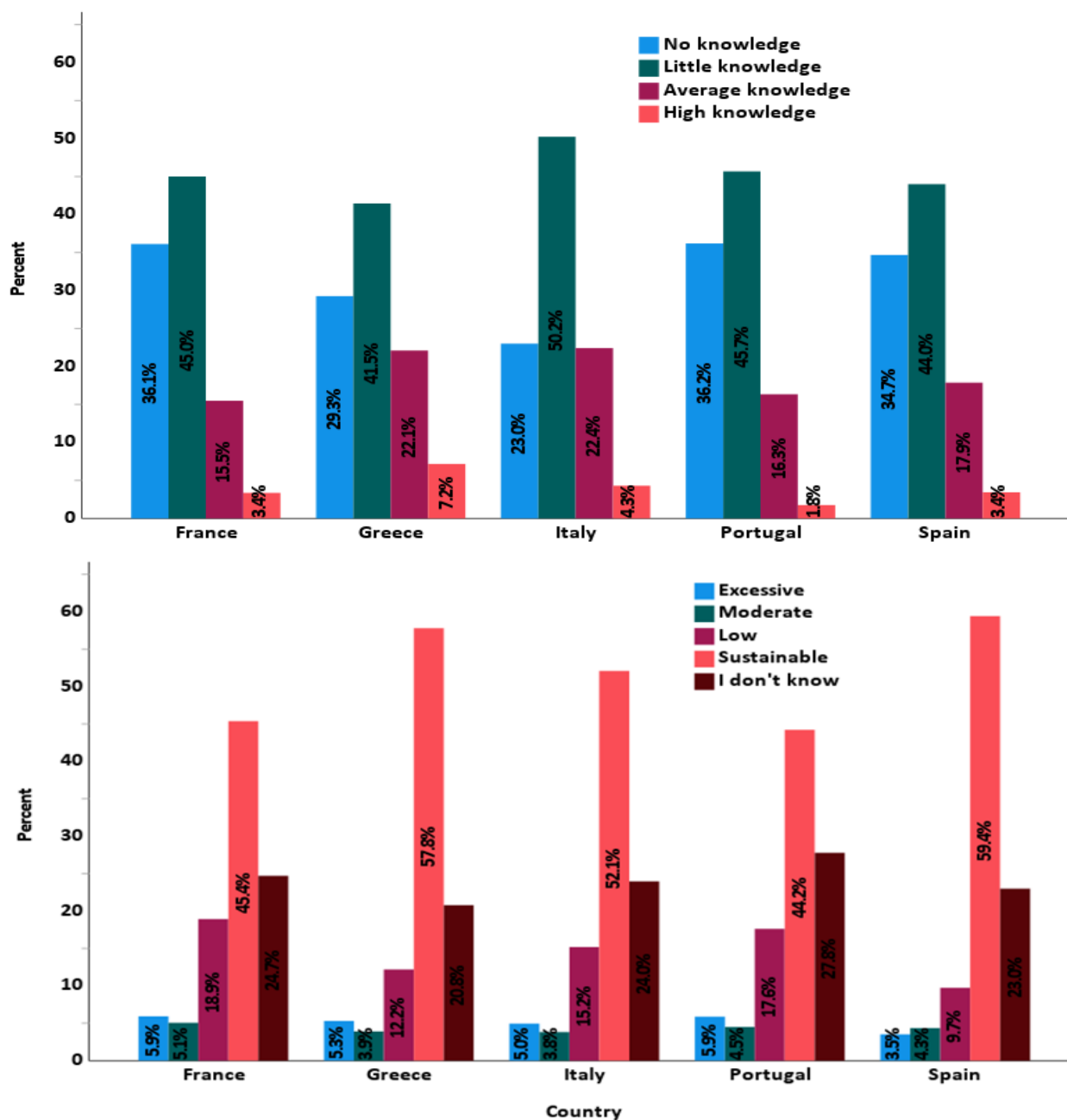


Figure 13. Knowledge and perception towards pesticide use in vineyards and olive groves



2.2.6 Satisfaction from previously purchased wines

Determining participants' satisfaction with their previous wine choices for regular consumption is crucial, as there is a reported connection between consumers' Willingness to Pay (WTP) premiums and their satisfaction and brand experience from past purchases, as noted by Dwivedi et al. (2018). To evaluate participants' satisfaction, an 11-point Likert scale ranging from +5 (highly satisfied) to -5 (highly dissatisfied) was employed. Figure 14 illustrates the mean satisfaction rankings by country.

Across all countries, the mean rank was positive, indicating overall contentment with the wines participants had previously bought. Examining the variations among the five countries, Portugal stood out with participants expressing the highest satisfaction levels regarding their previous wine purchases. Following Portugal, Greece, Italy, Spain, and France exhibited decreasing levels of satisfaction with their past wine choices.

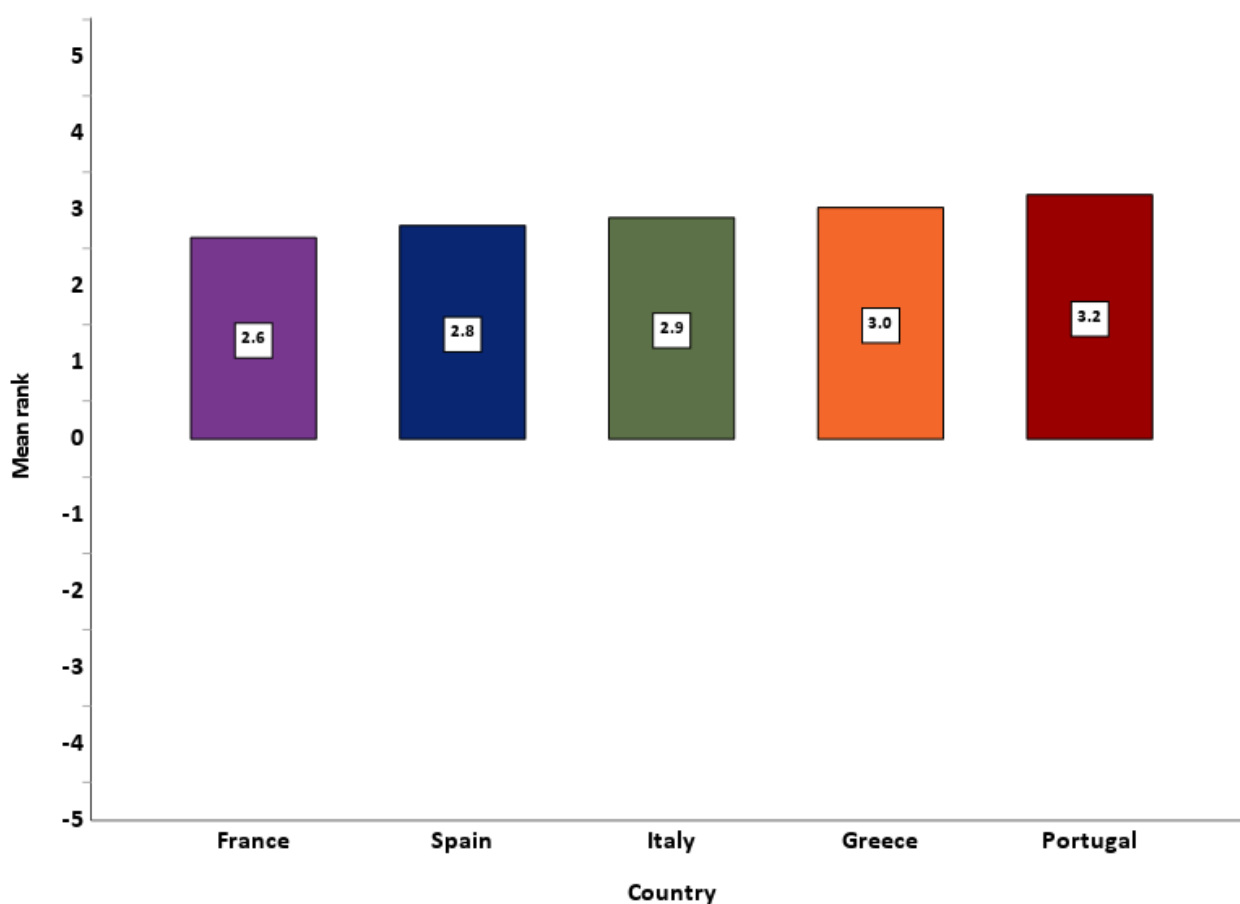


Figure 14. Satisfaction from previous purchases



3.3 Consumer perceptions and opinions of vineyard and olive grove farms

3.3.1 Perception of vineyard and olive grove activities in communities

The growing concerns about the adverse effects of agricultural activities on human settlements, such as changes in the landscape, competition for water, and loss of biodiversity, often lead to tensions between farmers and communities. These tensions have the potential to impact research outcomes, particularly in the context of Willingness to Pay (WTP) results. To address this, we included a question in our survey asking participants to express their general perception of the impact of vineyard and olive grove activities on human settlements, using a scale from +5 (indicating high positive impact) to -5 (indicating high negative impact).

Figure 15 presents the results depicting the overall perception of participants toward the influence of vineyard and olive grove activities on communities. The mean rankings from all five countries indicate a generally positive perception of winegrowing and olive grove activities. However, when comparing the rankings, participants from France exhibit the least positive perception of vine and olive growing activities, while those in Spain achieve the highest mean rank.

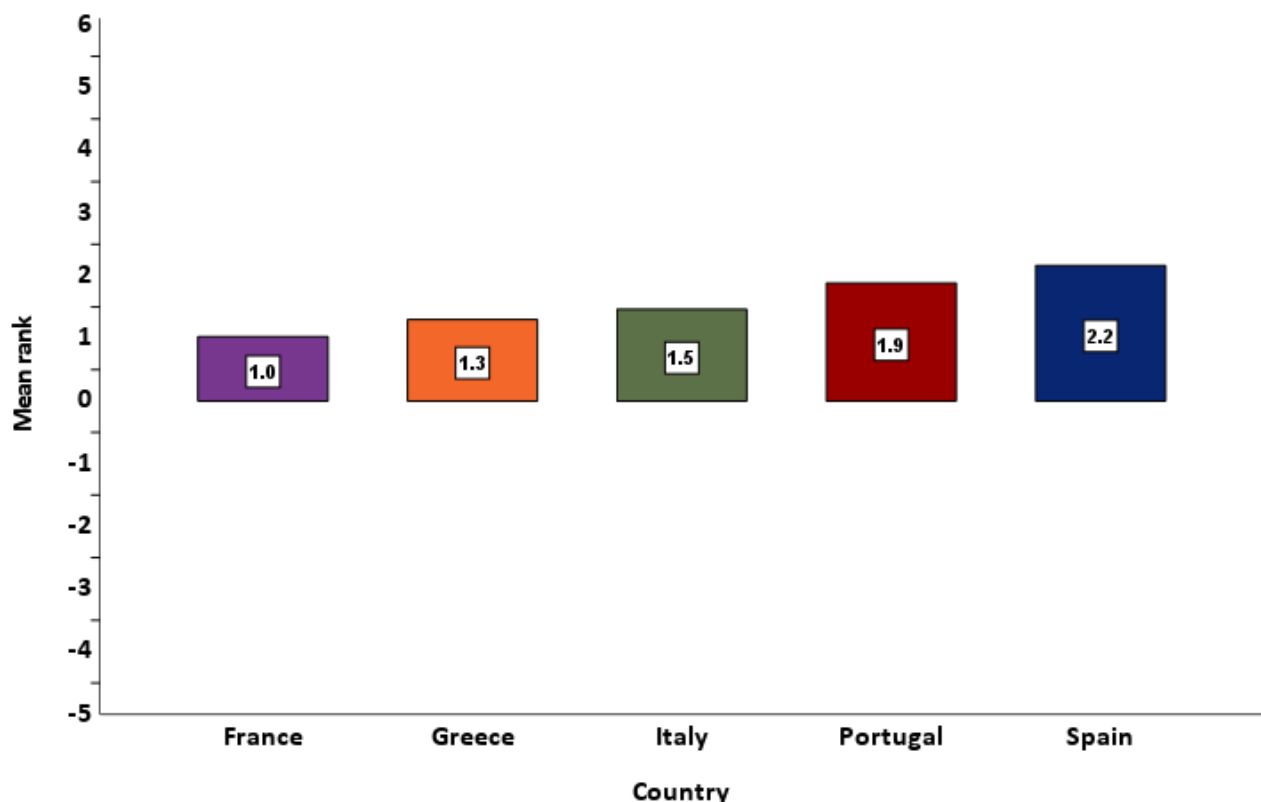


Figure 15. Perceived impact of vineyards and olive grove activities on communities

After assessing participants' views on the impact of vineyard and olive grove farms on human settlements, they were asked about whether specific activities, such as *farm mechanization* (the use of equipment, tools, and machinery to enhance efficiency in agricultural practices) and *farm expansion*



(increasing the size or capacity of farm operations), are perceived as nuisances or threats to human settlements.

Figure 16 displays the responses from participants across the five countries. The five responses could be categorized into three subgroups: a) those who do not perceive it as a threat or nuisance (probably not and definitely not), b) those who are uncertain (may or may not), and c) those who see it as a threat (probably yes and definitely yes).

Concerning mechanization (Fig. 16a), approximately 50% of participants across all countries do not view farm mechanization as a threat. Approximately 20% of participants from France and Portugal consider mechanization a potential threat or nuisance to human settlements, with lower percentages in Greece (8%), Italy (12%), and Spain (12%).

In terms of the perceived threat from farm expansion activities, a higher proportion of participants express concerns compared to mechanization. From Fig. 16b, roughly 35% of participants from France, 17% from Greece, 19% from Italy, 27% from Portugal, and 20% from Spain consider vineyard and olive grove expansion activities as threats to human settlements.

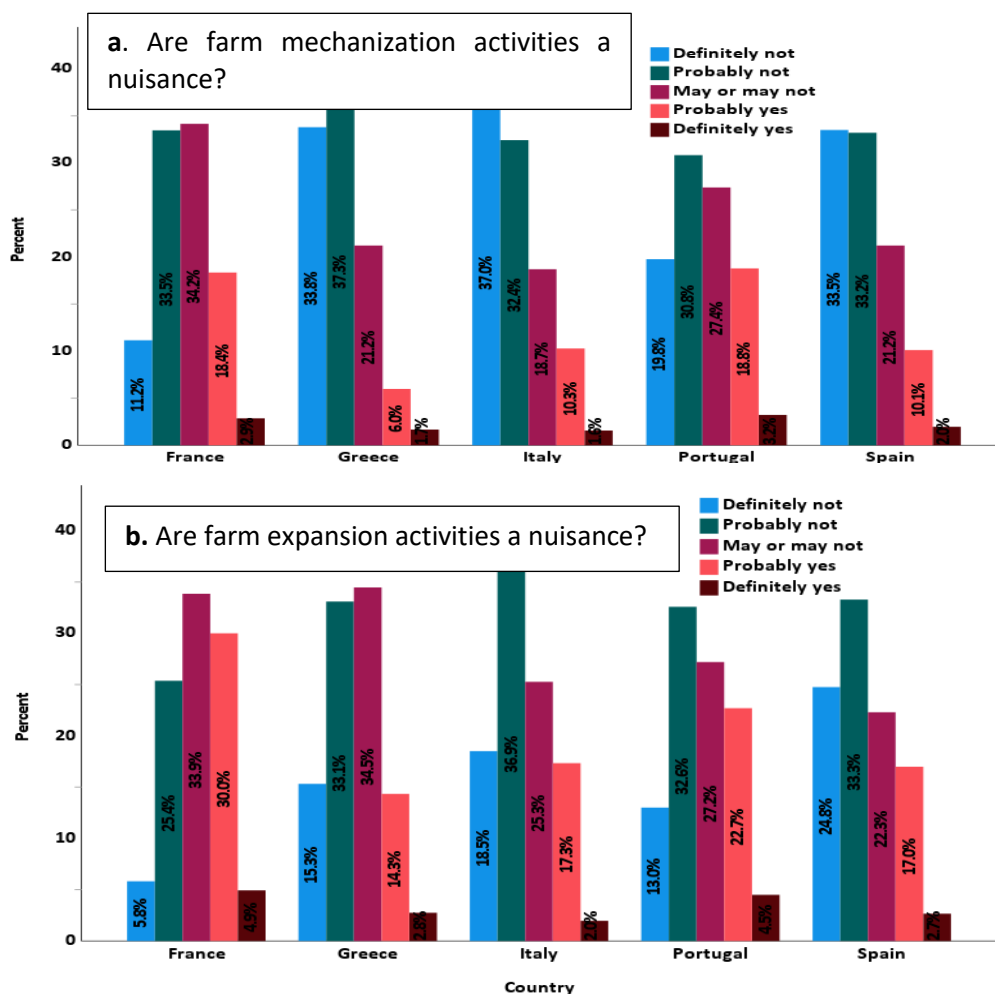


Figure 16. Threat of mechanization and expansion of vineyard and olive grove on

3.3.2 Reasons behind negative perception

For participants who perceive vineyard and olive grove activities as threats to human settlements, we aimed to understand the rationale behind their responses. Consequently, we asked them to specify the reasons for their earlier answers. The provided justifications, illustrated in Fig. 17, include concerns about water pollution, olfactory nuisances, competition for resources, and risks associated with pesticide use—which emerged as the most frequently chosen reason across all case study countries.

It is important to note that the survey, which focused on exploring alternative innovations to contentious plant protection products, might have influenced responses towards highlighting "pesticide use dangers," as indicated by participants. Nevertheless, this underscores consumers' apprehensions regarding the potential hazards associated with the use of contentious Plant Protection Products (PPPs) in proximity to human settlements.

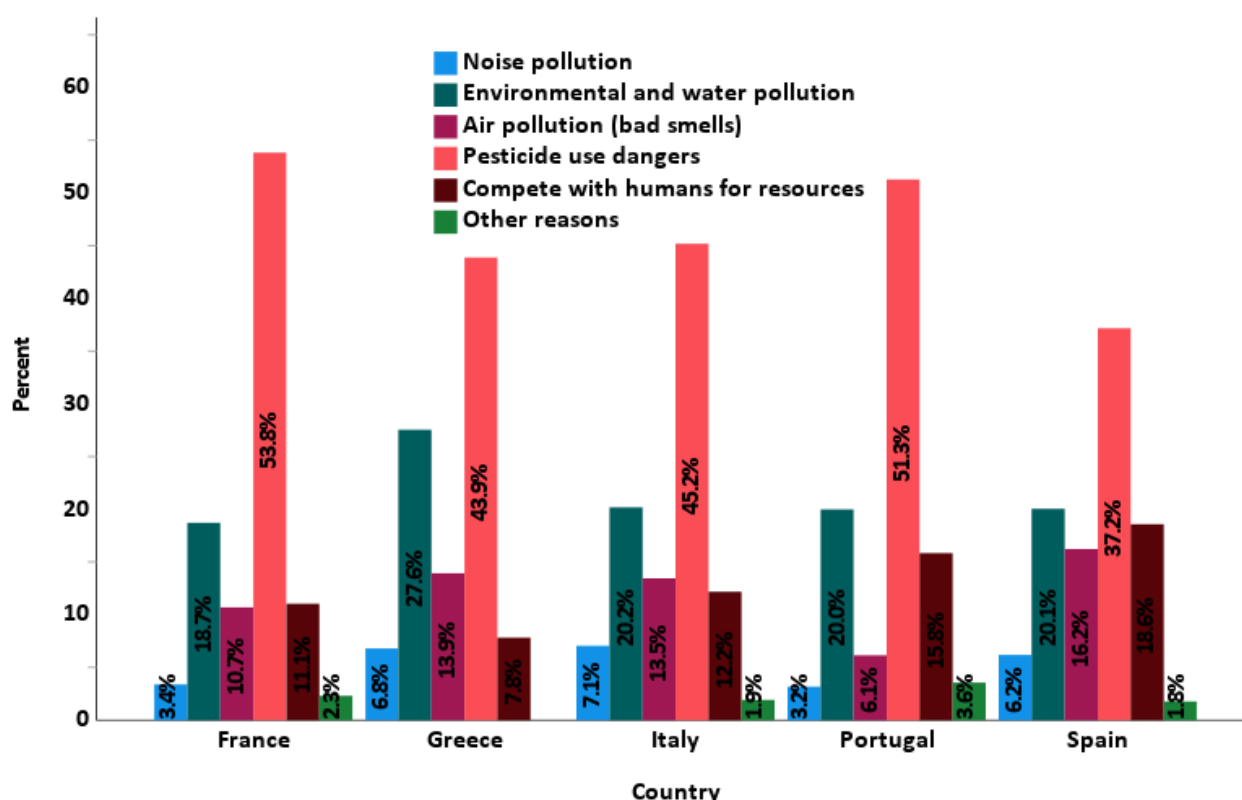


Figure 17. Reasons for considering mechanization and expansions as threats

Table 5 presents a summary overview of all the sociodemographic features, perceptions, opinions, and preferences of the participants involved in this subtask of the study. The sociodemographic attributes indicate a well-balanced national representation within the sample, a crucial aspect for policy-oriented studies of this kind. The comprehensive coverage of perceptions, opinions, and other variables assessed by the survey lays the groundwork for a thorough evaluation of participants' Willingness to Pay (WTP) for wines and olive oil from alternative innovations to contentious Plant Protection Products (PPPs).

Table 5. Summary of sociodemographic characteristics of participants in the experiment

Country		France	Greece	Italy	Portugal	Spain
Sample		1013	1018	1021	1021	1018
Gender	Female	51.0%	51.1%	50.2%	51.7%	50.4%
	Male	48.9%	48.6%	49.1%	48.1%	49.4%
Age categories	18-24 years	11.7%	9.2%	9.5%	9.7%	9.2%
	25-34 years	16.2%	15.8%	15.1%	15.6%	15.9%
	35-44 years	18.5%	20.3%	19.1%	20.8%	21.9%
	45-54 years	19.5%	21.2%	22.6%	20.7%	21.9%
	>55 years	34.1%	33.4%	33.7%	33.3%	31.0%
	Up to secondary	7.7%	25.3%	10.1%	11.4%	21.5%
Education level	Post-secondary diploma	42.0%	19.4%	53.2%	39.8%	28.3%
	University (Bachelor)	35.5%	39.4%	22.3%	34.1%	30.1%
	University post graduate. (BSc/Master/PhD)	14.8%	15.8%	14.4%	14.8%	20.1%
Employment	Student	4.6%	6.5%	5.8%	3.8%	5.2%
	Unemployed	6.1%	13.7%	11.3%	9.6%	12.4%
	Employee	59.1%	53.3%	49.4%	65.5%	56.7%
	Employer/Business owner	8.3%	11.6%	14.1%	8.1%	12.0%
	Retired	19.9%	12.1%	14.6%	9.4%	10.3%
	Other (Specify)	1.9%	2.8%	4.9%	3.5%	3.4%
Net monthly household income	< 1.000 €	9.3%	41.6%	16.7%	42.6%	17.9%
	1.000-2.000 €	34.9%	39.1%	47.5%	40.5%	44.3%
	2.001-3.000 €	26.9%	10.0%	20.3%	11.7%	23.7%
	3.001-4.000 €	13.7%	2.8%	5.7%	2.3%	6.5%
	4.001-5.000 €	7.0%	2.1%	4.5%	1.1%	3.6%
	> 5.000 €	8.1%	4.5%	5.3%	1.9%	4.0%
Wine preference	Conventional	72.3%	75.8%	72.0%	92.3%	82.6%
	Non-conventional	27.7%	24.2%	28.0%	7.7%	17.4%
Olive oil preference	Conventional	52.2%	65.2%	48.6%	83.2%	75.3%
	Non-conventional	47.8%	34.8%	51.4%	16.8%	24.7%
Decision making	Exclusively the respondent	43.1%	49.4%	42.9%	38.5%	44.4%



Place of residence	Mostly the respondent	30.5%	31.1%	32.5%	32.9%	31.9%
	The respondent and someone else	26.4%	19.4%	24.6%	28.6%	23.7%
	A city of less than 25,000 residents	50.2%	12.5%	32.7%	25.2%	21.8%
	A city of between 25,000 to 50,000 residents	16.0%	12.4%	16.4%	23.0%	14.9%
	A city of between 50,000 to 75,000 residents	9.2%	13.0%	10.7%	10.9%	11.0%
	A city of between 75,000 to 100,000 residents	7.5%	11.8%	9.7%	11.3%	9.4%
	A city of more than 100,000 residents	17.1%	50.4%	30.6%	29.7%	42.8%
	No knowledge	36.1%	29.3%	23.0%	36.2%	34.7%
Pesticide use awareness	Low level	45.0%	41.5%	50.2%	45.7%	44.0%
	Medium level	15.5%	22.1%	22.4%	16.3%	17.9%
	High level	3.4%	7.2%	4.3%	1.8%	3.4%
	Excessive	18.8%	14.4%	23.8%	25.5%	13.4%
Opinion on pesticide use	High	9.4%	29.9%	15.4%	13.6%	19.8%
	Moderate	14.7%	24.2%	16.5%	22.3%	15.2%
	Sustainable	6.3%	6.7%	8.8%	8.7%	12.4%
	Minimum	41.4%	19.8%	28.2%	26.1%	33.6%
Average stated purchase price (Reference price)	Wine (€)	10.12	8.84	6.83	4.88	7.86
	Olive oil (€)	9.91	8.21	8.41	5.76	6.75





3.4 Receptive behaviour of consumer

Consumer receptive behaviour was assessed using the adapted WNS, as outlined in Table 3. Following Rabadán (2021) and Ristic et al. (2016) the individual scores on the WNS were computed for each consumer by summing the values of the 8 items, with the negative items (1, 2, 4, 5, and 8) reversed. Consequently, higher scores signify a less receptive behaviour, indicating a reduced tendency to try new wines. Conversely, lower scores identify consumers as more receptive, reflecting a greater propensity to try new wines.

Results of the ranking are shown in Figure 18. Consumers in France produced the highest mean rank of the 8 WNS items used to assess consumers' receptiveness to unfamiliar wines. They are followed by consumers in Italy, Portugal, Spain and Greece in decreasing order. Thus, consumers in France and Italy have relatively lower tendency to try new wines compared to consumers in Greece and Spain

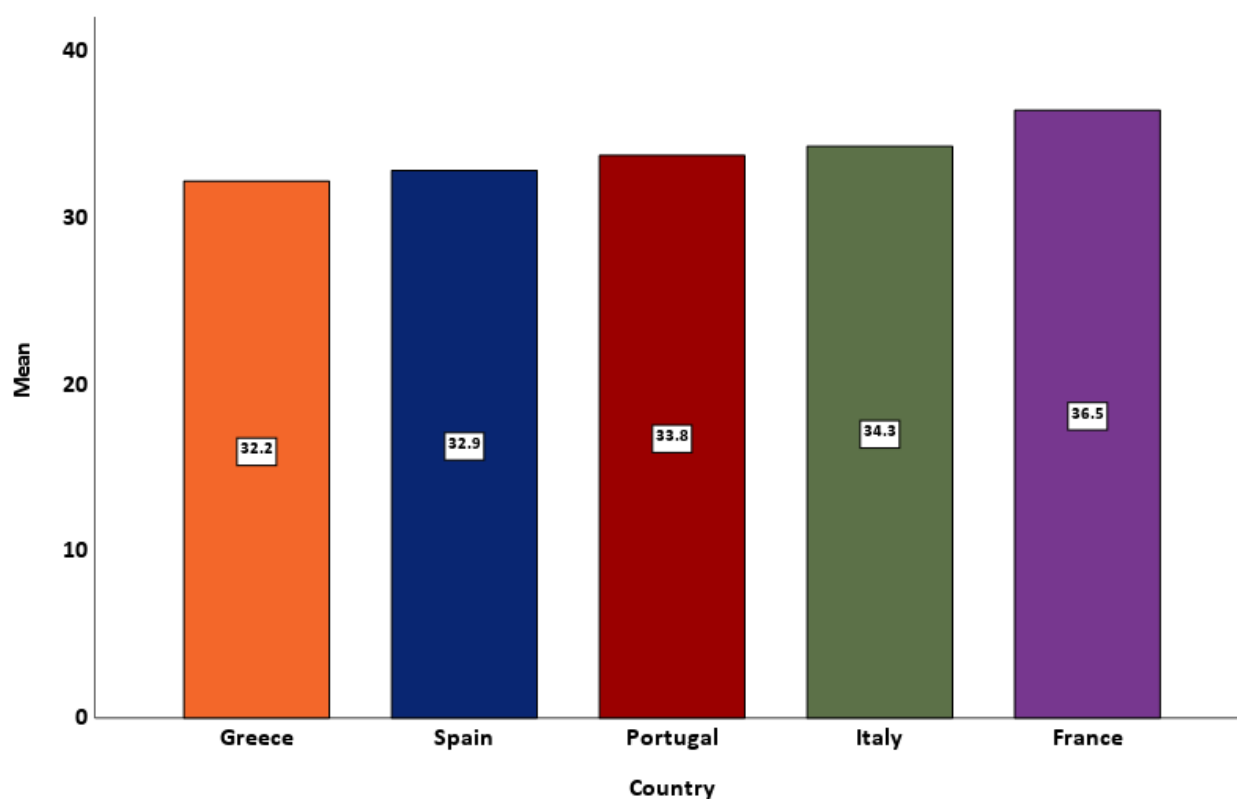


Figure 18. Participants' mean score of the 8 WNS items

For additional insights into the distribution of the 8 WNS items, refer to Figure 19 and Table 6. By examining the frequency distributions in Figure 19, outliers with notably extreme receptive behaviours can be identified. It's noteworthy that a minimal number of consumers in France, Greece, and Portugal displayed extremely low receptive behaviour, which is considered in subsequent analyses.

The reliability of the 8 WNS items was evaluated in each case study by computing the internal consistency of the scale using Cronbach's Alpha. The obtained values were 0.60 for France, 0.74 for Greece, 0.72 for Italy, 0.67 for Portugal, and 0.69 for Spain. Thus, all values of Cronbach's Alpha, except for France, demonstrate an acceptable level of validity, as indicated in the final row of Table 6.



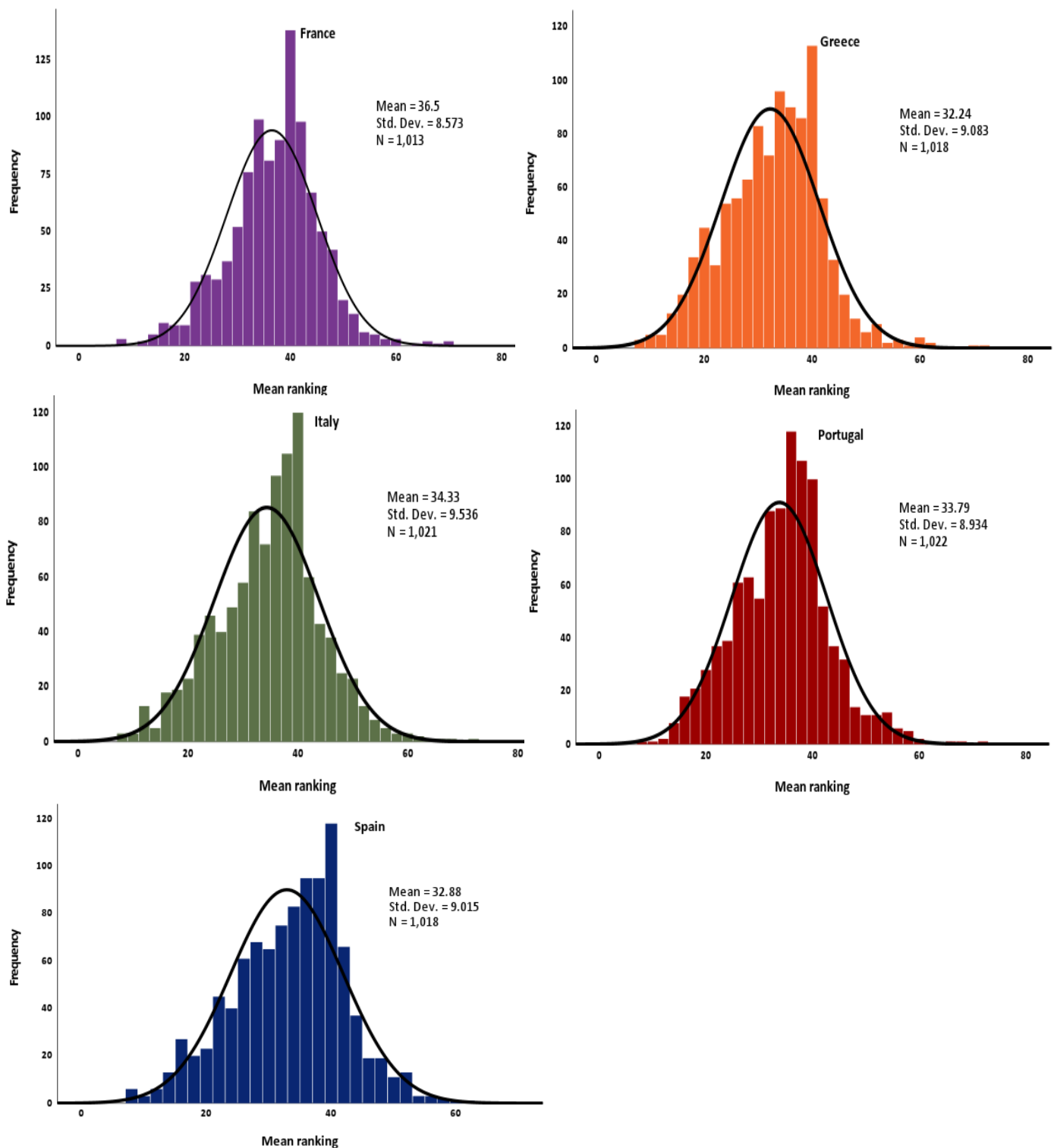


Figure 19. Frequency distribution of the 8 WNS items for each of the five countries



The NOVATERRA project has received funding from the European Commission's Horizon 2020 grant agreement number 101000554.

NOVATERRA : Integrated Novel Strategies for Reducing the Use and Impact of Pesticides, Towards Sustainable Mediterranean Vineyards and Olive Groves

Table 6. Descriptive statistics of the 8 WNS item to assess receptive behaviour

Items	Sample (N)	Polled (5,092)	France (1,013)	Greece (1,018)	Italy (1,021)	Portugal (1,022)	Spain (1,018)
Total score (all). Computed as the sum of ratings from 9 Likert scale, after reversing the five items (1,2,4,5,8)	Mean	33.95	36.50	32.24	34.33	33.79	32.88
	St. deviation	9.15	8.57	9.08	9.54	8.93	9.02
	Min.	8.00	8.00	8.00	8.00	8.00	8.00
	Max.	72.00	69.00	72.00	72.00	71.00	61.00
1. I like going to places serving wines from different countries(R)	Mean	4.21	4.42	3.80	4.35	4.47	4.02
	St. deviation	1.93	2.07	1.74	1.98	1.90	1.89
2. I will drink almost any wine (R)	Mean	5.65	6.36	5.17	5.42	5.88	5.43
	St. deviation	2.32	2.27	2.24	2.31	2.31	2.25
3. I am afraid to drink wines I have never had before	Mean	4.25	4.32	4.20	4.18	4.18	4.38
	St. deviation	2.19	2.20	2.13	2.21	2.18	2.26
4. At social gatherings, I will try a new wine (R)	Mean	3.41	3.95	3.24	3.63	3.23	3.00
	St. deviation	1.68	1.84	1.51	1.60	1.66	1.60
5. I like wines from different countries (R)	Mean	3.79	3.92	3.44	3.97	4.02	3.59
	St. deviation	1.83	1.95	1.58	1.87	1.88	1.79
6. If I do not know what wine it is, I won't try it	Mean	4.35	4.71	4.33	4.46	3.97	4.27
	St. deviation	2.25	2.24	2.17	2.30	2.21	2.29
7. I do not trust new wines	Mean	4.06	4.39	4.16	4.14	3.52	4.08
	St. deviation	2.19	2.20	2.13	2.18	2.06	2.22
8. I am constantly trying new and different wines (R)	Mean	4.23	4.44	3.90	4.18	4.52	4.10
	St. deviation	2.04	2.10	1.82	1.99	2.22	1.96
Cronbach' Alfa (8 items)		0.69	0.60	0.74	0.72	0.67	0.69

R=reversed

3.4.1 Structure validation of the 8 WNS items

To validate the categorization of consumers into low receptive (those with a low tendency to try new wines) and high receptive (those with a high tendency to try new wines), we conducted an exploratory Principal Component Analysis (PCA) on the 8 WNS items. The scree plot, which aids in determining the number of factors to retain in a PCA, affirmed that two dimensions explain the total variance in the 8 items across all countries. The two dimensions together explained at least 54% of the variance in all 8 WNS items in all the countries indicating a high goodness of fit of the two dimension PCA.

The PCA results thus, identified two main factors, consistent with Fernández-Ruiz et al. (2013), separating the positive items into the high wine receptivity factor (High WN in Fig. 20) and the negative ones into the low wine receptivity factor (Low WN in Fig. 20), as summarized in Table 7. The distinct separation between these two groups underscores the suitability of the WNS in characterizing receptive behaviours of consumers. The two factors are visually presented in Figure 20 to emphasize the associated items and factor correlations.

As shown in Table 7, all 8 items were appropriately categorized within the PCA, except for item 2 ("I will drink almost any wine") in France and Spain. Again, item 2 exhibited positive associations with both



components in all five countries, and this lack of a clear association with a specific component is also evident in the Pooled sample. However, removing item 2 did not significantly enhance the internal consistency, as the obtained Cronbach-Alpha values remained similar.

The results of consumers' receptive behaviour measured the 8 WNS items offer valuable insights into the diversity among consumers regarding their willingness to try new wine products and the variations in the behavioural attitudes across the five Mediterranean countries. The observed heterogeneity justifies the necessity for separate estimation analysis for each country regarding consumers' Willingness to Pay (WTP) for products derived from alternative innovations to contentious plant protection products (PPP) as executed in this deliverable.

Although the extent of consumers' receptive behaviour toward olive oil remains uncertain, we posit that there could be shared receptive attitudes among consumers toward both new wine and new olive oil. However, it's crucial to acknowledge that receptivity to unfamiliar products depends on the context, suggesting that being receptive to one product may not necessarily imply a similar attitude toward another product. Nonetheless, considering that both products (wine and olive) from alternative innovations are not entirely novel but sustainably produced using pesticide-reducing methods, it wouldn't be unreasonable to assume some degree of similarity in consumers' receptive behaviours.



Table 7. The PCA analysis on the 8 WNS items to assess consumers' receptivity

WNS items	Pooled		France		Greece		Italy		Portugal		Spain	
	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
5. I like wines from different countries	0.78	-0.07	0.77	-0.08	0.75	-0.09	0.78	-0.03	0.81	-0.06	0.81	-0.05
1. I like going to places serving wines from different countries	0.75	-0.01	0.74	-0.05	0.74	0.04	0.74	-0.03	0.76	0.06	0.77	-0.02
8. I am constantly trying new and different wines	0.74	0.00	0.69	0.09	0.76	-0.01	0.72	-0.02	0.75	-0.05	0.73	0.04
4. At social gatherings, I will try a new wine	0.64	-0.25	0.71	-0.09	0.59	-0.26	0.63	-0.15	0.58	-0.37	0.66	-0.29
2. I will drink almost any wine	0.53	0.26	0.32	0.41	0.55	0.14	0.65	0.18	0.53	0.29	0.44	0.39
7. I do not trust new wines	-0.01	0.88	-0.08	0.85	-0.12	0.88	-0.04	0.88	0.05	0.84	-0.06	0.86
6. If I do not know what wine it is, I won't try it	-0.02	0.85	-0.07	0.80	0.13	0.88	-0.02	0.85	-0.01	0.82	-0.04	0.84
3. I am afraid to drink wines I have never had before	-0.02	0.79	-0.07	0.77	-0.01	0.81	0.03	0.82	-0.04	0.77	-0.07	0.80
Explained variance of the WNS	32.7%	25.3%	28.6%	26.2%	36.3%	22.1%	34.4%	25.0%	31.7%	26.3%	33.8%	26.1%
Total Explained variance	58.07%		54.7%		58.49%		59.42%		58.04%		59.90%	
KMO Test	0.75		0.73		0.76		0.76		0.75		0.76	
Bartlett Test (significance)	10413.43 (0.000)		1661.4 (0.000)		2309.1 (0.000)		2258.9 (0.000)		2036.7 (0.000)		2321.6 (0.000)	



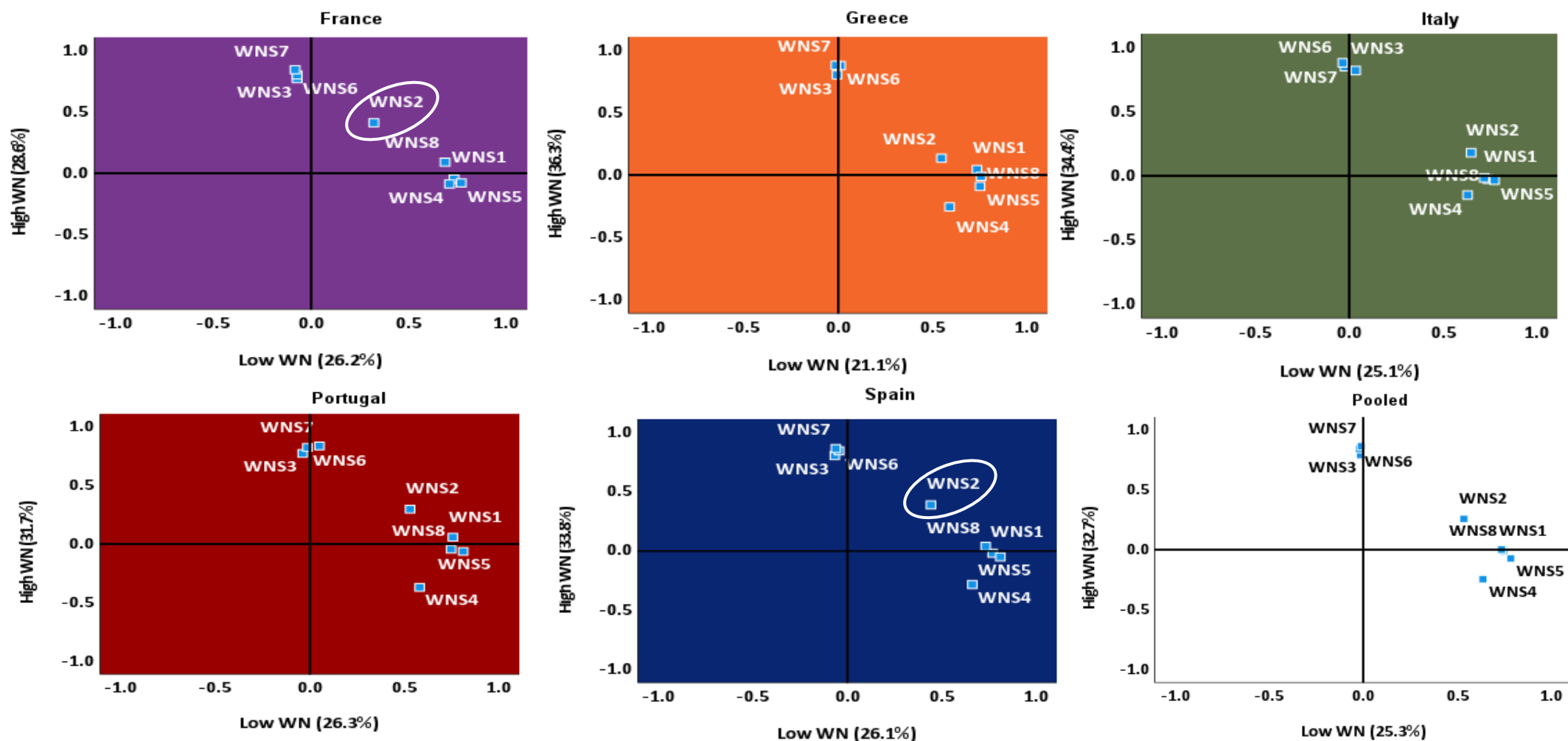


Figure 20. Factorial loading of the two principal components of the WNS with the 8 items





3.5 Consumer willingness to pay for products from alternative innovations

3.5.1 Wine

The outcome of choice experiment is used to evaluate consumers' intentions and willingness to pay for wine produced from pesticide-reducing innovations. As outlined in the methodology section, the choice experiment comprised three red wine alternatives. These alternatives comprised of two hypothetical red wines created based on the findings from pesticide-reducing innovations under NOVATERRA and a reference option, representing the last conventional red wine purchased by the consumer. The hypothetical red wines were assumed to be more sustainable versions of the reference, consequently priced higher.

The two hypothetical alternatives were unlabelled and designated as Wine1 and Wine2, while the reference was labelled as NONE (indicating a preference for the last purchased wine). Opting for either of the hypothetical red wines (Wine1 or Wine2) signified an intention to pay for sustainable wine from alternative innovation, while choosing NONE indicated otherwise. It is crucial to note that all other wine attributes influencing consumer choice, such as brand, taste, and vintage, were assumed to be fixed. The primary distinctions between the reference wine and the hypothetical wines were price, minimal pesticide use, and certification.

Table 8 displays the average percentage of participant selections among the three alternatives. On the whole, an average of 78% of consumers expressed an intention to pay more by choosing the hypothetical red wines from pesticide-reducing innovations in the 8 choice rounds, while 22% indicated their unwillingness by selecting the reference. When comparing across different countries, Greek consumers showed the highest percentage (84%) of those willing to pay a premium for sustainably produced wines, followed by Portugal (81%), Italy (77%), Spain (76%), and France (73%).

Table 8. Average selection in the choice experiment

Choice alternative	France	Greece	Italy	Portugal	Spain	Pooled
Hypothetical wine (Wine1 or Wine2)	73.3%	84.0%	76.6%	80.8%	75.5%	78.1%
Reference wine (last purchased wine)	26.7%	16.0%	23.4%	19.2%	24.5%	21.9%





3.5.2 Estimates of willingness to pay premium

The consumers' Willingness to Pay (WTP) is estimated using the random parameter logit (RPL) model. The results of the RPL model (Table 9) indicate that, with a high level of confidence (99% confidence level), we can reject the null hypothesis that all coefficients are jointly equal to zero, as evidenced by a highly significant Log-Likelihood ratio test. The goodness of fit of the model is evaluated using McFadden's pseudo- R^2 was within acceptable range. A pseudo- R^2 of 0.3 represents a decent model fit for a discrete choice model. This value can be interpreted as an R^2 between 0.6 and 0.8 for the linear model equivalent. Across all countries, the RPL model demonstrates acceptable goodness of fit, with McFadden's Pseudo R^2 values ranging between 0.28 and 0.32.

The coefficients of the Alternative Specific Constant (ASC), which takes a value of "1" when a sustainable hypothetical red wine is selected and "0" when the reference wine is selected, were consistently positive and significant across all countries. This suggests high consumer preference for the hypothetical sustainable red wines produced from alternative pesticide-reducing innovations over the standard conventional wines.

The coefficients associated with the pesticide reduction attribute were positive and significant in all five countries, indicating that consumers place a premium on pesticide reduction in conventional wine growing. The actual WTP premium placed on pesticide reduction, calculated as the percentage of consumers' average stated reference wine price, ranged from 0.65% to 2.11% of a standard 750ml red wine. The estimated WTP premium for Italy was the highest (2.11%) for a unit volume of pesticide reduction, while France exhibited the lowest value (0.65%) among the Mediterranean countries. The estimates suggest that for a unit volume of pesticide reduction achieved at the farm level, consumers are willing to pay between 0.65% and 2.11% more of the price for a standard conventional red wine depending on the country.

In addition to pesticide reduction, consumers place a significant value on regulatory bodies certifying the sustainability of wines from alternative innovations. By leveraging the additive feature of the RPL model, the WTP premium for different certifications for wines from alternative innovation is determined by summing the WTP premium for pesticide reduction and the premium placed on any type of certification bodies. The outcome of that analysis shows that the WTP premium estimates increase between 1.3% and 7.4% for Participatory Guaranteed Certification (PGC) and between 7.3% and 36.8% for European Commission Certification (EC). For Independent Certification (IC), the WTP premium estimates decreased by 1.1% and 1.9% in Greece and Spain, while increasing by 4.5%, 0.1%, and 4.33% for France, Italy, and Portugal, respectively. This suggests that European Commission certification is most valued, while Certification by independent bodies is the least valued in terms of the regulatory body whose certification is likely to extract the premium that consumers are willing to pay for pesticide-reducing sustainable wines. Therefore, consumers' WTP premium for sustainable conventional wines significantly depends on the type of certification body overseeing the sustainable measure such like pesticide reduction in winegrowing.



Table 9. Estimated willingness to pay (WTP) from random parameter logit (RPL) model

Attribute coefficient	France	Greece	Italy	Portugal	Spain
Pesticide reduction	0.023***	0.053***	0.045***	0.044***	0.024***
Standard error	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
WTP (%/750ml)	0.65%	2.09%	2.11%	1.66%	0.93%
Confidence interval	0.31-0.98	1.63-2.36	1.57-2.23	1.20-1.92	0.48-1.88
Independent certification	0.176***	-0.036	0.002	0.143***	-0.064*
Standard error	(0.038)	(0.038)	(0.038)	(0.035)	(0.035)
WTP (%/750ml)	4.51%	-1.09%	0.09%	4.33%	-1.88%
Confidence interval	2.36-6.13	-2.91-1.12	-2.32-2.31	2.13-6.24	-3.89-0.28
Participatory certification	0.093**	0.243***	0.127***	0.043***	0.079**
Standard error	(0.044)	(0.044)	(0.045)	(0.04)	(0.041)
WTP (%/750ml)	2.43%	7.36%	5.52%	1.30%	2.32%
Confidence interval	1.58-2.94	5.94-8.21	4.81-5.98	0.93-1.93	1.92-2.86
EU certification	0.285***	1.216***	0.757***	0.873***	0.880***
Standard error	(0.043)	(0.062)	(0.054)	(0.052)	(0.051)
WTP (€/750ml)	7.31%	36.84%	32.9%	26.45%	25.88%
Confidence interval	6.82-7.88	34.1-37.30	31.2-33.9	22.5-27.9	23.2-27.8
Price	-0.039***	-0.033***	-0.023***	-0.033***	-0.034***
Standard error	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Alternative Specific constant(ASC)	1.352***	1.330***	1.086***	1.433***	1.234***
Standard error	(0.075)	(0.076)	(0.078)	(0.072)	(0.072)
Number of observation (N)	716	776	717	934	828
McFadden R ²	0.279	0.302	0.303	0.323	0.314

***, **, * ==> Significance at 1%, 5%, 10% level.

Taking into account the average red wine market prices provided by the surveyed consumers in Table 5, the monetary worth of the percentage willingness to pay (WTP) without certification stands at 0.7 cents, 18 cents, 14 cents, 0.8 cents, and 0.7 cents for France, Greece, Italy, Portugal, and Spain respectively. These values escalate further with certification, especially when the certifying authority is the EU indicating a generally positive response in terms of consumers' willingness to pay for sustainable wines from alternative pesticide-reducing innovations.

The positive willingness to pay (WTP) premiums observed across all five countries underscores a growing trend toward environmentally and socially conscious consumption, reflecting an increasing preference for responsible and sustainable practices among consumers (Ur Rahman et al., 2023). However, variations in WTP estimates among countries suggest that consumer concerns and priorities regarding the environmental impact of pesticide usage by wine producers are influenced by national contexts. The notable increase in WTP estimates when conventionally produced wines from reduced pesticide use are certified underscores the significance of certification as a tangible indicator of sustainability for consumers (Morone et al., 2021). Without certification, consumers lack a reliable means to verify the sustainability or safety of wines produced with limited pesticide use, potentially leading to heightened perceptions of risk that negatively impact purchasing intentions for sustainable products (Brach et al., 2018). Consequently,



the European Commission (EC) certification emerges as the most valued certification among wine consumers in this study, likely due to its perceived trustworthiness compared to other certification schemes.

3.5.3 Factors influencing consumers' preference for sustainable wines

It is known in the literature that several factors influence the choice and that in preference sustainable wines (Schäufele & Hamm, 2017; Sogari et al., 2016). For this reason, we sought to identify the key factors affecting the consumers' preference for sustainable wine from alternative innovations. We identify the factors using the Random Parameter Logit model by interacting the Alternative Specific Constant and with the some intrinsic and extrinsic characteristics such as sociodemographic, attitudinal, economic, awareness, and receptivity to new wines. The results presented in the part b of Table A3 in the Annexe reveals 5 categories of factors that influence consumers' preference for sustainable wines.

i. Sociodemographic characteristics

Gender: We found that in women in Greece and Portugal have higher preference for sustainable wines compared to men. The results for the other countries were insignificant

Age: The preference for sustainable wine was higher among younger consumers compared the older consumer in Portugal. However, in France, Portugal and Spain, the sustainable wine preference was higher among old consumers

Education: The preference for sustainable wines was higher among consumers with higher levels of education in Portugal. The influence of education was insignificant in the remaining countries.

Household size: Consumers with larger household size have lower preference for sustainable wines in Greece and Spain. For the rest of the countries household size did not influence wine preference.

ii. Knowledge/awareness

Knowledge of pesticide use: The subjective knowledge of consumers on pesticide use in vineyards has a positive influence on consumers' preference for sustainable wines in Portugal and Spain. This implies that awareness or knowledge was important to choosing sustainable wines in Portugal and Spain. For the remaining countries, the influence of knowledge of pesticide use in vineyards was not significant.

iii. Environmental concern attitude

Consumer perception: The influence of consumers' perception of vineyard activities as explored in Figures 16 and 17 regarding the impact of vineyard farms on their communities was examined on their preference for sustainable wine. Our results from the interaction Random Parameter Logit (RPL) model reveals that individuals expressing concerns about vineyard activities, particularly regarding pesticide use, exhibit a stronger preference for sustainable wine in Greece, Portugal, and Spain compared to those without such concerns. However, this relationship was not statistically significant for France and Italy.

iv. Economic factors

Prevailing wine price: The prevailing market price of wine reported by consumers has a negative influence on their preference for sustainable conventional wines in Italy. This implies that consumers who are already exposed to higher prices preferred standard conventional wines (reference) compared to the sustainable wine from alternative innovations.





Employment: Consumers with gainful employment strong higher preference for sustainable wines preference in all the case study countries except Greece.

Income level: The level of consumers' monthly income as depicted in Figure 4 has a significant and positive influence on consumers' preference for sustainable wines in France, Portugal and Spain.

v. Exploratory behaviour

Receptivity to new wine: Finally, we investigated the impact of consumers' openness to trying new wines, as assessed by the adaptive 8 WNS items, on their preference for sustainable wine products. The findings indicate that greater resistance or lower receptive behaviour negatively affects consumer preference for sustainable wines in France and Italy. This suggests that consumers who are less receptive in terms trying new wine have a lower preference for sustainable wines in the two countries. However, this relationship was not statistically significant in the remaining countries.





3.5.4 Olive oil

For olive oil consumers, we employed the contingent valuation method (CVM) to gauge their intention and willingness to pay for olive oil produced using alternative pesticide-reducing innovations, as detailed in the method section. The CVM involved a two-step payment card approach. In the first step, consumers were presented with a range of payment options and asked to indicate which range they were willing to pay for olive oil from alternative innovation. In the second step, they specified the exact amount from the previously selected range.

The results of the first step of the CVM are depicted in Figure 21 and Table 10. Similar to the wine experiment, a consistent majority (73.1%) of consumers across all countries expressed a willingness to pay extra, compared to those unwilling to do so (26.8%). When comparing across countries, Italian participants showed the highest percentage of positive responses (79.0%), while those in Spain exhibited the lowest (66.6%). The trend in the range of willingness to pay (WTP) displayed in Table 10 was consistent across all countries, with the percentage decreasing from the "0-1€" range to the ">1€" limit, indicating a preference for lower payment cards over higher ones.

The mean extra WTP for a litre bottle of sustainable olive oil produced from alternative pesticide-reducing innovations was calculated in the second stage of the CVM experiment, where consumers specified the exact amount they were willing to pay from their chosen range. This mean extra WTP, along with its percentage of the consumer-stated reference prices (i.e. average price of their previous purchase), is recorded in the last column of Table 10.

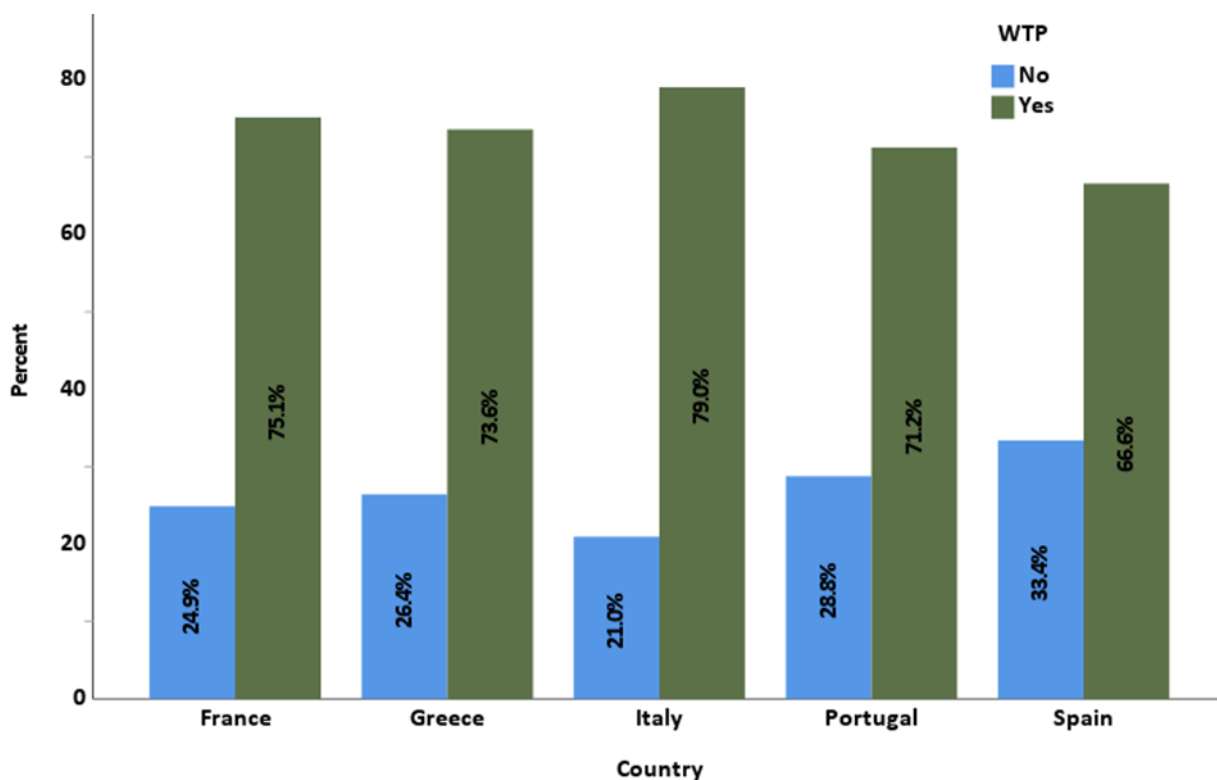


Figure 21. Responses from willingness to pay for sustainable olive oil



Consumers in France demonstrated the highest willingness to pay (WTP), with a mean extra WTP of €2.98 per litre of olive oil, followed by Greece (€2.24), Italy (€2.20), Spain (€2.15), and Portugal (€2.88). On average, the mean extra WTP represented approximately 26% for France, 23% for Greece, 22% for Italy, 24% for Portugal and Spain the average stated reference price. This indicates that consumers were generally willing to pay about 24% more for certified sustainable olive oils produced from pesticide-reducing innovations. This percentage average WTP of approximately 24% aligns closely with findings in existing literature. According to Li & Kallas (2021), the overall WTP premium for sustainability (in percentage terms) averages at 29.5%. They however noted that the average WTP results may vary depending on factors such as the region and the specific category of food.

Table 10. Response to contingent valuation on extra payment

COUNTRY	Premium (EUR)											Mean extra WTP	
	0€ (%)	<1€ (%)	1-2€ (%)	2-3€ (%)	3-4€ (%)	4-5€ (%)	5-6€ (%)	6-7€ (%)	7-8€ (%)	8-9€ (%)	>9€ (%)	€/L	%/L
<i>France</i>	24.9	16.6	16.1	13.5	7.9	7.9	4.2	4.0	2.2	2.0	0.7	2.98	25.9
<i>Greece</i>	26.4	16.7	16.5	14.0	6.5	5.9	4.7	3.8	3.1	2.3	0.1	2.24	23.4
<i>Italy</i>	21.0	17.6	16.6	13.1	8.7	8.4	4.8	3.9	3.5	2.1	0.3	2.20	22.4
<i>Portugal</i>	28.8	16.4	12.4	11.9	9.4	7.4	4.9	3.6	2.4	2.7	0.1	1.88	24.3
<i>Spain</i>	33.4	16.6	13.3	11.6	7.4	5.9	4.2	3.0	2.3	2.2	0.1	2.15	24.2
<i>Pooled</i>	26.9%					73.1 %						2.29	24.0

3.5.5 Factors influencing willingness to pay for sustainable olive oil

The factors influencing olive oil consumers' expected decision to pay extra for the proposed sustainable olive product from alternative innovations were identified using the Heckman sample selection model for each country. The explanatory variables used are described in Table A2 in the annexe.

Table 10 presents the partial effects of the Heckman model for the five countries. The partial effects are divided into three effects: direct effects, which indicate the influence of the explanatory variables on the outcome variable independent of selection bias; indirect effects, which indicate the influence of explanatory variables on the outcome variable through the selection process as captured by the inverse Mills ratio; and total effects, representing the combined impact of explanatory variables on the outcome variable, accounting for both direct and indirect effects.

The partial effects are calculated at the means of the independent variable vectors. Consequently, the means for direct effects pertain to only consumers selected into the outcome equation (i.e., WTP: >0), while the means for indirect effects are derived from the entire sample used for the Probit selection equation (i.e. both those willing to pay extra and those not willing). If a variable appears in both the selection and outcome equations, the total effect becomes the sum of both the direct and indirect effects.

For all countries, the likelihood ratio test rejects the independence of error terms between the selection and outcome equations. Additionally, the Inverse Mills Ratios are all significant at the 1% level, indicating the presence of selection bias if the decision to pay more is not considered, thus validating the suitability of the sample selection model for this analysis.



Table 11. Partial effects of the Heckman sample selection model

Variable	France	Greece	Italy	Portugal	Spain
Direct effect in the regression					
Age	-0.60***(0.20)	-	-0.58***(0.15)	-0.41***(0.15)	-0.58***(0.15)
<i>Confidence interval</i>	1.00 ~ -0.20		-0.88 ~ -0.28	-0.70 ~ -0.13	-0.88 ~ -0.28
Income	0.39**(0.17)	0.65***(0.14)	0.35***(0.14)	0.54***(0.18)	0.35***(0.14)
<i>Confidence interval</i>	0.05 ~ 0.73	0.38 ~ 0.91	0.09 ~ 0.62	0.02 ~ 0.89	0.09 ~ 0.61
Education level	0.08*(0.05)	0.08*(0.05)	0.08**(0.04)	-	0.08** (0.04)
<i>Confidence interval</i>	(-0.01 ~ 0.19)	-0.01 ~ 0.16	0.01 ~ 0.15		0.01 ~ 0.15
Employment status	-	-1.13*** (0.36)	-	-	-
<i>Confidence interval</i>		-1.82 ~ -0.43			
Household size	-	-	0.15**(0.07)	-	0.14**(0.07)
<i>Confidence interval</i>			0.01 ~ 0.28		0.01 ~ 0.28
Purchase frequency	0.05***(0.01)	0.06***(0.01)	0.05***(0.01)	-	0.05***(0.01)
<i>Confidence interval</i>	0.02 ~ 0.08	0.03 ~ 0.08	0.03 ~ 0.06		0.02 ~ 0.06
Previous purchase price	0.08***(0.03)	0.18*** (0.03)	0.10*** (0.03)	-	0.10*** (0.03)
<i>Confidence interval</i>	0.02 ~ 0.13	0.13 ~ 0.24	0.05 ~ 0.16		0.05 ~ 0.16
Indirect effect in LAMBDA (means are for all observations)					
Age	0.50*** (0.13)	0.19** (0.10)	0.33** (0.11)	0.22** (0.11)	0.33*** (0.11)
<i>Confidence interval</i>	0.245 ~ 0.76	0.01 ~ 0.37	0.12 ~ 0.15	0.01 ~ 0.43	0.13 ~ 0.54
Gender	-0.39* (0.20)	-	-0.52** (0.22)	-	-0.52** (0.22)
<i>Confidence interval</i>	-0.78 ~ 0.01		-0.95 ~ -0.08		-0.95 ~ -0.08
Income	-0.43*** (0.13)	-	-0.18* (0.10)	-0.28* (0.15)	-0.18* (0.10)
<i>Confidence interval</i>	-0.67 ~ -0.18		-0.38 ~ 0.02	-0.58 ~ 0.02	-0.38 ~ 0.02
Education level	-0.21*** (0.05)	-	-	-	-
<i>Confidence interval</i>	-0.30 ~ -0.11				
Employment status	-0.51** (0.23)	-	-	-0.56** (0.28)	-
<i>Confidence interval</i>	-0.96 ~ -0.06			-1.12 ~ -0.01	
Purchase frequency	-0.04*** (0.01)	-	-	-	-
<i>Confidence interval</i>	-0.06 ~ -0.01				
Previous purchase price	-0.02*** (0.01)	-	-	-	-
<i>Confidence interval</i>	-0.03 ~ -0.01				
Total effect for variables in both parts					
Income	-	0.50*** (0.16)	-	-	-
<i>Confidence interval</i>		0.18 ~ 0.82			
Education	-0.12* (0.07)	-	-	-	-
<i>Confidence interval</i>	-0.25 ~ 0.02	0.128			
Employment status	-	-1.17*** (0.39)	-	-	-
<i>Confidence interval</i>		-1.92 ~ -0.40			
Previous purchase price	0.06* (0.03)	0.13** (0.06)	-	-	-
<i>Confidence interval</i>	-0.02 ~ 0.11	0.12 ~ 0.24			

Standard errors are in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: Standard errors are in parentheses: bank means insignificant at all three level



i. Direct effects

Age: It is widely acknowledged that younger consumers exhibit a greater inclination towards sustainability in their purchasing habits, demonstrating a heightened engagement with eco-friendly practices compared to older age cohorts. Consequently, it is anticipated that the younger generation would demonstrate a greater willingness to pay for sustainable olive oil compared to older consumers.

As anticipated, the direct partial effect of age is significant (at a 99% significance level) and negative in all five countries, indicating that younger consumers are indeed willing to pay more for sustainable olive oil produced from alternative pesticide-reducing innovations. This finding is consistent with research indicating that Generation Z (individuals born between 1997 and 2012) is particularly influential in driving sustainability efforts and displaying a strong commitment to fostering a more sustainable world (Gomes et al., 2023).

Income levels: Typically, individuals with higher income levels demonstrate a greater willingness to pay for sustainable food products. This inclination stems from their greater disposable income, which allows them to allocate more funds towards premium-priced items, including those produced sustainably as proposed in this study. The results of all five countries confirm this expectation, indicating that consumers with higher monthly income earnings are indeed willing to pay more compared to those with lower monthly incomes. The significance of the findings varied: France and Greece showed significance at a 95% confidence level, while Italy, Portugal and Spain exhibited significance at a 99% confidence level.

Purchase frequency: The Heckman sample selection model further demonstrates that consumers who make purchases more frequently throughout the year are more inclined to pay more (at a 99% significance level) compared to those with lower yearly purchase frequencies in all the case study countries. This observation is expected, as individuals who frequently buy a particular product are likely more familiar with its qualities and benefits. This familiarity can cultivate a stronger dedication to sustainability and result in a greater willingness to invest in the sustainable production of the product.

Education levels: The results also indicate that higher levels of education significantly and positively influence consumers' willingness to pay more. This trend is evident among consumers in France (at a 99% significance level), as well as Italy, Greece and Spain (all at a 95% significance level). Higher education levels often lead to increased awareness and understanding of environmental and social issues, including the implications of food production on sustainability. This heightened awareness may serve as a motivating factor for individuals with higher education levels to invest more in sustainable products compared to those with lower levels of education.

Previous purchase price (reference price): Once more, the results revealed that consumers with higher stated "previous purchase price" are more inclined to pay more premium compared to those with lower stated previous purchase price. This observation holds true in all the five countries with a significance level of 99%. This outcome is reasonable because consumers typically use past purchase prices as benchmarks when assessing the value of similar products. Therefore, if consumers have previously paid lower prices, they may exhibit less willingness to pay a higher price in subsequent transactions.

Employment status: The impact of consumers' employment status on their willingness to pay more was significant in Greece and Portugal. However, the direction of this effect varied: it was negative in Greece but positive in Portugal. Typically, it's expected that employed individuals would be willing to pay more compared to those who are unemployed, given the correlation between employment and income levels. However, contrary to this expectation, employed consumers in Greece have lower willingness to pay





premium. Expectedly, in Portugal, employed individuals demonstrated willingness to pay higher premium for olive oil produced from alternative pesticide-reducing innovations.

Household Size: The findings also indicate that household size influences consumers' willingness to pay more for the suggested sustainable olive oil in Italy and Spain at 95% significance level. The positive direct effect suggests that larger households are willing to pay more compared to smaller ones, which contrasts with our initial expectation. However, it's plausible that larger households may enjoy economies of scale when buying food products in bulk (Nelson, 1988). Consequently, they might exhibit a greater willingness to pay more for sustainable food items, as the cost per unit may decrease with larger purchases.

ii. Indirect effect

The indirect effect explains how the explanatory variables influence the outcome variable through the selection process. In this study, the indirect effect captures how the likelihood of being selected into the sample influences the relationship between the explanatory variables and the outcome variable (i.e., willingness to pay more). The variables with significant partial indirect effects are presented in the second segment of Table 10.

It is worth noting that all the variables influencing consumer willingness to pay more premium for sustainable olive oil (direct effect) exhibit contrasting signs in the indirect effect. For instance, while age negatively influences the premium willingness to pay (WTP) under the direct effect, suggesting that older consumers are inclined to pay less compared to younger ones in all five countries, it exerts a positive influence on the outcome variable in the indirect effect in the respective countries. This discrepancy can be attributed to age's significance in the sample selection process. For example, in France, an age distribution quota was applied, allocating 11.47% to 18-24 age group, 16.83% to 25-34, 17.99% to 35-44, 19.55% to 45-54, and 34.16% to 55+. Consequently, older consumers are more likely to participate in the experiment, thus yielding a positive indirect effect of age on the premium WTP through the selection process. The positive indirect effects therefore arises because as age increases, the probability of being selected into the sample also increases, resulting in a bias against younger consumers in the sample selection process.

Besides age, various factors such as income levels, purchase frequency, level of education, previous purchase price, and employment status exhibit significant negative indirect effects on premium willingness to pay (WTP) among consumers in France. In Greece, only the age of consumers demonstrates a noteworthy indirect influence on the outcome variable. In Portugal, income level and employment status exert significant indirect negative effects on the outcome variable, along with age, which has positive indirect effects. Lastly, both Italy and Spain, income and gender have significant indirect negative impacts on premium WTP, suggesting that individuals with lower incomes as well as females are more likely to be selected into the survey experiment compared to their counterparts, higher income earners, and males respectively.

iii. Total effect

The total effect in the Heckman selection model represents the overall impact of explanatory variables on the outcome variable, taking into account both the direct effect and the indirect effect mediated through the selection process. Mathematically, it is the sum of the direct and indirect effects if a variable appears in both the selection and outcome equations.

As presented in the final segment of Table 11, education demonstrates a negative total effect on consumers' premium willingness to pay (WTP) in France, suggesting that individuals with higher education





levels are less inclined to pay more compared to those with lower education levels. However, a closer examination of the direct and indirect effects of education reveals that the indirect effect outweighs the direct effect. This suggests that highly educated consumers were less likely to be selected into the survey, leading to a negative bias against them and resulting in a stronger negative indirect effect compared to the direct effect of education. A similar negative total effect is observed for employment status among consumers in Greece.

Conversely, positive total effects are observed for "income" in Greece (significant at a 99% significance level) and "previous purchase price" in both France (at a 90% significance level) and Greece (at a 95% significance level), influencing premium WTP. This indicates that consumers with higher incomes in Greece and those with higher previous purchase prices are willing to pay a higher premium for sustainable olive oil produced from alternative pesticide-reducing innovations.





3.5.6 Protest response

Of the approximately 27% who expressed their unwillingness to pay extra for olive oil from alternative innovations (in Table 10), further inquiries were made to ascertain the underlying reasons for this stance. The stated rationales are documented in Table 12 below. More than half of those reluctant to pay extra cited the already high prices as their primary concern. It is not surprising that a majority of consumers attribute their reluctance to pay extra to recent price hikes, particularly post COVID-19 pandemic and the Russia-Ukraine war.

The aftermath of the pandemic and the war in Ukraine has seen a general increase in food prices, leading many consumers to face tighter budgets (van Meijl et al., 2024). Consequently, consumers are likely to exhibit greater price sensitivity in their purchasing decisions, impacting their willingness to pay for premium or sustainable products.

Following closely behind the issue of high prices is the lack of sufficient income, accounting for approximately 17% of responses, which underscores the significant influence of economic conditions on purchasing decisions.

In addition to the economic factors, some consumers believe it is the responsibility of farmers and governmental bodies to absorb any cost arising from the production of sustainable products. This sentiment is reflected in around 14% of the responses. Notably, only about 9% of those unwilling to pay extra expressed a simple lack of interest in paying additional premiums. These consumers, along with those who do not believe in pesticide reduction, could be considered true response among all the consumers unwilling to pay extra. The remainder may be viewed as protest responses, as these consumers are interested in the product but have reasons for their reluctance to pay extra (Frey & Pirscher, 2019; Strazzera et al., 2003).

Unlike the wine experiment where we separated the buyers of conventional wines from organic or other sustainable wines, the olive experiment included all kinds of buyers including organic olive oil. Hence majority of those who selected “other reason” stated they already purchase ecological or organic olive oil and will not pay more for a conventional product produced from reduced use of pesticides.

Table 12. Reason behind consumer unwilling to pay extra

Reasons	Percentage
Prices already too high	54.05%
My income is not enough	16.99%
Pesticide reduction is not important to me	1.58%
It is farmers’ duty to reduce pesticide	8.10%
I do not believe in new alternative innovations	2.56%
Government must pay for the innovation	6.23%
I’m just not interested in paying extra	9.17%
Other reasons	1.30%
I already buy organic olive oil	1.2%
All stakeholders must contribute	-
Alternative innovation should not affect prices	-
I have no reason	-





3.5.7 Impact of recent food price hikes on responses

In the final phase of the survey, which assessed consumers' willingness to pay for sustainable conventional wine and olive oil produced from alternatives of contentious plant protective products, we examined the reliability of the choices and responses provided in both the wine choice experiment and the olive oil contingent valuation in light of recent food price increases. Specifically, we asked consumers whether their survey responses would have differed if food prices had not recently risen.

The findings, depicted in Figure 22, indicate that at least 30% of respondents in all countries would have probably altered their answers if recent food price hikes had not occurred. However, the majority (at least 50%) of consumers across all countries stated that the recent inflation in food prices did not influence their responses. The significant proportion of consumers who indicated potential changes in their responses in the willingness-to-pay experiments underscores the need for cautious interpretation of these results in the context of policy development. Therefore, our findings offer a snapshot perspective and should not be construed as fixed attitudes of consumers toward sustainable products.

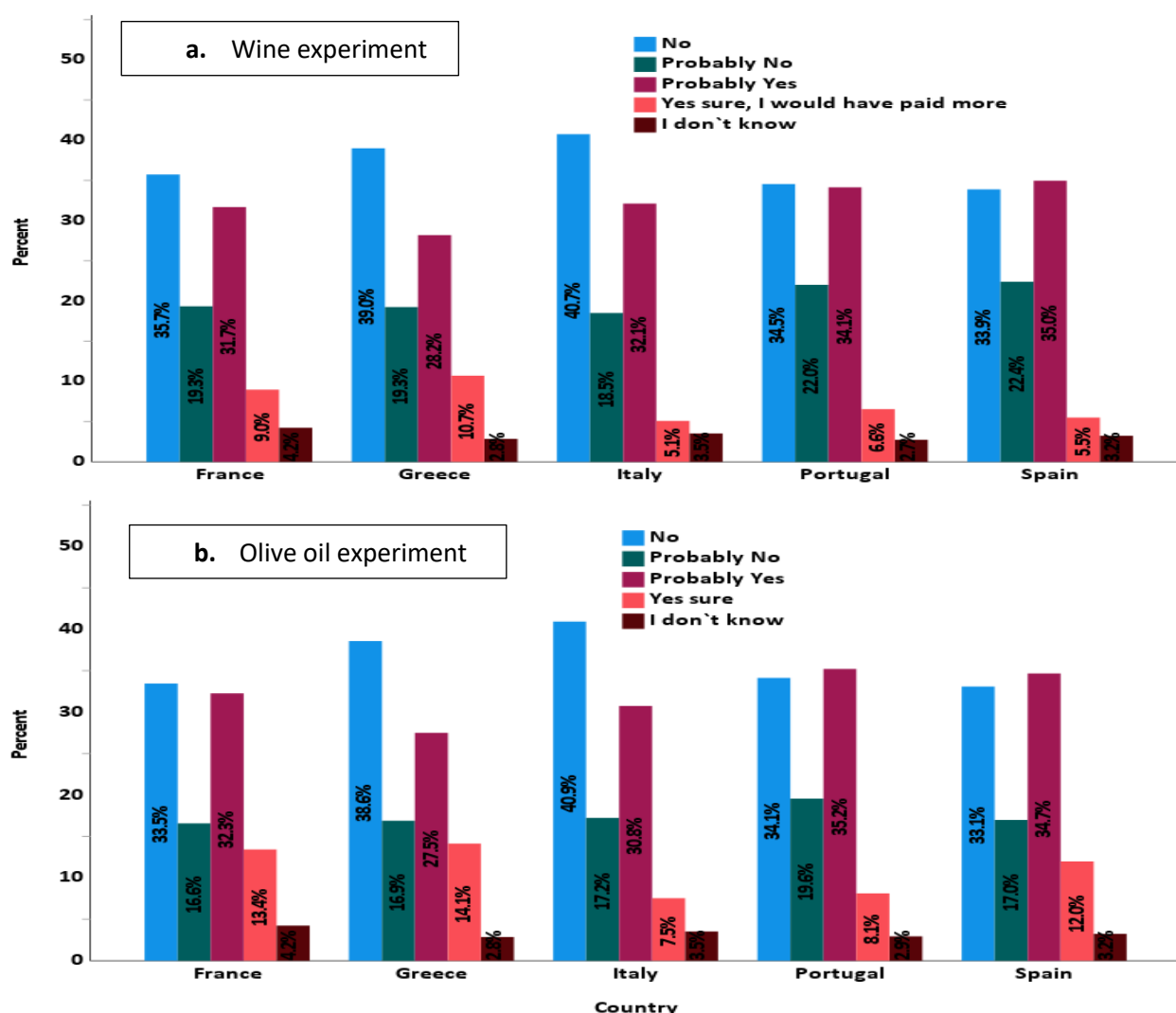


Figure 22. Impact of price hike on responses of consumers





3.5.8 Implications of results

Those who advocate for sustainable production through limited use of pesticides must recognize that reducing pesticide use in agriculture **requires collaboration among stakeholders** throughout the supply chain, from **producers to consumers**. Recent research **emphasizes holistic strategies** that involve all stakeholders, as outlined in frameworks such as the one proposed by Jacquet et al. (2022). This framework emphasizes the **importance of supporting both public policies and private initiatives to transition toward pesticide-free agri-food systems**. To formulate effective public policies, robust empirical evidence free from biases and subjective judgments is crucial. Therefore, the results of this study provide **valuable empirical evidence of consumers' perspective and willingness to contribute to pesticide reduction through their purchase/consumption decisions**.

These perspectives of wine and olive oil consumers are particularly important, especially amidst ongoing resistance within the EU parliament regarding proposals to reduce pesticide use in agriculture. It is important to recognize that consumers can influence producers by **expressing their preferences through market choices, potentially driving pesticide reduction efforts**. Thus, pesticide reduction can be consumer-driven if consumers choose products with reduced pesticide footprints. Therefore, the results hold significance for discussions surrounding the EU's proposal to halve pesticide use by 2030 under the EU Green Deal.

The study's findings indicate a **promising potential market for sustainable conventional wines and olive oils**, provided their pesticide footprints are lower than current levels. Consumers' willingness to pay a premium for products with reduced pesticide use signals a positive market response for vineyard and olive growers considering investments in pesticide-reducing innovations. However, it's important to emphasize that consumers' apparent positivity and willingness to pay extra rely on effectively communicating the pesticide reduction levels, as demonstrated in our experiments. Nevertheless, the current EU regulation on food and beverage labels lacks requirements for disclosing the environmental footprints of pesticides. This absence of regulatory mandates poses a challenge to producers who could otherwise capitalize on the potential market for sustainable conventional wine and olive oil. Hence, any future eco-labelling schemes revealing pesticide footprints could motivate producers to adopt pesticide-reducing innovations. In the absence of such labelling, policymakers might consider offering subsidies to make these innovations economically viable for vineyard and olive growers. The observed differences in consumers' **willingness to pay within and across countries underscore the importance of targeted marketing efforts and segmentation by industry stakeholders**. Understanding the factors influencing consumers' preferences is crucial for effective targeting. The study provides insights into various intrinsic and extrinsic variables that can aid in segmenting and targeting consumers in the wine and olive oil sectors. The findings offer practical guidance for policymakers, winegrowers, and marketers navigating the complexities of the sustainable wine and olive market.

In terms of **policy recommendations**, understanding the diverse factors influencing consumers' preferences can inform targeted policy and **marketing strategies**. Tailoring efforts based on sociodemographic characteristics, knowledge levels, environmental attitudes, and economic factors can enhance sustainable purchases among consumers that could drive sustainable production among growers. **Promoting awareness of pesticide reduction efforts and their benefits** through transparent labelling and certification schemes is crucial. By considering these insights, policymakers and industry stakeholders can **develop policies to promote greater consumer acceptance of sustainable wine and olive oil**, thus encouraging farmer adoption of pesticide-reducing innovations. The study also highlights the **potential**





impact of recent food price increases on consumer willingness to pay for sustainable products. While more than half of respondents indicated that recent food price increases did not influence their responses, a significant proportion expressed uncertainty. This suggests that consumer attitudes and behaviours toward sustainable products may be dynamic and influenced by various factors, including economic conditions. Therefore, policymakers and industry stakeholders should approach sustainability initiatives with an awareness of potential variability in consumer preferences and responses over time.





4. Summary and conclusions

This particular subtask is part of the NOVATERRA project and has three main objectives: firstly, to determine the extent to which **consumers are willing to pay** or intend to purchase sustainable wine and olive oil produced from alternative pesticide-reducing innovations that have been identified in other work packages; secondly, to calculate the **premium that consumers are willing to pay**; and thirdly, to identify the **factors that influence** consumer **WTP** decisions. Using a carefully designed experimental survey involving over **5000 wine and olive oil consumers from five Euro-Mediterranean countries**, we show that overall, consumers **have positive intentions towards sustainable conventional wines and olive oils** produced from innovations that seek to reduce pesticide use.

In the wine segment, the analysis of the choice experiment results using the random parameter logit (RPL) model reveals a **promising consumer preference and willingness to pay a premium** for sustainable red wines derived from pesticide-reducing innovations in all the case study countries. However, the estimated consumers' willingness to pay premium for sustainable **wine attributes such as pesticide reduction and certification varied among the different countries**. The differences in the willingness to pay estimates among countries reveals the heterogeneity among countries in terms of consumers' willingness to contribute to pesticide reduction through their purchasing habits. The premium attached to sustainable certification, particularly, when issued by the European Commission underscore the relevance of certification bodies in the signalling of sustainability practices to consumers. Furthermore, the wine choice experiment results reveal **various categories of factors that influence consumers' preference for sustainable wines** made with pesticide-reducing innovations, including sociodemographic, attitudinal, economic, awareness, and behavioural variables. Aligning marketing and production strategies with consumer preferences can lead to a positive change in the vineyard sector, resulting in lower pesticide usage.

In the case of olive oil, the contingent valuation experiment analysed using the Heckman sample selection model **yields insightful results for addressing sustainable pesticide use in the olive oil sector**. The results reveal that consumers are willing to pay a premium for sustainable olive oil derived from pesticide-reducing innovations, amidst heterogeneity across countries in terms of estimated premium willingness to pay. The results also highlight key demographic and socioeconomic factors influencing consumers' willingness to pay for sustainable olive oil from alternative innovations.

The results underscore the **growing importance of sustainability factors in consumer decision-making** and indicate potential advantages for **the wine and olive oil industries to take advantage of the expanding market** demand for eco-friendly products.





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Annexes

Table A 1. Definition/measurements of variables used in the random parameter models

Main factor	Variable coding	Mean				
		France	Greece	Italy	Portugal	Spain
Sociodemographic						
Gender	1 = male, otherwise 0	0.49	0.47	0.51	0.49	0.49
Age	1-5 (0=18-24, 5=55+ years)	3.62	3.66	3.67	3.55	3.56
Education	1-5 (1=primary, 5=masters or above)	3.52	3.43	3.35	3.52	3.43
Household size	Number of persons in household	2.56	2.91	2.88	2.81	2.92
Perceived knowledge/awareness						
Pesticide use in vines	1-7 (1= no knowledge, 7=expert)	2.17	2.57	2.45	2.18	2.23
Seeing description of pesticide reducing innovation	1 = see description, otherwise 0	0.50	0.48	0.50	0.52	0.49
Environmental attitude						
Concern of pesticides impact on environment	1-7 (1 = no concern, 7 = high concern)	4.32	4.83	4.77	4.82	4.42
Economic factors						
Prevailing wine price	Euros € per 750ml bottle	10.12	8.84	6.83	4.88	7.86
Employment status	1 = employed, otherwise 0	0.65	0.65	0.60	0.75	0.68
Income level	1-7 (1= <1000€, 7=>6000€)	3.00	1.90	2.40	1.84	2.39
Exploratory behaviour						
Resistance to trying new wine	Continuous (new wine resistance scale)	32.21	31.95	34.33	33.65	32.95
TOTAL		716	765	717	934	828

Table A 2. Definition/measurements of variables used in the Heckman sample selection models

Variable: Measurement coding
Education level: 1-5 (1=primary, 5=masters or above)
Gender: female (0); male (1)
Age: 1-5 (0=18-24, 5=55+ years)
Employment status: not working (0); working (1)
Household size: Total number of persons in the household
Purchase frequency: Count of purchase in a year
Previous purchase price: Price in €/litre of olive oil las purchased
Income: 1-7 (1= <1000€, 7=>6000€)





Table A 3. Random parameter logit results with interaction to test consumer preferences

	France	Greece	Italy	Portugal	Spain
a. Base model with WTP					
Pesticide reduction	0.023***	0.053***	0.045***	0.044***	0.024***
Standard errors	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
WTP (%/750ml)	0.65	2.09	2.11	1.66	0.93
Confidence interval	0.31-0.98	1.63-2.36	1.57-2.23	1.20-1.92	0.48-1.88
Independent certification	0.176***	-0.036	0.002	0.143***	-0.064*
Standard errors	(0.038)	(0.038)	(0.038)	(0.035)	(0.035)
WTP (%/750ml)	4.51	-1.09	0.09	4.33	-1.88
Confidence interval	2.36-6.13	-2.91-1.12	-2.32-2.31	2.13-6.24	-3.89-0.28
Participatory guaranteed certification	0.093**	0.243***	0.127***	0.043***	0.079**
Standard errors	(0.044)	(0.044)	(0.045)	(0.04)	(0.041)
WTP (%/750ml)	2.43	7.36	5.52	1.30	2.32
Confidence interval	1.58-2.94	5.94-8.21	4.81-5.98	0.93-1.93	1.92-2.86
European commission certification	0.285***	1.216***	0.757***	0.873***	0.880***
Standard errors	(0.043)	(0.062)	(0.054)	(0.052)	(0.051)
WTP (€/750ml)	7.31	36.84	32.90	26.45	25.88
Confidence interval	6.82-7.88	34.1-37.30	31.2-33.9	22.5-27.9	23.2-27.8
Price	-0.039***	-0.033***	-0.023***	-0.033***	-0.034***
Standard errors	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Alternative specific constant (ASC)	1.352***	1.330***	1.086***	1.433***	1.234***
Standard errors	(0.075)	(0.076)	(0.078)	(0.072)	(0.072)
b. RPL model with interaction terms					
Sociodemographic					
Gender x ASC	-	1.493***	ns	1.938***	-
Standard errors	-	(0.119)	-	(0.715)	-
Age x ASC	-0.849***	-	0.370**	-0.646**	-0.601**
Standard errors	(0.323)	-	(0.179)	(0.269)	(0.245)
Education x ASC	-	-	-	0.8951***	-
Standard errors	-	-	-	(0.291)	-
Household size x ASC	-	-0.419***	-	-	-0.438**
Standard errors	-	(0.004)	-	-	(0.219)
Perceived knowledge					
Knowledge of pesticide activities x ASC	-	-	-	0.212***	1.400***
Standard errors	-	-	-	(0.059)	(0.345)
Environmental concern attitude					
Concern towards environment x ASC	-	0.332**	-	0.488***	1.956**
Standard errors	-	(0.129)	-	(0.181)	(0.973)
Economic factors					
Prevailing wine x ASC	-	-	-0.085***	-	-
Standard errors	-	-	(0.025)	-	-





<i>Employment status x ASC</i>	0.019*		1.638***	2.132***	1.1975***
Standard errors	(0.003)	-	(0.602)	(0.897)	(0.555)
<i>Income level x ASC</i>	0.844***			1.136**	0.436**
Standard errors	(0.280)	-	-	(0.465)	(0.210)
Exploratory behaviour					
<i>Receptivity to new wine</i>	-0.082*		- 0.094***		
Standard errors	(0.046)	-	(0.031)	-	-
No of observation. (N)	716	765	717	934	828
McFadden R²	0.279	0.302	0.303	0.323	0.314

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: Standard errors are in parentheses: bank denotes insignificant at all three level





NOTE BOX 1. Summarized steps in dynamic reference-dependent choice experiment.

Stage one

1. Price of reference wine: Please indicate how much you usually pay for a standard **750ml red wine** for your regular consumption at home (if in doubt, please state the price of your last purchase). **Response** ---**XX**---€

2. Attributes of reference wine: Please indicate the importance of each of the following wine attributes to you when purchasing **red wine** for regular home consumption (*NB: The relevant wine attributes were listed and consumer ranked them on an 11-point Likert scale of importance*).

Stage two

3. Description hypothetical sustainable red wine: In order to produce wine sustainably with less environmental impacts, conventional winegrowers have adopted precision farming technologies to **reduce the levels of pesticide used in vineyards**. Red wines produced from **reduced pesticide use** are either certified by one of certification bodies (*described in survey*) or not, and may have slightly higher price compared to what you usually pay.

4. Choice experiment question: You indicated that you usually pay **XX€** (*referred from stage one*) for your **750ml bottle of red wine** for regular consumption at home.

Which **red wine** below will you purchase for your usual home consumption based on the level of **pesticide reduced, price, and certification?**

Imagine that these **red wines** below are from the same **brand** and have the **same attributes** as those you usually purchase for regular home consumption.

Wine 1 • 30% Pesticide reduction • Independent/Third-party certification  (XX +15%) €	Wine 2 • 20% Pesticide Reduction • No certification  (XX +5%) €	None of these (I prefer my last purchase)
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[NB: If a consumer indicated the price of the reference wine was 5€, the prices displayed for Wine1 and Wine2 are 5.75€ and 5.25€ respectively]



