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Evaluation of the Objectives and Concerns of Farmers to Apply Different Agricultural Managements in Olive Groves: The Case of Estepa Region (Southern, Spain)

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Abstract: Olive groves are representative of the landscape and culture of Spain. They occupy 2.5 M ha (1.5 M ha in Andalusia) and are characterised by their multifunctionality. In recent years, socio-economic and environmental factors (i.e., erosion) have compromised their sustainability, leading farmers to abandon their farms or intensify their management. The main objective/purpose of this research was to study the drivers and concerns that condition farmers' choice of a given olive grove management model. Taking the *Estepa* region as a case study (Andalusia, Spain), surveys were conducted among farmers with integrated and organic managed olive groves. The socio-economic aspects were the main objectives and concerns of the farmers with integrated olive groves. In the case of farmers with organic management, conservation objectives prevailed, and their concerns were oriented to environmental threats. The education level was a key factor in the adoption of given farm management, as it increased the level of environmental awareness. In the context of multifunctional agriculture, it would be desirable to increase this awareness of the environmental threats against olive groves, in order to provide incentives for the implementation of agri-environmental practices that would enhance the sustainability of these systems.

Keywords: farm income; landscape ecology; multifunctional agriculture; olive groves; social demands; socio-ecosystems; sustainability

1. Introduction

The agricultural systems of olive groves form multifunctional socio-ecological landscapes of notable importance in the Mediterranean basin, occupying 5 M ha of the Useful Agricultural Surface (UAS) of Europe [1–3]. Spain is the country with the largest olive-growing area in the world, reaching 2.5 M ha, 60% of which is concentrated in the Andalusia Region (southern Spain) [4]. This wide extension of olive growing in Spain gives it a high production of olives and, in particular, of olive oil. It is the first supplier of this product, with an average yield of 1.19 t year^{-1} throughout the last five collection campaigns (2012/2013–2016/2017) [5]. However, despite their wide representation and continued production, the olive grove agricultural systems present a high degree of uncertainty regarding their sustainability. The main driving factors of this situation are the rural migration and, consequently, the abandonment of agricultural land that has taken place since the 1950s, along with price volatility in agricultural markets [6,7]. In addition, the implementation, in 1957, of the Common Agricultural Policy (CAP), which originally provided incentives for the productive performance of farms, contributed negatively to the sustainability of traditional agricultural systems [8–11].

In face of the economic vulnerability of olive groves, farmers have had to opt for alternative models of agricultural management that would help ensure the persistence of these crops. In this sense, some farmers have chosen to intensify the management of their farming systems by increasing olive tree density and providing energy inputs such as fertilizers, pesticides, and the application of irrigation to maximize production yield [12–14]. However, this intensification led to some negative multidimensional externalities, such as greater soil erosion and diffused pollution derived from the indiscriminate use of agrochemicals [11,15]. In the last few years, other types of environmentally friendly management have been consolidated, such as integrated or organic farming (Table 1). In this type of agricultural system, taking into account the multifunctional agriculture framework, it is highly advisable to consider their economic, social, and environmental dimensions (i.e., Triple Bottom Line approach) in order to assess their sustainability and to promote a stable supply of ecosystem services (ES) to society [16–18].

Table 1. Main characteristics and agricultural practices carried out in the integrated and organic farming of the olive grove [14]. *Desvareto* is an agricultural practice related to the removal of stems from the olive tree.

Characteristics and Agricultural Practices	Integrated Farming	Organic Farming
Mechanisation	Allowed on slopes <20%	Allowed on slopes <20%
Water regime	Rainfed or deficit irrigation	Rainfed or deficit irrigation
Age of olive trees (years)	>25	10–25 (modern crops)
Plant density (trees ha^{-1})	100–500	100–500
Pruning	Biannual	Biannual
Waste disposal	Burning/Grinder	Grinder
Desvareto	Required	Required
Plant covers	Partial	Total
Pest management	Synthetic pesticides (chemical compounds)	Non-synthetic pesticides (organic compounds)
Fertilisation	Synthetic (foliar and soil; fertigation)	Organic (foliar and soil)
Harvesting	Manual vibrator	Manual vibrator

Although both farming models have great similarities, the integrated olive management model allows the implementation of partial plant covers, the use of chemically synthesised pesticides and fertilisers (i.e., NPK fertilisers, glyphosate) in a regulated way by external agencies, and deficit irrigation in water stress situations [14,19]. Differentially, organic olive groves are modern crops, where only the use of organic pesticides and fertilisers is allowed, and the use of irrigation is minimised. Additionally, from a legislative point of view at the Spanish level, the implementation of partial and total plant covers is mandatory in integrated and organic agriculture respectively, in order to minimise the loss of organic matter and soil fertility due to erosive processes [3,20–24].

As farming systems, the contribution of provisioning ES of olive groves is essential and, therefore, must be valued from the political dimension. The CAP, consisting of an income support pillar (Pillar 1) and a rural development support pillar (Pillar 2), with annual subsidies granted to agriculture (37.8%

of the general budget of the European Union (EU)) and specific national policies such as the Law on Olive Groves or the General Plan for Olive Groves in Andalusia support farmers at different levels by improving the profitability of crops and olive groves, respectively [22,23,25,26]. Historically there has been a transition from a productivist CAP where the "single payment" was predominant in Pillar 1, to a more environmentally-friendly CAP, where 30% of the budget for direct payments is based on a "greening" regime, referring to the obligations of farmers with arable land to introduce crop rotation and diversification, and to preserve natural grasslands [27]. On the other hand, aid under Pillar 2 of the CAP favours rural development, becoming more important in olive groves [28,29]. This support is aimed at farmers who, in a non-mandatory way, adopt environmentally-friendly agricultural management models such as integrated or organic farming, where the implementation of plant cover that mitigates the consequences of erosion processes on soil degradation and its negative impact on olive productivity stands out [20,26,30]. In the current political and legislative framework, the new post-2020 CAP reforms are geared towards achieving environmental objectives such as fighting climate change and supporting European farmers in achieving a sustainable and competitive agricultural sector [31]. Thus, basic payments will continue to be dependent on the size of farms, giving greater priority to small and medium-sized farms and young farmers [32]. The new challenges proposed for the new CAP focus on promoting an intelligent, resilient, and diversified agricultural sector that guarantees food security; the emphasis on environmental care; and the strengthening of the socio-economic fabric of rural areas in order to ensure the sustainability of agriculture in Europe [33,34]. Assuming that a continuous and stable contribution by ES to society is a guarantee of the sustainability of agricultural systems, olive groves stand out for their multifunctional nature and the multiple functions they contribute to society [35,36]. In this sense, although the most valuable ES provided by olive groves corresponds to productive and supply services of olives and olive oil [14,37], "Agenda 2000" and the 2003 reforms of the CAP led to the recognition of non-productive services for these agricultural systems [38]. The olive groves contribute to regulation ES, helping to mitigate erosion and climate change because of their carbon sequestration capacity [39–41]. They also contribute to socio-cultural ES, because of the rural culture associated with these crops and their contribution to employment generation (i.e., 10% of the agricultural sector), and to agricultural income (i.e., 6% of national income in Spain) [4,17]. In addition, as components of agricultural landscapes, they constitute reservoirs of agrobiodiversity and wild biodiversity acting as transversal ES [42].

Although there are numerous comparative studies analysing the different management models applied in olive groves, quantifying their multifunctional character and evaluating their positive and negative externalities [3,11,17,20,21,43], the motivations (drivers) and concerns related to the adoption of a particular type of olive management, and the influence of soil erosion over these perceptions remains little investigated. Specifically, knowing the reasons behind farmers' choice of a given agricultural management model in olive groves is extremely important from socio-cultural, ecological, and political dimensions. This knowing allows us to understand how the cultural heritage and tradition linked to these crops influence their management and to encourage the implementation of tillage practices and subsidies that contribute to the economic and environmental stabilisation of olive groves [3,8,9,26]. On the other hand, soil erosion is one of the main threats to the sustainability of olive groves [9]; therefore, to know the ecological and economic impact of this threat on the sustainability of olive groves [18,21,43], it is necessary to understand how erosion affects farmers' perception of agricultural problems. Using a case study, the Protected Designation of Origin (PDO) *Estepa*, with 70% of its area covered by olive groves and annual benefits close to €225 M [44], the main objectives of this research were: (a) to evaluate the factors (aims/drivers and concerns of farmers) that determine the choice of a given olive management model; and (b) to analyse quantitatively the influence of the soil erosion level of the lands on the priorities of these choices. In this way, the information gathered will provide the basis for further targeted research to help ensure a fair standard of living for farmers and a stable supply of ES to society, reducing uncertainty about the sustainability of olive farming systems.

2. Material and Methods

2.1. Study Area

The olive-growing region of *Estepa* in Seville (Andalusia, Spain) was chosen as a particular case study (Figure 1), consolidated as a Protected Designation of Origin (PDO) at the European level in 2010 [45].

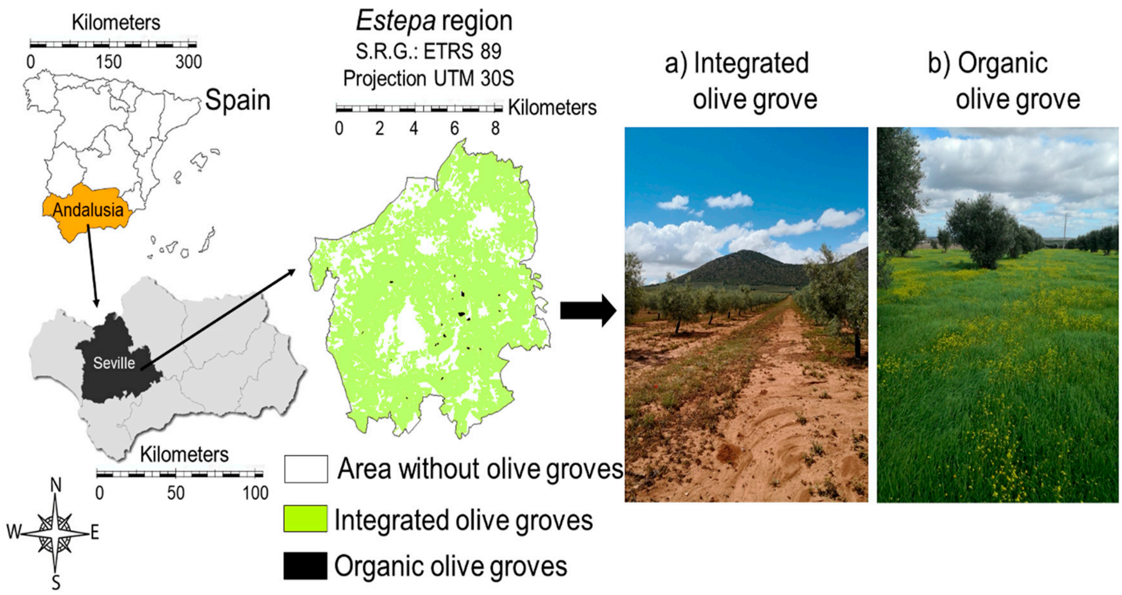

Figure 1. The geographical location of the PDO Estepa. Areas without olive groves, with integrated olive groves (**a**) and with organic olive groves (**b**) and images of the two types of management are shown.

This region, where the density of olive trees ranges from 100 to 500 trees ha^{-1} and climate is temperate Mediterranean with an annual rainfall of 400–500 mm, has 39,694 hectares of olive groves [43,46]. Olive groves are located mainly on limestone and silty soils with a depth between 30–150 cm [21]. Of the total olive-growing area in the *Estepa* region, 95% of the olive groves are managed under integrated rainfed management, with a minimum representation of plantations with deficit irrigation. In this type of management, the agricultural yield ranges between 3500–6000 kg olives ha^{-1} depending on the addition of water to the crop. It should be noted that the implementation of partial plant cover is required, and the application of chemical phytosanitary products is allowed in a regulated manner, including the possibility of adding maximum water volumes of 1500 cm^3 only during periods of water stress [14,44]. The integrated management is subject to the recommendations of the Integrated Production Associations (IPAs) and the Integrated Agricultural Treatment Groups (IATGs), whose main function is to provide technical guidance to farmers on good agricultural management practices in their crops, regulating the production and marketing of the olive oil produced [47]. In the study area, rainfed organic management is still incipient, with isolated plots with young trees covering approximately 500 ha. The agricultural yield of these farms ranges from 3500 to 5000 kg olives ha^{-1}, and it is mandatory to use total live or inert plant covers [44].

2.2. Location of Olive Groves, Erosive Levels, and Sample Design

Using official cartography and cadastral information [48,49], the olive groves belonging to the study area were geo-referenced, enabling the spatial and geographical location of olive groves managed in an integrated and organic way, as well as estimating their erosion levels using the Universal Soil Loss Equation (USLE) (Equation (1)) [50,51].

$$A = R \times K \times LS \times C \times P \quad (1)$$

where A: annual soil losses (t ha^{-1} year^{-1}); R: rain erosivity (J ha^{-1}); K: soil erodibility (Mg J^{-1}); LS: length and grade of the slope of the territory (dimensionless); C: ground cover (dimensionless); P: agricultural conservation practices (dimensionless).

Equation (1) was calibrated specifically for the study region following the study of Rodríguez Sousa et al. [21,43,46] and according to the erosive levels proposed by Moreira-Madueño (1991) [52] (Table 2). Rain erosivity (factor R), soil erodibility (factor K), and length and grade of slope (factor LS) were estimated using specific scientific-technical references for the study area and the criteria of Gisbert-Blanquer et al. (2012) [53,54]. The standards of Gómez et al. (2003) [55] were applied for C factor (tree cover) taking a value of 0.16 for integrated olive groves, considering adult olive trees with a 2.5 m canopy radius, corridors between trees of 4 m, and the presence of partial vegetation covers. For organic olive groves, the C factor took a value of 0.06 due to the presence of total vegetation covers. Finally, because all the groves presented tillage practices without mechanical erosion control, a value of 1 was assumed for P factor (agricultural conservation practices) [43].

Table 2. Estimation of soil loss (A, t ha^{-1} year^{-1}) and classification of the erosion levels of integrated and organic olive groves in the *Estepa* region according to the USLE model.

Management	Erosion Level	Factors					A
		R	K	LS	C	P	
Integrated	Null	109.7	0.82	0.00 (0%)	0.16	1	—
	Slight	109.7	0.89	0.18 (3%)	0.16	1	2.81
	Moderate	109.7	0.56	0.70 (7%)	0.16	1	6.88
	Severe	109.7	0.95	2.20 (15%)	0.16	1	36.68
Organic	Null	109.7	0.82	0.00 (0%)	0.06	1	—
	Moderate	109.7	0.56	0.70 (7%)	0.06	1	2.58

Based on this classification, while integrated olive plots were found in all erosion levels, for organic olive groves, only farms in the null and moderate erosive states were found. Through the combination of agricultural management and erosion levels, six different treatments were identified: integrated olive groves on soils with null, slight, moderate, and severe erosion; and organic olive groves on soils with null and moderate erosion. Additionally, in each treatment, a random sampling was carried out, selecting nine plots in each erosion level integrated olive groves, obtaining a sample size of $n = 9 \times 4 = 36$ plots. On the other hand, all the organic olive grove plots were selected ($n = 19$ plots), from which 9 showed null erosion and 10 moderate erosion. Finally, the overall sample size was $n = 55$ plots (Figure 2).

2.3. Surveys Implementation

In each of the selected plots (i.e., sampling points), a survey was carried out for each owner/farmer, collecting a total of $n = 55$ surveys of farmers dedicated full time to olive growing (i.e., income coming mainly from agriculture ≥80%). In this way, for each plot, the biological genus, age category, and educational level of each surveyed farmer were collected, and the agricultural management (i.e., integrated or organic) of each olive crops was checked, which verified the correct implementation of the agronomic practices required in each case (i.e., obligatory use of partial and total plant covers in integrated and organic agriculture respectively [22,23]). In addition, qualitative information was collected using a scale from 0 (not important) to 9 (very important) for the main priorities of each owner with respect to their objectives to be achieved through the agricultural management model adopted in their plot, which also evaluated the agricultural perception regarding the main concerns considered as threats to the sustainability of the olive grove over time. The objectives and concerns proposed to farmers were selected based on European criteria based on the Eurobarometer 2016 technical report [56], which combines the analysis of the socio-economic and environmental dimensions of agricultural systems. In this sense, the proposed objectives were related to ensuring good quality of life for farmers, social factors, and environmental variables that would contribute to increasing the supply of ES from olive groves to society. On the other hand, the concerns were related to the main social and environmental threats against the sustainability of olive groves. Table 3 compiles the variables proposed for the qualitative assessment of the surveys carried out by farmers.

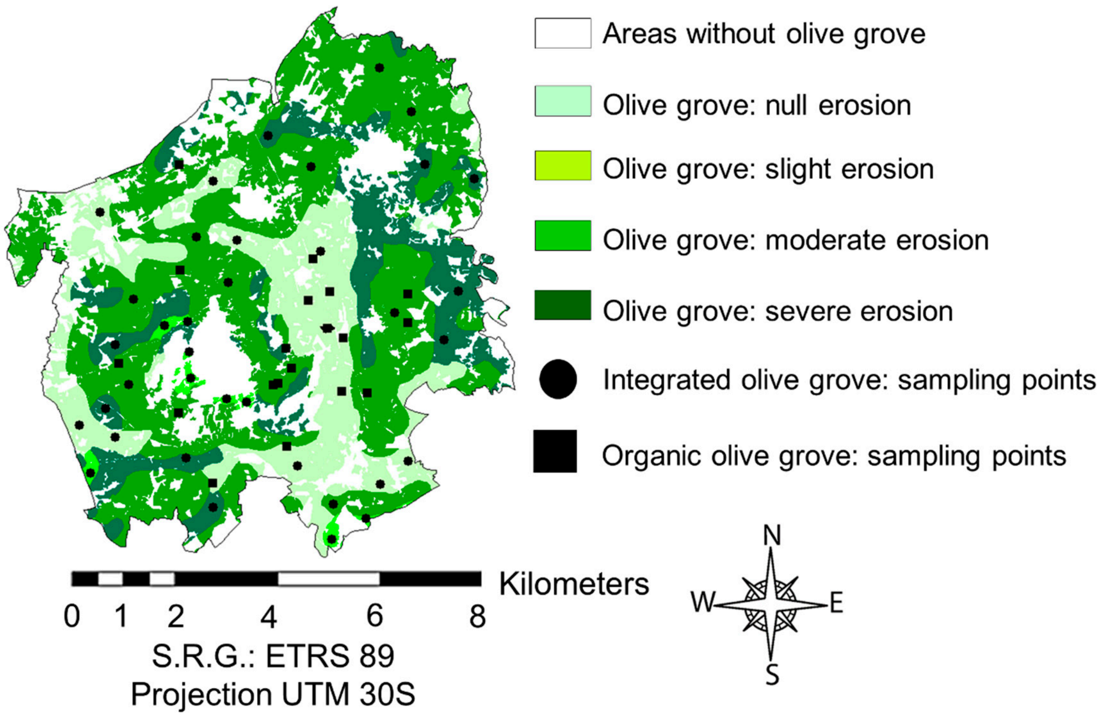

Figure 2. Sample design in the *Estepa* region, highlighting the sampling points where the surveys were carried out according to the agricultural management (i.e., integrated or organic) and the erosive state of the plots (i.e., null, slight, moderate, or severe).

Table 3. List of agricultural objectives and concerns proposed to farmers for assessment. In the "Other" section, farmers were able to suggest options not incorporated in the designed survey.

Objectives	Concerns
1. Farm income	1. Rural aging
2. Stability and economic security	2. Scarce infrastructure and public services
3. Personal reputation	3. Abandonment of rural activities
4. Respect for environment	4. Desertification and soil erosion
5. Get healthy products	5. Lack of local employment alternatives
6. Employment generation	6. Climate change
7. Generating a quality landscape and preserving the natural heritage	7. Low productivity and economic viabilit of the olive grove
8. Contributing to tourist offer	8. Loss of landscape and biodiversity of the olive grove
9. Other:	9. Other:

2.4. Statistical Analysis

In order to comparatively analyse the priorities/weights obtained for the objectives and the assumed concerns related to the olive grove, these ratings were standardised (i.e., normalised) to a range of 0 to 1 following the feature scaling or MinMax methodology (Equation (2)) as in the study by Rodríguez Sousa et al. (2019) [21]:

$$nX = (X - Xmin) \times (Xmax - Xmin)^{-1} \quad (2)$$

where nX: standardised/normalised variable (dimensionless, value ranging from 0 to 1); X: original variable; $Xmin$: minimum value of the original variable; $Xmax$: maximum value of the original variable.

A non-parametric Kruskal–Wallis test (H-test) was carried out in order to ascertain the existence of significant differences in the standardised priorities of the objectives and concerns expressed by farmers with integrated and organic olive plots, assuming the non-normal and heteroscedastic character of the results from the surveys carried out, due to working with frequency data (i.e., frequency of a given qualitative assessment for each option suggested in the surveys) [57]. In addition, having sampled plots from four different erosion levels (i.e., null, slight, moderate, or severe) to check the possible influence of erosion on the observed differences, a Tukey's post-hoc test was carried out on the integrated olive grove data. However, for organic olive groves, having only data coming from plots with two possible erosion states (i.e., null, moderate), the possible influence of the erosion processes was tested directly using an H-test without the need to perform any post-hoc test. All statistical analyses were carried out with RStudio and SPSS software, using the "car" library and "pgirmess" package and considering a level of significance of $\alpha = 0.05$ [58–60].

3. Results

3.1. Personal Information and Type of Soil Cover Applied

The farmers surveyed with integrated olive grove plots (n = 36) were males aged 45–54 years with an academic background lower than average university education (i.e., mandatory secondary education or high school). At the same time, of the farmers with organic olive groves (n = 19), 80% (n = 15) were men and 20% were women (n = 4), all of them within an age range of 35–45 years and with higher education. Specifically, 47.37% of the surveyed (n = 9) presented studies corresponding to professional training; 47.37% (n = 9) medium university studies (i.e., degree or bachelor's degree); and 5.26% (n = 1) higher university studies (i.e., official master's or PhD).

The checked soil cover conducted on-site during the surveys showed that some plots of olive groves presented inert covers (i.e., remains of pruning), scarce in the study area, or could be live covers. Cruciferous species, grasses, and leguminous were the most representative species: *Diplotaxis muralis* ((L.) DC., 1821), *Festuca indigesta* (Boiss., 1838), and *Vicia sativa* (L., 1753), respectively.

3.2. Assessment of Farmers' Objectives Related to Agricultural Management and Erosion Levels

Table 4 shows the standardised priorities of farmers with relation to socio-economic objectives corresponding to all erosive states of the olive-growing managements assessed.

Highly significant differences were detected with higher priorities in the integrated management of the olive grove to the objectives related to farm income, stability, and economic security. In the case of the organic olive growing, highly significant differences were detected for the objectives related to respect for the environment, the generation of a quality landscape and preservation of natural heritage, and the contribution to the tourist offer.

Tables 5 and 6 show the influence of erosive processes on the priorities of the agricultural objectives for the integrated and organic olive groves respectively.

Figure 3 compiles the standardised results of the Tukey's post-hoc test and the Kruskal–Wallis test carried out to find the existence of significant differences between the erosive states of integrated and organic olive groves, respectively.

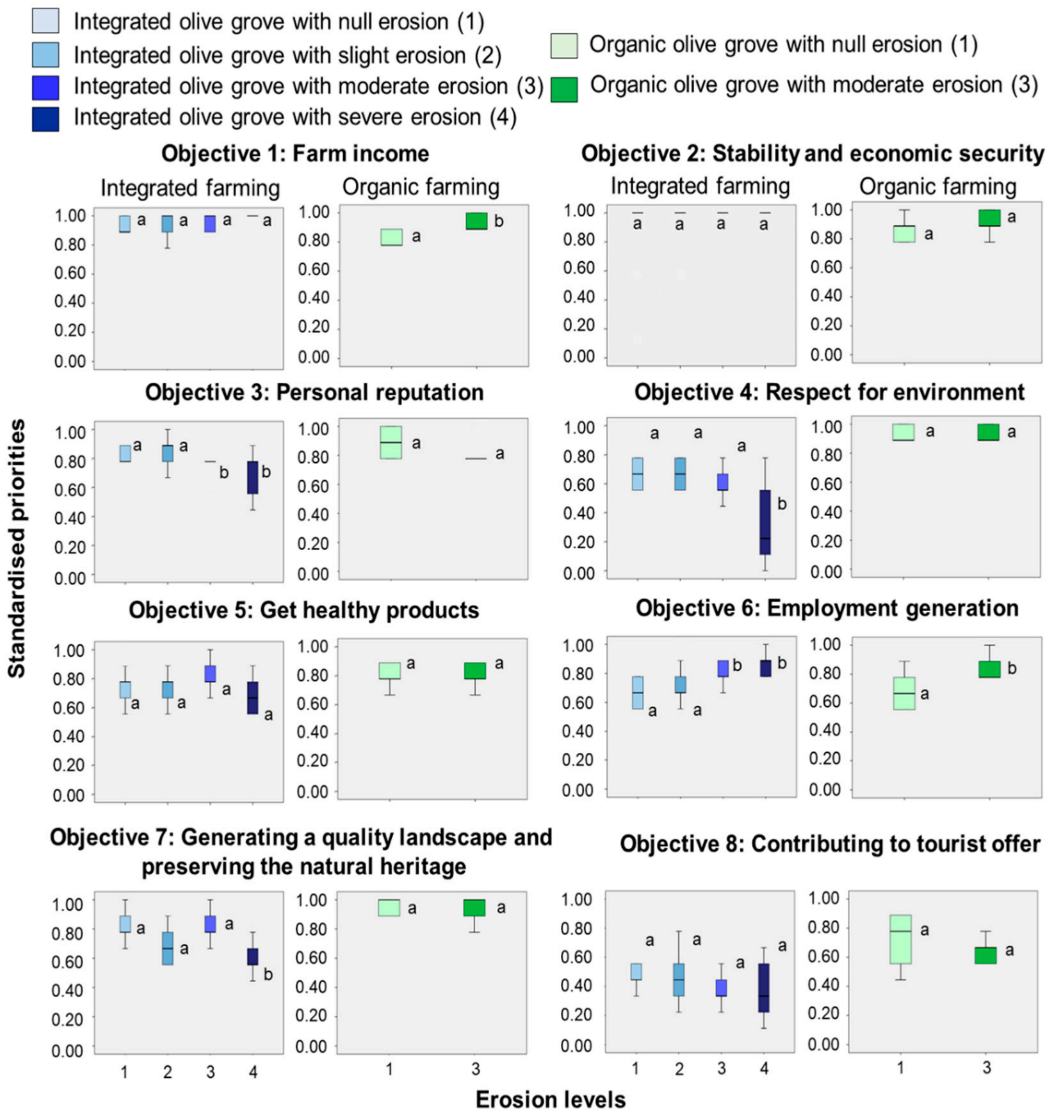

Figure 3. Boxplots showing the results of Tukey's post-hoc analysis and the Kruskal–Wallis test for each objective evaluated in the integrated and organic olive groves according to their erosion levels. The letters inside each boxplot indicate the classification groups generated to establish similar categories to each objective.

In the integrated management of the olive groves, the presence of two statistically differentiated groups was detected in the analysis of a greater personal reputation. In this sense, the plots with null and slight erosion (i.e., group a) showed a significantly higher weighting than plots with moderate and severe erosion (i.e., group b). Similarly, significant differences were also observed for the objective related to the employment generation, where plots with null and slight erosion (i.e., group a) showed significantly lower priorities than those evidenced by farmers with moderate and severe erosion plots (i.e., group b), the farmers of those plots giving greater importance to the achievement of this objective. For the objectives related to respect for the environment and the generation of a quality landscape and preservation of the natural heritage, two statistically differentiated groups were identified. This result showed that the owners of the plots with null, slight, and moderate erosion (i.e., group a) were, in a very significant way, higher than the priorities shown by the farmers with severely eroded plots (i.e., group b). For the organic management, very significant differences were observed according to the erosion level of the plots in relation to the farm income and the employment generation, with higher priorities in those plots with moderate erosion compared to plots with null erosion.

Table 4. Standardised priorities for the objectives in the integrated and organic management of the olive groves in the *Estepa* region in all erosive states assessed. Statistical values of *F* (Kruskal–Wallis test), and *p*-values; significant (<0.05 *), very significant (<0.01 **), and highly significant (<0.001 ***) are shown.

Objectives	Standardised Priorities		*F*	*p*-Value
	Integrated Olive Grove	Organic Olive Grove		
1. Farm income	0.96	0.88	19.23	<0.001 ***
2. Stability and economic security	0.99	0.90	20.23	<0.001 ***
3. Personal reputation	0.77	0.83	2.68	0.121
4. Respect for environment	0.58	0.93	94.97	<0.001 ***
5. Get healthy products	0.74	0.79	2.10	0.166
6. Employment generation	0.76	0.75	0.05	0.815
7. Generating a quality landscape and preserving the natural heritage	0.73	0.95	46.49	<0.001 ***
8. Contributing to tourist offer	0.42	0.67	33.49	<0.001 ***

Table 5. Standardised priorities for the evaluated objectives of integrated olive groves in the *Estepa* region within its erosive levels. Statistical values of *F* (Kruskal–Wallis test) and *p*-values; significant (<0.05 *), very significant (<0.01 **), and highly significant (<0.001 ***) are shown.

Objectives	Integrated Olive Grove					
	Erosion Levels				*F*	*p*-Value
	Standardised Priorities					
	Null	Slight	Moderate	Severe		
1. Farm income	0.94	0.95	0.96	1.00	1.96	0.139
2. Stability and economic security	0.96	0.99	1.00	1.00	1.45	0.245
3. Personal reputation	0.83	0.84	0.77	0.65	4.15	0.014 *
4. Respect for environment	0.67	0.68	0.62	0.35	6.97	0.001 **
5. Get healthy products	0.75	0.72	0.81	0.68	2.13	0.115
6. Employment generation	0.67	0.73	0.80	0.84	4.07	0.015 *
7. Generating a quality landscape and preserving the natural heritage	0.81	0.68	0.81	0.60	7.66	0.001 **
8. Contributing to tourist offer	0.47	0.43	0.41	0.37	0.55	0.648

Table 6. Standardised priorities for the evaluated objectives of organic olive groves in the *Estepa* region within their erosive levels. Statistical values of *F* (Kruskal–Wallis test) and *p*-values; significant (<0.05 *), very significant (<0.01 **), and highly significant (<0.001 ***) are shown.

Objectives	Organic Olive Groves			
	Erosion Levels		*F*	*p*-Value
	Standardised Priorities			
	Null	Moderate		
1. Farm income	0.83	0.93	13.63	0.002 **
2. Stability and economic security	0.88	0.93	1.60	0.224
3. Personal reputation	0.88	0.78	4.41	0.052
4. Respect for environment	0.94	0.93	0.21	0.653
5. Get healthy products	0.78	0.80	0.26	0.616
6. Employment generation	0.68	0.83	9.76	0.007 **
7. Generating a quality landscape and preserving the natural heritage	0.96	0.94	0.43	0.520
8. Contributing to tourist offer	0.70	0.64	0.80	0.382

3.3. Assessment of Farmers' Concerns Related to the Sustainability of the Agricultural Management Evaluated and Erosion Levels

Table 7 shows the standardised priorities for the main concerns that may affect agricultural sustainability in relation to the evaluated olive managements for all erosion levels. It should also be highlighted that an additional concern that was not incorporated in the pre-designed survey was detected for farmers with organic olive groves directed towards the possible threat that the use of glyphosate as a broad-spectrum herbicide may pose to food security (i.e., ninth concern). Because the use of glyphosate and its consequences was only proposed at one level of the study (i.e., organic olive grove), a statistical test comparing this concern with the integrated management model could not be performed.

The results (i.e., standardised priorities) showed the existence of significant and highly significant differences between the integrated and organic management models of olive groves with regard to concerns about rural aging, the abandonment of rural activities, and the low productivity and economic viability of the olive grove, with greater weightings in integrated olive groves. On the other hand, with higher priorities in organic farming, highly significant differences were identified between the two agricultural management models studied with regard to concerns about desertification and soil erosion, climate change, and loss of landscape and biodiversity of the olive grove.

Tables 8 and 9 show the standardised priorities of the main concerns of farmers, for the integrated and organic management of olive groves, according to the erosion levels of the plots.

Table 7. Standardised priorities for the main concerns as threats to the agricultural sustainability in the integrated and organic management of olive groves in *Estepa* region in all erosive states. Statistical values of *F* (Kruskal–Wallis test) and *p*-values; significant (<0.05 *), very significant (<0.01 **), and highly significant (<0.001 ***) are shown.

Concerns	Standardised Priorities		*F*	*p*-Value
	Integrated Olive Grove	Organic Olive Grove		
1. Rural aging	0.81	0.75	4.65	0.046 *
2. Scarce infrastructure and public services	0.70	0.72	0.56	0.464
3. Abandonment of rural activities	0.97	0.64	179.06	<0.001 ***
4. Desertification and soil erosion	0.60	0.94	338.46	<0.001 ***
5. Lack of local employment alternatives	0.63	0.59	2.54	0.130
6. Climate change	0.50	0.90	250.24	<0.001 ***
7. Low productivity and economic viability of the olive grove	0.92	0.70	42.33	<0.001 ***
8. Loss of landscape and biodiversity of the olive grove	0.40	0.86	207.97	<0.001 ***
9. Other: Use of glyphosate as a threat to food security	—	0.85	—	—

Table 8. Standardised priorities for the main concerns in the olive groves with integrated management within their erosive levels in *Estepa* region. Statistical values of *F* (Kruskal–Wallis test) and *p*-values; significant (<0.05 *), very significant (<0.01 **), and highly significant (<0.001 ***) are shown.

Concerns	Integrated Olive Grove					
	Erosion Levels				*F*	*p*-Value
	Standardised Priorities					
	Null	Slight	Moderate	Severe		
1. Rural aging	0.75	0.77	0.84	0.86	4.89	0.007 **
2. Scarce infrastructure and public services	0.62	0.63	0.73	0.83	7.80	<0.001 ***
3. Abandonment of rural activities	0.94	0.96	0.98	1.00	2.66	0.064
4. Desertification and soil erosion	0.47	0.48	0.64	0.80	23.30	<0.001 ***
5. Lack of local employment alternatives	0.60	0.62	0.63	0.65	0.59	0.621
6. Climate change	0.44	0.48	0.51	0.58	3.88	0.018 *
7. Low productivity and economic viability of the olive grove	0.81	0.90	0.96	1.00	22.19	<0.001 ***
8. Loss of landscape and biodiversity of the olive grove	0.40	0.41	0.42	0.37	0.23	0.870
9. Other: Use of glyphosate as a threat to food security	—	—	—	—	—	—

Figure 4 compiles the standardised results corresponding to the Kruskal–Wallis test and the Tukey's post-hoc test carried out to classify the erosive states of each olive management model in statistically differentiated groups for each agricultural concern studied.

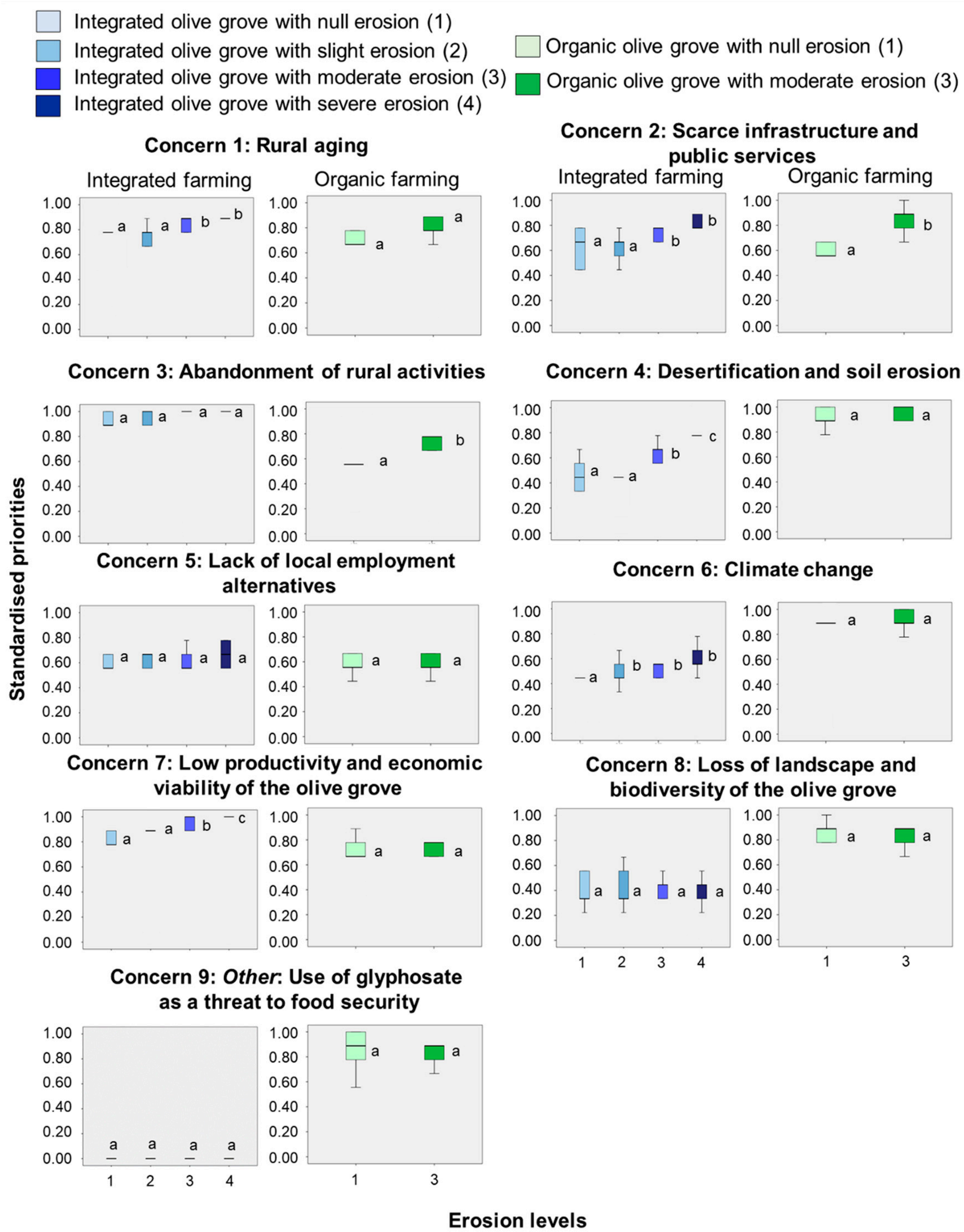

Figure 4. Boxplots showing the results of Tukey's post-hoc analysis and the Kruskal–Wallis test for each concern evaluated in the integrated and organic olive groves according to their erosion levels. The letters inside each boxplot, indicate the classification groups generated to establish similar categories to each objective.

In the integrated olive grove, there were significant differences according to the erosion level of the plots with respect to the climate change, originating two statistically differentiated groups, one formed by the plots of null erosion (i.e., group a), and another group formed by plots with slight, moderate, and severe erosion (i.e., group b), this last one showing a higher weighting on this threat. For the concern related to rural aging, two groups with very significant differences were observed. Thus, plots with null and slight erosion (i.e., group a) showed a lower degree of concern for this threat than plots with moderate and severe erosion (i.e., group b). Highly significant differences were found for different concerns of farmers: (a) for the scarcity of infrastructures and public services, two statistically differentiated groups—plots with null and slight erosion and plots with moderate and severe erosion; (b) for desertification and soil erosion, three different groups—plots with null and slight erosion, plots with moderate erosion, and plots with severe erosion; and (c) for the low productivity and economic viability of the olive grove, three groups—plots with null erosion, plots with slight erosion, and plots with moderate and serious erosion. For these last three concerns, greater weightings were observed as the erosion status of the plots increased. Finally, in organic olive groves, highly significant differences in terms of erosion were detected for the concerns related to the scarcity of infrastructures and public services and the abandonment of rural activities, showing higher priorities in the plots with higher erosion levels (i.e., moderate erosion).

Table 9. Standardised priorities for the main concerns in the olive groves with organic management within their erosive levels in *Estepa* region. Statistical values of *F* (Kruskal–Wallis test) and *p*-values; significant (<0.05 *), very significant (<0.01 **), and highly significant (<0.001 ***) are shown.

Concerns	Organic Olive Groves			
	Erosion Levels			
	Standardised Priorities		***F***	***p*-Value**
	Null	**Moderate**		
1. Rural aging	0.72	0.78	2.17	0.160
2. Scarce infrastructure and public services	0.59	0.85	39.20	<0.001 ***
3. Abandonment of rural activities	0.56	0.73	21.18	<0.001 ***
4. Desertification and soil erosion	0.91	0.96	1.88	0.189
5. Lack of local employment alternatives	0.59	0.58	0.11	0.736
6. Climate change	0.89	0.91	0.37	0.550
7. Low productivity and economic viability of the olive grove	0.68	0.73	0.83	0.375
8. Loss of landscape and biodiversity of the olive grove	0.88	0.84	0.87	0.363
9. Other: Use of glyphosate as a threat to food security	0.88	0.83	0.74	0.401

4. Discussion

Assessing the sustainability of farming systems in general, and olive growing in particular, is a complex objective that requires the use of the multifunctional framework of agriculture and a joint assessment of the economic, social, and environmental dimensions of these systems [17,43,61–63]. In this sense, only an approach based on the Triple Bottom Line that balances these three dimensions can substantially contribute to the analysis of the viability of olive grove agricultural landscapes over time, ensuring the maintenance of the multiple ES that these landscapes generate for society [3,18,64–66].

The assertion made by Sgroi et al. (2015) [67] regarding economic benefit as an essential aspect in the maintenance of agricultural and, specifically, olive-growing activity was corroborated in the study carried out, with a satisfactory farm income being the main objective to be achieved by farmers with integrated olive groves. In this sense, it is worth noting that integrated olive growing is an agricultural management model that combines practices that are more respectful of the environment than intensive olive grove management models while maintaining an optimal production level capable of generating an income that provides a fair standard of living for farmers [3,25,68,69]. On the other hand, the organic olive grove is a management model where the environmental impacts derived from the different farming practices are minimised [24,70]. Additionally, the possibility of applying chemically synthesised fertilizers is eliminated [22,23]. Although the economic aspect of the crop was an important factor in the continuity of the rural activity in this type of farming, higher priorities were shown for the objectives related to the environmental dimension of the olive grove. Specifically, the most outstanding objectives were related to the implementation of agronomic practices that contribute to the conservation of the soil environment, and the generation of a quality landscape, thus preserving the natural heritage [20,71]. This last objective takes on special importance in Andalusia, where there is a deep-rooted cultural tradition linked to olive-growing activity, being historical crops and transforming elements of the landscape in the south of Spain [10,17]. The difference detected in terms of the greater relevance (i.e., higher priorities/weightings) of the economic and environmental dimensions of the olive grove between integrated and organic olive-growing managements for the study area was, in fact, closely related to the higher educational level shown by farmers with organic olive groves [72,73]. All farmers with organic olive groves presented a higher educational level (i.e., professional training or university studies), while farmers with integrated olive grove plots presented medium studies (i.e., mandatory secondary education or high school). This different academic formation generated a greater familiarity on the part of the owners of organically managed plots with the agricultural problems related to the biology of the crop and the environment, knowing in greater detail the intrinsic dynamics of olive cultivation [8,43].

Regarding the analysis of the main agricultural concerns perceived as threats to the long-term sustainability of olive growing, differences were also observed between the two agricultural approaches analysed. In this respect, farmers with integrated olive groves were extremely concerned about the social and productive aspects of the olive grove, highlighting rural aging linked to agricultural abandonment and the impact on the economic performance of farms due to insufficient production [74], with the difficulties in the continuity of agricultural activity being the main concern, with farmers having to complement their income with other lucrative activities [75]. On the other hand, environmental concerns such as erosion and climate change dominated in farmers with organic olive groves. As with the agricultural objectives, the difference observed between the highest priorities for socio-economic and environmental concerns shown by farmers with integrated and organic olive groves respectively is intrinsically related to the age and educational level of the farmers. In general terms, farmers with integrated farms showed a higher age and average educational level, engaging in agricultural activity predominantly for reasons of cultural heritage where the main concerns are to obtain a decent standard of living from their agricultural activity and to ensure its economic sustainability [76]. On the other hand, the younger age of the farmers surveyed with organic olive groves and their higher level of education gives them a perception of the agricultural system where not just its socio-economic dimension is relevant, highlighting the environmental dimension of the crop as a key factor to ensure its ecological sustainability [46,56]. Thus, environmental factors are crucial for the long-term sustainability of the crop and, from a multidimensional perspective, are the basis of the main socio-economic threats to the crops from the alteration of biological and ecological factors in the agricultural systems with a direct impact on the viability of the farms [55,77].

In the surveys of farmers applying organic management, a recurrent concern related to food security, which was not raised in the questionnaire formulated, emerged. The farmers surveyed were apprehensive about the indiscriminate use of glyphosate as a broad-spectrum herbicide, in line with the main demands of society towards agriculture in the Eurobarometer technical report published by the European Commission (2016) [56]. In this sense, concern was expressed regarding the use of glyphosate as a broad-spectrum herbicide, a practice widely used in integrated olive groves [78]. This concern deserves special attention due to the repercussions that the use of glyphosate can have on products obtained from olive groves, in addition to the consequences derived from human consumption of these products on health, as it is a product related to the development of multiple diseases [79,80].

Assuming that the education level of farmers can condition their perception about the objectives and agricultural threats to the sustainability of the olive grove, it would be highly desirable, as already proposed by Rodríguez Sousa et al. (2019) [46] and Guzmán et al. (2013) [81], to set up and consolidate active information channels from the administration at different scales to the social actors related to the olive grove on appropriate environmental management practices to ensure the sustainability of these agrosystems over time. Different institutions at different scales and with different perspectives (top-down information arising, for example, by FAO, EU, ministries, and regional governments, environmental agencies) should continuously and affordably inform farmers, and in turn, farmers should raise their demands and concerns (bottom-up information) to these institutions. In this way, fluid and relevant information channels would be established that would result in better management of agricultural systems with a cross-cutting and adaptive objective of sustainability and rural development [82].

From a legislative point of view, the results obtained suggest how the objectives of the farmers belonging to the study area are largely adapted to the structure of the current CAP (i.e., CAP 2014–2020) and to the modifications planned for the post-2020 CAP. Although the CAP seeks to promote the economic stability of agricultural holdings in general, its environmental dimension is becoming increasingly relevant, promoting the sustainability of agriculture through aid aimed at encouraging rural development and the adoption of environmentally friendly practices [26,83,84]. Obtaining an agricultural income that allows a fair standard of living, which is the main objective of farmers with olive groves under integrated management, corresponds essentially to the support provided by Pillar 1 of the CAP, based on direct aid and the "greening" regime [28,33]. The changes planned for the post-2020 CAP have three specific objectives aimed at maintaining appropriate economic stability, namely (a) ensuring fair incomes; (b) increasing the competitiveness of the agricultural sector; and (c) rebalancing equilibrium in the food chain [31]. Furthermore, the predominant environmental priorities of farmers with organic olive groves are addressed in the support provided by Pillar 2 of the CAP. From an environmental perspective, these objectives are shared by the post-2020 CAP, where four objectives are closely linked to environmental conservation and rural development: (a) fight against climate change; (b) protection of the environment; (c) conservation of landscape and biodiversity; and (d) maintenance and promotion of living rural areas [28,31]. Regarding the concerns perceived by farmers as threats to the sustainability of their crops, the results coincide with the interpretation of these threats by the CAP 2014–2020, with the challenges becoming more acute in the post-2020 CAP. Thus, the new CAP already includes measures aimed at promoting agricultural continuity and generational change in order to reduce rural aging, a concern expressed by farmers with integrated olive groves, with aid targeted at young people and small farmers [26,85]. On the other hand, the concerns shown by farmers with organic olive groves are more linked to environmental factors which, as mentioned above, are increasingly considered at the EU level, with progressively larger budget allocation to mitigate the negative effects of agriculture (i.e., diffuse pollution, erosion, greenhouse gas emissions) and to promote environmentally friendly agricultural practices [11,29,32,55,74,86,87].

Taking erosion as one of the main threats to the sustainability of olive-growing systems due to their development in Mediterranean environments and on predominantly silty soils where there are few stabilising aggregates for the soil environment [46,88], it is worth mentioning the important role played by the CAP in promoting agri-environmental practices that minimise its economic-productive and ecological consequences [26–28]. In this sense, Pillar 2 of the CAP promotes, through the corresponding subsidies, the voluntary implementation of measures such as the application of plant cover and the minimisation of tillage practices, measures which, according to multiple studies, have proven to be very effective in reducing the loss of nutrients, fertility, and soil weight [20,53,74,89]. Considering soil erosion as a possible conditioning variable of the priorities obtained in terms of the objectives and concerns evaluated, an inverse relationship between the erosion level and the environmental objectives was evident for integrated management. This observation is due to the fact that greater erosion generally requires greater application of chemical inputs to the crop and more labour to maintain an optimal level of agricultural production [8,46]. In this sense, the demand for employment is a key agricultural concern that increases with the level of erosion on agricultural farms, and the presence of labour is essential to provide a stable food supply to society [3,25]. Thus, according to Rodríguez-Pleguezuelo et al. (2018) [20], a change towards the organic management of olive groves in

Andalusia would act as a promoter of employment generation, since according to Spanish legislation this model of agricultural management is associated with the implementation and maintenance of soil cover and the use of organic fertilizers, practices that require a greater number of specialised workers [22,23]. In addition, for the integrated management of olive groves, environmental concerns obtained higher priorities as the erosion status of the plots increased, probably due to the harmful effects of erosion on soil fertility and agricultural yield [21,46,74]. Finally, for organic management, the increase in erosive processes showed a greater concern for the scarcity of infrastructure and rural abandonment, as more machinery was needed to obtain olives, and it was more likely that these exploitations would be abandoned, especially those of a marginal nature [8,43].

5. Conclusions

Olive groves form multifunctional socio-ecological systems where the economic, social, and ecological dimensions of the crop interact with each other, leading to the generation of productive and non-productive ecosystem services (ES) to society. Despite the limitations of the study conducted, where the in situ verification of agricultural management was determined through visual observation of the agronomic practices carried out by farmers and the information collected through the questionnaires was qualitative, the results showed relevant information regarding the main conditioning factors for the adoption of a given agricultural model. Thus, while the socio-economic dimension (i.e., job stability and economic benefit) was consolidated as the main axis on which the concerns and the desired objectives of the farmers with integrated olive groves, the owners with organic olive groves showed a higher degree of education level and a greater familiarity with the main biological aspects of the crop, resulting in a higher priority for the environmental dimension of the cultivation. In this sense, the greater environmental awareness of these farmers resulted in a greater weighting of the objectives related to the yield and the farm income and of the main biological and edaphic threats (i.e., soil degradation as a consequence of erosion processes, or climate change and its impact on the sustainability of the olive crop). Additionally, the existence of erosive processes led to greater environmental awareness in plots where high/severe soil loss showed its negative repercussions on agricultural sustainability, evidencing in those plots the use of more intensive farming practices in order to maintain a stable production level of the crop.

Considering that in the present study, the degree of the education level of farmers was a key factor in the adoption of the organic olive system, it would be particularly desirable to carry out several activities (i.e., training workshops) aimed at promoting greater awareness among farmers of the environmental threats that can undermine the sustainability of olive-growing systems, encouraging the implementation of agricultural practices (i.e., minimisation of tillage practices, implementation of soil vegetal covers) that help to guarantee the viability of these systems in the long term, ensuring a stable and sustainable supply of their ES.

Taking into account the political and legislative context of the current CAP and the economic-environmental trends observed for the future post-2020 CAP, it would be highly advisable to carry out research aimed at going deeper into the key factors that influence the adoption of a particular agricultural model in olive growing by farmers. In this sense, future studies should be oriented towards the achievement of the following goals: (a) carry out more generalist works on a wider geographical scale, where the validity of the results obtained is not limited to a particular region or PDO of olive oil; (b) perform experimental designs where the surveys designed and carried out on farmers are not closed or dichotomous, encouraging the participation of rural actors and the proposal of conflicting aspects in olive groves by farmers; and (c) execute more elaborate data processing, using statistical and mathematical methodologies aimed at establishing a hierarchy of the relevance of the factors studied, with emphasis on Multi-Criteria Decision-making Analysis (MCDA), highlighting methodologies as Analytic Hierarchy Process (AHP) or Analytic Network Process (ANP). Thus, through the development of these research lines, a broad knowledge can be provided aimed at evaluating and increasing the relationship between existing agricultural demands and concerns to ensure the continuity of agricultural activity in olive groves and the multidimensional objectives that are pursued through of the subsidies granted by the EU and by the CAP to the agricultural sector, being able to increase the compatibility between rural needs and demands towards agriculture by the socio-political sector.

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References

1. Matthews, R.; Selman, P. Landscape as a Focus for Integrating Human and Environmental Processes. *J. Agric. Econ.* **2006**, *57*, 199–212. [CrossRef]
2. Eurostat. *Estadísticas Sobre Estructura de las expLotaciones Agrícolas*; Eurostat (European Statistics): Brussels, Belgium, 2018; Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farm_structure_statistics/es (accessed on 4 April 2020).
3. Sousa, A.A.R.; Parra-López, C.; Sayadi-Gmada, S.; Barandica, J.; Rescia, A. A multifunctional assessment of integrated and ecological farming in olive agroecosystems in southwestern Spain using the Analytic Hierarchy Process. *Ecol. Econ.* **2020**, *173*, 106658. [CrossRef]
4. Agriculture and Environment. Available online: http://www.ine.es (accessed on 5 April 2020).
5. Cifras Aceite de Oliva. Available online: http://www.internationaloliveoil.org (accessed on 1 April 2020).
6. Bielsa, I.; Pons, X.; Bunce, B. Agricultural Abandonment in the North Eastern Iberian Peninsula: The Use of Basic Landscape Metrics to Support Planning. *J. Environ. Plan. Manag.* **2005**, *48*, 85–102. [CrossRef]
7. Filho, W.L.; Mandel, M.; Al-Amin, A.Q.; Feher, A.; Jabbour, C.J.C. An assessment of the causes and consequences of agricultural land abandonment in Europe. *Int. J. Sustain. Dev. World Ecol.* **2016**, *24*, 554–560. [CrossRef]
8. Duarte, F.; Jones, N.; Fleskens, L. Traditional olive orchards on sloping land: Sustainability or abandonment? *J. Environ. Manag.* **2008**, *89*, 86–98. [CrossRef]
9. Spoerer, M. Agricultural protection and support in the European Economic Community, 1962–1992: Rent-seeking or welfare policy? *Eur. Rev. Econ. Hist.* **2015**, *19*, 195–214. [CrossRef]
10. Infante-Amate, J.; Villa, I.; Aguilera, E.; Torremocha, E.; Guzmán, G.; Cid, A.; Emanueli, F. The Making of Olive Landscapes in the South of Spain. A History of Continuous Expansion and Intensification. *Environ. Hist.* **2016**, *5*, 157–179. [CrossRef]
11. López-Pintor, A.; Sanz-Cañada, J.; Salas, E.; Rescia, A.J. Assessment of Agri-Environmental Externalities in Spanish Socio-Ecological Landscapes of Olive Groves. *Sustainability* **2018**, *10*, 2640. [CrossRef]
12. Caraveli, H. A comparative analysis on intensification and extensification in mediterranean agriculture: Dilemmas for LFAs policy. *J. Rural. Stud.* **2000**, *16*, 231–242. [CrossRef]
13. Flohre, A.; Fischer, C.; Aavik, T.; Bengtsson, J.; Berendse, F.; Bommarco, R.; Ceryngier, P.; Clement, L.W.; Dennis, C.; Eggers, S.; et al. Agricultural intensification and biodiversity partitioning in European landscapes comparing plants, carabids, and birds. *Ecol. Appl.* **2011**, *21*, 1772–1781. [CrossRef]
14. AEMO. *Aproximación a los Costes del Cultivo del Olivo. Cuaderno de Conclusiones del Seminario AEMO*; AEMO (Asociación Española de Municipios del Olivo/Spanish Association of Municipalities of Olive groves): Córdoba, Spain, 2012; Available online: http://www.webcitation.org/77MCvuNPx (accessed on 8 April 2020). (In Spanish)

15. Palma, P.; Alvarenga, P.; Palma, V.L.; Fernandes, R.M.; Soares, A.M.V.M.; Barbosa, I.R. Assessment of anthropogenic sources of water pollution using multivariate statistical techniques: A case study of the Alqueva's reservoir, Portugal. *Environ. Monit. Assess.* **2009**, *165*, 539–552. [CrossRef] [PubMed]
16. Randall, A. Valuing the outputs of multifunctional agriculture. *Eur. Rev. Agric. Econ.* **2002**, *29*, 289–307. [CrossRef]
17. Martínez-Sastre, R.; Ravera, F.; González, J.; Lopez, C.; Bidegain, I.; Munda, G. Mediterranean landscapes under change: Combining social multicriteria evaluation and the ecosystem services framework for land use planning. *Land Use Policy* **2017**, *67*, 472–486. [CrossRef]
18. Lampridi, M.G.; Sørensen, C.G.; Bochtis, D. Agricultural Sustainability: A Review of Concepts and Methods. *Sustainability* **2019**, *11*, 5120. [CrossRef]
19. Real Decreto 1201/2002, de 20 de Noviembre, Por el Que se Regula la Producción Integrada de Productos Agrícolas. Available online: https://www.boe.es/buscar/doc.php?id=BOE-A-2002-23340 (accessed on 18 March 2020).
20. Pleguezuelo, C.R.R.; Zuazo, V.H.D.; Martínez, J.R.F.; Peinado, F.J.M.; Martín, F.M.; García-Tejero, I.F. Organic olive farming in Andalusia, Spain. A review. *Agron. Sustain. Dev.* **2018**, *38*, 20. [CrossRef]
21. Sousa, A.A.R.; Barandica, J.M.; Rescia, A.J.; Sousa, R. Estimation of Soil Loss Tolerance in Olive Groves as an Indicator of Sustainability: The Case of the *Estepa* Region (Andalusia, Spain). *Agronomy* **2019**, *9*, 785. [CrossRef]
22. Ley 5/2011, de 6 de Octubre, del Olivar de Andalucía. Available online: https://www.boe.es/buscar/act.php?id=BOE-A-2011-17494 (accessed on 3 March 2020).
23. Plan Director del Olivar Andaluz Decreto 103/2015. Available online: http://www.webcitation.org/77MO1YwQe (accessed on 1 April 2020).
24. EUR-lex. *Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on Organic Production and Labelling of Organic Products and Repealing Council Regulation (EC) No 834/2007*; EUR-lex (European Union Law): Brussels, Belgium, 2018; Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.150.01.0001.01.ENG (accessed on 25 September 2020).
25. EC. *The Attitudes of European Citizens towards Environment. Special Eurobarometer 217/Wave 62.1—TNS Opinion & Social*; EC (European Commission): Brussels, Belgium, 2005; Available online: http://ec.europa.eu/public_opinion/index_en.htm (accessed on 25 March 2020).
26. Nazzaro, C.; Marotta, G. The Common Agricultural Policy 2014–2020: Scenarios for the European agricultural and rural systems. *Agric. Food Econ.* **2016**, *4*, 89. [CrossRef]
27. Louhichi, K.; Ciaian, P.; Espinosa, M.; Perni, A.; Paloma, S.G.Y. Economic impacts of CAP greening: Application of an EU-wide individual farm model for CAP analysis (IFM-CAP). *Eur. Rev. Agric. Econ.* **2017**, *45*, 205–238. [CrossRef]
28. Dwyer, J.; Ward, N.; Lowe, P.; Baldock, D. European Rural Development under the Common Agricultural Policy's 'Second Pillar': Institutional Conservatism and Innovation. *Reg. Stud.* **2007**, *41*, 873–888. [CrossRef]
29. Ramniceanu, I.; Ackrill, R. EU rural development policy in the new member states: Promoting multifunctionality? *J. Rural Stud.* **2007**, *23*, 416–429. [CrossRef]
30. Erjavec, K.; Erjavec, E. 'Greening the CAP'—Just a fashionable justification? A discourse analysis of the 2014–2020 CAP reform documents. *Food Policy* **2015**, *51*, 53–62. [CrossRef]
31. Carey, M. The Common Agricultural Policy's New Delivery Model Post-2020: National Administration Perspective. *EuroChoices* **2019**, *18*, 11–17. [CrossRef]
32. Plan Estratégico de España Para la PAC Post 2020. Available online: https://www.mapa.gob.es/es/pac/post-2020/default.aspx (accessed on 15 September 2020).
33. Jongeneel, R.; Erjavec, E.; Azcárate, T.G.; Silvis, H. Assessment of the Common Agricultural Policy after 2020. In *Palgrave Advances in Bioeconomy: Economics and Policies*; Springer Science and Business Media LLC: Berlin, Germany, 2019; Volume 1, pp. 207–228.
34. Minotti, B.; Zagata, L. Towards Food Policy for Europe: A Comparison of the Post-2020 Common Agricultural Policy Discourses. *Eur. Countrys.* **2020**, *12*, 53–66. [CrossRef]
35. Balzan, M.V.; Sadula, R.; Scalvenzi, L. Assessing Ecosystem Services Supplied by Agroecosystems in Mediterranean Europe: A Literature Review. *Land* **2020**, *9*, 245. [CrossRef]

36. Michalopoulos, G.; Kasapi, K.A.; Koubouris, G.; Psarras, G.; Arampatzis, G.; Hatzigiannakis, E.; Kavvadias, V.; Xiloyannis, C.; Montanaro, G.; Malliaraki, S.; et al. Adaptation of Mediterranean Olive Groves to Climate Change through Sustainable Cultivation Practices. *Climate* **2020**, *8*, 54. [CrossRef]
37. Coq-Huelva, D.; García-Brenes, M.D.; Sabuco-I-Cantó, A. Commodity chains, quality conventions and the transformation of agro-ecosystems: Olive groves and olive oil production in two Andalusian case studies. *Eur. Urban Reg. Stud.* **2012**, *19*, 77–91. [CrossRef]
38. López, C.P.; Calatrava-Requena, J.; De-Haro-Giménez, T. A systemic comparative assessment of the multifunctional performance of alternative olive systems in Spain within an AHP-extended framework. *Ecol. Econ.* **2008**, *64*, 820–834. [CrossRef]
39. Lal, R. Soil Carbon Sequestration Impacts on Global Climate Change and Food Security. *Science* **2004**, *304*, 1623–1627. [CrossRef] [PubMed]
40. Rodríguez-Entrena, M.; Barreiro-Hurle, J.; Gómez-Limón, J.A.; Espinosa, M.; Castro-Rodríguez, J. Evaluating the demand for carbon sequestration in olive grove soils as a strategy toward mitigating climate change. *J. Environ. Manag.* **2012**, *112*, 368–376. [CrossRef]
41. Aguilera, E.; Lassaletta, L.; Gattinger, A.; Gimeno, B.S. Managing soil carbon for climate change mitigation and adaptation in Mediterranean cropping systems: A meta-analysis. *Agric. Ecosyst. Environ.* **2013**, *168*, 25–36. [CrossRef]
42. Solomou, A.; Sfougaris, A. Comparing conventional and organic olive groves in central Greece: Plant and bird diversity and abundance. *Renew. Agric. Food Syst.* **2011**, *26*, 297–316. [CrossRef]
43. Sousa, A.A.R.; Barandica, J.M.; Sanz-Cañada, J.; Rescia, A.J. Application of a dynamic model using agronomic and economic data to evaluate the sustainability of the olive grove landscape of *Estepa* (Andalusia, Spain). *Landsc. Ecol.* **2019**, *34*, 1547–1563. [CrossRef]
44. Specifications for Protected Designation of Origin Estepa. Ministry of Agriculture, Fisheries and Rural Development. Available online: http://www.juntadeandalucia.es/export/drupaljda/PliegoEstepamodificado.pdf (accessed on 31 March 2020).
45. Cañada, J.S.; Vázquez, A.M. Quality certification, institutions and innovation in local agro-food systems: Protected designations of origin of olive oil in Spain. *J. Rural Stud.* **2005**, *21*, 475–486. [CrossRef]
46. Sousa, A.A.R.; Barandica, J.M.; Rescia, A.J. Ecological and Economic Sustainability in Olive Groves with Different Irrigation Management and Levels of Erosion: A Case Study. *Sustainability* **2019**, *11*, 4681. [CrossRef]
47. Sánchez-Escobar, F.; Coq-Huelva, D.; Sanz-Cañada, J. Measurement of sustainable intensification by the integrated analysis of energy and economic flows: Case study of the olive-oil agricultural system of *Estepa*, Spain. *J. Clean. Prod.* **2018**, *201*, 463–470. [CrossRef]
48. Plan Nacional para la Observación del Territorio: Sistema de Información Sobre Ocupación del Suelo de España. Available online: www.siose.es (accessed on 11 April 2020).
49. Datos Espaciales de Referencia de Andalucía (DERA): G17 Divisiones Administrativas. Available online: http://www.webcitation.org/77MQd2rHN (accessed on 2 April 2020).
50. Wischmeier, W.H.; Smith, D.D. *A Universal Soil-Loss Equation to Guide Conservation Farm Planning*, 1st ed.; International Society of Soil Science: Madison, WI, USA, 1961; pp. 418–425.
51. Benavidez, R.; Jackson, B.; Maxwell, D.; Norton, K. A review of the (Revised) Universal Soil Loss Equation ((R)USLE): With a view to increasing its global applicability and improving soil loss estimates. *Hydrol. Earth Syst. Sci.* **2018**, *22*, 6059–6086. [CrossRef]
52. Moreira-Madueño, J.M. *Capacidad de Uso y Erosión de Suelos. Una Aproximación a la Evaluación de Tierras en Andalucía*; Junta de Andalucía, Agencia del Medio Ambiente: Sevilla, Spain, 1991; Available online: http://www.juntadeandalucia.es/medioambiente/web/Red_informacion_ambiental/productos/Publicaciones/articulos/articulos_pdf/Paralelo.PDF (accessed on 7 April 2020). (In Spanish)
53. Gómez-Calero, J.A. *Sostenibilidad de la producción de olivar en Andalucía. Instituto de Agricultura Sostenible. Instituto de Agricultura Sostenible*; CSIC (Centro Superior de Investigaciones Científicas/Spanish National Research Council): Córdoba, Spain, 2010; Available online: https://www.ias.csic.es/sostenibilidad_olivar/Sost_2009/Sostenibilidad_de_la_Producci%F3n_de_Olivar_en_Andaluc%EDa3.pdf (accessed on 29 March 2020). (In Spanish)
54. El factor K de la ecuación universal de pérdidas de suelo (USLE). Available online: http://hdl.handle.net/10251/16850 (accessed on 21 March 2020).

55. Gómez, J.; Battany, M.; Renschler, C.S.; Fereres, E. Evaluating the impact of soil management on soil loss in olive orchards. *Soil Use Manag.* **2006**, *19*, 127–134. [CrossRef]
56. EC. *Europeans, Agriculture and the CAP. TNS Opinion & Social. Special Eurobarometer 440*; EC (European Commission): Brussels, Belgium, 2016; Available online: http://data.europa.eu/euodp/en/data/dataset/S2087_84_2_440_ENG (accessed on 4 April 2020).
57. González, C.G.; Lise, A.V.; Felpeto, A.B. *Tratamiento de Datos con R, Statistica y SPSS*, 1st ed.; Ediciones Díaz de Santos: Madrid, Spain, 2013; pp. 217–415. (In Spanish)
58. SPSS. *IBM Statistical Package for the Social Sciences for Windows*, SPSS version 21.0; IBM Corp: Armonk, NY, USA, 2012.
59. RStudio. *Open Source and Enterprise-Ready Professional Software for R*, RStudio version 0.98.1102; RStudio Inc.: Boston, MA, USA, 2009–2014; Available online: https://www.rstudio.com/products/RStudio/ (accessed on 11 April 2020).
60. Gandrud, C. *Reproducible Research with R and R Studio*, 2nd ed.; Chapman and Hall/CRC: New York, NY, USA, 2016; pp. 29–78.
61. Rescia, A.J.; Sanz-Cañada, J.; Del Bosque-González, I. A new mechanism based on landscape diversity for funding farmer subsidies. *Agron. Sustain. Dev.* **2017**, *37*, 182. [CrossRef]
62. Cappelletti, G.M.; Grilli, L.; Nicoletti, G.M.; Russo, C. Innovations in the olive oil sector: A fuzzy multicriteria approach. *J. Clean. Prod.* **2017**, *159*, 95–105. [CrossRef]
63. De Luca, A.I.; Falcone, G.; Stillitano, T.; Iofrida, N.; Strano, A.; Gulisano, G. Evaluation of sustainable innovations in olive growing systems: A Life Cycle Sustainability Assessment case study in southern Italy. *J. Clean. Prod.* **2018**, *171*, 1187–1202. [CrossRef]
64. Parras-Alcántara, L.; Lozano-García, B.; Keesstra, S.D.; Cerda, A.; Brevik, E.C. Long-term effects of soil management on ecosystem services and soil loss estimation in olive grove top soils. *Sci. Total. Environ.* **2016**, *571*, 498–506. [CrossRef] [PubMed]
65. Torres-Miralles, M.; Grammatikopoulou, I.; Rescia, A. Employing contingent and inferred valuation methods to evaluate the conservation of olive groves and associated ecosystem services in Andalusia (Spain). *Ecosyst. Serv.* **2017**, *26*, 258–269. [CrossRef]
66. Montanaro, G.; Xiloyannis, C.; Nuzzo, V.; Dichio, B. Orchard management, soil organic carbon and ecosystem services in Mediterranean fruit tree crops. *Sci. Hortic.* **2017**, *217*, 92–101. [CrossRef]
67. Sgroi, F.; Foderà, M.; Di Trapani, A.M.; Tudisca, S.; Testa, R. Cost-benefit analysis: A comparison between conventional and organic olive growing in the Mediterranean Area. *Ecol. Eng.* **2015**, *82*, 542–546. [CrossRef]
68. Morris, C.; Winter, M. Integrated farming systems: The third way for European agriculture? *Land Use Policy* **1999**, *16*, 193–205. [CrossRef]
69. Nayak, P.; Nayak, A.; Panda, B.; Lal, B.; Gautam, P.; Poonam, A.; Shahid, M.; Tripathi, R.; Kumar, U.; Mohapatra, S.; et al. Ecological mechanism and diversity in rice based integrated farming system. *Ecol. Indic.* **2018**, *91*, 359–375. [CrossRef]
70. López, C.P.; De-Haro-Giménez, T.; Calatrava-Requena, J. Diffusion and Adoption of Organic Farming in the Southern Spanish Olive Groves. *J. Sustain. Agric.* **2007**, *30*, 105–151. [CrossRef]
71. Stobbelaar, D.J.; Kuiper, J.; Van Mansvelt, J.D.; Kabourakis, E. Landscape quality on organic farms in the Messara valley, Crete. *Agric. Ecosyst. Environ.* **2000**, *77*, 79–93. [CrossRef]
72. Phillips, J.M. Farmer Education and Farmer Efficiency: A Meta-Analysis. *Econ. Dev. Cult. Change* **1994**, *43*, 149–165. [CrossRef]
73. Bernal-Jurado, E.; Mozas-Moral, A.; Fernández-Uclés, D.; Medina-Viruel, M.J. Determining Factors for Economic Efficiency in the Organic Olive Oil Sector. *Sustainability* **2017**, *9*, 784. [CrossRef]
74. Gómez, J.A.; Infante-Amate, J.; De Molina, M.G.; Vanwalleghem, T.; Taguas, E.V.; Lorite, I. Olive Cultivation, its Impact on Soil Erosion and its Progression into Yield Impacts in Southern Spain in the Past as a Key to a Future of Increasing Climate Uncertainty. *Agriculture* **2014**, *4*, 170–198. [CrossRef]
75. Kristensen, S.B.P.; Busck, A.G.; Van Der Sluis, T.; Gaube, V. Patterns and drivers of farm-level land use change in selected European rural landscapes. *Land Use Policy* **2016**, *57*, 786–799. [CrossRef]
76. Fleskens, L.; Duarte, F.; Eicher, I. A conceptual framework for the assessment of multiple functions of agro-ecosystems: A case study of Trás-os-Montes olive groves. *J. Rural. Stud.* **2009**, *25*, 141–155. [CrossRef]
77. Ropero, R.F.; Rumí, R.; Aguilera, P.A. Bayesian networks for evaluating climate change influence in olive crops in Andalusia, Spain. *Nat. Resour. Model.* **2018**, *32*, e12169. [CrossRef]

78. Resolución de la dirección general de sanidad de la producción agraria. Available online: https://www.mapa.gob.es/agricultura/pags/fitos/registro/productos/pdf/22992.pdf (accessed on 5 April 2020).
79. Gasnier, C.; Dumont, C.; Benachour, N.; Clair, E.; Chagnon, M.-C.; Séralini, G.-E. Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines. *Toxicology* **2009**, *262*, 184–191. [CrossRef]
80. Bai, S.H.; Ogbourne, S.M. Glyphosate: Environmental contamination, toxicity and potential risks to human health via food contamination. *Environ. Sci. Pollut. Res.* **2016**, *23*, 18988–19001. [CrossRef] [PubMed]
81. Guzmán, G.; López, D.; Román, L.; Alonso, A.M. Participatory Action Research in Agroecology: Building Local Organic Food Networks in Spain. *J. Sustain. Agric.* **2012**, *37*, 127–146. [CrossRef]
82. Rodríguez-Cohard, J.C.; Sánchez-Martínez, J.D.; Gallego-Simón, V.J. Olive crops and rural development: Capital, knowledge and tradition. *Reg. Sci. Policy Pract.* **2018**, *11*, 935–949. [CrossRef]
83. Matthews, A.; Salvatici, L.; Scoppola, M. Trade Impacts of Agricultural Support in the EU. *Res. Agric. Appl. Econ.* **2017**, 120p. [CrossRef]
84. Rizov, M. Rural development under the European CAP: The role of diversity. *Soc. Sci. J.* **2005**, *42*, 621–628. [CrossRef]
85. Manos, B.; Bournaris, T.; Chatzinikolaou, P. Impact assessment of CAP policies on social sustainability in rural areas: An application in Northern Greece. *Oper. Res.* **2010**, *11*, 77–92. [CrossRef]
86. Mäder, P.; Berner, A. Development of reduced tillage systems in organic farming in Europe. *Renew. Agric. Food Syst.* **2011**, *27*, 7–11. [CrossRef]
87. West, T.O.; Marland, G. Net carbon flux from agricultural ecosystems: Methodology for full carbon cycle analyses. *Environ. Pollut.* **2002**, *116*, 439–444. [CrossRef]
88. Loumou, A.; Giourga, C. Olive groves: The life and identity of the Mediterranean. *Agric. Hum. Values* **2003**, *20*, 87–95. [CrossRef]
89. Durán-Zuazo, V.H.; Pleguezuelo, C.R.R. Soil-Erosion and Runoff Prevention by Plant Covers: A Review. *Sustain. Agric.* **2009**, *28*, 785–811. [CrossRef]