SISTEMAS DE CALIDAD CERTIFICADA Y BUENAS PRÁCTICAS EN EL SECTOR OLIVARERO DE ANDALUCÍA: ANÁLISIS DE DIFUSIÓN Y EVALUACIÓN MULTIFUNCIONAL

TESIS DOCTORAL

Ascensión Hinojosa Rodríguez

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TITULO: *Sistema de calidad certificada y buenas prácticas en el sistema agroalimentario olivarero de Andalucía: análisis de difusión y evaluación multifuncional*

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Memoria de tesis doctoral presentada por

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Dr. Carlos Parra López

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TÍTULO DE LA TESIS:
SISTEMAS DE CALIDAD CERTIFICADA Y BUENAS PRÁCTICAS EN EL SECTOR OLIVARERO DE ANDALUCÍA: ANÁLISIS DE DIFUSIÓN Y EVALUACIÓN MULTIFUNCIONAL

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INFORME RAZONADO DEL/DE LOS DIRECTOR/ES DE LA TESIS

(se hará mención a la evolución y desarrollo de la tesis, así como a trabajos y publicaciones derivados de la misma).

La Tesis Doctoral consiste en un compendio de 4 publicaciones en revistas internacionales ISI de alto impacto indexadas en el JCR (Journal Citation Report), más una Introducción y unas Conclusiones generales. La investigación realizada se enmarca dentro del Proyecto de Investigación RTA2008-00024-00-00 "Economía de la innovación y dinámica del sistema agroalimentario olivarero de Andalucía: Desarrollo de estrategias para su sostenibilidad y competitividad (ECOINNOLI)", financiado por el Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA). En concreto, la doctoranda ha disfrutado de una beca predoctoral asociada a dicho proyecto (resolución del INIA de 20 de agosto de 2008). Además, la doctoranda ha colaborado en otros proyectos (PAIDI P07-SEJ-03121 y RTA2006-00055-00-00) sobre análisis del papel multifuncional de los sistemas olivareros de Andalucía.

La Tesis Doctoral presenta un hilo conductor común que es el estudio de los factores de adopción de los Sistemas de Calidad Certificada más relevantes en el Sistema Agroalimentario Olivarero de Andalucía (especialmente Producción Integrada, Denominaciones de Origen Protegidas y norma ISO 9001), a nivel de producción agraria e industrial, y la identificación de las prácticas agrarias e industriales susceptibles de ser mejoradas en relación a su competitividad y sostenibilidad. La homogeneidad de la Tesis queda de manifiesto en la Introducción general, especialmente en la 'Metodología general de la investigación' en la que se puede observar que el marco metodológico propuesto es común en todos los artículos de la Tesis. Las similitudes y diferencias de resultados obtenidos en la fase agraria e industrial son sintetizadas en las Conclusiones generales.

Los trabajos y publicaciones derivados de la Tesis son los siguientes:

Artículos en revistas

- Parra-López, C.; Hinojosa-Rodríguez, A.; Sayadi, S.; Carmona-Torres, C. (2015). "Protected Designation of Origin as a Certified Quality System in the Andalusian olive oil industry: Adoption factors and management practices". Food Control, 51: 321-332. http://www.sciencedirect.com/science/article/pii/S0956713514006872
- Hinojosa-Rodríguez, A.; Parra-López, C.; Carmona-Torres, C.; Sayadi, S.; Gallardo-Cobos, R. (2014). "Certified Quality Systems and farming practices in olive growing: The case of integrated production in Andalusia". Renewable Agriculture and Food Systems, 29(4): 291-309. http://dx.doi.org/10.1017/S174217051300015X
- Hinojosa-Rodríguez, A.; Parra-López, C.; Carmona-Torres, C.; Sayadi, S. (2014). "Protected Designation of Origin in the olive growing sector: Adoption factors and goodness of practices in Andalusia, Spain". New Medit, 13(3): 2-12. http://www.iamb.it/share/img_new_medit_articoli/984_02hinojosa.pdf
- Hinojosa-Rodríguez, A.; Parra-López, C.; Carmona-Torres, C.; Sayadi, S. (2014). "Factores de adopción de la Producción Integrada en el sector olivarero de Andalucía". Revista Española de Estudios Agrosociales y Pesqueros, 237: 49-76. http://www.magrama.gob.es/es/ministerio/servicios/publicaciones/ART%C3%8DCULO_1652_tcm7-335178.pdf

Comunicaciones y ponencias en Congresos y Jornadas

- Hinojosa-Rodríguez, A.; Parra-López, C.; Carmona-Torres, C.; Sayadi, S. (2013). "Factores de adopción de la producción integrada en el sector olivarero de Andalucía". IX Congreso de Economía Agraria. Asociación Española de Economía Agraria (AEEA). Castelldefels (Barcelona), 3-5 sept. Contributed paper, presentación oral.
- Hinojosa-Rodríguez, A.; Parra-López, C.; Carmona-Torres, C.; Sayadi, S. (2013). "Estudio comparativo de las prácticas agronómicas utilizadas en la olivicultura integrada y convencional de Andalucía". XVI Simposium Científico-Técnico, Expoliva 2013. Jaén, 8-11 mayo. Contributed paper, presentación póster.
- Hinojosa-Rodríguez, A.; Parra-López, C.; Sayadi, S.; Erraach, Y.; Carmona-Torres, C. (2011). "Certified Quality Systems and good practices in the olive processing industries of the south of Spain: Especial focus on ISO 9000". Olivebioteq 2011: International Conference for Olive Tree and Olive Products. Chania, Crete, Greece. 31 oct. – 4 nov. Libro de Proceedings editado con ISBN 978-618-80367-2-7, 978-618-80367-3-4. Contributed paper, presentación oral. Programa disponible en: http://www.nagref-cha.gr/olivebioteq/index_htm_files/OLIVEBIOTEQ_Schedule_v2.pdf
- Hinojosa Rodríguez, A.; Parra López, C.; Sayadi, S.; Bertuglia, A.; Erraach, Y. (2011). "Los sistemas de calidad certificada en la industria olivarera de Andalucía". VIII Congreso de la Asociación Española de Economía Agraria (AEEA). Madrid, 14-16 sept. Contributed paper, presentación oral. Resumen publicado on-line: http://aeea2011.es/sites/default/files/Resumenes_Comunicaciones_y_Posters_VIII_Congreso_Economia_Agraria.pdf
- Hinojosa Rodríguez, A.; Parra López, C.; Carmona Torres, C.; Sayadi, S.; Erraach, Y. (2011). "Estrategias de calidad en el olivar andaluz: Especial

referencia a las DOP". Taller "La comunidad mountain.TRIP y los resultados de la investigación sobre buenas prácticas en olivares de zonas montañosas y frágiles". IFAPA Centro Camino de Purchil. Consejería de Agricultura y Pesca. Junta de Andalucía. Granada. 7 jun. Poster paper, presentación oral.

- Hinojosa Rodríguez, A.; Parra López, C.; Carmona Torres, C.; Sayadi, S.; Erraach, Y. (2011). "Las Denominaciones de Origen Protegidas como principal sistema de calidad certificada en el sector olivarero de Andalucía". XV Simposium Científico-Técnico Expoliva 2011. Jaén, 11-14 mayo. Actas editadas en CD con ISBN 978-84-938900-0-1. Poster paper, presentación oral. Resumen publicado on-line: http://www.expoliva.com/expoliva2011/simposium/resumenes/ECO-15.pdf.
- Hinojosa Rodríguez, A.; Parra López, C.; Carmona Torres, C.; Sayadi, S. (2011). "Certified quality systems and good practices in the olive farming sector of Andalusia, Spain: Special focus on Protected Designations of Origin". 5th International European Forum (Igls-Forum) on System Dynamics and Innovation in Food Networks. February 14-18. Innsbruck-Igls, Austria. Contributed paper, presentación oral. Publicado on-line: http://centmapress.ilb.uni-bonn.de/ojs/index.php/proceedings/article/viewFile/157/149

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Por todo ello, se autoriza la presentación de la tesis doctoral.

Córdoba, 16 de julio de 2015

Firma del/de los director/es

Fdo.: Carlos Parra López

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ABREVIATURAS

- AAO: Agencia para el Aceite de Oliva
- AESA: Agencia Española de Seguridad Alimentaria
- AICA: Agencia de Información y Control Alimentarios
- AOC: Appellation d'Origine Contrôlée
- APIs: Asociaciones de Producción Integrada
- ATRIAs: Asociaciones para el Tratamiento Integrado en Agricultura
- BOJA: Boletín Oficial de la Junta de Andalucía
- BRC: British Retail Consortium
- CAP: Consejería de Agricultura y Pesca
- CE: Comunidad Europea
- CEE: Comunidad Económica Europea
- CES: Consejo Económico y Social
- CESE: Consejo Económico y Social Europeo
- COI / IOC: Consejo Oleícola Internacional/ International Olive Council
- DOC: Denominazione d'Origine Controllata
- DOP / PDO / AOP: Denominación de Origen Protegida / Protected Designation of Origin / Appellation d'Origine Protégée
- EC: European Commission
- FAECA: Federación Andaluza de Empresas Cooperativas Agrarias
- FAO: Organización de las Naciones Unidas para la Alimentación y la Agricultura
- FAOSTAT: Organización de las Naciones Unidas para la Alimentación y la Agricultura Dirección de Estadística
- FEDER: Fondo Europeo de Desarrollo Regional
- ICT: Information and Communication Technologies
- I+D+i / R&D&I: Investigación, Desarrollo e Innovación / Research and Development and Innovation
- IECA: Instituto de Estadística y Cartografía de Andalucía
- IFAPA: Instituto de Investigación y Formación Agraria y Pesquera de Andalucía
- IFS: International Food Standard
- INE: Instituto Nacional de Estadística
- INIA: Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

- ISO: Organización Internacional de Estandarización
- IT / TIC: Information Technology / Tecnologías de la Información y la Comunicación
- MAGRAMA: Ministerio de Agricultura, Alimentación y Medio Ambiente
- MAPA: Ministerio de Agricultura, Pesca y Alimentación
- MARM: Ministerio de Medio Ambiente y Medio Rural y Marino
- MEC: Ministerio de Economía y Competitividad
- OCDE / OECD: Organización para la Cooperación y el Desarrollo Económicos / Organization for Economic Cooperation and Development
- OILB / IOBC: Organización Internacional de Lucha Biológica / International Organisation for Biological Control
- PAC: Política Agraria Común
- PI / IP: Producción Integrada / Integrated Production
- R&D: Research and Development
- SAAO: Sistema Agroalimentario Olivarero
- SCC / CQS: Sistemas de Calidad Certificada / Certified Quality Systems
- SMEs: Small and medium enterprises
- UE / EU: Unión Europea / European Union
- UNE: Una Norma Española

RESUMEN

En la actualidad, debido a la globalización de la economía y la expansión del mercado internacional, la calidad se considera un elemento estratégico de competitividad. En este contexto y debido a una serie de factores como la aparición de nuevas regiones olivareras en el mundo, la disminución de ayudas agrarias y el aumento de la demanda de la calidad por los consumidores, el aceite de oliva de calidad diferenciada se ha convertido en la clave para la supervivencia del sector olivarero de Andalucía, líder mundial del olivar y de vital importancia socioeconómica en la región. La diferenciación de la calidad y su certificación a través de la implementación de Sistemas de Calidad Certificada (SCC) es voluntaria, garantiza el cumplimiento de unos estándares de calidad por encima de los obligatorios y puede suponer una ventaja competitiva para las empresas y agricultores en el mercado.

El objetivo general de esta Tesis Doctoral es doble: 1) determinar los factores de adopción de los SCC más relevantes en el Sistema Agroalimentario Olivarero (SAAO) de Andalucía, es decir aquellas características de agricultores e industriales y sus empresas que estén relacionados y puedan explicar la adopción de dichos SCC; y 2) identificar las prácticas agrarias e industriales asociadas a la adopción de dichos SCC, con la finalidad de determinar si son técnica, económica y/o ambientalmente superiores a las convencionales. La finalidad última es proporcionar información útil para el diseño de políticas públicas y estrategias empresariales que favorezcan una mayor difusión de los SCC y prácticas más competitivas y sostenibles en el SAAO de Andalucía. Para ello, se llevó a cabo una encuesta a 400 olivicultores y 101 industrias del aceite de oliva de las principales regiones olivareras de Andalucía en 2010/2011. El trabajo se centrará especialmente en la Producción Integrada (PI) y Denominaciones de Origen Protegidas (DOP) en la fase agraria, y en Denominaciones de Origen Protegidas e ISO 9001, en la fase industrial, como SCC más relevantes en la actualidad.

Los resultados indican bajos niveles de conocimiento y adopción de los SCC en el SAAO de Andalucía. La adopción, en el caso de la PI y DOP, parece estar determinada por la presencia de olivar en zonas poco productivas como estrategia de supervivencia, más que por características de olivicultores e industriales, quienes en general, perciben la adopción de innovaciones como un proceso de alto coste económico. Lo anterior sugiere la importancia de continuar investigando para demostrar que los costos asociados a la adopción de los SCC son una inversión que se puede recuperar en el medio a largo plazo. En esta línea, la facilitación del acceso al crédito podría ayudar a potenciar la adopción de dichos SCC en el sector. Por su parte, la adopción de la norma ISO 9001 ha sido liderada por industrias cuyo personal directivo o de gestión, más joven, con mayor formación y más familiarizado con las nuevas tecnologías de la información y comunicación, está más dispuesto a asumir riesgos y menos centrado en el beneficio económico, lo que podría explicar en parte dicha adopción. En este sentido, la renovación generacional y profesionalización del sector, son cuestiones prioritarias para potenciar la adopción de la norma ISO 9001, en particular, y de los SCC, en general.

Las prácticas agrarias e industriales asociadas a los SCC anteriores (PI, DOP e ISO 9001), no son muy distintas de las convencionales. Las prácticas agrarias podrían ser mejoradas en general mientras que las prácticas industriales son en general realizadas de forma adecuada debido sobre todo a los avances tecnológicos introducidos en el sector del olivar desde los años 90 del pasado siglo. En el caso de la PI, existe un mayor uso de buenas prácticas agrarias, debido fundamentalmente a la implementación de prácticas de conformidad con la normativa de PI. A pesar de ello, y al igual que ocurre con las DOP e ISO 9001, algunas prácticas son realizadas de forma poco adecuada, lo que sugiere añadir a estos SCC nuevos valores como la sostenibilidad y el respeto al medio ambiente. Otras cuestiones prioritarias para potenciar la adopción de los SCC analizados son el desarrollo de nuevas estrategias comerciales basadas en combinaciones de productos innovadores; mejorar la detección de prácticas fraudulentas; el establecimiento de

métodos más robustos de organización colectiva y colaboración en las etapas iniciales de la cadena agroalimentaria; y la promoción un mayor conocimiento de los SCC entre los consumidores.

ABSTRACT

Currently, due to globalization of the economy and expansion of international markets, quality is considered a strategic element of competitiveness. In this context and due to a number of factors such as the emergence of new olive-growing regions in the world, the decreasing agricultural support and increasing demand for quality by consumers, differentiated quality olive oil has become a key for the survival of the olive sector in Andalusia. Andalusia is the world-leading olive oil producing region and the olive sector is of critical socioeconomic importance in the region. Differentiation of quality and its certification through the implementation of Certified Quality Systems (CQS) is voluntary, ensures compliance with quality standards beyond mandatory ones and can provide a competitive advantage for organizations and farmers in the market.

The general objective of this PhD Thesis is twofold: 1) to determine the adoption factors of the most relevant CQS in the Olive Agro-food System (OAFS) of Andalusia, that is, those characteristics of farmers and olive oil producers and their farms and companies that are related and can explain the adoption of these CQS; and 2) to identify the farming and industrial practices associated with the adoption of these CQS, in order to determine whether they are technically, economically and/or environmentally better than conventional practices. The aim is to provide useful information for the design of public policies and business strategies encouraging a wider diffusion of CQS and more competitive and sustainable practices in the OAFS of Andalusia. For that, a survey to 400 olive farmers and other survey to 101 olive oil industries from the main olive-growing provinces of Andalusia were carried out in 2010/2011. The work focuses on the most relevant CQS nowadays: Integrated Production (IP) and Protected Designations of Origin (PDO) in the agricultural link of the OAFS, and PDO and ISO 9001, in the industrial link.

The results show, in general, low knowledge and adoption rates of the CQS in the OAFS of Andalusia. The adoption, in the case of IP and PDO, seems to be determined by the presence of olive trees in marginal areas as a survival strategy, rather than by characteristics of farmers and olive oil producers, who generally perceive the adoption of innovations as a highly expensive process. This suggests the importance of continuing researches demonstrating that costs associated with the adoption of the CQS are an investment that can be recovered in the medium to long term. In this line, facilitating access to credit could help drive the adoption of these CQS in the sector. Otherwise, the adoption of ISO 9001 has been leaded by olive oil industries whose managerial and supervisory staff is younger and more trained, more familiarized with new technologies of information and communication, more willing to take risks and less focused on the economic profit. This may, at least partly, explain its adoption. In this respect, the generational renewal and professionalization of the sector, are priorities for strengthening the adoption of ISO 9001, in particular, and CQS, in general.

Farming and industrial practices associated with previous CQS (IP, PDO and ISO 9001), are not very different from the conventional ones. Farming practices could be improved in general while industry practices are generally carried out properly due mainly to technological advances introduced in the olive sector since the 90s of the last century. In the case of IP, there is an increased use of good farming practices, mainly due to the implementation of practices in accordance with IP regulation. However, as for PDO and ISO 9001, some practices are inadequately carried out, suggesting the need of adding new values to these CQS such as sustainability and respect the environment. Other priority issues to enhance the adoption of the CQS analysed are to development new commercial strategies based on combinations of innovative products; to improve the detection of fraudulent practices; the establishment of more robust methods of collective organization and collaboration in the initial stages of the agro-food chain; and to promote a wider knowledge of CQS among consumers.

ÍNDICE

INTRODUCCIÓN GENERAL

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1. HIPÓTESIS DE PARTIDA

El sistema agroalimentario olivarero (SAAO) de Andalucía, de vital importancia económica, sociocultural y territorial en la región, comprende el sector productor de aceituna, el sector agroindustrial que la transforma en su principal producto, el aceite de oliva, y el sector de la distribución y comercialización, que suministra el producto a los consumidores. Entre los diferentes agentes que forman parte de este sistema (agricultores, cooperativas, industrias transformadoras, envasadoras, comercializadoras, etc.), y entre estos y otros agentes sociales entre los que se encuentran los consumidores, tienen lugar diferentes tipos de interacciones e interdependencias, condicionadas por el contexto sociocultural, ambiental, institucional, político, etc. Esta dinámica, que plantea continuos retos a los diferentes agentes del sistema y a los decisores públicos, requiere la redefinición constante de estrategias y políticas para la adopción de innovaciones tecnológicas e institucionales que aseguren la competitividad y la sostenibilidad de la actividad de los agentes, individualmente y del sistema en su conjunto. La presente investigación se centra en el análisis de las dos primeras etapas del SAAO, correspondientes a la fase agraria (agricultores) e industrial (fundamentalmente almazaras), y en las principales regiones olivareras de Andalucía (Jaén, Córdoba y Granada).

La hipótesis de partida que se pretende contrastar en esta investigación es doble: (i) La estrategia de calidad en el SAAO de Andalucía está excesivamente centrada en algunos Sistemas de Calidad Certificada (SCC), mientras que la mayoría son escasamente conocidos y adoptados, lo que supone un coste de oportunidad para la competitividad del sector; así los factores de adopción de los SCC más relevantes serán analizados para potenciar su difusión; y (ii) la adopción

de uno o varios SCC por parte de un agente del SAAO no conlleva necesariamente la implementación de prácticas de producción, gestión y/u organización óptimas desde un punto de vista multifuncional y de sostenibilidad económica, ambiental y social; así se investigará hasta qué punto los SCC más relevantes conllevan el uso de mejores prácticas agrarias e industriales y cómo se pueden mejorar las mismas y así contribuir a un desarrollo más competitivo y sostenible del SAAO de Andalucía.

2. IMPORTANCIA DEL OLIVAR EN ESPAÑA Y EN ANDALUCÍA

En la actualidad, la superficie mundial de olivar asciende a unos 10 millones de hectáreas que se distribuyen fundamentalmente por países de la Cuenca Mediterránea donde se localiza el 98,5% de dicha superficie (FAO, 2015). El resto de superficie de olivar, esto es el 1,5% del total, se localiza en los demás ambientes mediterráneos del planeta como California, Australia, ciertas partes de China, Sudáfrica, y algunas zonas del sur de América entre Argentina, Chile y Uruguay (Delgado et al., 2013).

La Unión Europea (UE), la región olivarera más importante del mundo, concentra aproximadamente la mitad de la superficie mundial de olivar, y es la principal productora de aceitunas y de aceite de oliva. En 2011, la producción de aceitunas en la UE fue del 65,6% de la producción mundial (FAO, 2015), concentrándose la mayor parte de esta producción (95,5%) en unos pocos países como España (58,0%), Italia (23,6%) y Grecia (13,9%) (EC, 2013).

España es el país líder mundial, tanto en términos de superficie como de producción de aceitunas: 2,5 millones de hectáreas y 6,2 millones de toneladas de aceitunas por año en el periodo 2007-2012 (MAGRAMA, 2013), lo cual representa el 25,4% de la superficie y el 33,8% de la

producción mundial (FAO, 2015). La mayor parte de la producción española (el 94,0% en 2011 y el 90% en 2012) (MAGRAMA, 2012; MAGRAMA, 2013) va a almazaras que producen principalmente aceite de oliva y el resto es procesado como aceituna de mesa. El aceite de oliva español es principalmente destinado a la exportación: el 62% del aceite producido en la campaña 2013/2014 fue exportado (AICA, 2015) incluyendo tanto el producto final envasado como el producto a granel para ser procesado y posteriormente envasado. Las exportaciones de aceite de oliva están experimentando un claro incremento; mientras que la producción de aceite de oliva se incrementó un 13,2% en el periodo 2009-2011 (MAGRAMA, 2012), las exportaciones se incrementaron en un 23,8% en el mismo periodo (MEC, 2012), siendo el aceite de oliva uno de los 4 productos exportados más representativos por parte de la industria alimentaria española en 2013, sólo por detrás del vino y de la carne de porcino (MAGRAMA, 2015b). El principal destino de las exportaciones de aceite de oliva español en la campaña 2010/2011 fue el resto de los países de la UE (76,4% de las exportaciones) seguido por Estados Unidos, Australia y China (6,1%, 2,3% y 2,2%, respectivamente) (MEC, 2012). Teniendo en cuenta el destino del aceite de oliva español por países, cabe destacar el ascenso experimentado por China hasta el séptimo puesto en la campaña 2010/2011 (por detrás de Italia, Portugal, Francia, Estados Unidos, Reino Unido y Australia), habiéndose incrementado las exportaciones a este país en un 266% en tan sólo dos campañas (MEC, 2012). La mayor parte de la producción española se obtiene en las cooperativas, las cuales facturan más del 70% del aceite de oliva producido, dando muestras de la importancia del movimiento cooperativo en el sector, y una minoría de almazaras privadas pertenecen a grandes empresas (Sanz Cañada y Macías Vázquez, 2005).

Andalucía, en el sur de España, es con diferencia la región olivarera más importante del país. En el año 2012, el olivar en Andalucía representó el 61,6% de la superficie, y el 75,7% y 72,4% de la producción de aceitunas y de aceite de oliva virgen nacional, respectivamente (MAGRAMA, 2013). En términos macroeconómicos, el olivar proporcionó el 27,7% de la producción vegetal en

la región en 2010 (CAP, 2012) y generó el 32,0% del empleo agrario (Gómez Limón y Arriaza Balmón, 2011). El olivar es el segundo sector agrario más importante en la región después de la producción de vegetales (CAP, 2012). A pesar de su importancia, el sector productor del aceite de oliva en Andalucía muestra un "problema de marketing" ya que los aceites de oliva procedentes del sector cooperativo tienen escasa presencia en el mercado de aceites de oliva envasados. Por lo tanto, están perdiendo una gran parte del valor añadido del producto final, favoreciendo a unas pocas empresas embotelladoras y a las grandes plataformas de distribución (Parras Rosa et al., 2003). Un pequeño número de empresas son poseedoras de la mayor parte de las marcas más valoradas, acaparando el control de la gran parte del aceite vendido en los grandes mercados (Anania y Pupo D'Andrea, 2008). Concretamente el 45% del total de las ventas del sector de las grasas y aceites de la industria agroalimentaria española en 2012 correspondió a 10 empresas (MAGRAMA, 2014c). Por lo tanto, la competitividad a través de la diferenciación en el mercado y la creación de valor de cara al consumidor, es una estrategia fundamental para la supervivencia de los agricultores e industrias, especialmente para los pequeños y medianos, que no pueden competir con las grandes cadenas de distribución cuyas estrategias de marketing están principalmente basadas en el precio (Silva Pérez, 2005; Montegut Salla et al. 2007).

3. ANTECEDENTES

En el sector del aceite de oliva la adopción de sistemas de gestión de calidad como la norma ISO 9001 es poco generalizada, como se confirmará con los resultados obtenidos, siendo más frecuentes las estrategias de calidad basadas en las Denominaciones de Origen Protegidas (DOP) y en la Producción Integrada (PI). La literatura internacional sobre la norma ISO 9001 en el sector del olivar, se ha ocupado de temas como la demanda y el conocimiento de la norma por los

consumidores de aceite de oliva (Galluzzo, 2007) y la utilización de la norma como una estrategia de calidad por parte de las cooperativas almazaras (Marbán Flores, 2005; Maza et al., 2009; Montegut Salla, 2006; Montegut Salla et al., 2007). Sin embargo, los factores relacionados con su adopción en el sector del olivar permanecen sin explorar, tanto en Andalucía como a nivel mundial. Por otra parte, otra cuestión que aún no se ha estudiado en profundidad es si la adopción de esta norma ISO está relacionada con la aplicación de mejores prácticas (o más óptimas) en comparación con las prácticas convencionales en la industria del aceite de oliva. En este sentido, sólo se identificaron algunas referencias en la literatura que destacan una correlación positiva entre la adopción de la norma ISO 9001 y el uso de mejores prácticas (Vilar Hernández, 2003; Vilar Hernández et al., 2009).

Con respecto a las DOP, su difusión ha sido muy importante en el sector del olivar en Andalucía, ya que la superficie de olivar bajo DOP aumentó un 70% en la última década (MAPA, 2001; MAGRAMA, 2014b). A pesar de la importancia relativa de las DOP en el sector, los factores que explican su adopción y difusión, no han sido suficientemente analizados. Los estudios se han centrado en las DOP como estrategia de diferenciación de la calidad para mejorar la viabilidad económica del olivar en Italia (Polelli et al., 2007; Roselli et al., 2009), Portugal (Baptista y Biswas, 2010), y España, en las regiones de Castilla la Mancha (Marbán Flores, 2003, 2004, 2005) y Andalucía (Sanz Cañada y Macías Vázquez, 2005, 2008). También se ha estudiado la demanda y aceptación del aceite de oliva con DOP entre los consumidores (Fotopoulos y Krystallis, 2001; van der Lans et al., 2001; Krystallis y Ness, 2005; Espejel et al, 2007; Navarro García et al., 2010; Erraach y Sayadi, 2011), y la comercialización y venta de aceite de oliva con DOP (Ruiz Avilés et al., 2007; Ruiz Castillo, 2008; Martín Cerdeño, 2009).

Por otra parte, la "bondad" u optimalidad de las prácticas de gestión asociadas con las DOP en comparación con las prácticas convencionales, es un tema poco estudiado al igual que en el caso de la norma ISO 9001. En general son muy escasos los trabajos que tratan de relacionar la

adopción de sistemas de calidad y la implementación de buenas prácticas de producción, gestión y organización en el sector olivarero, siendo una excepción los estudios de Moyano et al. (2002), que centran su atención sobre el efecto de la adopción de determinadas buenas prácticas agroindustriales relacionadas con la estructura productiva y de almacenamiento por parte de una muestra de almazaras de la provincia de Jaén, tales como el sistema de molturación, la capacidad de almacenamiento en depósitos de calidad, etc., en algunos indicadores de calidad previamente establecidos como el precio y la acidez del aceite; y el de Parra López y Calatrava Requena (2006), sobre las diferencias de las prácticas agronómicas implementadas por los olivareros ecológicos y convencionales de Andalucía. Se pueden definir "buenas prácticas" como el conjunto de especificaciones que contribuyen a la gestión racional del medio ambiente, el bienestar animal, la salud pública y la salud animal y vegetal, y la trazabilidad en todas las etapas de producción, transformación y distribución (CAP, 2006). Sin embargo, no está claro si la adopción de las DOP se relaciona con la implementación de mejores prácticas. La escasez de información sobre estos temas se hace patente por la revisión de la literatura internacional sobre DOP como un Sistema de Calidad Certificada en el sistema agroalimentario olivarero llevado a cabo por Hinojosa Rodríguez, et al. (2014). Las externalidades asociadas al aceite de oliva andaluz con DOP se ha analizado (Pérez y Pérez et al., 2013) resultando patente un predominio de externalidades económicas frente a las ambientales y socioculturales.

Aparte de las DOP y algunas normas ISO, otras estrategias de calidad de cierta relevancia en el SAAO son la Agricultura Ecológica y la Agricultura Integrada (también denominada Producción Integrada), apoyadas por regulaciones de la UE y nacionales y/o regionales, respectivamente; estas formas de producción constituyen hoy en día una alternativa de tendencia ascendente en Andalucía (CAP, 2013). La difusión de la agricultura ecológica e integrada en el olivar andaluz ha sido estudiada por Parra López y Calatrava Requena (2005) y Parra López et al. (2007b). En especial destaca el olivar en PI ya que supone el 54,5% y el 70,2% del total de la

superficie de PI en España y Andalucía, respectivamente (MAGRAMA, 2015a; MAGRAMA, 2013), mientras que el olivar ecológico está menos extendido y apenas representa el 6,7% y 3,5% del total de la superficie ecológica en España y Andalucía, respectivamente (MAGRAMA, 2014a; MAGRAMA, 2013). A pesar del relativo éxito de la adopción de la PI como una forma de innovación tecnológica, existen pocos estudios en relación con la difusión de la PI como estrategia de calidad en el sector agrícola en general, y en el sector del olivar andaluz en particular. Entre los escasos estudios sobre PI, algunos indican que la adopción de la PI, de manera similar a otros SCC, aumenta la competitividad de la agricultura y permite que los agricultores tengan acceso a nuevos mercados (Silva Pérez, 2005). Otros autores sostienen que, en el marco de la PI, la calidad se entiende como un concepto orientado a aumentar la sostenibilidad y la multifuncionalidad de la agricultura en lugar de centrarse exclusivamente en la producción y rentabilidad (Hinojosa et al., 2011). En el mismo sentido, algunos estudios anteriores comparan los impactos multifuncionales de la PI y convencional del olivar en Andalucía, entre otros sistemas de producción, demostrando su mejor rendimiento global, sobre todo desde una perspectiva ambiental, y también en términos de rentabilidad (Parra López el al., 2007a; Parra López et al., 2008; Gómez Limón y Arriaza Balmón, 2011).

En resumen, estos trabajos previos suponen una justificación de las hipótesis de partida de la investigación realizada sobre el escaso conocimiento y adopción de la mayoría de los sistemas de calidad disponibles en el SAAO de Andalucía y de los factores que explican su adopción y sobre el desconocimiento de la relación entre la adopción de sistemas de calidad y la implementación de mejores prácticas tanto en la fase agraria como en la fase industrial.

4. LA CALIDAD CERTIFICADA COMO ESTRATEGIA DE COMPETITIVIDAD

En los últimos años, la globalización de la economía y la expansión del mercado internacional han conducido a un rápido proceso de internacionalización de la calidad como un elemento crucial de competitividad para las empresas (Ruzevicius, 2008). Por ello en la actualidad es creciente la tendencia de las empresas a la introducción de la calidad en sus actividades como elemento estratégico para mantener e incrementar su competitividad. La calidad representa, por una parte, un instrumento que permite aumentar la confianza de los consumidores, cada vez más preocupados por la salubridad de los alimentos y por los efectos ambientales de la agricultura y, por otra, permite la salida de los productos a los mercados internacionales (Silva Pérez, 2005). En este sentido, la capacidad de las empresas para adoptar, utilizar y mejorar tecnologías es un factor determinante de su éxito (Fernández Pérez, 2006); y lograr, mantener y aumentar su competitividad, depende en gran parte de la diferenciación y comunicación de una calidad superior de productos/servicios hacia los consumidores (Magd y Curry, 2003).

Debido al incremento de la distancia entre productores y consumidores, es difícil para los compradores observar si los proveedores cumplen una serie de requisitos de calidad de los productos y servicios (Terlaak y King, 2006). La certificación de la calidad a través de Sistemas de Calidad Certificada (SCC) puede reducir la asimetría de información en la cadena agroalimentaria y así generar una ventaja competitiva para las empresas certificadas (Ruzevicius, 2008; Terlaak y King, 2006). Además, los SCC suponen un mayor incentivo a los vendedores para proporcionar productos de alta calidad a los intermediarios y consumidores finales (Albano y Lizzeri, 2001). Los SCC son voluntarios y normalmente suponen la garantía de un estándar de calidad por encima de las normas obligatorias por emplear un conjunto de prácticas específicas de producción, gestión y/u organización. Normalmente, estas prácticas deben ser verificadas por una tercera parte o auditor (Terlaak y King, 2006). Los SCC pueden tener diferentes enfoques en

términos de la calidad, que garantizan a los consumidores o clientes (Caracuel García, 2004; Lucena et al., 2004; Maza et al., 2009): seguridad alimentaria, propiedades organolépticas, valor nutricional, procesado de las materias primas, origen, sostenibilidad, cuidado medioambiental, seguridad y salud laboral de los productores, mercado justo, bienestar animal, etc. El conjunto de prácticas de gestión asociadas con un SCC puede representar una forma de innovación tecnológica, si entendemos innovación en el sentido amplio como una idea, práctica u objeto percibido como nuevo por un individuo (Rogers y Shoemaker, 1971).

El sector olivarero no es una excepción a esta tendencia de creciente importancia de la calidad. La calidad del aceite de oliva y la productividad del sector oleícola español han experimentado una importante mejora desde principios de la década de los 90 del pasado siglo hasta la actualidad, debido sobre todo en la introducción de innovaciones tecnológicas y difusión de buenas prácticas tanto en explotaciones como en almazaras (Sanz Cañada et al., 2011). Por otra parte, el incremento de la demanda del consumidor por los aceites de oliva de calidad, diferenciados a través de atributos de calidad de producto y proceso, tales como los ligados al origen o a técnicas alternativas de producción, se está convirtiendo en un factor clave de futuro (Anania y D'Andrea, 2008). El aceite de oliva de calidad está empezando a adquirir connotaciones positivas entre los consumidores tanto en los países desarrollados como en las clases sociales medias y superiores de los países en vías de desarrollo (Sanz Cañada y Macías Vázquez, 2008). En este contexto, producir aceitunas y aceite de oliva de calidad diferenciada puede suponer una ventaja competitiva para los olivicultores e industrias del aceite de oliva. Así, dada la situación actual de globalización de los mercados, la puesta en producción de nuevas regiones olivareras en el mundo, y el incremento de la demanda de la calidad por parte de los consumidores, la "estrategia de calidad" en el sistema agroalimentario olivarero (SAAO) de Andalucía como herramienta para la competitividad es clave para mantener el liderazgo a nivel mundial y garantizar las supervivencia de muchas pequeñas y medianas explotaciones e industrias.

Entre los SCC que pueden ser aplicados en el SAAO los más destacados son: (i) regulaciones públicas europeas, como las DOP y la agricultura ecológica; (ii) regulaciones nacionales y/o regionales, tanto públicas, como la PI, como privadas, como las normativas específicas para el aceite de oliva virgen extra en cuanto a especificación de producto (UNE-34601), proceso de transformación (UNE-34605) y envasado (UNE-34606); (iii) protocolos internacionales, como las normas ISO (Organización Internacional de Normalización); (iv) protocolos de la distribución, como GLOBALGAP, International Food Standard (IFS), British Retail Consortium (BRC) y Nature's Choice. A pesar del amplio abanico de SCC y de la importancia de adoptar una estrategia de diferenciación de calidad, actualmente sólo unos pocos SCC son adoptados en el SAAO de Andalucía, destacando los respaldados por regulaciones públicas como es el caso de la Producción Integrada, basada en el respeto al medioambiente y el respaldo científico de las prácticas empleadas, y las DOP, basadas en la especificidad territorial (Silva Pérez, 2005).

5. PRINCIPALES SISTEMAS DE CALIDAD CERTIFICADA EN EL SISTEMA AGROALIMENTARIO OLIVARERO DE ANDALUCÍA

5.1. Producción Integrada

La PI surge como una reacción a los problemas asociados al uso masivo de productos químicos en la agricultura convencional, con un potencial impacto en el medio ambiente, la calidad alimentaria, la sostenibilidad y la supervivencia del medio rural (Parra López et al., 2008), obtiene productos agrícolas de alta calidad teniendo en cuenta las exigencias de la sociedad y la protección del medio ambiente (MAPA, 2002). La creciente preocupación de la sociedad por la seguridad

alimentaria y el medio ambiente está llevando al consumidor a interesarse cada vez más por alimentos de calidad cuya producción sea respetuosa con el medio ambiente. En este contexto, la PI está cobrando importancia en los últimos años, ya que es una forma alternativa de producción de alimentos basada en el respeto medioambiental, por lo que responde a las demandas de los consumidores desempeñando por tanto un importante papel social. El origen del concepto de PI se remonta al año 1977 y se estableció como resultado de un encuentro en Suiza de un grupo de investigadores promovido por la Organización Internacional de Lucha Biológica (OILB), en respuesta al uso masivo de pesticidas sintéticos en agricultura. El alcance de la PI incluyó y fue más lejos que el manejo integrado de plagas, concepto que previamente apareció en Europa y Estados Unidos en los años 50 del pasado siglo y se considera como punto de partida y pilar básico de la PI (CAP, 2005).

Aunque en la actualidad no existe un marco legal europeo sobre PI, son numerosos los documentos de la UE que mencionan la PI como un sistema de producción agraria sostenible que ayuda a la protección de la salud humana y del medio ambiente (Malavolata y Avilla Hernández, 2008). En los últimos años han surgido en Europa en el ámbito de la PI numerosas iniciativas públicas con marcos normativos nacionales y/o regionales (Portugal, Francia, Reino Unido, Bélgica o España) que conviven con otras normas de PI desarrolladas por la iniciativa privada, lo que ha provocado una situación normativa un tanto heterogénea, y por tanto confusa para el conjunto de la sociedad (CESE, 2014). Con la intención de homogeneizar esta situación normativa, han surgido algunas iniciativas entre las que destaca la creación en el año 2001 de la organización "Iniciativa Europea para el Desarrollo Sostenible de la Agricultura", responsable de la creación de un código europeo de la PI que ha servido para que la FAO (Organización de las Naciones Unidas para la Alimentación y la Agricultura) defina las prácticas sostenibles en la agricultura, y la publicación en 2013 de la guía de prácticas europeas sobre PI por parte de la "Asamblea Europea de Regiones Productoras de Frutas y Hortalizas" (CESE, 2014). Recientemente el Comité

Económico y Social Europeo (CESE), órgano consultivo de la UE fundado en 1957 que ofrece asesoramiento especializado a las grandes instituciones de la UE (Comisión, Consejo y Parlamento Europeos), ha elaborado un dictamen de iniciativa en el que contempla la necesidad de establecer unos estándares mínimos comunitarios sobre la PI (CESE, 2014).

En España, el Real Decreto 1201/2002 establece las normas generales de PI que deben cumplir los productos agrícolas acogidos a dicho sistema de producción, y define la PI como un sistema agrario de producción de frutas y vegetales que maximiza el uso de los recursos y los mecanismos de producción y una agricultura sostenible a largo plazo, introduciendo métodos de control químico y biológico y otras técnicas que satisfagan las demandas de la sociedad, protección del medio ambiente y productividad agraria, además de operaciones de manejo, embalaje, procesado y etiquetado de productos como frutas y vegetales incluidos en el sistema (MAPA, 2002). Además de la normativa general, existen normas técnicas específicas nacionales que regulan la PI de diferentes cultivos como hortícolas, cítricos, ajo, algodón y remolacha azucarera. Por su parte, las comunidades autónomas con competencias en materia de agricultura pueden desarrollar su propia normativa sobre PI. En los últimos años, la PI ha experimentado un importante crecimiento. En la última década, la superficie de PI en España se ha triplicado alcanzando 831.702 ha en el año 2013, siendo el olivar el cultivo más extendido en este tipo de producción con una superficie del 54,5%, y Andalucía la comunidad autónoma con mayor superficie de PI del país (62,6%) (MAGRAMA, 2015a), lo que se traduce en que la mayor parte de la superficie de PI de Andalucía se corresponde con el olivar (70,2%), llegando éste en 2013 a alcanzar 365.160 ha, lo que supone el 23,7% de la superficie total de su olivar (MAGRAMA, 2015a; MAGRAMA, 2013).

En Andalucía, la normativa que regula la PI y su indicación en productos agrarios y sus transformados es el Decreto 245/2003 de 2 de septiembre, modificado por el Decreto 7/2008 de 15 de enero; además existen reglamentos específicos de PI para los siguientes cultivos: olivar,

arroz, fresa, frutales de hueso, cítricos, hortícolas bajo abrigo (tomate, calabacín, melón, sandía, pepino, pimiento, berenjena y judía), patata, algodón, uva de vinificación y remolacha azucarera, alfalfa, flor cortada y lechuga. La PI del olivar en Andalucía está regulada por la Orden de 15 de abril de 2008 por la que se aprueba el Reglamento específico de PI de olivar (BOJA núm. 83) modificada posteriormente por: (i) Orden de 8 de junio de 2010 (BOJA núm. 117) y (ii) Orden de 16 de febrero de 2012 (BOJA núm. 39) (CAP, 2015). Esta norma consta de dos partes fundamentales: prácticas agronómicas (incluyendo prácticas obligatorias, recomendadas y prohibidas) y estrategias de control integrado (Orellana et al., 2011). Los reglamentos específicos de PI de Andalucía para industrias de obtención de aceite oliva virgen extra (Orden de 12 de junio de 2013, BOJA núm. 117) y para industrias de obtención de aceituna de mesa (Orden de 27 de septiembre de 2012, BOJA núm. 196) vienen a completar la normativa necesaria para abarcar todo el proceso productivo del aceite de oliva y de la aceituna de mesa.

5.2. Denominaciones de Origen Protegidas

En respuesta a la demanda de los consumidores por alimentos de calidad ligados a un entorno geográfico determinado (Erraach et al., 2013; MARM, 2011), y debido a la riqueza en productos agroalimentarios existentes en la región europea, la UE desarrolla a principios de los años 90 del pasado siglo un sistema normativo para proteger y promover sus productos agrarios y alimenticios de calidad (MARM, 2011). Para ello se inspira en sistemas nacionales ya existentes como las "Denominaciones de Origen Controladas" de Francia (AOC: Appellation d'Origine Contrôlée) e Italia (DOC: Denominazione d'Origine Controllata) (EC, 2007). La normativa inicial creada en 1992 (Reglamento (CEE) 2081/92) es posteriormente mejorada y sustituida en 2006 (Reglamento (CE) 510/2006); y en la actualidad, la normativa en vigor desde enero de 2013 es el Reglamento (CE) 1151/2012 del Parlamento y del Consejo de 21 de noviembre de 2012 sobre los regímenes

de calidad de los productos agrícolas y alimenticios (MAGRAMA, 2014d); en dicho reglamento se define una DOP como: “Un nombre que identifica un producto originario de un lugar determinado, una región o, excepcionalmente, de un país, cuya calidad o características se deben fundamental o exclusivamente a un medio geográfico particular, con los factores naturales y humanos inherentes a él, y cuyas fases de producción tengan lugar en su totalidad en la zona geográfica definida”. También en dicha normativa se especifica que todo producto agrícola o alimenticio acogido a una DOP, debe cumplir determinadas condiciones establecidas en un “pliego de condiciones” relativas a obtención del producto, controles y certificación, etiquetado, etc. (UE, 2012). Puesto que se asocian con los conceptos de cultura, origen y tradición (CAP, 2013), las DOP de olivar también se utilizan como estrategia para promocionar aceites producidos en zonas rurales generalmente menos favorecidas y por tanto menos productivas y rentables, siendo un claro ejemplo de ello el olivar tradicional de montaña que en el caso de España supone casi la tercera parte de su olivar, contribuyendo de este modo a la supervivencia del medio rural (Sanz Cañada et al., 2011).

En España existen en la actualidad un total de 29 DOP de olivar con una superficie inscrita de 696.147,6 ha, lo que supone el 27,8% del olivar nacional; de éstas, 12 se encuentran en Andalucía ocupando el 30,1% de la superficie de su olivar (464.516 ha) (MAGRAMA, 2014b; MAGRAMA, 2013). La producción de aceite de oliva virgen extra protegido en España en 2013 fue de 132.982 toneladas, sin embargo apenas fue comercializado como tal el 19,5 % del mismo, siendo su principal destino el mercado nacional (MAGRAMA, 2014b). Este hecho no es reciente puesto que en 2001, de todo el aceite de oliva virgen extra producido en la zona correspondiente a la inscrita bajo DOP en España, apenas se comercializó bajo aceite certificado un 14,6% (MAPA, 2001). Estudios previos en varios países productores ponen de manifiesto la baja prima en el precio del aceite de oliva con DOP, que no es suficiente para compensar los costes adicionales asociados a una DOP (Fotopoulos y Krystallis, 2001; van der Lans et al, 2001; Krystallis y Ness, 2005;

Galluzzo, 2007; Roselli et al, 2009), lo que podría explicar en cierto modo la baja tasa de comercialización del aceite protegido bajo su correspondiente certificación.

Cada DOP cuenta con un pliego de condiciones en el que se recogen aspectos como: nombre de la DOP; descripción del aceite, que en este caso ha de ser de la máxima categoría de calidad, es decir, aceite de oliva virgen extra; definición de la zona geográfica; elementos que prueban que el producto es originario de la zona; controles y certificación; obtención del producto, técnicas de cultivo, variedades utilizadas, características fisicoquímicas y organolépticas de los aceites obtenidos, etc.

5.3. Normas ISO

La Organización Internacional de Estandarización (ISO) es una organización independiente no gubernamental líder mundial en el desarrollo de normas internacionales, creada en 1947 para facilitar la coordinación internacional y la unificación de las normas industriales (ISO, 1997). En 2012 esta organización estaba constituida por los organismos nacionales de normalización de 164 países de todo el mundo y contaba con 19.100 normas publicadas (ISO, 2012). Estas normas son revisadas regularmente y se agrupan en familias que cubren casi todas las industrias, abarcando la tecnología, seguridad alimentaria, agricultura y salud (ISO, 2009). Su implantación supone una serie de ventajas para empresas, consumidores y organismos públicos, algunas de las cuales son: (i) para las empresas, mejoran la eficiencia de los procesos y reducen costes; (ii) para los consumidores, facilitan el acceso a productos y servicios de calidad; (iii) para los organismos públicos, sirven como modelo para el desarrollo de normativas públicas relacionadas con la salud, seguridad, y protección del medio ambiente (ISO, 2013).

Entre las normas ISO de aplicación al SAAO podemos destacar las familias: ISO 9000, 14000 y 22000, relativas a la gestión de la calidad, gestión ambiental y gestión de la seguridad alimentaria, respectivamente. Dentro de estas familias, las normas vigentes más destacadas son: ISO 9001:2008, sobre los requisitos de los sistemas de gestión de la calidad; ISO 14001: 2004, sobre requisitos con orientación para el uso de sistemas de gestión ambiental; ISO 22000: 2005 sobre directrices generales para la gestión de la seguridad alimentaria; e ISO 19011: 2011, sobre las directrices para las auditorías de los sistemas de gestión. Esta última norma, aunque aborda aspectos de gestión medioambiental, se incluye en la familia de normas ISO 9000 relativas a la gestión de la calidad.

En España, la implantación de sistemas de gestión de la calidad y sistemas de gestión ambiental y su certificación según las normas ISO 9000 e ISO 14001 es una práctica cada vez más habitual en las empresas de la industria alimentaria. Las primeras certificaciones se realizaron en los años 90 del pasado siglo, certificándose las 4 y 3 primeras empresas según la normas ISO 9000 e ISO 14001 respectivamente, para pasar a 1818 y 298 empresas certificadas según las mismas normas en 2005 (MAPA, 2005; González Camacho, 2007). En el caso concreto del SAAO, se ha visto que la implantación de un sistema de gestión de la calidad según la norma ISO 9001 en el proceso de molturación del aceite de oliva, tiene como resultado final el incremento porcentual en la obtención de producto de calidad (Vilar et al., 2009).

6. OBJETIVOS DE LA TESIS

Los objetivos de la presente tesis doctoral son tres:

(1) Describir la situación actual de conocimiento y adopción de diversos Sistemas de Calidad Certificada (SCC) en el sector del olivar en Andalucía, tanto en la fase agraria o de obtención de la aceituna, como en la fase industrial o de elaboración de aceite. Este objetivo requiere previamente identificar, ubicar espacialmente y caracterizar las principales zonas olivareras de Andalucía (Jaén, Córdoba y Granada).

(2) Analizar el proceso de difusión de la innovación que suponen los SCC más relevantes en el olivar de Andalucía, caracterizando a los agricultores y empresarios industriales, así como a las explotaciones olivareras e industrias transformadoras que los han adoptado, frente al resto de olivicultores, empresarios, explotaciones e industrias que no los han adoptado, determinando los factores de adopción relevantes.

(3) Identificar las prácticas agrarias e industriales de producción, gestión y organización asociadas con la adopción de los diferentes SCC y valorar comparativamente, con respecto a las prácticas agrarias e industriales convencionales, sus comportamiento técnico, ambiental y económico con el fin de determinar si son las prácticas óptimas para favorecer la sostenibilidad y competitividad en el SAAO de Andalucía.

En definitiva, se trata de determinar los factores de adopción de los SCC más relevantes en el SAAO de Andalucía, así como de identificar las prácticas agrarias e industriales susceptibles de ser mejoradas en dichos SCC en relación a su competitividad y sostenibilidad, con el objetivo final de proporcionar información útil para el diseño de políticas públicas y estrategias empresariales que favorezcan la difusión de los SCC y la sostenibilidad y competitividad del SAAO de Andalucía. Estos objetivos están en plena consonancia con la Ley 5/2011, de 6 de octubre, del

Olivar de Andalucía, y el Plan Director del Olivar, aprobado por el Decreto 103/2015, de 10 de marzo, que establecen como prioridades para el olivar andaluz, entre otras, la mejora de la productividad de las explotaciones; la sostenibilidad ambiental y a la lucha contra el cambio climático, adaptando, en su caso, las técnicas de cultivo; la elaboración de un código de buenas prácticas de gestión de las explotaciones; y la difusión de sistemas de aseguramiento de la calidad de las producciones y de garantías para los consumidores, con especial atención a los procedimientos de obtención, al etiquetado opcional, a las certificaciones y al origen de las mismas.

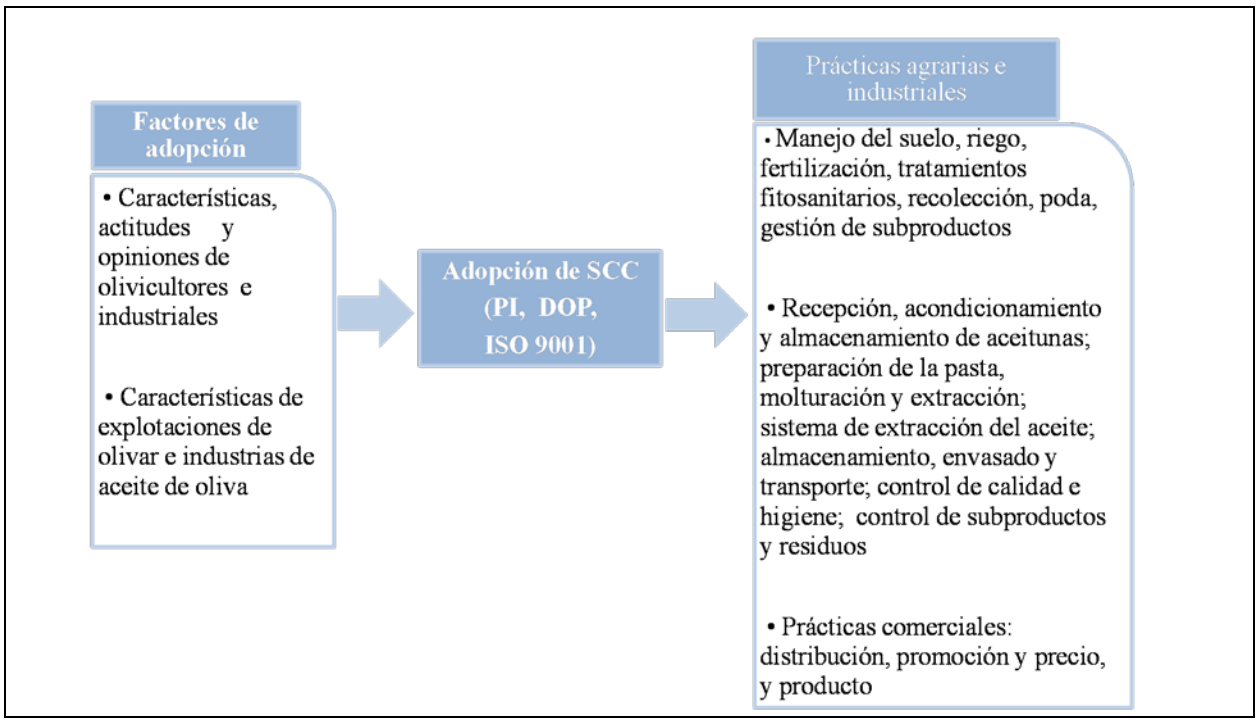
7. METODOLOGÍA GENERAL DE LA INVESTIGACIÓN

El trabajo realizado se encuadra en el contexto metodológico de la teoría de Difusión de Innovaciones, en particular en la versión más reciente del modelo teórico de Rogers (Rogers, 2003). Esta teoría fue concebida formalmente con el trabajo pionero de Ryan y Gross (1943) y ha sido ampliamente utilizado en el estudio de la difusión de innovaciones en agricultura. Esta teoría propone que las características, actitudes y opiniones de los individuos o grupos de individuos condicionan su comportamiento respecto a la adopción de innovaciones. En relación con lo anterior, la actitud del factor humano hacia la innovación es uno de los factores que pueden impedir o estimular la actividad innovadora de una empresa. Además, las características de las empresas (en este caso explotaciones e industrias olivareras), como el tamaño y la localización entre otras, también van a condicionar la adopción de estas innovaciones (Fernández Pérez, 2006). La adopción de sistemas de gestión de calidad, y por tanto de SCC, es un ejemplo de innovación no

sólo por su primera introducción sino porque su adopción implica nuevos o significativamente mejorados procesos, métodos y normas de producción destinados a la obtención de nuevos productos y/o a la mejora de la calidad de los ya existentes (Manual de Oslo, 2005). La adopción de una innovación conlleva una serie de consecuencias que deben ser analizadas (Rogers, 2003). En nuestro caso se pretende investigar si la adopción de diferentes SCC incide en la implementación de mejoras prácticas agrarias e industriales.

En este contexto, se estudian 1) las características de agentes productores e industriales del SAAO de Andalucía, así como las características de sus explotaciones e industrias (fundamentalmente almazaras), relacionadas con la adopción de las diferentes prácticas de producción, organización y gestión asociadas a diferentes SCC; y 2) las prácticas agrarias e industriales asociadas a la adopción de los diferentes SCC.

Figura 1. Metodología general de la investigación



El trabajo empírico ha consistido en dos encuestas, una a agricultores y otra a industriales, cuyo fin es doble: (i) Caracterizar a agricultores e industriales y sus explotaciones e industrias, con el fin de determinar los factores de adopción de los diferentes SCC; (ii) Analizar las prácticas implementadas, con el fin de obtener información acerca de las prácticas de producción, organización y gestión implementadas por los diferentes agentes y determinar si son mejores que las convencionales y si se pueden mejorar. Para definir los cuestionarios se han utilizado como referente la información recogida fundamentalmente en un cuestionario sobre la adopción de innovaciones tecnológicas a agricultores ecológicos y convencionales, y un cuestionario a Asociaciones de Producción Integrada (APIs) de olivar, ambos desarrollados por Parra López (2003). También se han utilizado cuestionarios del Instituto Nacional de Estadística y del Instituto de Estadística y Cartografía de Andalucía (INE, 2007a y b; INE, 2008; IECA, 2006 y 2007); distintos manuales y guías entre los que podemos destacar los siguientes: Guía para la aplicación del sistema de trazabilidad en la empresa agroalimentaria (AESA, 2004), Manual de Producción Integrada en Olivar en Andalucía (CAP, 2005), Manual de Oslo (Manual de Oslo, 2005), Manual de buenas prácticas agrarias en los diferentes sistemas productivos de olivar andaluz (CAP, 2006), Estudio de la cadena de valor y formación de precios del aceite de oliva (CAP, 2009), entre otros. Además se han consultado los trabajos de Fernández Pérez (2006), Venze Deza (1995), Diputación Provincial de Jaén (2007), Bertuglia (2007), Sanz Cañada et al. (2008), CES Jaén (2009), así como diversos informes y artículos científicos.

En el cuestionario a olivicultores (Anexo I) se han incluido cuatro bloques de preguntas. El primer bloque de cuestiones relativo a las características de la explotación, incluye una serie de subapartados que nos permite obtener información general acerca de la explotación. El segundo bloque de cuestiones sobre prácticas agronómicas y sistemas de calidad certificada, nos proporciona información que nos permite identificar y definir las prácticas de producción, organización y gestión implementadas en este caso, por los olivicultores. El tercer bloque de

cuestiones, sobre actitudes y opiniones hacia la I+D+i, nos permite obtener información sobre cuál es la actitud o predisposición del olivicultor frente a la introducción de innovaciones en su explotación, qué innovaciones son las que realmente ha implantado y las que pretende implantar y de qué factores depende el que el olivicultor introduzca o no innovaciones en su explotación. El cuarto y último bloque se refiere a las características de la persona entrevistada, pues es importante saber si las características socioeconómicas y de dedicación a la agricultura de la persona que responde al cuestionario pueden influir en la variabilidad de las respuestas. En el caso de una explotación, la persona entrevistada puede ser bien el titular de la explotación o el jefe de la explotación, siempre que esté activo en la agricultura. En la encuesta sobre la estructura de las explotaciones agrarias 2007 del Instituto Nacional de Estadística (INE, 2007b), se define al titular de la explotación como la persona física o jurídica que, actuando con libertad y con autonomía, asume el riesgo de una explotación agrícola, dirigiéndola por sí o mediante otra persona. En concreto, se considera titular al propietario cuando lleve directamente sus tierras, al arrendatario, al aparcero y a todo aquel que asuma el riesgo de una explotación, cualquiera que sea el régimen de tenencia de la tierra. Según la misma encuesta, el jefe de explotación es definido como la persona responsable de la gestión corriente y cotidiana de la explotación agrícola. En general, coincide con el titular aunque puede ser un miembro de la familia del titular u otra persona asalariada.

El cuestionario a agentes de la industria (Anexo II) se compone de seis bloques de cuestiones. Los bloques primero y último, correspondientes a características de la empresa y características de la persona entrevistada, respectivamente, nos proporciona información complementaria a la que necesitamos para alcanzar los objetivos de esta investigación al igual que ocurre con el cuestionario a olivicultores. El resto de bloques de preguntas de este cuestionario se refiere a las prácticas industriales implementadas en la empresa, como segundo bloque; a las prácticas comerciales implementadas en la empresa, como tercer bloque de cuestiones; y las preguntas

referidas al nivel de conocimiento y adopción en la empresa de los sistemas de calidad certificada, forman el cuarto bloque; al igual que en el cuestionario a agricultores, el quinto bloque sobre actitudes y opiniones de la persona entrevistada (presidente, gerente, miembro del comité directivo, técnico, etc.) hacia la I+D+i, nos proporciona información sobre la actitud o predisposición del empresario a la hora de introducir innovaciones en su empresa, sobre las innovaciones implantadas y sobre los factores de los que depende que la empresa introduzca o no innovaciones.

En cuanto a la selección de la muestra, la zona objeto de estudio es la correspondiente a las principales provincias productoras de aceituna de almazara de Andalucía (Jaén, Córdoba y Granada) (IECA, 2012a y b). La población de referencia de los olivareros se ha tomado del Instituto Nacional de Estadística a través del Censo Agrario (explotaciones que declaran superficie en la campaña 2004/05). La muestra de agricultores se ha obtenido por muestreo aleatorio dirigido y se ha estratificado proporcionalmente a la importancia del olivar en los diferentes municipios. Para ello, se han delimitado zonas olivareras homogéneas en base a la superficie media olivarera por explotación y al número de explotaciones olivareras por superficie municipal. La selección de la muestra de industrias se ha realizado utilizando información de la Agencia para el Aceite de Oliva (actual Agencia de Información y Control Alimentarios) en la que los datos recogidos hacen referencia a la campaña 2005-2006. Se han diferenciado tres tipos de industrias: almazaras, envasadoras, y almazaras que también son envasadoras. La muestra de industrias se ha obtenido por muestreo aleatorio dirigido habiéndose estratificado proporcionalmente al número de industrias por municipio. Finalmente, se ha entrevistado a un total de 400 agricultores y 101 industrias en las tres provincias objeto de estudio, entre mayo de 2010 y febrero de 2011. Para los olivicultores se obtiene para variables dicótomas al 95% de nivel de confianza un error muestral del 2,94% para proporciones extremas (p=0.9 y q=0.1) y del 4,90% para proporciones intermedias

(p=q=0.5). Para industriales el error es del 6,32% para proporciones extremas y del 10,54% para proporciones intermedias.

Los análisis que se han llevado a cabo y las metodologías empleadas han sido las siguientes:

- Conocimiento y adopción de Sistemas de Calidad Certificada: Se ha llevado a cabo un análisis descriptivo del grado de conocimiento y adopción de los SCC más relevantes por parte de olivicultores y empresarios industriales. Los SCC analizados son: DOP, agricultura ecológica e integrada, normativas ISO (ISO 9001, 14001, 19011, y 22000), GLOBALGAP, International Food Standard (IFS), Nature's Choice, BRC (British Retail Consortium), normativa acerca de la gestión de la investigación, desarrollo e innovación (UNE 166002); y regulaciones específicas para el aceite de oliva virgen extra (producto, UNE 34601; transformación, UNE 34605; envasado, UNE 34606). Adicionalmente, se han descrito las actitudes y opiniones de agricultores e industriales sobre diversas cuestiones sobre la I+D+i en olivar.

- Análisis de adopción de los Sistemas de Calidad Certificada: La adopción, como fenómenos individual y conjunto, de los diferentes SCC más relevantes en el sector del olivar en Andalucía se ha estudiado a través de un análisis bivariante y multivariante cuando ha sido posible de las características de olivicultores e industriales y sus explotaciones y empresas que han adoptado dichos SCC frente al resto. El objetivo ha sido identificar diferencias significativas entre olivicultores e industriales y sus explotaciones e industrias adoptantes de SCC y frente a los no adoptantes.

- Comparación de las prácticas agrarias e industriales usadas en los SCC más relevantes frente a las convencionales: El análisis bivariante ha permitido identificar aquellas prácticas significativamente diferentes entre explotaciones e industrias que implementan SCC y el resto y comparar su comportamiento económico, técnico y ambiental.

8. ESTRUCTURA EN CAPÍTULOS

La tesis doctoral se ha estructurado en diferentes capítulos, cada uno de los cuales es independiente en cuanto a numeración de apartados y referencias. El primer capítulo se corresponde con la presente Introducción general. Seguidamente aparecen cuatro capítulos correspondientes a cuatro artículos publicados en revistas internacionales de impacto (el cuarto se encuentra en revisión), y un último capítulo sobre las Conclusiones generales de la investigación. Los Anexos I y II, que aparecen al final del trabajo, se corresponden con los cuestionarios de las encuestas realizadas a olivicultores e industrias de aceite de oliva, respectivamente.

Cada uno de los artículos que se incluyen en esta tesis se centra en el estudio de alguno de los SCC más relevantes en el SAAO de Andalucía, bien a nivel de agricultores o bien de industrias, y tiene un doble objetivo que se detalla a continuación:

- Artículo primero: (i) determinar los factores de adopción de la PI a nivel agrario, estudiando las características de olivicultores que la han adoptado así como las características de sus explotaciones, frente a las características del resto de olivicultores que no han adoptado la PI y de sus explotaciones; (ii) identificar las prácticas agrarias diferenciales asociadas a la PI y determinar su comportamiento ambiental, económico y técnico en relación a las prácticas agrarias adoptadas por el resto de olivicultores.

- Artículo segundo: (i) determinar los factores de adopción de las DOP a nivel agrario, estudiando las características de olivicultores que han adoptado una DOP así como las características de sus explotaciones, frente a las características del resto de olivicultores que no han adoptado una DOP y de sus explotaciones; (ii) identificar las prácticas agrarias diferenciales asociadas a las DOP y determinar su comportamiento ambiental, económico y técnico en relación a las prácticas agrarias adoptadas por el resto de olivicultores.

- Artículo tercero: (i) determinar los factores de adopción de las DOP a nivel industrial, estudiando las características de empresarios que han adoptado una DOP así como las características de las industrias que éstos gestionan, frente a las características del resto de empresarios que no han adoptado una DOP y de las industrias que gestionan; (ii) identificar las prácticas industriales y/o comerciales diferenciales asociadas a las DOP y determinar su comportamiento ambiental, económico y técnico en relación a las prácticas industriales y/o comerciales adoptadas por el resto de empresarios.

- Artículo cuarto: (i) determinar los factores de adopción de la norma ISO 9001 a nivel industrial, estudiando las características de empresarios que han adoptado la norma ISO 9001 así como las características las industrias que estos gestionan, frente a las características del resto de empresarios que no han adoptado la norma ISO 9001 y de las almazaras que gestionan; (ii) identificar las prácticas industriales y/o comerciales diferenciales asociadas a la norma ISO 9001 y determinar su comportamiento ambiental, económico y técnico en relación a las prácticas industriales y/o comerciales adoptadas por el resto de empresarios.

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ARTÍCULO PRIMERO

CERTIFIED QUALITY SYSTEMS AND FARMING PRACTICES IN OLIVE GROWING: THE CASE OF INTEGRATED PRODUCTION IN ANDALUSIA.

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ARTÍCULO PRIMERO: CERTIFIED QUALITY SYSTEMS AND FARMING PRACTICES IN OLIVE GROWING: THE CASE OF INTEGRATED PRODUCTION IN ANDALUSIA

ABSTRACT

The competitiveness of the olive agro-food sector depends heavily on its ability to adapt to the current scenario of increasingly internationalised interchanges, segmentation of markets, differentiation of consumption behaviours, and changing public support for agriculture. Quality differentiation and certification through a Certified Quality System (CQS) ensures the quality of products and services beyond mandatory levels and generates a competitive advantage for certified firms. In the Andalusian olive growing sector, the largest in the world, Integrated Production (IP) plays an important role. IP certifies a higher quality of the product and production process by guaranteeing the implementation of farming practices which are hypothetically more sustainable, environmentally friendly, profitable, fair for farmers and healthy for consumers. This paper investigates the underlying factors that have conditioned the diffusion of IP and tries to confirm the differential and higher quality provided by this CQS. A survey of 400 farmers from the main olive-growing provinces of Andalusia was carried out in 2010/2011 on the basis of face to face interviews following a structured questionnaire.

The results corroborate low levels of knowledge and adoption of most of the available CQS in the sector. They also confirm the higher quality of IP olive products and processes since farmers

adopting this CQS are implementing better farming practices from an agronomic, environmental and economic point of view. The better practices are especially those related to soil management, irrigation, phytosanitation and harvesting. Otherwise, olive farmers in general seem to be entrenched in a relatively closed information system where 'contagion' of information among themselves and from close sources is the main diffusion driver, with no significant influence from external sources such as public and private R&D institutions. Moreover a lack of orientation of farmers towards satisfying customers' requirements when innovating was detected. Strengthening the diffusion of IP would require bringing information closer to farmers in an accessible manner. The work of R&D institutions is essential in this context. Special emphasis should be placed on the medium to long term economic benefits and improved competitiveness associated with IP, these being the main concerns of farmers. Improved access to credit would also probably encourage its adoption. It is also necessary to convince farmers of the environmental and social benefits associated with IP. Reinforcing public policies promoting the professionalization of the sector and training in marketing are also necessary measures.

Keywords: Olive growing; Certified Quality Systems; Integrated Production; good agricultural practices; adoption factors; innovation.

1. INTRODUCTION

An increase in the segmentation of markets and in the differentiation of consumption behaviours is a key factor for the future of the world olive oil market, which will lead to a major quality-based product diversification and differentiation of marketing strategies. Increasing consumer demand is anticipated for olive oils which are differentiated on the basis of product and process quality attributes, such as those linked to origin or to alternative production techniques such as organic agriculture[1]. The globalisation of the world economy and the expansion of international trade have led to rapid processes of quality internationalization as a crucial element of companies' competitiveness[2]. Achieving, enhancing and sustaining competitiveness is dependent on delivering superior quality products/services to consumers[3]. The image of quality olive oils is currently taking on increasingly more positive connotations amongst consumers in developed countries, as well as in the upper middle classes of society in developing countries[4]. In this context, producing olives and olive oil of differentiated quality can result in a competitive advantage for olive farmers and industries. Given the globalisation of markets and the increasing distances between producers and potential consumers, it is difficult for buyers to observe the qualifications of suppliers[5]. Certification through Certified Quality Systems (CQS) may reduce information asymmetries in supply chains and thereby generate a competitive advantage for certified firms[5,2] by ensuring the quality of products and services and eliminating technical barriers in trade[2]. Moreover, it provides further incentives for the seller to provide high-quality goods[6] to intermediate customers and final consumers. CQS are voluntary and usually require an organization to demonstrate that it achieves a standard of quality beyond conventional and mandatory levels by employing a specific set of management practices. Usually, these practices must be verified by a third party auditor[5]. CQS can be seen as institutions in the sense that they are rules that facilitate coordination between people by helping them form expectations that each

person can reasonably hold in dealing with others[7]. Quality is a multidimensional and complex concept that can be interpreted from diverse perspectives[8], and the various different CQS can have different focuses in terms of the quality they guarantee to consumers or customers[9,10,11]: food security, organoleptic properties, nutritional value, raw material treatment, origin, sustainability, environmental care, health of producers, fair trade, animal welfare, etc. Although certification of quality through the implementation of a CQS is a costly process, its adoption is usually aimed at minimising cost in relation to profit[12]. The set of management practices associated with a CQS may represent a form of technological innovation for farmers, if we understand innovation in a broad sense as an idea, practice or object perceived of as new by an individual[13].

Spain is the world-leading olive (*Olea europaea, spp.*) growing country both in terms of surface area and production: 2.4 million ha and 6.2 million tonnes of olives per year in the period 2005-2010, which represents 24.9% of the world's olive surface area and 35.8% of world production[14]. Most of the Spanish production (93.0% in 2009)[15] goes to olive mills to produce mainly olive oil and the rest is processed as table olives. Spanish olive oil is mainly destined for exportation: 62.8% was exported in 2009[15], including both the final bottled product and the bull olive oil to be subsequently processed and bottled. Moreover, olive oil exportation is clearly increasing: whereas olive oil production increased by 3.2% per year in the period 1996-2009, exportation increased by 14.8% per year in the same period[16,15]. The main destinations of Spanish exports, according to the most recent data available (2009), were the rest of the EU-27 countries (74.8% of exports) and emerging markets such as USA and Australia (7.3% and 2.7% respectively)[15]. The Spanish olive production sector consists primarily of a wide group of small/medium olive growers organised into olive oil cooperatives, which account for more than 70% of the olive oil produced, and a minority of private olive oil mills belonging to large farmers[4]. Andalusia, located in the south of Spain, is by far the country's most important olive growing

region. Andalusian olive cultivation represented 61.9% of the olive surface area and 84.3% of olive production in Spain in 2009[15]. In macroeconomic terms, olive growing provides 27.7% of Andalusian plant production in 2010[17], and generates 32% of the agricultural employment[18], this being the second largest agricultural sector in the region after the production of vegetables[17]. A large share of the olive groves of Andalusia are located in marginal areas and would incur financial losses if the EU subsidies were to disappear; specifically 58.3% of farms and 61.5% of the olive area[19]. The Andalusian olive producing sector faces a 'marketing problem' with regard to olive oil cooperatives, which draw together most of the olive producers and primary extraction industries and have a weak presence in the bottled olive oil market, thus losing a big share of the added value of the final product in favour of a few bottling industries and big distribution platforms[20]. A very small number of firms own the most valuable labels and control most of the olive oil sold in the largest markets[1]. Therefore competitiveness through differentiation in the market and consumer value creation is a fundamental strategy for farmers to survive, especially for small/medium farmers, since they cannot compete with large-scale distribution whose marketing strategies are mainly based on price[21].

Certified Quality Systems available for Andalusian olive growers include 1) EU, Spanish and Andalusian public regulations, such as Protected Designation of Origin (PDO), organic and integrated agriculture; 2) ISO norms, such as 9001, 14001, 19011, and 22000; and 3) retailers' private protocols, such as GLOBALGAP, International Food Standard (IFS) and Nature's Choice, among others. Despite the wide range of potentially adoptable CQS and the importance of a strategy of differentiated certified quality for the agents of the olive agro-food system, currently only a few CQS are adopted. In the last few decades, certification of the product and processes in the Andalusian olive sector in particular and the agro-food system in general has relied almost exclusively on a few CQS backed by public regulations; the adoption of privately financed quality

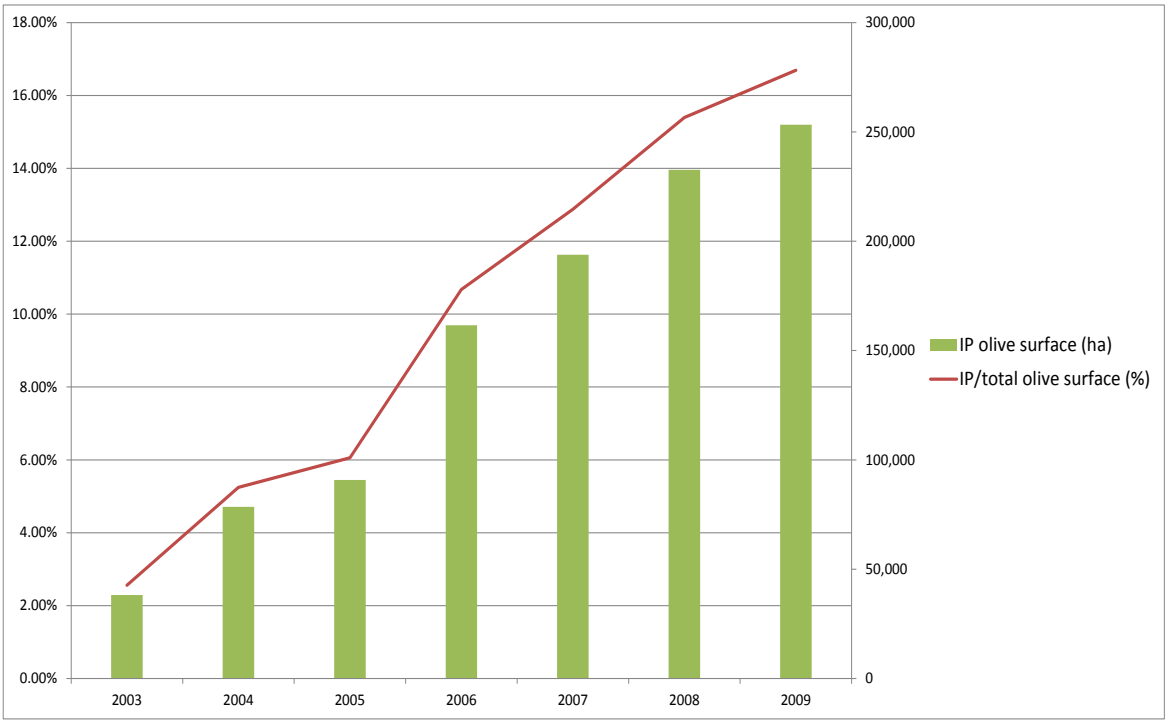
schemes is token by comparison[22]. Two trends in quality certification can be distinguished: 1) certification of alternative production systems associated with more sustainable and environmentally responsible practices which are profitable and fair for farmers and healthy for consumers, such as those promulgated by integrated production and organic agriculture; and 2) certification of the origin of the product, through schemes such as the Protected Designation of Origin. Among these relatively widespread CQS, the one which stands out most is integrated production (IP).

IP is an alternative agricultural production system which arose as a reaction against problems surrounding conventional chemical agriculture, related to the environment, food quality, sustainability and the survival of the rural world[23]. The origin of the concept of Integrated Production goes back to 1977 and was established as a result of a researchers' meeting in Switzerland, organized by the OILB/IOBC (Organisation Internationale de Lutte Biologique / International Organisation for Biological Control). This organization began its attempt to define the concept of integrated production in the 60s, in response to the massive use of synthetic pesticides in agriculture. The scope of IP included and went further than the integrated pest management concept which previously appeared in Europe and the United States in the 50s. The OILB/IOBC is the organization possessing the greatest experience and authority on aspects of IP, and since 1977 it has run a recognition service for regional plans and a commission on integrated production[24]. In Spain, as in other countries, the regulation of IP began at regional level, first in Catalonia in 1993 and then in Andalusia in 1995 (Decree 215/1995) following the OILB/IOBC guidelines. Subsequently, in 2002, the first regulation of IP at national level was established with Royal Decree 1201/2002. This regulation defines IP as farming systems for vegetable and fruit production which make maximum use of resources and production mechanisms and ensure long term sustainable agriculture, introducing biological and chemical control methods and other

techniques that reconcile the demands of society, environmental protection and agricultural productivity, as well as operations for the handling, packaging, processing and labelling of vegetable and fruit products included in the system. The main goal of defining IP principles and rules is to achieve high quality production by means of an efficient use of production factors, taking into account sustainability criteria and environmental compliance[25]. This norm also established the general IP rules for farms and processing industries, distinguishing between mandatory, forbidden and recommended practices. Additionally, the norm defines some crop-specific technical standards developed by an IP national commission, such as those referring to vegetables, citrus, garlic, cotton and sugar beet. Once the national regulations had been set, Spanish regions had to adapt their own regional regulations to them. IP olive growing in Andalusia is regulated by the Order of 15 April 2008 (BOJA num.83). This norm consists of two fundamental parts: agronomic practices (including mandatory, recommended and forbidden practices) and integrated control strategies[25]. Regulated agricultural practices are related to the soil, land preparation, tillage and management of vegetation cover; planting; fertilizing; irrigation; pruning; integrated control; and harvesting. Mandatory practices related to soil management are soil conservation practices to reduce soil erosion; with regard to fertilization, olive farmers have to do at least one foliar test per year as well as a physical and chemical soil analysis in each farm; in terms of irrigation, they have to carry out a test on water quality every two years in an accredited laboratory, and flooding irrigation is forbidden; in pest control, wherever possible, they have to use biological rather than chemical control methods; with respect to harvesting, it is forbidden to mix olives taken from the trees and the ground and to transport them in bags. Otherwise, the control strategy is based on inspection, identification and treatment, mainly conducted through periodical visits from field technicians. At least one onsite check a year is performed on every farm. The specific regulations for agronomic practices and integrated control strategies must be changed when technological advances make it advisable[25]. IP is an upward trend in Andalusia (Figure 1),

representing 16.7% of the total olive area in 2009[26,27]. This is a relatively high adoption rate compared to other CQS which are just starting to be recognised by farmers.

Figure 1: Evolution of Integrated Production olive surface in Andalusia (2003-2009)



Source: CAP, Consejería de Agricultura y Pesca, Junta de Andalucía: http://www.cap.junta-andalucia.es/agriculturaypesca/portal/

Despite the relative success of the adoption of IP as a form of technological innovation, it is remarkable how few studies in the international literature deal with the diffusion of IP as a quality strategy in the agricultural sector in general and the Andalusian olive growing sector in particular. In fact, the international literature on Certified Quality Systems in the olive agro-food system can be classified into the following different categories, which makes the lack of IP studies patent: [1] PDO, as a quality differentiation strategy for olive producers[28,29,4,30,31,32,33], its consumer demand/acceptance[34,35,36,37,38,39,40] and its market[41,42]; [2] organic agriculture, its process of diffusion/adoption in the olive sector[43,44,45,46] and its multifunctional impacts[47,48,23,18] [3] ISO 9001,

its adoption as a market strategy[29] and its influence on olive oil quality[49]; [4] quality, in general, as a market strategy for olive producers[28,21,50], and as an output associated with the adoption of certain good practices[51]; and [5] consumer demand for quality olive oil[52,53,54]. Among the scarce studies on IP, some indicate that the adoption of IP, similarly to other CQS, increases the competitiveness of agriculture and allows farmers to access new markets[22]. Other authors argue that in the IP framework, quality is understood as a globally oriented concept to increase the sustainability and multifunctionality of agriculture rather than focusing solely on production and profitability[55]. Along the same lines, some previous studies compared the multifunctional impacts of integrated production and conventional olive growing in Andalusia, among other production systems, and demonstrated its better global performance, particularly from an environmental perspective, but also in terms of profitability[47,23,18].

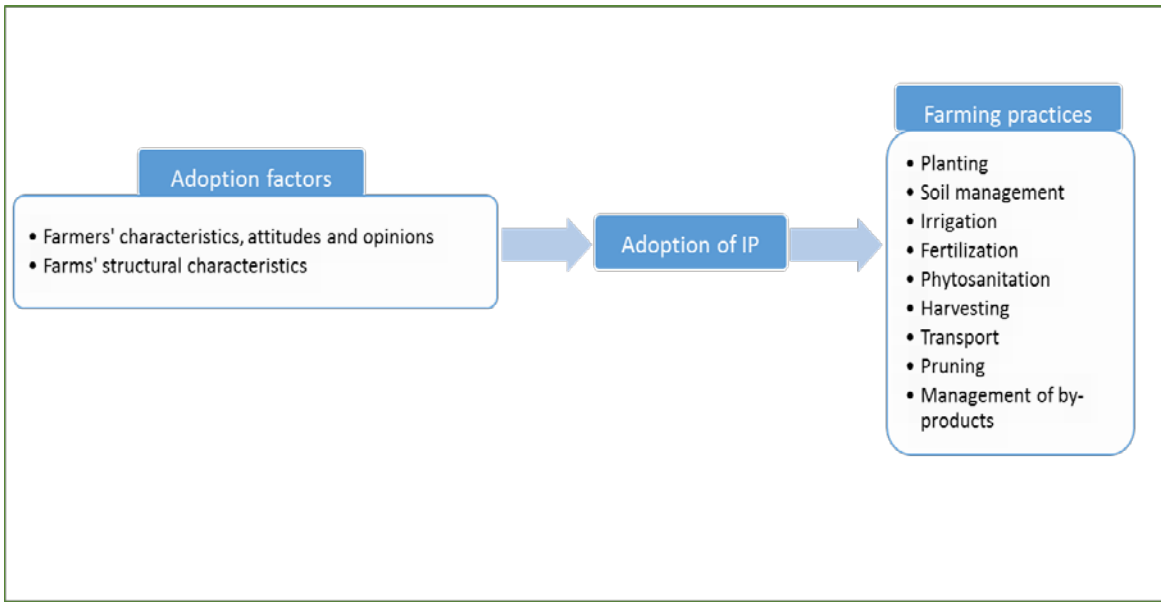
With this in mind, this research aims to contribute to filling this gap in the literature on the adoption of integrated production as a quality innovation in the agricultural sector in general and the olive growing sector in particular. The specific objectives of this paper are as follows: (1) Describing and updating the general situation regarding the knowledge of, adoption of and intention to adopt a wide range of available CQS in the olive growing sector of Andalusia; (2) Comparing the farming practices really implemented by farmers adopting IP, as the most widely diffused CQS, to those of other farmers (non-IP), to check whether the adoption of IP is linked with a real change in farming practices and whether these practices are better from an agronomic, environmental and/or economic perspective; and (3) Identifying the adoption factors of IP, i.e. the differential characteristics of farmers and farm structures that may be related with each other and serve to shed light on the adoption of the IP certification scheme. The final aim of the research is to investigate the interconnection between the characteristics of farmers and farms and the adoption of IP, the most widespread CQS in Andalusian olive growing, and between the adoption

of IP and quality improvement, defining quality in terms of better farming practices for the environment, food quality and agricultural sustainability. Unveiling these links would help us to better understand the underlying mechanisms that have conditioned the diffusion/adoption process of IP in the region and provide a scientific basis for strengthening the diffusion of IP. This would allow the design of more effective public policies and private strategies to further stimulate the extension of IP and to steer the recognition and adoption of other CQS in the Andalusian olive growing sector.

2. METHODOLOGY

The research followed the methodological scheme summarised in Figure 2. A survey of 400 farmers from the main olive growing provinces of Andalusia was carried out from May 2010 to February 2011. The main provinces in terms of production and surface area devoted to olive oil are Jaen, Cordoba and Granada[56,57]. The stratification of the survey was proportional to the number of olive farmers in five major homogeneous olive growing zones, previously defined, which include municipalities of similar importance for olive cultivation in terms of olive surface area over total surface area.

Figure 2: Methodological scheme of the research



The survey was carried out on the basis of face to face interviews following a structured questionnaire which basically consists of four parts:

I. CQS known of and adopted: the CQS analysed include a wide range of available CQS for olive farmers, including public regulations (PDO, organic and integrated production), ISO norms (9001, 14001, 19011, and 22000), and private protocols. CQS adopted are strictly those for which farmers are officially registered.

II. Farming practices implemented: Reference is made to the practices of planting, soil management, irrigation, fertilization, phytosanitary treatments, harvesting, transport, pruning and management of by-products. Farming practices are variables which are potentially related to the adoption of CQS in general and IP in particular.

III. Characteristics, attitudes and opinions of the olive farmers: These include agricultural training, sources of information on CQS, objectives when producing, objectives when

innovating, difficulties in innovating and priorities in R&D, among others. All these are variables that can be related to the adoption of IP.

IV. Structure of the olive farms: Questions related to farm area distribution, yield, type of labour force, destination of the product and slope of the land, among others. These can also be related to the adoption of IP.

The analyses carried out, which are in accordance with the objectives of the study and the results obtained, are as follows:

1. Knowledge and adoption of Certified Quality Systems and attitudes towards R&D and innovation: A descriptive statistical analysis was carried out of the knowledge and degree of adoption of the CQS currently available to olive farmers. Additionally, some olive farmers' attitudes and opinions regarding R&D are described.

2. Farming practices associated with Integrated Production: On the basis of a bivariate statistical analysis of the agricultural practices implemented and the adoption of IP, we aimed to identify those practices which are significantly different due to the implementation of this certification scheme and also those practices which are implemented equally by IP and non-IP adopters. Bivariate statistical correlations are based on: (1) Corrected Yates χ^2 for contingent tables when d.f. (degree of freedom) = 1; (2) Pearson χ^2 for contingent tables when d.f. > 1; (3) χ^2 for bivariate logit when proof for contingent tables is not statistically reliable. The aim is to identify significant differences between farmers and farms which implement IP and those that do not.

3. Adoption factors of Integrated Production: A bivariate statistical analysis was conducted of the characteristics of olive farmers and farms and the adoption of IP. Bivariate statistical

correlations are based on the same tests as for analysis 2 ‘Farming practices associated with Integrated Production’.

3. RESULTS

3.1. Knowledge and adoption of Certified Quality Systems and attitudes towards R&D and innovation

The most widely adopted quality systems among those studied are Integrated Production and PDO, with adoption rates of 16.8% and 16.1% respectively (Table 1). Organic farming is only adopted by 1.5% of farmers. The remaining quality systems (ISO, GLOBALGAP, IFS, and Nature’s Choice) are not adopted at all and are known of by less than 6.0% of interviewees, almost none of whom had any intention of adopting them. These data confirm the generally low degree of knowledge and adoption of CQS in the Andalusian olive growing sector.

Table 1. CQS knowledge and adoption rates by Andalusian olive farmers

	Knowledge	Adoption	Intention of adopting
Public regulations			
– Integrated production (y/n)	n.a.	67(16.8)/333(83.2)	n.a.
– PDO (y/n)	n.a.	64(16.1)/335(83.9)	n.a.
– Organic agriculture (y/n)	n.a.	6(1.5)/393(98.5)	n.a.
ISO norms			
– ISO 9000 (y/n)	23(5.7)/377(94.3)	0(0.0)/400(100.0)	3(0.6)/397(99.4)
– ISO 14001 (y/n)	18(4.6)/381(95.4)	0(0.0)/400(100.0)	0(0.0)/400(100.0)
– ISO 19011 (y/n)	4(1.1)/395(98.9)	0(0.0)/400(100.0)	0(0.0)/400(100.0)
– ISO 22000 (y/n)	1(0.3)/398(99.7)	0(0.0)/400(100.0)	0(0.0)/400(100.0)
– Other ISO (y/n)	0(0.0)/400(100.0)	0(0.0)/400(100.0)	0(0.0)/400(100.0)
Retailers’ private protocols			
– GLOBALGAP (y/n)	4(1.1)/395(98.9)	0(0.0)/400(100.0)	0(0.0)/400(100.0)
– IFS (y/n)	1(0.3)/398(99.7)	0(0.0)/400(100.0)	1(0.3)/398(99.7)
– Nature´s Choice (y/n)	1(0.3)/398(99.7)	0(0.0)/400(100.0)	0(0.0)/400(100.0)
– Others (y/n)	4(1.1)/395(98.9)	0(0.0)/400(100.0)	0(0.0)/400(100.0)

Note: Figures are absolute frequencies (number of answers) and percentages (% of answers) for yes/no questions. n.a. = not available.

With respect to the attitudes and opinions of olive farmers regarding R&D and innovations (Table 2), on average - without differentiating between IP and non-IP farmers - they find out about new olive farming practices and CQS mainly through other farmers (59.8% of interviewees), their own personal experience and practice (54.3%), agricultural associations (52.5%) and conferences, fairs, exhibitions, etc. (51.4%). This highlights the importance of personal contact with close sources which are internal to the agricultural system. Other sources of information, which can be considered external, such as customers, consultants, commercial laboratories, private R&D institutes, universities, public research organisations, and technological centres are scarcely used; in fact, these are used by less than 10.0% of farmers in all cases. Internet is cited by 13.2% of interviewees, representing a new means of communication to be exploited in the olive production sector. Otherwise, the main priority of olive farmers as producers is economic profit, since 94.9% of farmers attribute a great deal of importance to this factor. This high consideration for profit seems to determine their opinions on innovation in two ways. Firstly, the objectives that an innovation must pursue, according to farmers (Table 2), mostly refer to the productive function of agriculture, such as improving sale conditions (45.9%), achieving lower labour costs per unit of product (21.7%), and increasing production capacity (11.6%). Secondly, the factors perceived of as hampering the innovation process are mainly related to financing and costs: lack of funds at the farm (41.2%), high cost (34.1%) and other cost factors (10.1%). Nevertheless, concerns about quality and environment are also important for farmers when producing, such as obtaining healthy products (cited by 61.0%) and respecting the environment (57.3%), as shown in Table 2. Finally, the main research needs identified concern technical questions (genetic improvement for resistance to diseases, 26.6%), and marketing and new markets (olive oil differentiation, 21.6%; non-traditional consuming countries, 16.1%; and international consumer markets, 14.1%).

Table 2. Attitudes and opinions of Andalusian olive farmers towards innovation

	Absolute frequencies and percentages
Sources of information on new olive farming practices and CQS	
− Other farmers (y/n)	239(59.8)/160(40.2)
− Personal experience and practice (y/n)	217(54.3)/183(45.7)
− Agricultural associations (y/n)	210(52.5)/190(47.5)
− Conferences, fairs, exhibitions, etc. (y/n)	205(51.4)/194(48.6)
− Suppliers (y/n)	152(38.2)/247(61.8)
− Papers, radio and television (y/n)	119(29.7)/281(70.3)
− Internet (y/n)	53(13.2)/347(86.8)
− Professional and sectorial associations (y/n)	45(11.2)/355(88.8)
− Public research organisations (y/n)	39(9.7)/361(90.3)
− Scientific journals and publications (y/n)	20(5.0)/379(95.0)
− Others (y/n)	10(2.6)/389(97.4)
− Universities, high education centres (y/n)	9(2.3)/390(97.7)
− Customers (y/n)	8(2.1)/391(97.9)
− Consultants, commercial laboratories, private R&D institutes (y/n)	1(0.3)/398(99.7)
− Technological centres (y/n)	0(0.0)/400(100.0)
Priorities when producing	
− Economic profit (None/Little/Some/Quite/A lot)	0(0.0)/1(0.3)/5(1.3)/14(3.5)/379(94.9)
− Obtaining healthy products (None/Little/Some/Quite/A lot)	0(0.0)/ 1(0.4)/ 19(4.8)/ 135(33.8)/ 244(61.0)
− Respect for the environment (None/Little/Some/Quite/A lot)	0(0.0)/ 1(0.4)/ 27(6.7)/ 142(35.7)/ 228(57.3)
− Assuming a low risk (None/Little/Some/Quite/A lot)	0(0.0)/ 4(1.1)/ 31(7.7)/ 161(40.5)/ 202(50.7)
− Personal prestige (None/Little/Some/Quite/A lot)	1(0.2)/ 5(1.3)/ 34(8.4)/ 182(45.5)/ 178(44.6)
− Others (None/Little/Some/Quite/A lot)	0(0.0)/ 0(0.0)/ 0(0.0)/ 0(0.0)/ 6(100.0)
Objectives of innovation	
− Improving sale conditions	182(45.9)
− Lower labour costs per unit of product	86(21.7)
− Increasing production capacity	46(11.6)
− Greater olives and olive oil quality	19(4.8)
− Respecting the environment	18(4.5)
− Replacing old processes	18(4.4)
− Getting a multifunctional agriculture	15(3.7)
− Improving work conditions	7(1.7)
− Complying with olive regulations	4(1.0)
− Improving IT capabilities	3(0.6)
− Satisfying customers' requirements	0(0.0)
− Increasing prestige	0(0.0)
− Others	0(0.0)
Factors that difficult innovation	
− Lack of on-farm funds	165(41.2)
− Too high cost	136(34.1)
− Other cost factors	40(10.1)
− Lack of off-farm funds (outer financing)	35(8.8)
− Dominance of established enterprises	11(2.7)
− Lack of information about technology	9(2.3)
− Lack of qualified staff	1(0.3)
− Lack of information about markets	1(0.3)
− Difficulties in finding R&D partners	0(0.0)
− Other knowledge factors	0(0.0)
− Uncertainty about the demand of innovative goods and services	0(0.0)
− No demand of innovations	0(0.0)
− Other market factors	0(0.0)
Demanded research topics	
− Olive genetic improvement: Resistance to Verticillium disease	106(26.6)
− Marketing implications of the olive oil differentiation	86(21.6)
− Olive oil in non-traditional consuming countries	64(16.1)
− Consumer behaviour in international markets	56(14.1)
− Using covers for disinfection of soils affected by Verticillium disease	46(11.6)
− Irrigation, estimation of irrigation thresholds. Control of alternate bearing	19(4.8)
− Potential demand of new products with olive oil and demand of by-products	15(3.8)
− Innovation in production, sustainability and use of olive waste	3(0.9)
− Other research topics related to marketing, organisation, assets and territory	3(0.6)

Note: Figures are absolute frequencies (number of answers) and relative frequencies (% of answers) for 1) yes/no questions; 2) more than two options and single choice questions.

3.2. Farming practices associated with Integrated Production

The agricultural practices currently implemented in Andalusia under the Integrated Production scheme and a comparison with those used by the rest of farmers are summarised in Table 3. Although Picual is the main olive variety used in planting[58], it is used significantly less by IP farmers than by non-IP ones (62.1% vs. 83.7% of farmers respectively), and conversely Hojiblanca is used more (29.2% vs. 4.9% respectively). Hojiblanca is a milder flavoured variety and has some technical advantages associated with its lesser diffusion in Andalusia, such as less competition for labour at harvest time, fewer fruit set problems and less competition in the market. The Picual variety, on the other hand, presents other important advantages such as higher oil yield, higher rusticity and adaptation to a wider range of conditions, earlier ripening, ease of picking and higher olive stability[59]. In any case, IP farmers seem to be in a more advantageous position than non-IP farmers to sell to extra-local markets in which a milder flavour could be more appreciated and to explore new consumer niches in the local markets.

Soil management practices applied by IP farmers are more environmentally friendly since they consist of extending soil cover and reducing bare soil: 75.6% of IP farmers cover the soil compared to 15.4% of non-IP. This could be related, at least in part, to the steeper slope of the areas where IP farms are located, as we will see later, and the fact that soil covering to avoid erosion is a requirement to apply for certain EU agro-environmental subsidies in sloping areas. Irrigation is less widespread among IP farmers (17.3% of IP vs. 31.0% of non-IP), which could be related to the presence of IP in more marginal areas. A higher proportion of IP farmers analyse water quality before irrigation (81.8% vs. 26.2% of non-IP), which is highly recommended. Irrigation has some benefits such as increasing production and generating employment because it requires a little more labour. However, it could have some negative environmental impacts

associated with water consumption (a limiting production resource in the region), soil erosion and water contamination. Irrigation practices implemented by IP farmers are therefore superior from an environmental point of view, although it is not clear whether they are better overall. Although irrigation is less common among IP farmers, the application of fertilizers through irrigation water is higher (11.7% of the IP vs. 4.1% of the non-IP farmers who irrigate) and application to the leaves with a spray is lower (35.3% vs. 52.9%). These fertilization practices could have a negative environmental impact, greater in the case of IP farmers. Conversely, the application of phytosanitary treatments is more rational from an agronomic and environmental perspective in the case of IP, since this is done to a greater extent only when the infestation/infection surpasses a determined threshold or in response to expert advice (50.8% of IP vs. 21.8% of non-IP farmers). It is worth noting that both types of farmers do implement some recommended practices with no significant differences between them, such as localising the phytosanitary treatments on the source of infestation (done by less than 4% of both types of farmers).

With regard to harvesting, collecting the fallen olives from the ground through mechanical means is more common among IP farmers (61.2%) than among non-IP ones (35.0%). The use of specific machinery can replace a huge amount of labour and reduce costs for farmers in the long term. In marginal areas, where IP is more common, this could be vital to the survival of olive farms. The separation of the olives picked from ground and trees is also more common for IP farmers (95.3% of IP vs. 60.8% of non-IP), which is recommended for obtaining a high quality olive oil. Management of small pruning offcuts is more rational from an environmental point of view for IP farmers since they shred and incorporate them into the ground more (56.7% of IP vs. 21.9% of non-IP) and burn less (41.8% vs. 77.5% of non-IP). The remaining practices referring to transport, pruning and management of other by-products are not statistically different for IP and non-IP farmers, with one noteworthy common factor being the scarce use of boxes when

transporting the olives, which is recommended to avoid their deterioration and a subsequent decrease in quality.

Table 3. Farming practices implemented by IP and non-IP farmers

	Absolute frequencies and percentages		Correlation statistics(+)	
	IP	Non-IP	$\chi 2$ (d.f.)	p (sign.)
PLANTING				
Olive variety			33.282(5)	0.000(**)
− Picual	42(62.1)	278(83.7)		
− Hojiblanca	20(29.2)	16(4.9)		
− Picudo	3(3.9)	20(6.0)		
− Others	3(4.9)	11(3.2)		
− Arbequina	0(0.0)	5(1.6)		
− Lechin of Sevilla	0(0.0)	2(0.6)		
− Lechin of Granada	0(0.0)	0(0.0)		
SOIL MANAGEMENT				
Main soil management technique			109.075(3)	0.000(**)
− Bare soil, little tillage or shallow tillage, weed control with herbicides	12(17.3)	134(40.5)		
− Soil covered by spontaneous or cultivate plants	51(75.6)	51(15.4)		
− Bare soil, no tillage, weed control with herbicides	3(5.1)	81(24.6)		
− Bare soil, conventional farming (constant tillage)	1(1.9)	64(19.5)		
IRRIGATION				
Irrigation (y/n)	12(17.3)/55(82.7)	103(31.0)/229(69.0)	4.056(1)	0.044(*)
Irrigation system			0.595(2)	0.743(n.s.)
− Trickle irrigation	12(100.0)	99(97.3)		
− Flooding irrigation	0(0.0)	2(2.1)		
− Sprinkler irrigation	0(0.0)	1(0.6)		
Timing of irrigation			1.120(1)	0.290(n.s.)
− Fixed calendar (non-depending on crop needs)	5(41.7)	64(62.1)		
− Following expert advice (depending on crop needs)	7(58.3)	39(37.9)		
Analysis of water quality	9(81.8)/2(18.2)	27(26.2)/76(73.8)	4.872(1)	0.027(*)
FERTILIZATION				
Fertilization (y/n)	67(100.0)/0(0.0)	332(99.9)/0(0.1)	0.000(1)	1.000(n.s.)
Method for the application of fertilizers			10.578(2)	0.005(**)
− Spray application to the leaves	24(35.3)	175(52.9)		
− Direct application to the soil	36(53.0)	142(43.0)		
− Through irrigation water (fertirrigation)	8(11.7)	14(4.1)		
Fertilizers used			0.472(1)	0.492(n.s.)
− Inorganic fertilizers (NPK)	67(100.0)	326(98.2)		
− Organic fertilizers (pruning offcuts, compost, etc.)	0(0.0)	6(1.8)		
Analysis before fertilization			0.982(1)	0.322(n.s.)
− None	39(58.2)	218(65.5)		
− Soil or leaf	28(41.8)	115(34.5)		
PHYTOSANITARY TREATMENTS				
Phytosanitary treatments (y/n)	67(100.0)/0(0.0)	330(99.1)/3(0.9)	0.000(1)	0.997(n.s.)
Treatment of olive fruit fly (Bactrocera oleae)			2.963(2)	0.227(n.s.)
− Non-biological insecticide	61(95.1)	182(98.4)		
− Mass traps (one trap per tree = pheromones + glue + pyrethroids)	2(2.9)	1(0.3)		
− Biological control (Opius concolor)	1(2.0)	2(1.3)		
Treatment of olive moth (Prays oleae)			0.005(1)	0.944(n.s.)
− Chemical treatments	64(100.0)	284(99.0)		
− Biological control (Bacillus thuringiensis)	0(0.0)	3(0.9)		
Treatment of peacock spots, olive leaf blotch, olive leaf spot (Spilocaea oleagina/ Cycloconium oleaginum)			0.953(1)	0.329(n.s.)
− Copper fungicides	64(100.0)	320(97.1)		
− Pruning to clear	0(0.0)	10(2.9)		
− Other chemical treatments	0(0.0)	0(0.0)		
Timing of the phytosanitary treatments			22.026(1)	0.000(*)
− On a fixed calendar basis or with the first symptoms of infestation/infection	32(49.2)	253(78.2)		

− When the infestation/infection surpasses a determined threshold or in response to expert advice	33(50.8)	70(21.8)		
Localization of the phytosanitary treatments			2.639(1)	0.104(n.s.)
− The whole plantation	63(96.1)	320(99.0)		
− Only the source of infestation/infection	3(3.9)	3(1.0)		
HARVESTING				
Timing of the harvest			3.654(1)	0.056(n.s.)
− According to a fruit ripeness index	44(66.0)	256(77.5)		
− On a fixed calendar basis	23(34.1)	74(22.5)		
Method for collecting the fallen olives from ground			17.517(2)	0.000(**)
− By hand	26(38.8)	200(60.2)		
− Mechanical means	41(61.2)	116(35.0)		
− No collecting	0(0.0)	16(4.9)		
Method for picking the olives from the trees			0.397(1)	0.529(n.s.)
− Branch or trunk vibrators	64(96.1)	307(92.5)		
− Hand–pole beating	3(3.9)	25(7.6)		
− Handpicking	0(0.0)	0(0.0)		
Separation of ground and tree olives (y/n)	64(95.5)/3(4.5)	202(60.8)/130(39.2)	28.630(1)	0.000(**)
TRANSPORT				
Ways of carrying the olives from the olive grove to the mill			3.756(2)	0.153(n.s.)
− In the tractor or lorry trailer	67(100.0)	322(97.0)		
− Sacks	0(0.0)	8(2.5)		
− Boxes	0(0.0)	2(0.5)		
PRUNING				
Main pruning technique			3.620(1)	0.057(n.s.)
− Traditional, severe, each one or two years	58(87.0)	248(75.0)		
− Low intensity pruning, every 2 or 3 years	9(13.1)	83(25.0)		
MANAGEMENT OF BY-PRODUCTS				
Wood			0.265(1)	0.606(n.s.)
− Combustible	66(98.1)	320(96.2)		
− Others	1(1.9)	12(3.8)		
− Furniture manufacture	0(0.0)	0(0.0)		
Small sized pruning offcuts			33.298(3)	0.000(**)
− Burning	28(41.8)	258(77.5)		
− Shredding and incorporation into the ground	38(56.7)	73(21.9)		
− Combustible	1(1.5)	2(0.6)		
− Animal food	0(0.0)	0(0.0)		
Leaves			0.481(2)	0.786(n.s.)
− Others	3(66.7)	13(62.7)		
− Combustible	1(33.3)	6(30.7)		
− Animal food	0(0.0)	1(6.6)		
− Therapeutic uses: hypertension, astringents, etc.	0(0.0)	0(0.0)		

*(+)Corrected Yates $\chi 2$ for contingent tables when degree of freedom (d.f.) = 1; (2) Pearson $\chi 2$ for contingent tables when d.f.> 1; (3) $\chi 2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. = not significant. y/n = yes/no.*

3.3. Adoption factors of Integrated Production

Differences between the farmers and farms using IP and the rest can be related to and serve to explain the adoption of IP (Figure 2).

With regard to the characteristics, attitudes and opinions of farmers (Table 4), both types are mainly owner and active farmers (91.0% of IP and 92.4% of non-IP) although there are more IP producers who are tenants (9.0% vs. 2.2% of non-IP). IP farmers play more of a dual role on the farm, doing management and physical work simultaneously (91.3% vs. 77.2% of non-IP) whereas performing exclusively management duties or physical activities is more frequent in the case of non-IP. This indicates that IP farmers are more wholeheartedly dedicated to agriculture. Moreover, IP farmers belong more frequently than the rest to agricultural cooperatives (96.8% of IP vs. 77.8% of non-IP), PDO schemes (34.8% vs. 12.3%) and, logically, associations of IP farmers (69.0% vs. 1.7%) although less to agricultural unions (3.7% vs. 14.3%). This indicates that IP farmers are, in general, more connected to professional networks, which are some of the most important sources of information for Andalusian olive farmers, as discussed previously. It must also be highlighted that both types of farmers, with no significant differences, are mainly middle-aged or older (46-65 years), male, with primary level education, experienced in agriculture (11-30 years) and wholly or mainly reliant on agriculture for their income. In line with their greater involvement in professional networks, the sources of information of IP producers are based to a greater extent on agricultural associations (93.3% vs. 44.3% of non-IP) and other farmers (80.6% vs. 55.7%), that is to say, sources which are internal to the production system, and less on their personal experience and practice (32.7% vs. 58.6%) and external sources such as suppliers (6.0% vs. 44.7%), papers, radio and television (13.1% vs. 33.0%) and public research organizations (0.0% vs. 11.6%). This highlights the importance of personal contact with other farmers and agricultural associations as a

source of information for IP farmers, and the relatively low importance of sources outside the production system. Although their priorities as producers and the objectives of innovation for both types of farmers are not different, these mainly being linked to economic and productive aspects as shown previously, they differ on the factors that hamper innovation and the topics that need to be researched. Thus high cost is the main factor that hinders innovation for IP farmers (49.4% compared to 31.1% of non-IP), whereas lack of funds at the farm is the most important factor cited by non-IP farmers (44.1% compared to 26.9% of IP). This could be related to the extra costs that IP implantation and implementation can entail and this is highlighted by those who have already adopted IP and the potentially lower financial solvency of non-IP farmers. With respect to their research demands, IP farms are more interested in market-related topics, such as consumer behaviour in international markets and the marketing implications of olive oil differentiation, and less on technical issues, such as genetic improvement, irrigation, etc. This highlights the greater focus of IP farmers on new and international markets.

Table 4. Characteristics, attitudes and opinions of IP and non-IP farmers

	Absolute frequencies and percentages		Correlation statistics(+)	
	IP	Non-IP	$\chi 2$ (d.f)	p (sign.)
CHARACTERISTICS OF FARMERS				
Age			7.047(5)	0.217(n.s.)
− 18-25	0(0.0)	4(1.1)		
− 26-35	7(10.7)	19(5.6)		
− 36-45	11(16.3)	43(12.8)		
− 46-55	24(36.3)	98(29.4)		
− 56-65	18(26.5)	123(36.9)		
− >65	7(10.2)	47(14.1)		
Sex			0.898(1)	0.343(n.s.)
− Male	61(91.3)	316(94.9)		
− Female	6(8.7)	17(5.1)		
Civil state			6.647(4)	0.156(n.s.)
− Married	60(88.8)	289(86.8)		
− Single	7(11.2)	27(8.2)		
− Widower/widow	0(0.0)	9(2.7)		
− Separated	0(0.0)	6(1.9)		
− Others	0(0.0)	1(0.4)		
Education level			8.398(5)	0.136(n.s.)
− Primary education	41(61.0)	161(48.5)		
− No education	9(13.1)	84(25.3)		
− Secondary education	4(6.0)	36(11.0)		
− Medium graduate	5(6.8)	22(6.6)		
− High graduate	6(8.2)	18(5.4)		
− Vocational training	3(4.9)	11(3.2)		
Legal status with respect to the farm			12.357(3)	0.006(**)
− Owner and active farmer	61(91.0)	305(92.4)		

− Tenant farmer	6(9.0)	7(2.2)		
− Wage earner	0(0.0)	13(3.8)		
− Other	0(0.0)	5(1.6)		
Dedication to agriculture (years)			7.708(3)	0.052(n.s.)
− 0-10	10(15.0)	37(11.2)		
− 11-20	12(17.3)	82(25.0)		
− 21-30	27(40.5)	85(25.9)		
− > 30	18(27.1)	124(37.9)		
Importance of agriculture in final income			3.126(3)	0.373(n.s.)
− Total	20(30.3)	129(38.8)		
− Partial main	30(44.9)	114(34.2)		
− Partial secondary	13(19.9)	74(22.3)		
− Marginal	3(4.9)	15(4.7)		
Agricultural training			6.845(4)	0.144(n.s.)
− Experience	29(43.2)	171(51.8)		
− Courses, lectures, etc.	31(46.8)	144(43.6)		
− Agricultural university education	3(3.9)	11(3.2)		
− Agricultural vocational training	4(6.1)	4(1.1)		
− Others	0(0.0)	1(0.4)		
Type of work in the farm			7.110(2)	0.029(*)
− Management and physical work	61(91.3)	255(77.2)		
− Exclusively management	6(8.7)	62(18.6)		
− Exclusively physical work	0(0.0)	14(4.1)		
Membership of associations or agricultural collectives				
− Agricultural cooperatives (y/n)	65(96.8)/2(3.2)	259(77.8)/74(22.2)	12.19(1)	0.000(**)
− Protected Designation of Origin (y/n)	23(34.8)/44(65.2)	41(12.3)/291(87.7)	18.399(1)	0.000(**)
− Association of integrated farmers (y/n)	46(69.0)/21(31.0)	6(1.7)/327(98.3)	214.55(1)	0.000(**)
− Agricultural union (y/n)	2(3.7)/65(96.3)	47(14.3)/285(85.7)	5.463(1)	0.019(*)
− Associations for Integrated Pest Management (y/n)	5(7.7)/62(92.3)	10(3.1)/322(96.9)	1.946(1)	0.163(n.s.)
− Agricultural Transformation Society (y/n)	0(0.0)/ 67(100)	2(0.6)/330(99.4)	0.000(1)	1.000(n.s.)
− Association of organic farmers (y/n)	0(0.0)/67(100.0)	2(0.5)/331(99.5)	0.000(1)	1.000(n.s.)
− Others (y/n)	0(0.0)/67(100.0)	0(0.1)/332(99.9)	0.791(1)	0.374(n.s.)
Prospects of continuity in the agricultural activity			1.044(1)	0.307(n.s.)
− Continuing until retirement	54(82.9)	252(76.4)		
− Leaving before retirement	11(17.1)	78(23.6)		
If CAP subsidies disappear, how would it affect your continuity in agriculture			2.010(1)	0.156(n.s.)
− Would probably leave	38(56.1)	222(66.6)		
− Would continue	29(43.9)	111(33.4)		
Future of the olive farm			6.925(3)	0.074(n.s.)
− Children will inherit it	56(87.5)	245(75.9)		
− Will rent it	5(8.5)	30(9.3)		
− Will sell it	1(2.0)	34(10.4)		
− Other	1(2.0)	14(4.3)		
ATTITUDES AND OPINIONS OF FARMERS				
Sources of information on new olive farming practices and CQS				
− Other farmers (y/n)	54(80.6)/13(19.4)	185(55.7)/147(44.3)	13.343(1)	0.000(**)
− Personal experience and practice (y/n)	22(32.7)/45(67.3)	195(58.6)/138(41.4)	3.851(1)	0.000(**)
− Agricultural associations (y/n)	63(93.3)/4(6.7)	147(44.3)/185(55.7)	53.375(1)	0.000(**)
− Conferences, fairs, exhibitions, etc. (y/n)	36(54.3)/31(45.7)	169(50.8)/164(49.2)	0.097(1)	0.755(n.s.)
− Suppliers (y/n)	4(6.0)/63(94.0)	148(44.7)/184(55.3)	33.619(1)	0.000(**)
− Papers, radio and television (y/n)	9(13.1)/58(86.9)	110(33.0)/223(67.0)	9.337(1)	0.002(**)
− Internet (y/n)	12(17.5)/55(82.5)	41(12.3)/292(87.7)	1.073(1)	3.00(n.s.)
− Professional and sectorial associations (y/n)	6(9.5)/61(90.5)	39(11.6)/294(88.4)	0.193(1)	0.66(n.s.)
− Public research organisations (y/n)	0(0.0)/67(100.0)	39(11.6)/294(88.4)	7.415(1)	0.006(**)
− Scientific journals and publications (y/n)	6(8.7)/61(91.3)	14(4.3)/318(95.7)	1.728(1)	0.189(n.s.)
− Others (y/n)	9(13.1)/58(86.9)	1(0.4)/331(99.6)	34.153(1)	0.000(**)
− Universities, high education centres (y/n)	0(0.0)/67(100.0)	9(2.8)/323(97.2)	0.832(1)	0.362(n.s.)
− Customers (y/n)	0(0.0)/67(100.0)	8(2.5)/324(97.5)	0.649(1)	0.420(n.s.)
− Consultants, commercial laboratories, private R&D institutes (y/n)	0(0.0)/67(100.0)	1(0.4)/331(99.6)	0.000(1)	1.000(n.s.)
− Technological centres (y/n)	0(0.0)/67(100.0)	0(0.0)/333(100.0)	-	-
Priorities when producing				
− Economic profit (None/Little/Some/Quite/A lot)	0(0.0)/0(0.0)/0(0.0)/ 3(4.4)/64(95.6)	0(0.0)/1(0.4)/5(1.5)/ 11(3.4)/315(94.7)	2.519(3)	4.472(n.s.)

− Obtaining healthy products (None/Little/Some/Quite/A lot)	0(0.0)/0(0.0)/1(1.2)/ 21(31.5)/45(67.3)	0(0.1)/1(0.4)/18(5.5)/ 114(34.3)/198(59.7)	4.101(4)	0.393(n.s.)
− Respect for the environment (None/Little/Some/Quite/A lot)	0(0.0)/0(0.0)/4(5.9)/ 24(36.0)/38(58.1)	0(0.0)/1(0.4)/23(6.8)/ 118(35.6)/190(57.1)	0.592(3)	0.898(n.s.)
− Assuming a low risk (None/Little/Some/Quite/A lot)	0(0.0)/1(1.3)/6(9.4)/ 33(49.5)/26(39.8)	0(0.1)/4(1.1)/24(7.4)/ 129(38.7)/176(52.8)	3.857(4)	0.426(n.s.)
− Personal prestige (None/Little/Some/Quite/A lot)	0(0.0)/2(2.4)/4(5.8)/ 32(47.5)/30(44.3)	1(0.2)/4(1.1)/30(8.9)/ 150(45.0)/149(44.7)	1.707(4)	0.789(n.s.)
− Others (None/Little/Some/Quite/A lot)	0(0.0)/0(0.0)/0(0.0)/ 0(0.0)/2(100.0)	0(0.0)/0(0.0)/0(0.0)/ 0(0.0)/4(100.0)	-	-
Objectives of innovation			11.741(9)	0.228(n.s.)
− Improving sale conditions	37(55.7)	144(43.9)		
− Lower labour costs per unit of product	13(18.9)	73(22.3)		
− Increasing production capacity	6(8.2)	40(12.3)		
− Greater olives and olive oil quality	4(5.2)	15(4.7)		
− Respecting the environment	5(6.8)	13(4.1)		
− Replacing old processes	2(3.2)	15(4.7)		
− Getting a multifunctional agriculture	0(0.0)	15(4.4)		
− Improving work conditions	1(1.9)	5(1.7)		
− Complying with olive regulations	0(0.0)	4(1.2)		
− Improving IT capabilities	0(0.0)	3(0.8)		
− Satisfying customers' requirements	0(0.0)	0(0.0)		
− Increasing prestige	0(0.0)	0(0.0)		
− Others	0(0.0)	0(0.0)		
Factors hindering innovation			16.013(8)	0.042(*)
− Lack of on-farm funds	18(26.9)	147(44.1)		
− Too high cost	33(49.4)	103(31.1)		
− Other cost factors	6(8.7)	35(10.4)		
− Lack of off-farm funds (outer financing)	4(6.7)	31(9.2)		
− Dominance of established enterprises	3(4.4)	8(2.4)		
− Lack of information about technology	1(1.9)	8(2.4)		
− Lack of qualified staff	1(1.9)	0(0.0)		
− Lack of information about markets	0(0.0)	1(0.4)		
− Difficulties in finding R&D partners	0(0.0)	0(0.0)		
− Other knowledge factors	0(0.0)	0(0.0)		
− Uncertainty about the demand of innovative goods and services	0(0.0)	0(0.1)		
− No demand of innovations	0(0.0)	0(0.0)		
− Other market factors	0(0.0)	0(0.0)		
Demanded research topics			50.956(8)	0.000(**)
− Olive genetic improvement: Resistance to Verticillium disease	5(7.7)	101(30.4)		
− Marketing implications of the olive oil differentiation	24(36.0)	62(18.8)		
− Olive oil in non-traditional consuming countries	12(18.4)	52(15.6)		
− Consumer behaviour in international markets	20(30.0)	36(10.8)		
− Using covers for disinfection of soils affected by Verticillium disease	1(1.9)	45(13.5)		
− Irrigation, estimation of irrigation thresholds. Control of alternate bearing	1(1.9)	18(5.4)		
− Potential demand of new products with olive oil and demand of by-products	1(0.9)	14(4.3)		
− Other research topics related to innovation in production, sustainability and use of olive waste	2(3.2)	1(0.4)		
− Other research topics related to marketing, organisation, assets and territory	0(0.0)	3(0.8)		

*(+)Corrected Yates $\chi 2$ for contingent tables when degree of freedom (d.f.) = 1; (2) Pearson $\chi 2$ for contingent tables when d.f.> 1; (3) $\chi 2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. = not significant. y/n = yes/no.*

With respect to the structural characteristics of farms (Table 5), the most important differences are that IP farms are located to a greater extent that non-IP ones in less favoured areas on steeper slopes (mainly medium for IP vs. low for non-IP), thus they are less productive on average (mainly 2000-6000 kg olives ha^{-1} vs. 4000-8000 for non-IP), and are more often managed in a traditional non-intensive way (97.6% vs. 82.4% of non-IP). Additionally, IP farms use family labour supplemented with wage earners more (60.4% vs. 42.5% of non-IP) and exclusively wage-earner labour less. In terms of destination, the olives produced by IP farmers are more frequently destined to cooperative mills (94.9% vs. 72.3% of non-IP) and less to independent olive mills (5.1% vs. 27.7% of non-IP), which is in accordance with their higher membership to agricultural cooperatives as shown above.

Table 5. Structural characteristics of IP and non-IP farms

	Absolute frequencies and percentages		Correlation statistics(+)	
	IP	Non-IP	$\chi2$ (d.f)	p (sign.)
CHARACTERISTICS OF FARMS				
Olive surface area (ha)			2.645(3)	0.450(n.s)
- [0-1]	0(0.0)	6(1.8)		
- (1-5]	27(40.9)	137(41.3)		
- (5-10]	16(24.2)	97(29.2)		
- (10-]	23(34.8)	92(27.7)		
Organic olive grove (y/n)	0(0.0)/67(100.0)	6(1.8)/326(98.2)	0.312(1)	0.576(n.s.)
Type of cultivation			13.725(2)	0.001(**)
- Traditional	65(97.6)	261(82.4)		
- Intensive	2(2.4)	54(17.2)		
- Super-intensive	0(0.0)	1(0.4)		
Yield			25.173(4)	0.000(**)
- <2000 kg olives/ha	4(6.3)	18(5.5)		
- 2000-4000 kg olives/ha	11(15.8)	65(19.7)		
- 4000-6000 kg olives/ha	50(75.1)	151(45.7)		
- 6000-8000 kg olives/ha	2(2.8)	85(25.5)		
- >8000 kg olives/ha	0(0.0)	12(3.6)		
Age of the olive plantation			7.372(3)	0.061(n.s.)
- <10 years	2(2.4)	29(8.8)		
- 10-50 years	38(56.6)	169(50.7)		
- 51-100 years	25(37.8)	99(29.7)		
- >100 years	2(3.2)	36(10.7)		
Labour			22.397(5)	0.000(**)
- Family and temporary wage-earner	40(60.4)	141(42.5)		
- Exclusively family	23(33.9)	103(30.9)		
- Exclusively temporary wage-earner	4(5.6)	49(14.9)		
- Temporary and permanent wage-earner	0(0.0)	35(10.6)		
- Family, temporary and permanent wage-earner	0(0.0)	2(0.6)		
- Exclusively permanent wage-earner	0(0.0)	1(0.4)		
- Family and permanent wage-earner	0(0.0)	0(0.0)		
Destination of the product			1.313(2)	0.519(n.s.)
- Olive oil	67(100.0)	329(98.9)		
- Table olives	0(0.0)	1(0.2)		
- Both	0(0.0)	3(0.9)		
Soil slope			20.292(2)	0.000(**)
- Low	11(16.1)	147(44.4)		
- Medium	33(48.6)	121(36.6)		
- High	24(35.4)	63(19.0)		
Inserted cultivations (y/n)	0(0.0)/67(100.0)	4(1.2)/329(98.8)	0.052(1)	0.819(n.s.)
Livestock management (y/n)	0(0.0)/67(100.0)	1(0.2)/332(99.8)	0.000(1)	1.000(n.s.)
Main customer			16.589(1)	0.000(**)
- First degree cooperative mills	64(94.9)	240(72.3)		
- Independent oil mills	3(5.1)	92(27.7)		
- Second degree cooperative mills	0(0.0)	0(0.0)		
- Canning and bottling enterprises	0(0.0)	0(0.0)		
- Refineries	0(0.0)	0(0.0)		
- Refineries-bottling enterprises	0(0.0)	0(0.0)		
- Oil extraction enterprises	0(0.0)	0(0.0)		
- Wholesaling in destination	0(0.0)	0(0.0)		
- Distribution platforms (hypermarkets, etc.)	0(0.0)	0(0.0)		
- Buy centrals	0(0.0)	0(0.0)		
- Retailers	0(0.0)	0(0.0)		
- Final consumers	0(0.0)	0(0.0)		
- Others	0(0.0)	0(0.0)		
Main localization of customers			-	-
- Andalusia	66(100.0)	330(100.0)		

*(+)Corrected Yates $\chi2$ for contingent tables when degree of freedom (d.f.) = 1; (2) Pearson $\chi2$ for contingent tables when d.f.> 1; (3) $\chi2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. = not significant. y/n = yes/no.*

4. DISCUSSION

Quality differentiation and certification is a key issue for the future of the olive agro-food sector. The competitiveness of the olive growing sector depends heavily on the adaptation capacity of its economic agents to the changing conditions of the markets and the institutional environment. Issues such as food quality, protection of the environment, good farming practices, survival of the rural world and sustainability of agriculture have been incorporated over recent decades into the demands of an increasing number of consumers and citizens in general[23]. This phenomenon, especially notable in developed countries, the main destination of olive oil, is the result of changes in demographic and socio-cultural variables, consumer attitudes and the development of new lifestyles[60]. In the supply part of the agro-food chain, diverse Certified Quality Systems have been emerging since the 20th century as institutional innovations[61] induced, among other factors, by technical changes such as the availability of new production techniques, and alterations in the demand of consumers. A farmer adopting a CQS is the outcome of a complex push and pull process of simultaneously acting forces, consisting not only of final consumers, but also of intermediate customers and the farmer's own management practices[62]. Integrated Production stands out in the Andalusian olive growing sector as a CQS backed by public regulations which certifies the quality of the product as a result of the implementation of a set of farming practices intended to be more sustainable, environmentally friendly, profitable, fair for farmers and healthy for consumers. IP allows qualities which are 'extrinsic to the product', such as biodiversity conservation, to be introduced into the commodity through monitoring at the point of production[63]. IP farming practices may represent a technological innovation for many farmers in the sense that they are techniques which are not commonly known and used.

The results corroborated the higher quality of IP olive products and processes since IP is associated with a wider use of better farming practices from an agronomic, environmental and/or economic perspective, despite IP farms being located in less favoured regions. This is in agreement with other previous studies[47,23,18], which highlight the higher performance of IP both overall and for each of the three dimensions of sustainability: economic, social and environmental (especially the latter of these). However, we cannot conclude that the higher quality of IP olive growing is due to the IP requirements *per se* but rather to the manner in which the IP practices are really implemented within the restrictions which the IP norm imposes. Indeed, as previously stated, the IP olive norm is not completely fixed and allows some degree of flexibility, since some practices are only recommended. The majority of IP olive farmers interviewed implement agricultural practices in accordance with IP regulations, as is logical. If some mandatory/forbidden farming practice is not respected by a farmer and this is detected by control measures, the field technician performing the check can take provisional measures up to and including the withdrawal of IP certification. Our results, however, must be interpreted carefully, since the study was carried out for the main Andalusian olive zone and average conditions. In other scenarios of productivity, climate, etc., the results may change and need to be further investigated in order to fine-tune policy design[18]. Moreover, our methodological approach entails some simplifications and assumptions, as for any model. It does not allow us to determine, for example, the direct effect of adoption factors on the practices implemented but rather only the indirect effect of adoption factors, through the adoption of IP, on these practices, nor have potential inner relationships among adoption factors, or among practices, been taken into account. All these issues remain as further refinements for future research.

This research also confirms the scarce knowledge of, adoption of and intention to adopt most of the CQS by the Andalusian olive farmers. The reason may be the fact that, logically, although

they acknowledge the importance of obtaining healthy products and respecting the environment, their main priority is their economic profit as producers, and they perceive the adoption of technological innovations in general as costly processes they cannot afford due to lack of funds. With regard to their information channels, olive farmers seem to be entrenched in a relatively closed information system where 'contagion' of information among themselves and close sources is the main diffusion driver. The importance of interpersonal contact and contagion in the diffusion of IP, which was also pointed out in some previous studies on organic olive growing in Andalusia[46], highlights the 'information-intensive' nature of the process and the practical complexity of this innovation. In the current market conditions, in which consumers are demanding new food products that are safer and more sophisticated, while private businesses and the public sector try to recover credibility and consumer confidence, those most affected are the small scale producers and processors, since they have had to confront additional costs related to quality assurance[60]. Special emphasis should therefore be placed on the benefits of adopting CQS in the medium to long term, such as improved competitiveness and higher product quality[64]. Farmers need to be aware that quality is in increasing demand in the markets and that the economic benefits of adopting a CQS can exceed the costs of its implementation[65,35,66]. Improved access to credit would probably also increase the adoption of CQS, although this depends on macroeconomic conditions and expectations regarding the current context of global crisis are not clear. Credit could be channelled through agricultural associations to which Andalusian olive farmers are especially related. Apart from this, a change in mentality is required of farmers, who need to be convinced of the multiple functions of agriculture and the environmental and social benefits of IP insofar as it can condition the legitimacy of public support for agriculture in the near future. The efforts of external R&D institutions, both public and private, to tackle this knowledge transfer to the sector should be encouraged and a greater connection of these institutions with the internal networks of information for farmers is advisable, since the economic success of farmers

adopting CQS may depend on them attending training programmes[67]. Public institutions in particular should increase their involvement and support in the diffusion of IP due to the greater sustainability of this farming system and the improved welfare of society as a whole. Given the importance of interpersonal contact among farmers for the diffusion of this complex innovation, demonstrations of the experience of those who have already adopted IP could be an effective way of communicating and stimulating other farmers. Furthermore, alternative communication channels should be explored and encouraged, such as the use of IT for educating and training farmers, which is currently hardly used. However, given the socio-demographic characteristics of Andalusian olive farmers (mainly 46-65 years old and with primary level education), the widespread use of alternative channels may be a strategy confined to the medium to long term. This highlights, moreover, the importance of policies for the rejuvenation and formal education of the sector. Some of the factors that can explain the relative success of the diffusion of IP in the Andalusian olive growing sector are: the more complete and professional dedication of IP farmers to agriculture, their stronger links with professional networks, their greater presence in marginal areas where the olive is managed in a family-based, traditional and non-intensive manner and where the adoption of a CQS can represent an important strategy to compete in the market through the certification of quality, and their greater orientation towards new markets.

The demand part also needs important improvement. In effect, despite being IP market and demand one of the research topics most demanded by farmers, the lack of specific studies on this aspect is patent. More information is needed about the acceptance and demand of IP in national and international markets and consumers' willingness to pay. Although the available data indicate that IP has a moderate share of Andalusian agricultural production, it is not known which part of this production is finally marketed as IP and at what prices. This information, which is available for other CQS such as organic agriculture and PDO, can be decisive for farmers when considering

whether to adopt a quality system. Lack of market acceptance can be a major obstacle for the development of agro-food certification[68]. Research on other CQS indicates that it is necessary to stimulate 'quality culture' among consumers. Indeed, levels of knowledge and perception of quality are very low in the olive markets[33,39]. The act of educating and informing consumers is therefore one of the most important strategies to further boost the consumption and development of CQS. In the specific case of IP, emphasis should be placed on its overall quality, that is to say, on the environmental and social benefits above and beyond the higher intrinsic quality of the product, which lead to greater sustainability in the production process and the greater welfare of society as a whole.

5. CONCLUSIONS

This paper aims to fill a patent gap in the literature regarding 1) the underlying factors conditioning the adoption of Integrated Production in the Andalusian olive growing sector, i.e. the most relevant CQS in the most important olive producing region worldwide, and 2) the comparison of the farming practices really implemented by adopters and non-adopters of IP and their adequacy from an agronomic, environmental and economic perspective. The results confirm the hypothetically higher quality of IP olive agriculture due to the implementation of better farming practices which are in general more sustainable, environmentally friendly, profitable, fair for farmers and healthy for consumers. The IP practices regarded as especially good are those related to soil management, irrigation, phytosanitation and harvesting. However, certain good practices are scarcely used by IP farmers and there is room for improvement, including the application of

fertilizers to the leaves with spray, localising the phytosanitary treatments on the source of infestation, and the use of sacks for transporting the olives.

The results highlight the high impact on farmers' behaviour of sources of information internal to the agricultural system, such as other farmers, self-study, agricultural associations, etc., and the low importance of external sources, such as technological centres, consultants, commercial laboratories, private R&D institutes, customers, universities, and public research organisations. Moreover, a lack of orientation of the farmers towards the rest of the agro-food system is patent, since they do not pursue the objective of satisfying customers' requirements when innovating. Further extending the diffusion of innovations in general and CQS in particular would require bringing information closer to farmers in an accessible manner. The work of R&D institutions should focus more closely on this aspect. Information should meet the R&D needs of the sector, especially those linked to technical and marketing questions, and contribute to clarifying their financial concerns by emphasising the medium to long term improved competitiveness of IP. The environmental and social benefits of IP need to be appreciated by farmers as an added value increasingly demanded by consumers and society in general. The importance of promoting the professionalization and rejuvenation of the sector is also patent. Finally, we should also highlight the need for further research and development in the market and in the demand for IP.

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ARTÍCULO SEGUNDO

PROTECTED DESIGNATION OF ORIGIN IN THE OLIVE GROWING SECTOR: ADOPTION FACTORS AND GOODNESS OF PRACTICES IN ANDALUSIA, SPAIN

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ARTÍCULO SEGUNDO: PROTECTED DESIGNATION OF ORIGIN IN THE OLIVE GROWING SECTOR: ADOPTION FACTORS AND GOODNESS OF PRACTICES IN ANDALUSIA, SPAIN

ABSTRACT

In a context of increasing concentration and multinationalisation of olive oil supply, Protected Designation of Origin (PDO) represents an increasingly important strategy for competitiveness. Based on a survey of 400 olive growers in Andalusia, the leading olive producing region in the world, this paper investigates 1) the factors related to characteristics of olive farmers and farms, which have conditioned the adoption of PDO; and 2) the environmental, economic and agronomic goodness of PDO farming practices. A further diffusion of PDO would require highlighting PDO as a medium to long-term quality strategy especially for non-highly productive farmers, promoting membership of agricultural associations and the use of external sources of information about innovations, and making growers aware of the importance of respect for the environment when producing. PDO farmers seem to be targeting quality whereas other attributes, such as respect for the environment, are neglected to some extent. Therefore, most practices could be improved. A further greening of PDO practices would represent added value in the eyes of not just local but also international consumers and would be in line with trends in CAP 2014-2020. The role of public administrations in promoting the adoption of PDO and training in the use of more sustainable farming practices should be further strengthened.

Keywords: Olive production; Certified Quality Systems; differentiated quality; good farming practices; diffusion of innovations.

RÉSUMÉ

Dans un contexte de concentration croissante et de multinationalisation de l'approvisionnement de l'huile d'olive, l´Appellation d'Origine Protégée (AOP) représente une stratégie de plus en plus importante pour la compétitivité. À partir d´une enquête effectué auprès de 400 oléiculteurs en Andalousie, la principale région productrice du monde, cette étude examine 1) les facteurs en relation aux caractéristiques des agriculteurs et de leurs exploitations qui déterminent l'adoption de l´AOP; 2) La bonté environnementale, économique et agronomique des pratiques agricoles AOP. Une stratégie de diffusion de AOP devra se baser sur la mise en évidence que cette appellation est une stratégie de qualité à moyen et long terme, surtout pour les agriculteurs non très productifs, sur la promotion de l'adhésion aux associations agricoles, l'utilisation des sources d'informations externes sur les innovations, et l´augmentation de la conscience environnementale des oléiculteurs. Les agriculteurs qui adoptent l´AOP ciblent la qualité, étant autres attributs, tels que le respect environnemental négligés. En conséquence la plupart des pratiques utilisées pourraient être améliorées. Une autre écologisation des pratiques AOP serait une valeur ajoutée non seulement pour les consommateurs locaux mais aussi à l'échelle internationale, qui est de même en ligne avec les tendances de la PAC 2014-2020. Le rôle de l'administration publique pour favoriser l'adoption de l'AOP et la formation pour l'utilisation des pratiques agricoles les plus durables devrait être renforcé.

Mots-clés: Oléiculture ; Systèmes de Qualité Certifiés ; Qualité différenciée ; Bonnes pratiques agricoles ; diffusion des innovations.

1. INTRODUCTION

Olive growing plays an important socio-economic role in Andalusia, the most important olive growing region in the world, located in the south of Spain. Olive growing provided 27.7% of Andalusian fruit and vegetable production in 2010 (CAP, 2012), and generates around one third of agricultural employment, approx. 47.1% of which is family-based (CAP, 2009). Despite the technological improvements since the early 90s, especially in the mills, the sector currently faces a critical situation, especially in the first links of the agro-food chain. In this situation, two types of strategies emerge for olive growers to become more competitive, the first based on reducing production costs and the second based on increasing the olive oil price through consumer value creation (Sanz Cañada and Macías Vázquez, 2005; Velasco Gámez et al., 2011). The first set of strategies is driven by the mechanization of harvesting and pruning, which reduces costs and increases the efficiency of crop production (Polelli et al., 2007). These strategies could be difficult to implement in a context of constantly increasing input costs (mainly fuel), and especially difficult for olive growers who are not highly productive. The second set of strategies directed at increasing the olive oil price is focused on quality, food safety, supply concentration and promotion. Among them, product differentiation based on the highest quality is one of the most powerful competitive strategies (Terlaak and King, 2006; Roselli et al., 2009; Sanz Cañada and Macías Vázquez, 2009). Quality and food safety are important attributes for consumers in highly developed countries and for the upper middle classes in developing countries (Mili and Rodríguez-Zúñiga, 2001; Sanz Cañada and Macías Vázquez, 2005).

Certification of quality though the adoption of a Certified Quality System (CQS) is becoming an increasingly important sales and marketing strategy for competitiveness in the agro-food sector. The CQS available in Europe include public and other private public norms (Hinojosa-Rodríguez

et al., 2013). Protected Designation of Origin (PDO) is a public certification system in the framework of the EU quality policy that guarantees that agricultural products and foodstuffs are produced, processed and prepared in a given geographical area using recognized know-how (Regulation EU 1151/2012 of the European Parliament and of the Council), all without prejudice to other rules relating to food security, quality, labelling, or other applicable measures (Ruiz Castillo, 2008). PDO aims to promote and protect the names of agricultural products and food quality, conceived in response to the growing consumer demand for quality certificates (Fotopoulos and Krystallis, 2001). PDO can be seen as a distinctive sign of quality which may generate competitive and marketing advantages for products under its protection (Fotopoulos and Krystallis, 2001; Espejel et al., 2007). Items such as the 'image' of the territory, the specific skills and cultures of the production process, the concerns of both the local population and institutions, all contribute in different ways to the perception of the value of a PDO product, embedding the services and the tradition into the product itself (Roselli et al., 2009). Olive oil certified under a PDO scheme must fulfil a set of production requirements in reference to the varieties planted, the physical, chemical and organoleptic characteristics of the oil, which in all cases must be of the highest grade ('extra-virgin'), the geographical area where the olive groves are located and certain specifications regarding cultivation practices, among other features. The cultivation practices implemented must be the traditional ones of the geographical area under PDO, with no additional requirements or restrictions, except for the harvest and transport practices: Olives must be collected and transported separately according to their quality, distinguishing olives collected from the ground and from trees. A mixture of ground and tree olives would increase the acidity of the olive oil, thus reducing its quality.

PDO is the second most adopted CQS by Andalusian olive farmers, with an adoption rate of 16.1%, after integrated production, with 16.8% (Hinojosa-Rodríguez et al., 2013). Other

certificates of origin, such as Protected Geographical Indication (PGI), are not implemented in Andalusian olive growing. PDO olive oil in Spain in 2010 represents 7.1% of whole olive oil produced (MAGRAMA, 2010; AAO, 2011) and 18.0% of extra virgin olive oil (MAGRAMA, 2010, 2011). Only 22.1% (22,118 tonnes) of protected oil produced in 2010 (99,988 tonnes) was marketed as PDO (MAGRAMA, 2010); most of this olive oil was sold on the national market (83.8%) and the rest (16.2%) was exported to EU and third countries (9.7% and 6.5% respectively) (MAGRAMA, 2010).

With this in mind, the objectives of this paper are: (1) To determine the adoption factors of PDO in the olive growing sector, in other words, the characteristics of the farmers and farms related to the adoption of PDO; and (2) To investigate the relationship between PDO adoption and the farming practices implemented by olive growers, and evaluate the goodness of PDO vs. non-PDO practices. This would help to design policies for a wider diffusion of PDO and an improvement of PDO sustainability and competitiveness.

2. LITERATURE REVIEW

Despite the relative importance of PDO production in the Andalusian olive growing sector, the underlying mechanisms that have conditioned its adoption into the supply chain have not been sufficiently analysed. Moreover, the goodness of the farming practices associated with PDO olive growing vs. non-PDO practices has been analysed even less. Indeed, the international literature on PDO as a Certified Quality System in the olive agro-food system has dealt with diverse topics, but not those specifically analysed here, such as the demand/acceptance of PDO olive oil among

consumers (Fotopoulos and Krystallis, 2001; van der Lans et al., 2001; Krystallis and Ness, 2005; Espejel et al., 2007; Navarro García et al., 2010; Erraach and Sayadi, 2011); and the marketing and sale of PDO olive oil (Ruiz Avilés et al., 2007; Ruiz Castillo, 2008; Martín Cerdeño, 2009). Previous studies in various producing countries indicate the very low penetration rate, even among rural populations, and highlight the low premium on the price of PDO olive oil, which is not enough to compensate the additional costs of joining a PDO scheme (Fotopoulos and Krystallis, 2001; van der Lans et al., 2001; Krystallis and Ness, 2005; Galluzzo, 2007; Roselli et al., 2009). Externalities associated to Andalusian PDO olive oil has been analysed (Pérez-y-Pérez et al., 2013) being patent a dominance of economic vs. environmental and social externalities. The adoption of PDO has been analysed, with a different perspective from our work, as a quality differentiation strategy to improve the economic viability of olive agriculture in Italy (Polelli et al., 2007; Roselli et al., 2009), Portugal (Baptista and Biswas, 2010) and Spain, in particular in the regions of Castilla la Mancha (Marbán Flores, 2003, 2004, 2005) and Andalusia (Sanz Cañada and Macías Vázquez, 2005, 2008). The latter argue that there is a positive correlation between PDO adoption as an institutional innovation and the diffusion of technical innovations and good practices in the production process in the Andalusian olive agro-food chain. However, these studies are mostly qualitative and the level of detail in the practices and innovations analysed is not very high.

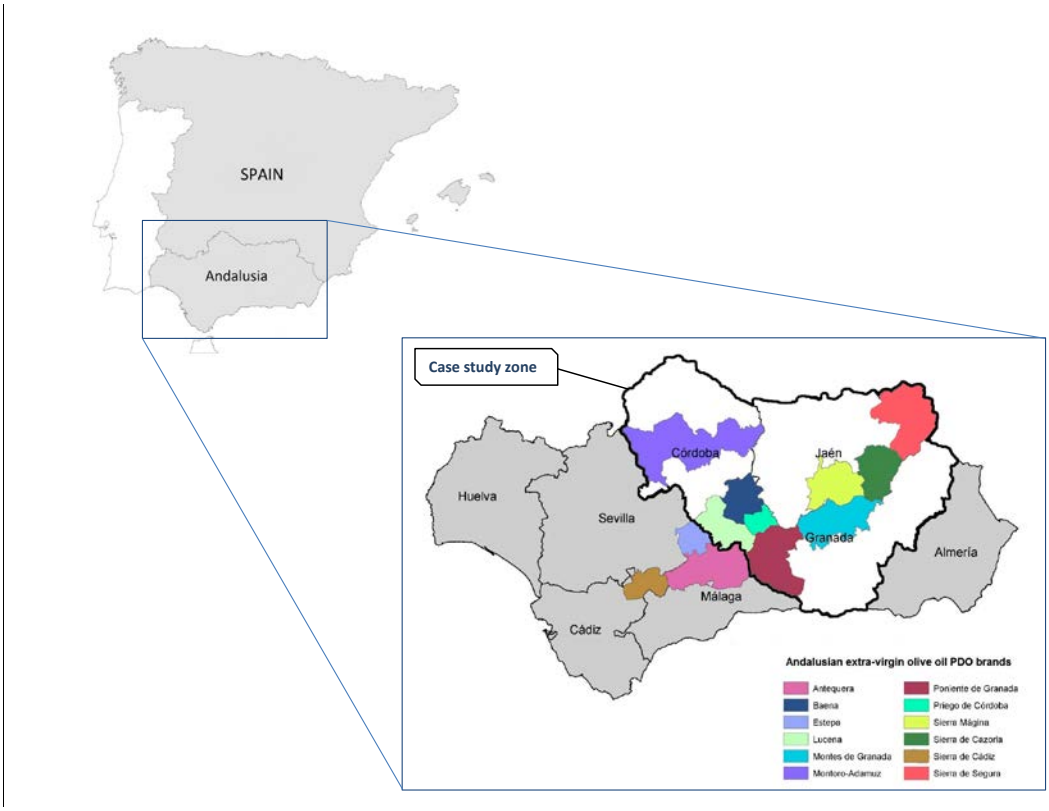
3. MATERIALS AND METHODS

The rationale of the research is that olive growers' characteristics, attitudes and opinions, and the structural characteristics of farms may affect the adoption of PDO and that the adoption of PDO may affect the farming practices implemented. The theoretical background behind this is the

Diffusion of Innovations paradigm, in particular the most recent version of the Rogers theory (Rogers, 2003). This paradigm was formally conceived with the seminal work of Ryan and Gross (1943), and has been widely used to study the diffusion of innovations in agriculture. It proposes a model to explain the relationships between the characteristics and attitudes of individuals (or groups of individuals) and their behaviour with respect to the adoption of innovations. Moreover, it highlights the importance of investigating the consequences of this adoption for adopters and other agents.

A survey of 400 farmers from the main olive growing provinces in Andalusia destined to olive oil production, namely Jaen, Cordoba and Granada (MAGRAMA, 2011), was carried out from May 2010 to February 2011. The survey was stratified proportionally to the number of olive farmers in homogeneous olive growing regions, which were previously delimited to include municipalities of similar importance for olive cultivation in terms of the average area of olive farms and density of farms over total surface area. Since 239,323 farmers are the targeted population, it is obtained for dichotomous variables at 95% confidence level a sampling error of 2.94% for extreme proportions (p=0.9 y q=0.1) and of 4.90% for intermediate proportions (p=q=0.5). The case study zone and the PDO areas are shown in Figure 1. The interviews were conducted face to face and followed a structured questionnaire.

Figure 1. Olive growing regions analysed and olive oil PDO areas in Andalusia



Source: Based on data from CAP website (http://www.cap.junta-andalucia.es/agriculturaypesca/portal)

The questionnaire, which is available to interested parties upon request, consisted of these parts:

I. Characteristics, attitudes and opinions of the olive farmers: These include agricultural training, information sources on new practices and CQS, objectives when producing, objectives when innovating, difficulties in innovating, and priorities in R&D, among others.

II. Structural characteristics of the olive farms: Related to farm area distribution, yield, type of labour force, destination of the produce and slope of the land, among others.

III. Farming practices implemented: These refer to planting, soil management, irrigation, fertilization, phytosanitary treatments, harvesting, transport, pruning and management of by-products.

The methods of analysis for each of the objectives are:

1) Adoption factors of PDO: First, variables that are individually related to the adoption of PDO are determined. A bivariate statistical analysis was conducted between the characteristics of olive farmers and farms and the adoption of PDO to detect characteristics significantly different between PDO and non-PDO. These differences can be related to and serve to explain, at least in part, the adoption of PDO. Bivariate statistical correlations are based on: (1) Corrected Yates χ^2 for contingent tables when degrees of freedom (d.f.) = 1; (2) Pearson χ^2 for contingent tables when d.f. > 1; (3) χ^2 for bivariate logit when proof for contingent tables is not statistically reliable. Additionally, we are interested in determining the main factors influencing PDO adoption, i.e. the minimum characteristics of farmers and farms, considering that the reasons and characteristics behind adoption may be interrelated. For this purpose, a multivariate binomial logit (logistic regression) model was adjusted. The dependent variable is 'adoption of PDO' (yes/no). The initial explanatory variables are those individually related to the adoption of PDO. These variables are subsequently selected by the backward stepwise Wald method, according to their significance and contribution to the explanation of the dependent variable.

2) Farming practices in PDO vs. non-PDO: Based on a bivariate statistical analysis between the agricultural practices implemented and the adoption of PDO, the aim is to identify those practices that are significantly different due to the implementation of this certification scheme. Bivariate statistical correlations are based on the same tests as for the previous topic. For each

group of farmers we determine whether the practices are frequently used, i.e. implemented by 50.0% or more of growers, or infrequently used, i.e. implemented by less than 50.0%. This threshold was proposed in the diffusion of innovations theory to define different categories of adopters (Rogers, 2003): 50% segregates innovators, early adopters and early majority from late majority and laggards. It is also the common threshold used for majorities in voting processes and other decision making processes. The goodness from an environmental, economic and agronomic perspective of practices is determined on the basis of the olive Integrated Production norm in Andalusia, regulated by the Order of 15 April 2008 -BOJA num.83. This norm regulates, based on scientific evidence, the agronomic practices required to achieve high quality production by means of an efficient use of production factors, taking into account sustainability criteria and environmental compliance (Parra-López and Calatrava-Requena, 2006; Orellana et al., 2011). Integrated practices demonstrated a high sustainability in the Andalusian olive groves (Parra-López et al., 2008; Hinojosa-Rodríguez et al., 2013) and could become the standard to receive public subsidies in a 'reinforced-compliance' context under the new CAP 2013 (Gómez Limón and Arriaza Balmón, 2011).

4. RESULTS

4.1. Adoption factors of PDO

4.1.1. Characteristics, attitudes and opinions of olive farmers

The personal characteristics of PDO farmers are in general not very different from those of non-PDO farmers and thus do not constitute adoption factors of PDO (Table 1). Both groups are mainly middle-aged or older (46-65 years), male, married and with primary level or no education. However, women are significantly more common in PDO (15.8%) than in non-PDO (3.7%) olive growing, thus gender does constitute an adoption factor. Dedication to agriculture represents an important set of adoption factors. PDO farmers have been in agriculture longer than non-PDO ones: 50.0% of PDO vs. 33.4% of non-PDO have been devoted to agriculture for more than 30 years. It is probably for this reason that their agricultural training is significantly more based on experience (72.5% of PDO vs. 46.0% of non-PDO) and less on courses and lectures (23.2% of PDO vs. 48.2% of non-PDO). PDO farmers are more often tenants (9.3% of PDO vs. 2.2% of non-PDO) and less often employees (0.0% of PDO vs. 3.8% of non-PDO), although both groups are predominantly owners and active farmers (more than 90.0% in both cases). Both types of farmers, with no significant differences, depend either totally or partially on agriculture as their main source of income (more than 70.0% in both groups), and are involved in management and physical work (more than 78.0% in both cases). With regard to their membership of agricultural associations, PDO farmers belong more frequently than the rest to agricultural cooperatives (95.5% vs. 78.2%), associations of integrated farmers (28.2 vs. 10.0%), and Associations for Integrated Pest Management –ATRIA– (16.1% vs. 1.5%), and less frequently to agricultural unions (2.5% of PDO

vs. 14.4% of non-PDO). The higher levels of ATRIA membership may be because many PDO brands belong to ATRIAs that provide technical advice for farmers. The greater membership of PDO farmers to associations of integrated farmers is logical, since they have more olive surface area devoted to integrated production, as we will see later. With respect to their prospects of staying in agriculture, both types of farmers intend in principle to continue until their retirement (more than 71.0% in both groups), but when prompted with the possibility of agricultural subsidies disappearing, a high percentage (more than 58.0% in both cases) think that they would probably give up agriculture.

Table 1. Characteristics, attitudes and opinions of PDO and non-PDO olive farmers

	Absolute frequencies and percentages		Correlation statistics(+)	
	PDO	Non-PDO	χ^2 (d.f)	p (sign.)
CHARACTERISTICS OF FARMERS				
Age			9.400(5)	0.094(n.s.)
− 18-25	0(0.0)	4(1.1)		
− 26-35	6(9.5)	20(5.9)		
− 36-45	13(19.8)	41(12.2)		
− 46-55	22(33.9)	100(29.9)		
− 56-65	14(21.5)	127(37.8)		
− >65	10(15.3)	44(13.1)		
Sex			12.736(1)	0.000(**)
− Male	54(84.2)	323(96.3)		
− Female	10(15.8)	12(3.7)		
Civil state			3.210(4)	0.523(n.s.)
− Married	59(91.2)	289(86.3)		
− Single	4(6.8)	30(9.1)		
− Widower/widow	1(2.0)	8(2.3)		
− Separated	0(0.0)	6(1.9)		
− Others	0(0.0)	1(0.4)		
Level of education			3.315(5)	0.652(n.s.)
− Primary education	31(48.2)	171(51.1)		
− No education	13(20.2)	80(23.8)		
− Secondary education	6(9.3)	34(10.3)		
− Graduate	4(6.6)	22(6.6)		
− Postgraduate	6(10.0)	17(5.0)		
− Vocational training	4(5.7)	10(3.1)		
Legal status with respect to the farm			12.445(3)	0.006(**)
− Owner and active farmer	58(90.7)	308(92.4)		
− Tenant farmer	6(9.3)	7(2.2)		
− Employee	0(0.0)	13(3.8)		
− Other	0(0.0)	5(1.6)		
Dedication to agriculture (years)			9.692(3)	0.021(*)
− 0 – 10	10(14.9)	37(11.3)		
− 11 – 20	8(11.7)	86(26.0)		
− 21 – 30	15(23.4)	97(29.3)		
− >30	32(50.0)	110(33.4)		
Dependence on agriculture in final income			1.175(3)	0.759(n.s.)
− Total	27(42.1)	122(36.4)		
− Partial main	21(32.3)	123(36.8)		
− Partial secondary	15(22.6)	73(21.8)		
− Marginal	2(2.9)	17(5.0)		
Agricultural training			19.028(4)	0.001(**)

− Experience	47(72.5)	153(46.0)		
− Courses, lectures, etc.	15(23.2)	160(48.2)		
− Agricultural university education	3(4.3)	10(3.1)		
− Agricultural vocational training	0(0.0)	8(2.3)		
− Others	0(0.0)	1(0.4)		
Type of work on the farm			2.665(2)	0.264(n.s.)
− Management and physical work	54(83.6)	262(78.8)		
− Exclusively management	11(16.4)	57(17.1)		
− Exclusively physical work	0(0.0)	13(4.1)		
Membership of associations or agricultural collectives				
− Agricultural cooperative (y/n)	61(95.5)/3(4.5)	262(78.2)/73(21.8)	9.115(1)	0.003(**)
− Association of integrated farmers (y/n)	18(28.2)/46(71.8)	34(10.0)/302(90.0)	13.860(1)	0.000(**)
− Agricultural union (y/n)	2(2.5)/63(97.5)	48(14.4)/287(85.6)	5.314(1)	0.021(*)
− Association for Integrated Pest Management –ATRIA– (y/n)	10(16.1)/54(83.9)	5(1.5)/330(98.5)	25.885(1)	0.000(**)
− Agricultural Transformation Society (y/n)	0(0.0)/64(100.0)	2(0.6)/333(99.4)	0.000(1)	1.000(n.s.)
− Association of organic farmers (y/n)	0(0.0)/64(100.0)	2(0.1)/333(99.9)	0.000(1)	1.000(n.s.)
− Others (y/n)	0(0.0)/64(100.0)	0(0.0)/335(100.0)	0.000(1)	1.000(n.s.)
Prospects of continuing in agriculture			1.209(1)	0.271(n.s.)
− Continuing until retirement	45(71.0)	262(78.7)		
− Leaving before retirement	18(29.0)	71(21.3)		
If CAP subsidies disappear, how would it affect your prospects of continuing in agriculture?			1.135(1)	0.287(n.s.)
− I would probably leave	38(58.3)	222(66.2)		
− I would continue	27(41.7)	113(33.8)		
Future of the olive farm			7.559(3)	0.056(n.s.)
− Children will inherit it	56(88.8)	244(75.7)		
− Will rent it	1(2.4)	34(10.5)		
− Will sell it	4(6.4)	31(9.6)		
− Other	1(2.4)	14(4.2)		
ATTITUDES AND OPINIONS OF FARMERS				
Sources of information (on new olive farming practices and CQS)				
− Other farmers (y/n)	47(73.2)/17(26.8)	192(57.3)/143(42.7)	5.164(1)	0.023(*)
− Personal experience and practice (y/n)	35(54.6)/29(45.4)	182(54.2)/154(45.8)	0.000(1)	1.000(n.s.)
− Agricultural associations (y/n)	46(71.9)/18(28.1)	163(48.8)/172(51.2)	10.701(1)	0.001(**)
− Conferences, fairs, exhibitions, etc. (y/n)	16(24.5)/49(75.5)	189(56.5)/146(43.5)	20.783(1)	0.000(**)
− Suppliers (y/n)	3(4.8)/61(95.2)	149(44.6)/186(55.4)	34.408(1)	0.000(**)
− Newspapers, radio and TV (y/n)	28(42.9)/37(57.1)	91(27.1)/244(72.9)	5.856(1)	0.016(*)
− Internet (y/n)	10(14.9)/55(85.1)	43(12.9)/292(87.1)	0.126(1)	0.723(n.s.)
− Professional and sectorial associations (y/n)	7(10.6)/58(89.4)	38(11.4)/297(88.6)	0.000(1)	1.000(n.s.)
− Public research organisations (y/n)	1(2.1)/63(97.9)	37(11.1)/298(88.9)	5.561(1)	0.033(*)
− Scientific journals and publications (y/n)	5(7.1)/60(92.9)	16(4.6)/320(95.4)	0.444(1)	0.505(n.s.)
− Universities, higher education centres (y/n)	2(3.7)/62(96.3)	7(2.0)/328(98.0)	0.003(1)	0.959(n.s.)
− Customers (y/n)	1(1.6)/63(98.4)	7(2.2)/328(97.8)	0.000(1)	1.000(n.s.)
− Consultants, commercial laboratories, private R&D institutes (y/n)	0(0.0)/64(100.0)	1(0.4)/334(99.6)	0.000(1)	1.000(n.s.)
− Technological centres (y/n)	0(0.0)/64(100.0)	0(0.0)/335(100.0)	-	-
− Others (y/n)	2(2.5)/63(97.5)	9(2.6)/327(97.4)	0.000(1)	1.000(n.s.)
Priorities when producing				
− Economic profit (No/Low/Average/High/Very high)	0(0.0)/0(0.0)/2(2.5)/ 4(6.0)/59(91.4)	0(0.0)/1(0.4)/4(1.0)/ 10(3.1)/ 320(95.5)	2.472(3)	0.480(n.s.)
− Obtaining healthy products (No/Low/Average/High/Very high)	0(0.0)/0(0.0)/1(2.1)/ 35(54.8)/28(43.1)	0(0.1)/1(0.4)/18(5.3)/ 100(29.8)/216(64.4)	15.049(4)	0.005(**)
− Respect for the environment (No/Low/Average/High/Very high)	0(0.0)/0(0.0)/6(9.3)/ 38(58.7)/21(32.0)	0(0.0)/1(0.4)/21(6.2)/ 104(31.2)/208(62.2)	21.137(3)	0.000(**)
− Assuming a low risks (No/Low/Average/High/Very high)	0(0.0)/0(0.0)/9(13.7)/ 38(58.5)/18(27.2)	0(0.0)/4(1.3)/22(6.5)/ 124(37.0)/184(55.2)	19.634(4)	0.001(**)
− Personal prestige (No/Low/Average/High/Very high)	0(0.0)/4(5.7)/9(14.0)/ 36(55.6)/16(24.4)	1(0.2)/2(0.5)/24(7.3)/ 146(43.5)/163(48.5)	19.971(4)	0.001(**)
− Others (No/Low/Average/High/Very high)	0(0.0)/0(0.0)/0(0.0)/ 0(0.0)/2(100.0)	0(0.0)/0(0.0)/0(0.0)0/ (0.0)/4(100.0)	-	-
Main objective of innovation			48.172(9)	0.000(**)
− Improving sale conditions	13(19.9)	169(51.0)		
− Lower labour costs per unit of product	17(26.0)	69(20.9)		
− Greater production capacity	20(31.6)	26(7.7)		
− Higher olive and olive oil quality	7(11.4)	12(3.5)		
− Respect for the environment	3(4.9)	15(4.5)		
− Replacement of old processes	1(2.0)	16(4.9)		

− Achieving multifunctional agriculture	0(0.0)	15(4.4)		
− Improving working conditions	1(2.0)	5(1.7)		
− Complying with olive regulations	1(2.2)	2(0.7)		
− Improving IT capabilities	0(0.0)	3(0.8)		
− Satisfying customers' requirements	0(0.0)	0(0.0)		
− Increasing prestige	0(0.0)	0(0.0)		
− Others	0(0.0)	0(0.0)		
Factors that hinder innovation			8.519(8)	0.384(n.s.)
− Lack of on-farm funds	25(38.9)	140(41.6)		
− Costs are too high	26(40.3)	110(33.0)		
− Other cost factors	5(8.0)	35(10.5)		
− Lack of off-farm funds (outside financing)	3(4.7)	32(9.6)		
− Dominance of established enterprises	2(2.8)	9(2.7)		
− Lack of information on technology	2(3.2)	7(2.1)		
− Lack of qualified staff	1(2.0)	0(0.0)		
− Lack of information on markets	0(0.0)	1(0.4)		
− Difficulties in finding R&D partners	0(0.0)	0(0.0)		
− Other knowledge-related factors	0(0.0)	0(0.0)		
− Uncertainty about demand of innovative goods/services	0(0.0)	0(0.0)		
− No demand for innovation	0(0.0)	0(0.0)		
− Other market-related factors	0(0.0)	0(0.0)		
Requested research topics			28.602(8)	0.000(**)
− Olive genetic improvement: Resistance to Verticillium disease	8(13.0)	98(29.2)		
− Marketing implications of olive oil differentiation	12(18.6)	74(22.2)		
− Olive oil in non-traditional consuming countries	6(8.6)	59(17.5)		
− Consumer behaviour in international markets	18(27.7)	38(11.4)		
− Using covers for disinfection of soils affected by Verticillium disease	15(22.7)	32(9.4)		
− Irrigation of olive grove, estimation of irrigation thresholds in critical periods. Control of alternate bearing	2(3.2)	17(5.1)		
− Potential demand for new products containing olive oil and demand for by-products	1(2.1)	14(4.1)		
− Other research topics related to innovation in production, sustainability and use of olive waste	1(2.0)	2(0.6)		
− Other research topics related to marketing, organisation, assets and territory	1(2.0)	1(0.4)		

*(+)Corrected Yates $\chi 2$ for contingent tables when degrees of freedom (d.f.) = 1; (2) Pearson $\chi 2$ for contingent tables when d.f.> 1; (3) $\chi 2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. (not significant) $p > 0.05$. y/n = yes/no.*

Attitudes and opinions are in general significantly different for PDO farmers and the rest (Table 1). Some sources of information on new farming practices and CQS are used significantly more frequently by PDO farmers: other farmers (73.2% of PDO vs. 57.3% of non-PDO), agricultural associations (71.9% vs. 48.8%), and newspapers, radio and TV (42.9% vs. 27.1%). On the other hand, PDO farmers use the following sources less frequently than the rest: information from public research organisations (2.1% vs. 11.1%), suppliers (4.8% of PDO vs. 44.6% of non-PDO) and conferences, fairs and exhibitions (24.5% vs. 56.5%). Most farmers in both groups, without significant differences, use their personal experience and practice as a source

of information on innovation (more than 54.0%). Internet is beginning to be used by both groups without significant differences: more than 12.0% in both groups. Other sources, such as customers, consultants, commercial laboratories and private R&D institutes, universities and higher education centres, technological centres, and scientific journals and publications are used by a minority of farmers: less than 7.0% in all cases and without differences between the two groups. These data highlight the importance of 'internal' sources which are close to the olive farmers for both groups, but especially for PDO olive growers. The use of 'external' sources by PDO growers is low - lower, in fact, than that of other farmers. Most of the information reaching PDO farmers seems to be channelled mainly through agricultural associations and contact with other farmers.

With respect to their priorities when producing, PDO farmers attribute relatively high importance to almost all the priorities analysed, although non-PDO farmers lend more importance to certain topics. For example, PDO farmers are slightly less concerned than others about taking minor risks when producing. This is logical as they are adopting an innovation and must take a risk. They also attach less importance to their personal prestige, and surprisingly to respecting the environment and obtaining healthy products. In any case, all these topics are either high or very high priority for the vast majority of farmers in both groups: e.g. more than 90.0% in both groups consider the environment to be a high or very high priority. Economic profit is the highest priority for both groups without significant differences, with more than 91.0% in both groups attaching very high importance to this aspect. The main objective of innovation and the research topics requested are significantly different for the two groups. The main objective of innovation for PDO farmers is more related to increasing production capacity (31.6% of PDO vs. 7.7% of non-PDO) and reducing labour costs (26.0% vs. 20.9%), and less to improving sale conditions (19.9% vs. 51.0%), which is the main objective of non-PDO growers. Improving olive and olive oil quality is also significantly more important for PDO olive farmers (11.4% of PDO vs. 3.5% of non-PDO).

These objectives, mainly related to productive and economic factors, are consistent with the high concern for economic profit in both types of farmers. Environmental aspects or satisfying consumer requirements are scarcely targeted by either group when innovating. Following this rationale, the most important factors that hinder innovation for farmers are economic/financial, such as high costs and lack of on-farm funds, cited by more than 33.0% of farmers in both groups. Along the same lines, the research topics most in demand are related to technical and economic matters. However, there are some differences between the two groups. PDO farmers request more research on consumer behaviour in international markets (27.7% of PDO vs. 11.4% of non-PDO) and using covers for the disinfection of soils (22.7% vs. 9.4%).

4.1.2. Structural characteristics of farms

PDO farms are significantly more often located in less favoured zones with steeply sloped land (42.4% of PDO vs. 17.8% of non-PDO) and are thus less productive: around 44.0% of PDO vs. 20.0% of non-PDO produce less than 4000 Kg olives per ha (Table 2). PDO farms include more surface area devoted to integrated production than other farms: 36.2% of PDO vs. 13.0% of non-PDO. Additionally, PDO farms depend more on exclusively family-based labour than non-PDO ones (40.8% vs. 29.7%) and less employee-based labour. The destination of olives to first-degree cooperative mills is more important for PDO farms (94.5% vs. 72.5%), in line with their previously mentioned greater membership of agricultural cooperatives. The two groups are similar in other features, such as the age of the plantation (around 50.0% are 10-50 years old), their traditional style of crop management (more than 84.0% in both groups), the destination of their produce to olive oil (almost 100.0%) and their main customer base being located within Andalusia (100.0% in both groups).

Table 2. Structural characteristics of PDO and non-PDO olive farms

	Absolute frequencies and percentages		Correlation statistics(+)	
	PDO	Non-PDO	χ^2 (d.f)	p (sign.)
CHARACTERISTICS OF FARMS				
Total farm area (ha)			1.742(3)	0.628(n.s)
− [0-1]	0(0.0)	6(1.8)		
− (1-5]	24(37.5)	140(41.80)		
− (5-10]	20(31.2)	93(27.8)		
− (10-]	20(31.2)	96(28.7)		
Organic olive grove (y/n)	1(2.0)/63(98.0)	5(1.4)/330(98.6)	0.000(1)	1.000(n.s.)
Integrated olive grove (y/n)	23(36.2)/41(63.8)	44(13.0)/291(87.0)	18.399(1)	0.000(**)
Type of cultivation			1.286(2)	0.526(n.s.)
− Traditional	57(88.9)	269(84.3)		
− Intensive	7(11.1)	49(15.3)		
− Super-intensive	0(0.0)	1(0.4)		
Yield			22.005(4)	0.000(**)
− <2000 Kg olives ha^{-1}	8(12.1)	15(4.4)		
− 2000-4000 Kg olives ha^{-1}	21(32.1)	55(16.5)		
− 4000-6000 Kg olives ha^{-1}	32(49.5)	170(50.9)		
− 6000-8000 Kg olives ha^{-1}	4(5.5)	83(24.8)		
− >8000 Kg olives ha^{-1}	1(0.9)	11(3.4)		
Age of the olive plantation			1.977(3)	0.577(n.s.)
− <10 years	3(4.0)	28(8.5)		
− 10-50 years	32(49.2)	175(52.2)		
− 51-100 years	24(36.5)	101(30.0)		
− >100 years	7(10.3)	31(9.3)		
Labour			16.440(5)	0.006(**)
− Family and temporary employees	27(42.4)	154(46.2)		
− Exclusively family	26(40.8)	99(29.7)		
− Exclusively temporary employees	11(16.8)	42(12.6)		
− Temporary and permanent employees	0(0.0)	35(10.6)		
− Family, temporary and permanent employees	0(0.0)	2(0.6)		
− Exclusively permanent employees	0(0.0)	1(0.4)		
− Family and permanent employees	0(0.0)	0(0.0)		
Destination of the product (olives)			1.258(2)	0.533(n.s.)
− Olive oil	64(100.0)	332(98.9)		
− Table olives	0(0.0)	1(0.2)		
− Both	0(0.0)	3(0.9)		
Land slope			20.175(2)	0.000(**)
− Low	16(25.7)	141(42.3)		
− Medium	20(32.0)	133(39.9)		
− High	27(42.4)	59(17.8)		
Inserted cultivations (y/n)	0(0.0)/64(100.0)	4(1.2)/331(98.8)	0.038(1)	0.846(n.s.)
Livestock management (y/n)	0(0.0)/64(100.0)	1(0.2)/335(99.8)	0.000(1)	1.000(n.s.)
Main customer			12.409(1)	0.000(**)
− First-degree cooperative mills	61(94.5)	243(72.5)		
− Independent oil mills	4(5.5)	92(27.5)		
Main customer base location				
− Andalusia	62(100.0)	334(100.0)	-	-

*(+)Corrected Yates $\chi 2$ for contingent tables when degrees of freedom (d.f.) = 1; (2) Pearson $\chi 2$ for contingent tables when d.f.> 1; (3) $\chi 2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. (not significant) $p>0.05$. y/n = yes/no.*

4.1.3. Main factors influencing PDO adoption

The specified logit model can be used to determine the main variables which could be targeted in certain policies aimed at boosting the diffusion of PDO (Table 3). Our focus is on short to medium term policies. In this case, it is assumed that only the farmers' characteristics, attitudes

and opinions can be affected by such policies. The structural characteristics of farms are supposedly fixed.

Table 3. Multivariate binomial logit model for PDO adoption

Variable	Code	B	Std. error	Wald	d.f.	p(sign.)
Membership of associations or agricultural collectives: Association for Integrated Pest Management	ATRIA	3.726	.925	16.216	1	0.000(**)
Sources of information: Suppliers	INFOSUP	-2.097	.737	8.101	1	0.004(**)
Sources of information: Newspapers, radio and TV	INFONEW	1.243	.445	7.785	1	0.005(**)
Priorities when producing: Respect for the environment[(a)]:	PENV			8.102	2	0.017(*)
- No, low, average	PENV_NLA	0.079	0.810	0.010	1	0.922(n.s.)
- High	PENV_H	1.173	0.438	7.172	1	0.007(**)
Main objective of innovation[(b)]:	OBJ			35.504	7	0.000(**)
- Achieving multifunctional agriculture or respecting the environment	OBJ_MENV	4.038	1.824	4.899	1	0.027(*)
- Replacement of old processes or improving IT capabilities	OBJ_PRIT	3.292	2.029	2.632	1	0.105(n.s.)
- Improving sale conditions	OBJ_SALE	3.099	1.700	3.322	1	0.068(n.s.)
- Higher olive and olive oil quality	OBJ_QUAL	6.910	1.908	13.120	1	0.000(**)
- Complying with olive regulations	OBJ_REG	6.296	2.256	7.786	1	0.005(**)
- Greater production capacity	OBJ_PROD	5.892	1.758	11.230	1	0.001(**)
- Lower labour costs per unit of product	OBJ_COST	4.854	1.722	7.943	1	0.005(**)
Integrated olive grove	INTEG	1.773	0.481	13.568	1	0.000(**)
Yield[(c)]:	YIELD			12.928	4	0.012(*)
- <2000 Kg olives/ ha	YIELD_2	3.179	1.796	3.135	1	0.077(n.s.)
- 2000-4000 Kg olives/ ha	YIELD_2T4	2.705	1.736	2.428	1	0.119(n.s.)
- 4000-6000 Kg olives/ ha	YIELD_4T6	1.362	1.718	0.628	1	0.428(n.s.)
- 6000-8000 Kg olives/ ha	YIELD_6T8	1.029	1.792	0.330	1	0.566(n.s.)
Main customer[(d)]: Independent oil mills	CUST_IND	-2.604	0.793	10.784	1	0.001(**)
Constant	C	-8.804	2.581	11.632	1	0.001(**)

Omnibus test over model coefficients: $\chi 2 = 165.497$; d.f. (degrees of freedom) = 18; Significance = 0.000(**)
–2 log likelihood = 184.499; Nagelkerke $R^2 = 0.583$; Hosmer&Lemeshow significance = 0.552
Probability of Correct Classification = 91.4% (cut value = 0.5)

*Dependent variable: Adoption of PDO (yes=1; no=0). Reference categories: [(a)]Very high (PENV_VH); [(b)]Improving working conditions (OBJ_WORK); [(c)]>8000 Kg olives/ ha (YIELD_8); [(d)]First-degree cooperative mills (CUST_COOP). Sign. (significance): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. (not significant) $p > 0.05$.*

Two types of farmers and farms have been defined due to their high relevance in analysing the effects of such policies (Table 4). Non-PDO farmer and farm with ex-ante extreme negative profile (type I) is defined by selecting the category that minimises the probability of PDO adoption for each variable of the model. For instance, not being a member of ATRIA minimises the probability of PDO adoption. Non-PDO farmer and farm with ex-ante modal profile (type II) is defined by the modal - i.e. the most frequent - category for each variable. For instance, not being a member of ATRIA is the most frequent condition of non-PDO farmers.

The proposed policies are targeted at shifting the characteristics, attitudes and opinions of farmers towards the categories that maximise the probability of PDO adoption. For instance, farmers of both types, I and II, are not members of ATRIAs (Table 4). The policies which serve to promote PDO should focus on changing this behaviour by making them become members of such agricultural associations.

Table 4. Typification of farmers and farms, and effects of the proposed policies

		Before policy intervention		**After policy intervention**	
Variable	**Code**	**Non-PDO farmer and farm with ex-ante extreme negative profile (Type I)**	**Non-PDO farmer and farm with ex-ante modal profile (Type II)**	**Non-PDO farmer and farm with ex-ante extreme negative profile (Type I')**	**Non-PDO farmer and farm with ex-ante modal profile (Type II')**
Membership of associations or agricultural collectives: Association for Integrated Pest Management (ATRIA)	ATRIA	No	No	Yes	Yes
Sources of information: Suppliers	INFOSUP	Yes	No	No	No
Sources of information: Newspapers, radio and TV	INFONEW	No	No	Yes	Yes
Priorities when producing: Respect for the environment	PENV	Very high	Very high	High	High
Main objective of innovation	OBJ	Improving work conditions	Improving sale conditions	Higher olive and olive oil quality	Higher olive and olive oil quality
Integrated olive grove	INTEG	No	No	No	No
Yield	YIELD	>8000 Kg olives/ ha	4000-6000 Kg olives/ ha	>8000 Kg olives/ ha	4000-6000 Kg olives/ ha
Main customer: Independent oil mills	CUST_IND	Yes	No	Yes	No
Probability of PDO adoption (%)		*0.000*	*1.283*	*83.812*	*99.635*

The proposed measures are the same for both types of farmers (Table 4):

- Promote membership of Associations for Integrated Pest Management (ATRIA)
- Limit, or at least do not promote, the use of suppliers as sources of information on new farming practices and CQS.
- Promote the use of newspapers, radio and TV as sources of information on agriculture.

- Make growers aware of the high importance of respect for the environment when producing.
- Highlight to farmers the importance of producing olives and olive oil of the highest quality when they consider innovating.

The joint effect of changing the targeted variables related to farmers' characteristics in the directions indicated would increase the probability of PDO being adopted. However, this effect is different for the two types. Type I (non-PDO farmers and farms with ex-ante extreme negative profile) would see an increase in probability from 0.000% to 83.812% (Table 4). Type II (non-PDO farmers and farms with ex-ante modal profile) would undergo an increase in probability from 1.283% to 99.635% (Table 4). These data reflect the high impact of the proposed measures to strengthen the diffusion of PDO olive growing in Andalusia.

4.2. Farming practices in PDO vs. non-PDO

The results summarised in Table 5 show that with regard to planting, although Picual is the main olive variety in both groups of growers, PDO farmers use this variety significantly less: 54.4% of PDO vs. 85.1% of non-PDO. PDO growers, however, use Hojiblanca more than non-PDO (25.0% of PDO vs. 5.9% of non-PDO) and also make greater use of Picudo (18.1% of PDO vs. 3.3% of non-PDO). The Hojiblanca and Picudo varieties have a milder flavour and some advantages associated with their lower diffusion in the region: less competition for labour during harvest, fewer fruit setting problems and less competition in the market. The milder flavour makes PDO olive oil more appropriate for sale in external and new markets where this flavour is more widely appreciated. Soil management is also significantly different for the two groups. PDO

farmers make greater use of soil cover with spontaneous vegetation or cultivated plants than non-PDO: 35.2% vs. 23.7%, respectively. This is a recommended practice involving less soil erosion and is a mandatory requirement for olive growing in less favoured areas to receive CAP subsidies. Soil management is therefore better implemented by PDO farmers, although here there is room for improvement as the recommended practices are not widely diffused, i.e. they are implemented by less than 50.0% of growers.

Table 5. Farming practices implemented by PDO and non-PDO olive farmers

	Absolute frequencies and percentages		Correlation statistics(+)	
	PDO	Non-PDO	χ^2 (d.f.)	p (sign.)
PLANTING				
Olive variety			41.159(5)	0.000(**)
− Picual	35(54.4)	285(85.1)		
− Hojiblanca	16(25.0)	20(5.9)		
− Picudo	12(18.1)	11(3.3)		
− Arbequina	0(0.0)	5(1.6)		
− Lechin de Sevilla	0(0.0)	2(0.6)		
− Lechin de Granada	0(0.0)	0(0.0)		
− Others	2(2.5)	12(3.7)		
SOIL MANAGEMENT				
Main soil management technique			16.874(3)	0.001(**)
− Bare soil, little tillage or shallow tillage, weed control with herbicides	32(50.1)	113(34.0)		
− Soil covered by spontaneous or cultivated plants	23(35.2)	79(23.7)		
− Bare soil, no tillage, weed control with herbicides	5(7.6)	80(24.0)		
− Bare soil, conventional farming (constant tillage)	5(7.2)	61(18.3)		
IRRIGATION				
Irrigation (y/n)	13(20.6)/51(79.4)	101(30.3)/234(69.7)	2.089(1)	0.148(n.s.)
Irrigation system			0.686(2)	0.710(n.s)
− Trickle irrigation	13(100.0)	97(97.3)		
− Flood irrigation	0(0.0)	2(2.1)		
− Sprinkler irrigation	0(0.0)	1(0.6)		
Timing of irrigation			3.257(1)	0.071(n.s.)
− Fixed calendar (not depending on crop needs)	12(87.4)	57(56.3)		
− Following expert advice (depending on crop needs)	2(12.7)	44(43.7)		
Analysis of water quality	4(30.8)/9(69.2)	32(31.7)/69(68.3)	2.089(1)	0.148(n.s)
FERTILIZATION				
Fertilization (y/n)	64(100.0)/0(0.00)	335(99.9)/0(0.1)	0.001(1)	1.000(n.s.)
Method for the application of fertilizers			5.308(2)	0.070(n.s.)
− Application by spray to the leaves	24(36.8)	175(52.5)		
− Direct application to the soil	37(57.2)	141(42.3)		
− Through irrigation water (fertirrigation)	4(6.0)	18(5.3)		
Fertilizers used			0.140(1)	0.708(n.s.)
− Inorganic fertilizers (NPK)	63(98.0)	330(98.6)		
− Organic fertilizers (pruning offcuts, compost, etc.)	2(2.0)	5(1.4)		
Analysis before fertilization			14.311(1)	0.000(**)
− None	55(85.4)	202(60.3)		
− Soil or leaf	9(14.6)	133(39.8)		
PHYTOSANITARY TREATMENTS				
Phytosanitary treatments (y/n)	64(100.0)/0(0.0)	332(99.1)/3(0.9)	0.001(1)	1.000(n.s.)
Treatment of olive fruit fly (Bractrocera oleae)			2.647(2)	0.266(n.s.)
− Non-biological insecticide	45(94.1)	199(98.3)		
− Mass trapping (one trap per tree = pheromones + glue + pyrethroids)	1(3.1)	1(0.5)		
− Biological control (Opius concolor)	1(2.7)	2(1.2)		
Treatment of olive moth (Prays oleae)			0.001(1)	1.000(n.s.)

− Chemical treatments	51(100.0)	297(99.1)		
− Biological control (Bacillus thuringiensis)	0(0.0)	3(0.9)		
Treatment of peacock spots, olive leaf blotch, olive leaf spot (Spilocaea oleagina= Cycloconium oleaginum)			0.001(1)	1.000(n.s.)
− Copper fungicides	61(97.9)	324(97.5)		
− Pruning to clear	1(2.1)	8(2.5)		
− Other chemical treatments	0(0.0)	0(0.0)		
Timing of phytosanitary treatments			6.573(1)	0.010(**)
− On a fixed calendar basis or with the first symptoms of infestation/infection	55(86.9)	230(70.7)		
− When the infestation/infection surpasses a threshold or following expert advice	8(13.1)	95(29.3)		
Localization of phytosanitary treatments			7.972(1)	0.005(**)
− The whole plantation	59(93.9)	324(99.5)		
− Only the source of infestation/infection	4(6.1)	2(0.6)		
HARVESTING				
Timing of harvest			2.386(1)	0.122(n.s.)
− According to a fruit ripeness index	43(67.3)	257(77.1)		
− On a fixed calendar basis	21(32.7)	76(22.9)		
Method for collecting the fallen olives from ground			8.460(2)	0.015(*)
− By hand	45(70.3)	180(53.9)		
− Mechanical means	15(22.9)	142(42.5)		
− No collecting	4 (6.8)	12(3.5)		
Method for picking the olives from the trees			0.000(1)	0.991(n.s.)
− Branch or trunk vibrators	59(92.0)	313(93.3)		
− Hand–pole beating	5(8.0)	23(6.7)		
− Handpicking	0(0.0)	0(0.0)		
Separation of ground and tree olives (y/n)	63(98.4)/1(1.6)	202(60.7)/131(39.3)	32.837(1)	0.000(**)
TRANSPORT				
Ways of carrying the olives from the olive grove to the mill			3.598(2)	0.165(n.s)
− In a tractor or lorry trailer	64(100.0)	325(97.0)		
− Sacks	0(0.0)	8(2.5)		
− Boxes	0(0.0)	2(0.5)		
PRUNING				
Main pruning technique			0.844(1)	0.358(n.s.)
− Traditional, severe, every 1 or 2 years	46(72.0)	260(78.0)		
− Low intensity pruning, every 2 or 3 years	18(28.0)	73(22.0)		
MANAGEMENT OF BY-PRODUCTS				
Wood			1.675(1)	0.196(n.s.)
− Fuel	64(100.0)	321(95.9)		
− Furniture manufacture	0(0.0)	0(0.0)		
− Others	0(0.0)	14(4.1)		
Small pruning offcuts			1.605(3)	0.658(n.s.)
− Burning	43(67.2)	242(72.2)		
− Shredding and incorporation into the soil	20(30.8)	91(27.1)		
− Fuel	1(2.0)	2(0.6)		
− Animal food	0(0.0)	0(0.0)		
Leaves			8.856(2)	0.012(*)
− Fuel	1(11.3)	6(54.0)		
− Animal food	0(0.0)	1(11.9)		
− Therapeutic uses: hypertension, astringents, etc.	0(0.0)	0(0.0)		
− Others	12(88.7)	4(34.1)		

*(+)Corrected Yates $\chi 2$ for contingent tables when degrees of freedom (d.f.) = 1; (2) Pearson $\chi 2$ for contingent tables when d.f.> 1; (3) $\chi 2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. (not significant) $p>0.05$. y/n = yes/no.*

Irrigation practices are very similar for both groups of farmers. Trickle irrigation is the recommended practice, as it saves a lot of water, and is widely implemented by both: more than 97.0% in both groups. Defining the time of irrigation following expert advice according to crop

needs, and analysing the water quality before irrigation, both good practices, are not widely used by the two types of farmers. The fertilization practices for PDO and non-PDO farmers are not very different either. They make little use of fertirrigation, which is recommended as an irrigation practice: less than 6.0% in both groups. However, one important difference, due to its environmental consequences, is the soil or leaf analysis to determine whether it is necessary to fertilize. This good practice is surprisingly more frequently used by non-PDO olive growers, although it is not widely used in either case: 14.6% of PDO vs. 39.8% of non-PDO.

The practices used for the phytosanitary treatments are not significantly different in general for the two types of growers. Both of them widely use chemical substances and non-biological insecticides, very effective but with negative impacts on the environment and on the economic performance of the olive farm if not properly managed in terms of timing and precision of application. In this respect, the application of pesticide treatments directly on the source of infestation/infection, which is recommended rather than applying to the whole plantation, is significantly more widespread among PDO olive farmers: 6.1% of PDO vs. 0.6% of non-PDO (Table 5). On the other hand, the application of treatments only when the infestation/infection surpasses a specified threshold or following expert advice, which is considered good practice, is better implemented by non-PDO growers: 13.1% of PDO vs. 29.3% of non-PDO. Therefore, both groups do apply the recommended practices for phytosanitation to a certain degree.

With regard to harvesting, both groups with no significant differences widely determine the time to harvest according to a ripeness index, which is recommended: more than 67.0% in both groups. Other harvesting practices with a great impact on the quality of the olive oil obtained are significantly better applied in PDO olive growing, as required by the PDO scheme. Hence, the separation of ground and tree olives is carried out by 98.4% of PDO farmers vs. 60.7% of non-PDO farmers. Not collecting the fallen olives from the ground, which may serve to greatly increase

the quality but entails renouncing additional sources of income, is scarcely implemented by either group, although significantly more by PDO growers: 6.8% of PDO vs. 3.5% of non-PDO.

The practices used to transport the olives, prune the olive trees and manage the by-products are very similar in PDO and non-PDO olive growing. Transportation in boxes is hardly ever adopted, by less than 1.0% of farmers in both cases, despite this being highly recommended to maintain the integrity of the olives and thus preserve their quality. Shredding and incorporating small pruning offcuts into the soil is a good practice for preventing soil erosion which is not widely implemented (by less than 30.0% in both groups).

5. POLICY IMPLICATIONS AND CONCLUSIONS

Protected Designation of Origin (PDO) is a Certified Quality System (CQS) in the framework of the EU quality policy that constitutes a valuable strategy of differentiation, especially for non-highly productive olive growers who cannot compete on price with the large packing groups and retailer labels in these segments, which still make up the bulk of the market (Sanz Cañada and Macías Vázquez, 2005). This strategy mainly targets local markets close to the production areas where the quality of the product attached to its origin may be more widely appreciated (Sanjuán et al., 2006).

The results highlight that the adoption of PDO by Andalusian olive growers is mainly determined by a few explanatory variables (Table 3) referring to: 1) farmers' characteristics, attitudes and opinions, such as ATRIA membership, sources of information, priority of respect for the environment when producing, and main objective of innovation, and 2) farms' structural

characteristics, such as growing integrated production olives, yield and main customer. Olive growers are very concerned with economic profit and financial issues, as is logical. They believe that innovations involve high costs they cannot afford. As mentioned before, previous studies indicate the very low penetration rate and premium on the price of PDO olive oil. However, PDO should be seen as a medium to long-term strategy. A quantitative expansion of the markets is expected and it will go hand-in-hand with a qualitative expansion, with an increasing demand for olive oils distinguished on the basis of product and process quality attributes (Anania and Pupo D'Andrea, 2008). Therefore, further sales and marketing developments are needed in the olive producing sector in a context of increasing concentration and multinationalisation of olive oil supply, with a very small number of bottling firms and large distribution enterprises controlling most of the market. In this sense, the olive growing sector in Spain, in general, and in Andalusia, in particular, displays a poor organizational structure. The small size of the farms and mills (Sanz Cañada and Macías Vázquez, 2005) implies a lack of ability to adapt to the requirements for the introduction and maintenance of a CQS and for innovation. In this situation, olive mills need to join together to be able to compete with other companies in the market (Montegut Salla et al., 2007). The ideal situation would be that all components of the olive producing sector worked together in unison. This collaboration could help to strengthen the organizational structure of the sector which may in turn lead to improvements in marketing (Montegut Salla et al., 2007; Sanz Cañada et al., 2011).

Otherwise, PDO farming practices are not very different, in general, from those used by non-PDO olive growers and the recommended techniques are infrequently used in both groups. It seems PDO farmers are focusing especially on quality and the financial viability of their economic activity. Therefore, there is room for improvement in many farming practices implemented under PDO. In this sense, Spanish olive oil PDOs face a new emerging challenge: besides displaying

differentiation in terms of organoleptic excellence and origin, they need to take on attributes of environmental friendliness and a greater degree of food safety and traceability to win over a significant share of the value chain at local level (Sanz Cañada and Macías Vázquez, 2005). Most PDO olive farms are located in less favoured areas of steep slopes and low productivity (CAP, 2002), depend to a greater extent on exclusively family-based labour, and are members of first-degree cooperative mills, as is confirmed by our results. PDO farms play an important multifunctional role as they help to improve the sustainability of rural areas through certain functions such as reducing erosion and protecting biodiversity and natural resources, combating the effects of climate change, and contributing to territorial cohesion (Ruiz Avilés et al., 2007). It is therefore desirable that besides promoting the idea of greater product quality being linked to a specific place as PDO scheme guarantees, PDO farmers also demonstrate a greater sustainability in the production process. It could be certified by the adoption of more sustainable and environmentally responsible farming practices, such as those associated with integrated production and organic agriculture. Although local certified-product systems are starting to incorporate quality attributes linked to the environment and sustainable development, much remains to be accomplished (Sanz Cañada and Macías Vázquez, 2005; Pérez-y-Pérez et al., 2013). This would be an added value in the eyes of not just local but also international consumers, which could increase their willingness to pay a premium on the price and serve to justify public support from a greener CAP. Olive farmers need to be aware of the environmental significance of agriculture and their role as producers of public goods (Sanz Cañada et al., 2011). In this context, PDO Regulatory Boards should play a more active role. They are institutions made up of farmers, cooperatives, industries, marketing companies and the public administration. They are responsible, among other things, for drawing up the reference standards or regulations for PDO and certifying and giving their seal of approval to any products wishing to use the official label (Sanz Cañada and Macías

Vázquez, 2005). Their support of farmers in adopting the most sustainable farming practices should be further strengthened.

In summary, PDO represents a small but increasing share of the olive oil produced in Andalusia. Attracting conventional farmers to PDO would entail providing them with information which highlights the economic attractiveness of PDO, as a medium to long-term strategy for competitiveness based on quality differentiation. Improvements should also be made in terms of palliating the short-term financial needs related to the implementation of PDO by facilitating access to credit. This is especially important since the main concerns of olive growers when producing and innovating are of an economic/financial nature. The importance of protecting the environment as an increasing demand from consumers and CAP should also be emphasised. The results indicate that there is room for improvement in many farming practices implemented under PDO especially from an environmental point of view. Farmers must also be aware of the need for further efforts to strengthen the organizational structure of the olive producing sector. This would benefit innovation in the sector in general and the adoption of Certified Quality Systems in particular. The design of public policies in support of PDO and sustainable agriculture should include training and information programs for farmers. The effective adoption of PDO, as for any complex adoption, is highly dependent on having an opportunity to carry out small-scale trials or at least to observe its implementation in near peers (Rogers, 2003). Given the high importance for farmers of internal and nearby sources of information, such as other farmers and agricultural cooperatives and associations, the strategy to bring relevant information closer to farmers could be twofold: 1) connect leading knowledge-generating external institutions, such as public research organisations, technological centres and universities, to the closer sources of information of farmers; this would entail great efforts to transfer knowledge from research to the sector; 2) incentivize farmers' direct use of external sources of information which are not widely diffused,

such as internet and scientific journals and publications; this would require significant promotional efforts on the part of public research organisations to make these sources known to farmers. In addition to this, other sources which are relatively successful and regularly used by PDO farmers should also be promoted, such as newspapers, radio, television and membership of Associations for Integrated Pest Management (ATRIA), since the technicians of these associations indirectly encourage awareness and adoption of PDO in olive growing.

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ARTÍCULO TERCERO

PROTECTED DESIGNATION OF ORIGIN AS A CERTIFIED QUALITY SYSTEM IN THE ANDALUSIAN OLIVE OIL INDUSTRY: ADOPTION FACTORS AND MANAGEMENT PRACTICES

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ARTÍCULO TERCERO: PROTECTED DESIGNATION OF ORIGIN AS A CERTIFIED QUALITY SYSTEM IN THE ANDALUSIAN OLIVE OIL INDUSTRY: ADOPTION FACTORS AND MANAGEMENT PRACTICES

ABSTRACT

Protected Designation of Origin (PDO) is a Certified Quality System (CQS) that guarantees that there is a link between the particular characteristics of the production process of certain foodstuffs and their geographical origin. However, there is room for manoeuvre with regard to the management practices implemented when it comes to PDO. This paper investigates the factors related to and explaining the adoption of PDO in the Andalusian olive industry, the main olive growing region in the world, including an analysis of the varying characteristics of mill enterprises, managerial and supervisory staff, and of the differences and similarities between the practices implemented by PDO enterprises compared with the rest. A structured personal interview was held with the managerial and supervisory staff of 101 olive mill enterprises in the main olive growing provinces of Andalusia. The results show that CQS are not in general very widespread but that PDO is relatively prevalent. However no clear adoption factors for PDO have been identified, since the structural characteristics of enterprises adopting PDO and the personal characteristics, attitudes and opinions of their managers and supervisory staff are very similar to those not adopting it. The adoption of PDO seems to be explained by a contagion effect among industries that are located within less favourable, steeply sloping areas. Moreover, the adoption of PDO is not generally linked to an implementation of better industrial practices, rather of better marketing

practices, since in general optimal industrial practices are already widespread in Andalusian olive mills. The policy and management implications of enhancing economic viability by increasing the spread of PDO, and by improving the practices implemented by PDO enterprises, are also discussed.

Keywords: Food quality assurance; certified quality systems; industrial and marketing practices; adoption factors; PDO; olive oil industry

1. INTRODUCTION

Differentiating the quality of products and processes can generate a competitive advantage for agro-food enterprises due to the fact that customers and final consumers are increasingly demanding higher-quality products and stricter, more transparent and verifiable controls in the production process. Achieving, enhancing and sustaining competitiveness is dependent on delivering superior quality products/services to consumers (Magd & Curry, 2003). In the agro-food chain, quality can only be imperfectly observed by the end customer (Carriquiry & Bruce, 2007), due to the increasing distance between suppliers and customers in the current context of economic globalisation and expansion of international trade (Terlaak & King, 2006). Therefore quality needs not only to be delivered, but also certified. Certification of products and processes through the implementation of a Certified Quality System (CQS) is voluntary and guarantees standards of quality that go beyond mandatory levels. Firms usually adopt CQS to obtain a market advantage and to build their reputation as a provider of products with certain claimed attributes (Carriquiry & Bruce, 2007).

Certification of quality is a key issue in the case of olive oil. Spain is the leading country in the world both in terms of olive production and surface area covered, representing 35.83% of world production and 24.86% of surface area on average in 2005-10 (FAO, 2012). The Spanish olive sector consists primarily of a wide group of small/medium olive growers organised into cooperatives with an olive oil mill, which account for more than 70% of the olive oil produced, plus a minority of private olive oil mills pertaining to larger farmers (Sanz Cañada & Macías Vázquez, 2005). Andalusia, a southern Spanish region, is the most important olive growing area in the country, representing 84.30% of the olive production and 61.89% of the olive surface area of Spain in 2009 (MARM, 2010b). The Andalusian olive sector faces a marketing problem because

the cooperative and small/medium-sized private olive mills, which make up the majority of olive producers, have a negligible profile in the market of bottled olive oil. Cooperative mills and small/medium-sized private mills cannot compete in price with the large packaging groups and retailer labels (Sanz Cañada & Macías Vázquez, 2005), and are forced to sell their product in bulk to big olive oil companies with a consequent loss of added value (Marbán Flores, 2003, 2005; Montegut Salla, et al., 2007). Additionally, the Spanish olive sector in general, and that of Andalusia in particular, currently face a critical situation, especially in the initial stages of the agro-food chain, due to the low productivity of a significant number of olive growers, since almost a third of the Spanish olive area is located in mountainous regions and managed in a traditional manner (Sanz Cañada, et al., 1998). The sector also faces a drop in olive oil prices since 2009 (CAP, 2011) and also in CAP subsidies. In this context, competitiveness through quality differentiation and certification in the marketplace is clearly a fundamental survival strategy for olive mill enterprises (Marbán Flores, 2003; Montegut Salla, et al., 2007). Quality differentiation will play a key role in the medium to long term, not only in traditional consumer markets but also in high income non-traditional countries, where there is a clear trend towards increasing market segmentation based on product quality (Anania & Pupo D'Andrea, 2008; Mili & Rodríguez-Zúñiga, 2001).

Protected Designation of Origin (PDO) is a CQS that guarantees that agricultural products and foodstuffs are produced, processed and prepared in a given geographical area using recognised know-how (Regulation EU 1151/2012 of the European Parliament and of the Council), all without prejudice to other rules relating to food security, quality, labelling, or other applicable measures (Ruiz Castillo, 2008). The spread of PDO has been impressive in the Andalusian olive sector: the olive surface under PDO increased by 166.43% between 2001 and 2008 and the quantity of olive oil produced under PDO schemes, which is of the highest extra-virgin quality, increased by

66.53% (MAPA, 2002; MARM, 2010c). Despite the relative importance of PDO in the sector, its adoption factors, i.e. the factors explaining its adoption and diffusion, have not been sufficiently analysed. Although the adoption of PDO has been analysed, studies have focused on a different perspective, taking PDO as a quality differentiation strategy for improving the economic viability of olive agriculture in Italy (Polelli, et al., 2007; Roselli, et al., 2009), Portugal (Baptista & Biswas, 2010) and Spain (Marbán Flores, 2003, 2004, 2005; Sanz Cañada & Macías Vázquez, 2005, 2008). Moreover, the 'goodness' or optimality of the management practices associated with PDO as compared to non-PDO is a topic which has not been much studied previously either. In effect, 'good practices' can be defined as the set of specifications that contribute to the sound management of the natural environment, animal welfare, public health and animal and plant health, and traceability through all stages of production, processing and distribution (CAP, 2006). However, it is not clear whether adopting PDO is related to the implementation of better practices. The scarcity of information on these topics is made patent by the international literature review on PDO as a Certified Quality System in the olive agro-food system carried out by Hinojosa-Rodríguez, et al. (2014).

In this context, this paper aims to contribute to the existing literature by investigating the factors conditioning the adoption of PDO as a CQS as well as PDO´s influence on the industrial and marketing practices implemented in the olive industry. The specific objectives of this study are: (1) to determine the adoption rates, i.e. the percentage of adoption, of the various available CQS including PDO in the olive mill industrial sector of Andalusia; (2) to define the adoption factors of PDO in the olive industry, i.e. the characteristics of the enterprises and their managerial and supervisory staff, which can explain the adoption of PDO; and (3) to examine the effect of the adoption of PDO on the implementation of optimal industrial and marketing practices by olive enterprises. The hypotheses of the research are that the Andalusian olive industry is not adopting

the wide range of CQS available, and that the adoption of a CQS such as PDO does not automatically guarantee the implementation of better management practices. Hence, the final aim of the research is to generate insights for the design of policies that would strengthen the spread of PDO, enhance economic viability and improve the industrial and marketing practices implemented by PDO enterprises.

2. MATERIAL AND METHODS

The managerial and supervisory staff members of 101 olive mill enterprises in the main olive growing provinces of Andalusia - Jaen, Cordoba and Granada (IEA, 2012a, 2012b) -, were interviewed face-to-face between May 2010 and February 2011. The survey sample was randomly stratified in proportion to the number of olive mill enterprises in five major homogeneous olive growing zones, which were previously clustered for the sake of facilitating the implementation of the survey. These zones encompass municipalities that are similar in terms of the share of olive surface over total agricultural surface, according to the census of the Spanish Olive Oil Agency online database (AAO, 2010). The distribution between PDO and non-PDO interviewees was random. Eventually information about 13 PDO and 88 non-PDO mill enterprises was gathered, which is in line with the share of PDO in the olive sector: olive oil produced under PDO represents 11% of the total extra-virgin olive oil produced in Andalusia (MARM, 2010a, 2010c). The survey was implemented using a structured questionnaire. Since 697 olive mills were registered, a sampling error of 6.32% for extreme proportions (p=0.9 y q=0.1) and of 10.54% for intermediate proportions (p=q=0.5) can be assumed for dichotomous variables at a 95% confidence level for

the whole sample. In any case, the aim was to achieve a comparison between PDO and non-PDO adopters rather than an inference to the entire sector.

The theoretical basis for the study is the Diffusion of Innovations paradigm, in particular the most recent version of the Rogers theory (Rogers, 2003). This paradigm was formally conceived through the seminal work of Ryan and Gross (1943), and has been widely used to study the diffusion of innovations in agriculture. It proposes a model for establishing relationships between the characteristics and attitudes of individuals (or groups of individuals) and their behaviour with respect to the adoption of innovations. Moreover, it highlights the importance of investigating the consequences of this adoption for adopters and other agents.

Three main analyses were carried out in line with the three stated objectives of this research. The purpose, data gathered, and the methods followed for each analysis are as follows:

1. Adoption rates of diverse CQS:

    1.1. Purpose: Describing the adoption rate among olive mill enterprises, i.e. the percentage of mills adopting the various available and potentially applicable CQS.

    1.2. Data gathered: CQS analysed include public norms, such as PDO, organic agriculture, and integrated production; and national regulations specific for olive oil and R&D&I, such as diverse UNE norms. These CQS were defined on the basis of secondary information, notably the review conducted by Bertuglia (2007).

    1.3. Method of analysis: Descriptive statistical analysis of adoption rates.

2. Adoption factors of PDO:

2.1. Purpose: Identifying similarities and differences between the personal characteristics, attitudes and opinions of managerial and supervisory staff adopting PDO and the rest, and between the mills adopting PDO and the rest. The differential characteristics may be adoption factors which are related to and which can explain the adoption of PDO.

2.2. Data gathered: Personal characteristics of managerial and supervisory staff including age, sex, education level, and position in the enterprise. Attitudes and opinions covered their engagement in R&D, innovation sources used, objectives in production and innovation, difficulties faced with regards to innovation and R&D priorities. Structural characteristics of the mill operators include type of enterprise, legal status, economic dimension, principal activities, and main suppliers and customers. Diverse sources were used to define the data needed: innovations (INE, 2006a; OECD, 2005); R&D (Sanz Cañada, et al., 2008; Sanz Cañada, et al., 2011); socioeconomic characteristics of managers (Parra-López, 2003; Parra-López, et al., 2007); and structural characteristics of the olive industry (CAP, 2010; INE, 2006b; OECD, 2005).

2.3. Method of analysis: Bivariate statistical analysis between the characteristics of mills, managerial and supervisory staff, and the adoption of PDO schemes. Statistical tests are based on: (1) Fisher's exact test for contingent tables when degree of freedom (d.f.) = 1; (2) Pearson χ^2 for contingent tables when d.f.> 1; (3) χ^2 for bivariate logit when proof for contingent tables is not statistically reliable. More complex multivariate statistical analyses were not carried out due to the limited size of the sample.

3. Industrial and marketing practices associated with PDO:

3.1. Purpose: Identifying similarities and differences between the management practices used by industries adopting PDO and the rest, and determining whether practices associated to PDO are to any extent better. Management practices will be divided into industrial and marketing practices. In order to establish the goodness or optimality of the industrial practices implemented by PDO and non-PDO enterprises, they will be compared against the optimal practices proposed by Integrated Production, as regulated in Andalusia by the Order of 12 June 2013 (BOJA num.117). Integrated Production, whose adoption is voluntary, proposes a set of high-standard practices considered as optimal from a technical, economic and/or environmental point of view (Parra-López & Calatrava-Requena, 2006). The goodness or optimality of PDO and non-PDO practices is determined by the degree of implementation of these optimal practices. Better practices therefore means a wider use of the optimal practices

3.2. Data gathered: Industrial practices cover the reception and storage of olives; oil extraction, storage, bottling/canning and transport; quality and hygiene control; and by-products and residues management. Marketing practices relate to distribution, promotion and price, and product strategies. The definition of the industrial and marketing practices was mainly based on OECD (2005) and the Andalusian Regulation on the integrated olive oil industry (BOJA nº 117, 18 June: Order of 12 June 2013).

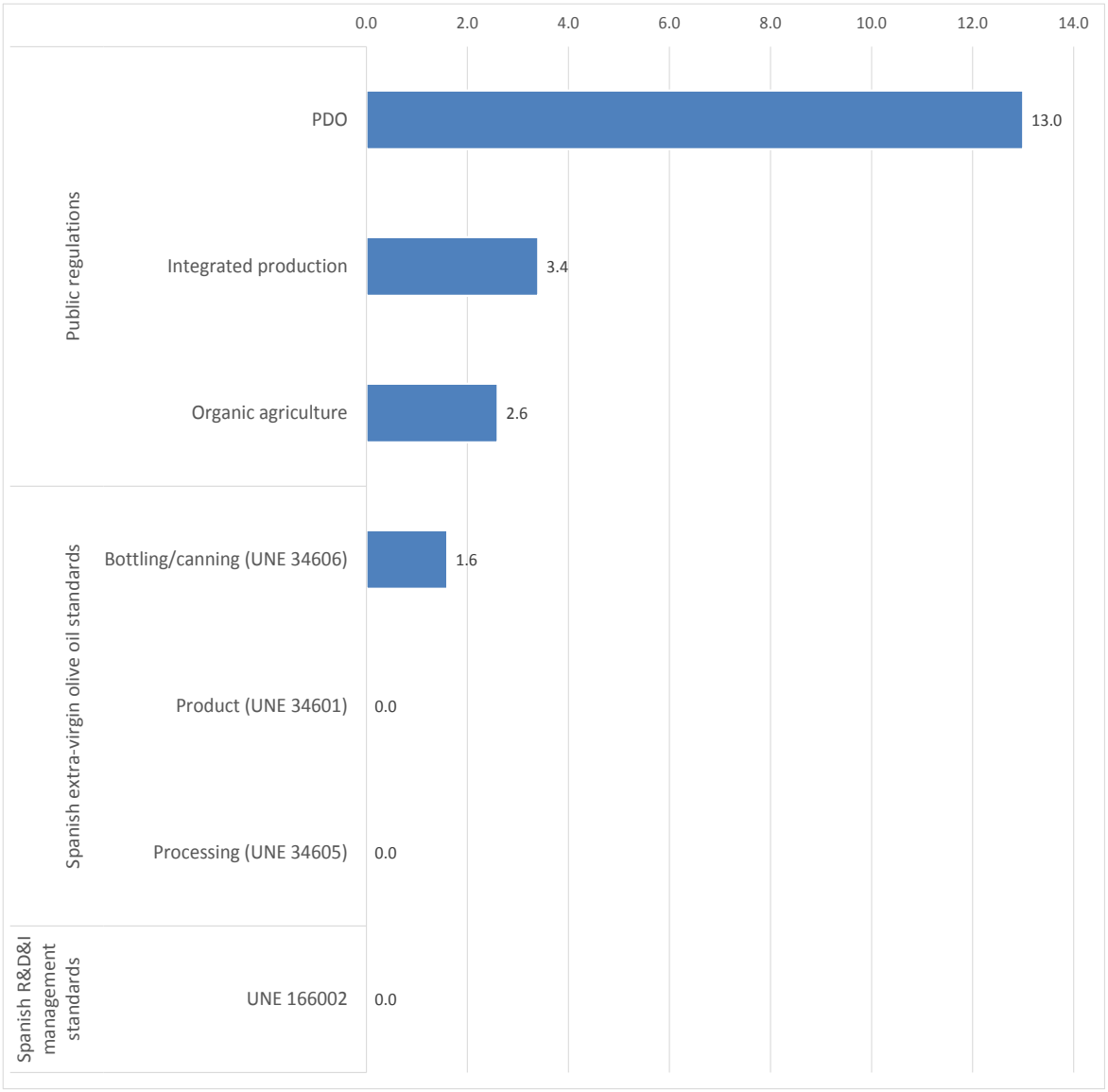
3.3. Method of analysis: Bivariate statistical analysis between the industrial and marketing practices and the adoption of PDO. Statistical tests are the same as for the adoption factors of PDO.

3. RESULTS

3.1. Adoption rates of diverse CQS

The most commonly implemented CQS is Protected Designations of Origin (PDO), the focus of this research, which has been adopted by 13.0% of olive mills (Figure 1). CQS guaranteeing greater sustainability and environmental care, such as integrated and organic production, have been adopted by less than 4% of olive mills. Other CQS are insignificant: UNE 34606, on extra-virgin olive oil bottling/canning, has been adopted by less than 2% of mills. The rest, including UNE 34601, 34605 and 166002, have not been adopted at all. In summary, certification of quality is not widespread, but a preponderance of PDO is demonstrated.

Figure 1. CQS adoption rates in Andalusian olive oil enterprises



3.2. Adoption factors of PDO

3.2.1. Personal characteristics, attitudes and opinions of managerial and supervisory staff

Differences between the characteristics, attitudes and opinions of managerial and supervisory staff, and between mills adopting PDO and the rest, may explain the adoption of PDO.

However, the results show that there are no significant differences between both groups (Table 1). With regard to the characteristics of interviewees they are, with no significant variations between PDO and non-PDO mills, managers (33.3%), members of the management team (14.6%), administrative assistants (13.8%), technical personnel (10.4%), presidents (7.8%) and mill foremen (7.3%). Most of them are male (only 10.9% are female), and middle-aged, i.e. 36-55 years old (66.6%). With regard to education level, apart from a minority with no studies (5.7%), the rest received a formal education: medium level graduate (30.7%); primary or secondary education (42.4%); and high level graduate (11.0%).

With respect to their attitudes and opinions regarding R&D and innovation there are no significant differences either. The participation of PDO and non-PDO managerial and supervisory staff in national or international R&D plans is on average very low, below 3%. As sources of innovation they mainly rely on their suppliers (79.9%), on conferences, fairs and expositions (71.9%), and on professional and sectorial associations (47.5%). These sources highlight the importance of personal contact and proximity for fostering innovation. They also use newspapers, radio and television (42.6%), internet (36.7%), public research organisations (23.2%) and the Andalusian Federation of Agricultural Cooperatives (FAECA) (22.9%) as sources. Otherwise, the main priority of olive mill managerial and supervisory staff is economic profit, with 92.2% of them attributing major importance to this factor. This strong emphasis on profit seems to influence their opinions on innovation in two ways. Firstly, the objectives that innovation should pursue, according to managerial and supervisory staff, mostly relate to production issues such as lowering labour costs per unit of product (34.1%), replacing old processes and products (22.0%), increasing production capacity (10.5%), and lowering energy consumption per unit of olive oil produced (6.7%). Surprisingly, a greater market share and entering new markets, enhanced olive oil quality, respect for the environment, and improving sanitary and safety conditions are not perceived as

important objectives for innovation, neither on average, nor specifically by PDO managerial and supervisory staff (less than 21%). Secondly, the factors perceived as hampering the innovation process are mainly related to financial and cost issues: lack of funds within the enterprise itself (47.5%), excessive costs (32.0%), lack of external financing (10.7%), and other cost factors (6.4%). Apart from economic profit, some other issues are also very important for managerial and supervisory staff, such as producing healthy products (cited by 72.9% as an area of major importance), personal prestige (67.4%), respecting the environment (64.6%) and minimising risk (58.8%). Finally, the main research needs identified by managerial and supervisory staff are again mostly related to production issues, in particular to technologies for the identification of fraud: biotechnology for uncovering fraud involving mixtures of oils (71.4%), detection of fraud involving the addition of 'deodorised' olive oil to virgin olive oil (6.1%), and measurement of pollutants in olive oil including the regulation of pesticides (5.3%). Other less important research needs relate to marketing and the opening new markets: selling olive oil in traditionally non-consuming countries (5.5%), use of extra-virgin olive oil as a substitute for other fats in the diet (3.6%), and identifying and strengthening the differentiation factors of olive oil (2.3%).

Table 1. Personal characteristics, attitudes and opinions of PDO vs. non-PDO managerial and supervisory staff

	Absolute frequencies and percentages			Correlation(+)	
	PDO & Non-PDO	PDO	Non-PDO	χ2(d.f.)/Fisher	p (sign.)
PERSONAL CHARACTERISTICS					
Position in the enterprise				6.430(6)	0.377(n.s)
− Manager	34(33.3)	4(33.3)	29(33.0)		
− Member of the management team	15(14.6)	0(0.0)	15(17.0)		
− Administrative assistant	14(13.8)	3(25.0)	11(12.5)		
− Technical personnel	11(10.4)	1(8.3)	9(10.2)		
− President	8(7.8)	2(16.6)	6(6.8)		
− Mill foreman	7(7.3)	1(8.3)	7(8.0)		
− Other	13(12.8)	1(8.3)	11(12.5)		
Age				1.449(1)	0.229(n.s.)
− 18-25	1(1.4)	0(0.0)	1(1.7)		
− 26-35	14(14.2)	4(30.2)	10(11.8)		
− 36-45	25(25.6)	3(21.3)	23(26.3)		
− 46-55	41(41.0)	5(37.3)	36(41.5)		
− 56-65	16(16.1)	1(11.2)	15(16.9)		
− More 65	2(1.6)	0(0.0)	2(1.9)		
Sex				F	0.153(n.s.)

− Male	90(89.1)	10(79.8)	79(90.4)		
− Female	11(10.9)	3(20.2)	8(9.6)		
Education level				1.817(1)	0.178(n.s.)
− Medium graduate	30(30.7)	5(37.2)	26(29.8)		
− Primary education	26(26.3)	2(18.0)	24(27.5)		
− Secondary education	16(16.1)	1(5.3)	15(17.7)		
− High graduate	11(11.0)	3(22.4)	8(9.4)		
− Vocational training	10(10.1)	1(10.6)	9(10.1)		
− No studies	6(5.7)	1(6.5)	5(5.6)		
ATTITUDES AND OPINIONS ABOUT R&D					
Participation in R&D&I plans					
− R&D national plan and other national plans (y/n)	3(2.9)/98(97.1)	0(0.0)/13(100.0)	3(3.3)/85(96.7)	F	0.658(n.s.)
− EU plans (y/n)	2(2.4)/99(97.6)	1(6.2)/12(93.8)	2(1.8)/86(98.2)	F	0.342(n.s.)
− Regional plans (y/n)	1(1.5)/100(98.5)	1(6.2)/12(93.8)	1(0.8)/87(99.2)	F	0.242(n.s.)
− Other international plans (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
Innovation sources in the enterprise					
− Suppliers (y/n)	81(79.9)/20(20.1)	8(63.6)/5(36.4)	72(82.4)/15(17.6)	F	0.084(n.s.)
− Conferences, fairs, expositions (y/n)	73(71.9)/28(28.1)	11(83.8)/2(16.2)	62(70.1)/26(29.9)	F	0.238(n.s.)
− Professional and sectorial associations (y/n)	48(47.5)/53(52.5)	3(26.3)/10(73.7)	44(50.6)/43(49.4)	F	0.058(n.s.)
− Papers, radio and television (y/n)	43(42.6)/58(57.4)	3(22.4)/10(77.6)	40(45.6)/48(54.4)	F	0.109(n.s.)
− Internet (y/n)	37(36.7)/64(63.3)	3(26.3)/10(73.7)	34(38.3)/54(61.7)	F	0.221(n.s.)
− Public research organisations (y/n)	23(23.2)/78(76.8)	2(16.2)/11(83.8)	21(24.2)/67(75.8)	F	0.391(n.s.)
− Andalusian Federation of Agricultural Cooperatives	23(22.9)/78(77.1)	5(38.5)/8(61.5)	18(20.7)/69(79.3)	F	0.143(n.s)
− Scientific journals and publications (y/n)	7(7.0)/94(93.0)	0(0.0)/13(100.0)	7(8.1)/81(91.9)	F	0.369(n.s.)
− Customers (y/n)	7(6.8)/94(93.2)	0(0.0)/13(100.0)	7(7.9)/81(92.1)	F	0.369(n.s.)
− Universities, higher education centres (y/n)	6(5.9)/95(94.1)	1(5.0)/12(95.0)	5(6.0)/83(94.0)	F	0.572(n.s.)
− Competitors or other enterprises with the same activity (y/n)	6(5.8)/95(94.2)	1(5.0)/12(95.0)	5(5.9)/83(94.1)	F	0.572(n.s.)
− Consultants, commercial laboratories, private institute of research and development (y/n)	3(2.9)/98(97.1)	0(0.0)/13(100.0)	3(3.3)/85(96.7)	F	0.572(n.s.)
− Technological centres (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
− R&D department (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
− Other sources of information (y/n)	6(6.4)/95(93.6)	0(0.0)/13(100.0)	6(6.9)/81(93.1)	F	0.424(n.s)
Objectives of innovation				1.673(1)	0.196(n.s.)
− Lower labour costs per unit of product	34(34.1)	2(16.2)	32(36.8)		
− Replacement of old processes and products	22(22.0)	2(15.1)	20(23.1)		
− Greater production capacity	11(10.5)	1(10.1)	9(10.6)		
− Greater market share and entering new markets	9(9.1)	2(16.2)	7(8.1)		
− Greater olive oil quality	9(9.0)	1(10.1)	8(8.8)		
− Lower energy consumption per unit of olive oil produced	7(6.7)	1(11.2)	5(6.1)		
− Producing respect for the environment	6(5.6)	3(21.1)	3(3.3)		
− Improving the work conditions	1(1.4)	0(0.0)	1(1.6)		
− Improving the sanitary and safety conditions	1(1.4)	0(0.0)	1(1.6)		
Factors that hinder innovation				0.284(1)	0.594(n.s.)
− Lack of in-enterprise funds	47(47.5)	6(44.6)	41(47.9)		
− Too high cost	32(32.0)	6(45.4)	26(29.9)		
− Lack of ex-enterprise funds	11(10.7)	0(0.0)	11(12.3)		
− Other cost factors	6(6.4)	1(5.0)	6(6.7)		
− Dominance of established enterprises	2(2.1)	0(0.0)	2(2.4)		
− Lack of qualified staff	1(0.7)	0(0.0)	1(0.8)		
− Other knowledge factors	1(0.7)	1(5.0)	0(0.0)		

Priorities when producing					
− Economic profit (None/Little/Occasional/Quite/A lot of)	0(0.0)/0(0.0)/2(2.2) /6(5.6)/93(92.2)	0(0.0)/0(0.0)/0(0.0) /1(10.1)/12(89.9)	0(0.0)/0(0.0)/2(2.6) /4(4.9)/81(92.5)	0.000(1)	0.999(n.s.)
− Obtaining healthy products (None/Little/Occasional/Quite/A lot of)	0(0.0)/0(0.0)/0(0.0)/ 27(27.1)/74(72.9)	0(0.0)/0(0.0)/0(0.0) /5(36.2)/ 8(63.8)	0(0.0)/0(0.0)/0(0.0) /23(25.7)/65(74.3)	0.354(1)	0.552(n.s.)
− Personal prestige (None/Little/Occasional/Quite/A lot of)	0(0.0)/1(0.7)/2(2.1)/ 30(29.8)/68(67.4)	0(0.0)/1(5.0)/1(5.0) /3(26.1)/8(63.8)	0(0.0)/0(0.0)/1(1.7) /27(30.4)/60(67.9)	1.025(1)	0.311(n.s.)
− Respect for the environment (None/Little/Occasional/Quite/A lot of)	0(0.0)/1(0.7)/4(3.5)/ 32(31.2)/65(64.6)	0(0.0)/1(5.0)/1(10.1) /3(25.2)/8(59.7)	0(0.0)/0(0.0)/2(2.6) /28(3.1)/57(65.3)	1.587(1)	0.208(n.s.)
− Assuming a low risk (None/Little/Occasional/Quite/A lot of)	0(0.0)/3(2.9)/4(4.2)/ 35(34.2)/59(58.8)	0(0.0)/0(0.0)/1(10.1) /4(31.1)/8(58.8)	0(0.0)/3(3.3)/3(3.3) /30(34.6)/52(58.8)	0.000(1)	0.989(n.s.)
Demanded research topics				0.000(1)	0.996(n.s.)
− Biotechnology for determination of fraud by mixture of oils	72(71.4)	10(73.7)	62(71.1)		
− Detection of fraud by 'deodorised' olive oil in virgin olive oil	6(6.1)	1(6.2)	5(6.1)		
− Olive oil in non-traditionally consuming countries	6(5.5)	1(5.0)	5(5.5)		
− Determination of pollutants in olive oil. Regulations of pesticides	5(5.3)	0(0.0)	5(6.1)		
− Use of extra-virgin olive oil as a substitute for other fats in the diet	4(3.6)	1(5.0)	3(3.3)		
− Differentiation factors of olive oil: involvement of marketing	2(2.3)	0(0.0)	2(2.6)		
− Rules for olive oil tasting	1(1.5)	0(0.0)	2(1.8)		
− New olive leaf products	1(0.8)	1(5.0)	1(0.9)		
− Potential demand for new products that contain olive oil and demand of by-products	1(0.8)	0(0.0)	1(0.9)		
− Olive oil and cancer	1(0.7)	0(0.0)	1(0.9)		
− Consumer behaviour in the international markets	1(0.7)	1(5.0)	0(0.0)		
− Olive oil micro-components and their effect on health	0(0.0)	0(0.0)	1(0.8)		

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.) = 1; Pearson $\chi 2$ for contingent tables when d.f.> 1; $\chi 2$ for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** $p \leq 0.01$; * $0.01 < p \leq 0.05$; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated.*

3.2.2. Structural characteristics of the olive mill enterprises

With respect to the structural characteristics of olive mills, the differences between PDO and non-PDO industries are not significant either (Table 2). Olive mills are located mainly in rural areas (65.7%). In terms of type of enterprise, they are mainly first degree cooperatives and independent mills (49.5% and 44.9%, respectively); a few enterprises are second degree cooperatives (5.6%). There are no refineries among the enterprises interviewed. Their legal status

is commonly in the form of cooperative societies (55.7%), with a fair share of limited liability companies and public limited companies (27.5% and 10.9%, respectively). In terms of economic dimension, on average enterprises are of a small size, since 69.0% have 9 or less employees and 29.0% have 10-49 members of staff. Additionally, annual turnover is less than 2 million € per year for more than half the enterprises (51.7%); and 40.8% have a turnover of 2-10 million euros per year. Among their main activities, pressing olives is carried out by all enterprises, i.e. they all have a mill; also most enterprises store olive oil (91.5%); and wholesale locally as well as bottling olive oil (89.2% and 81.0%, respectively). Among the types of olive oil produced or marketed, the most frequent are extra-virgin olive oils (99.2%), virgin olive oil (98.6%), and 'lampante' olive oil (97.0%), that is, olive oil without industrial processing. The main suppliers are farmers located in Andalusia. The main customers are canning and bottling enterprises (71.8%); some are wholesalers in destination (16.9%) and retailers (8.4%). Most of the main customers are located in Andalusia (52.3%) or the rest of Spain (40.1%) and few are located abroad (less than 7%).

Table 2. Structural characteristics of PDO vs. non-PDO olive oil enterprises

	Absolute frequencies and percentages			Correlation(+)	
	PDO & Non-PDO	PDO	Non-PDO	χ2(d.f.)/Fisher	p (sign.)
CHARACTERISTICS OF THE ENTERPRISE					
Type of enterprise					
- First degree cooperative mills (y/n)	50(49.5)/51(50.5)	9(67.5)/4(32.5)	41(46.8)/47(53.2)	F	0.110(n.s.)
- Independent oil mills (y/n)	45(44.9)/56(55.1)	4(32.5)/9(67.5)	41(46.8)/47(53.2)	F	0.222(n.s.)
- Second degree cooperative mills (y/n)	6(5.6)/95(94.4)	0(0.0)/13(100.0)	6(6.4)/82(93.6)	F	0.428(n.s.)
- Canning and bottling enterprises (y/n)	3(2.9)/98(97.1)	0(0.0)/13(100.0)	3(3.4)/85(96.6)	F	0.658(n.s.)
- Oil extraction enterprises (y/n)	1(0.7)/100(99.3)	0(0.0)/13(100.0)	1(0.8)/87(99.2)	F	0.871(n.s.)
- Refineries (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
- Refineries-bottling enterprises (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
- Others (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
Legal status				3.171(6)	0.787(n.s.)
-Cooperative society	56(55.7)	9(69.2)	47(53.4)		
-Limited liability company	28(27.5)	2(15.4)	26(29.5)		
-Public limited company	11(10.9)	2(15.4)	9(10.2)		
-Agricultural Transformation Society	2(2.2)	0(0.0)	2(2.3)		
-Community of assets	2(2.2)	0(0.0)	2(2.3)		
-Group society	1(0.8)	0(0.0)	1(1.1)		
-Others (self-employed worker)	1(0.7)	0(0.0)	1(1.1)		
Location				F	0.236(n.s.)
-Rural area	64(65.7)	7(52.4)	58(67.8)		
-Urban area	34(34.3)	6(47.6)	27(32.2)		
Economic dimension					
- Nº employees:				0.015(1)	0.903(n.s.)
- Up to 9	70(69.0)	10(73.9)	60(68.2)		
- 10 to 49	29(29.0)	3(26.1)	26(29.4)		
- 50 to 249	2(2.1)	0(0.0)	2(2.4)		
- 250 or more	0(0.0)	0(0.0)	0(0.0)		
- Annual turnover:				1.186(2)	0.553(n.s.)
- Up to 2 million euros/ year	50(51.7)	5(38.5)	45(54.2)		
- More than 2 to 10 million euros/ year	39(40.8)	7(53.8)	32(38.5)		
- More than 10 to 50 million euros /year	7(7.4)	1(7.7)	6(7.2)		
- More than 50 million euros/ year	0(0.0)	0(0.0)	0(0.0)		
Main activities					
-Pressing olives (y/n)	101(100.0)/0(0.0)	13(100.0)/0(0.0)	88(100.0)/0(0.0)	F	c
-Storing (y/n)	92(91.5)/9(8.5)	12(95.0)/1(5.0)	80(91.0)/8(9.0)	F	0.674(n.s.)
-Wholesaling at origin (y/n)	90(89.2)/11(10.8)	12(95.0)/1(5.0)	78(88.3)/10(11.7)	F	0.571(n.s.)
-Bottling/canning of olive oil (y/n)	82(81.0)/19(19.0)	10(72.6)/4(27.4)	72(82.2)/16(17.8)	F	0.280(n.s.)
-Refining of olive oil (y/n)	9(8.4)/92(91.6)	0(0.0)/13(100.0)	9(10.2)/79(89.8)	F	0.318(n.s.)
-Other (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
Type of olive oil produced or marketed					
-Extra-virgin olive oil (y/n)	100(99.2)/1(0.8)	13(100.0)/0(0.0)	87(99.1)/1(0.9)	F	0.871(n.s.)
-Virgin olive oil (y/n)	100(98.6)/1(1.4)	13(100.0)/0(0.0)	86(98.4)/1(1.6)	F	0.870(n.s.)
-Lampante olive oil (y/n)	98(97.0)/3(3.0)	12(93.8)/1(6.2)	86(97.4)/2(2.6)	F	0.342(n.s.)
-Olive oil (y/n)	13(13.1)/88(86.9)	0(0.0)/13(100.0)	13(15.0)/75(85.0)	F	0.147(n.s.)
-Olive pomace oil (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
-Crude olive pomace oil (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
Main customers				0.079(1)	0.779(n.s.)
-Canning and bottling enterprises	72(71.8)	8(58.6)	65(73.7)		
-Wholesaling in destination	17(16.9)	5(41.4)	12(13.2)		
-Retailers	9(8.4)	0(0.0)	9(9.7)		
-Oil extraction enterprises	1(0.8)	0(0.0)	1(0.9)		
-Centralised buyers	1(0.8)	0(0.0)	1(0.9)		
-Distribution platforms	1(0.7)	0(0.0)	1(0.8)		
-Refineries-bottling enterprises	1(0.7)	0(0.0)	1(0.8)		
Main localization of customers				0.752(3)	0.861(n.s.)
-Andalusia	50(52.3)	4(42.4)	45(52.9)		
-The rest of Spain	38(40.1)	5(51.2)	33(38.8)		
-Other countries of UE	6(6.7)	1(6.4)	6(7.1)		
-Other countries of world	1(0.8)	0(0.0)	1(1.2)		

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.) = 1; Pearson χ2 for contingent tables when d.f.> 1; χ2 for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p ≤ 0.01; * 0.01< p ≤ 0.05; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated.*

3.3. Industrial and marketing practices associated with PDO

3.3.1. Industrial practices

The industrial and marketing practices implemented by olive mills may be affected by the adoption of PDO. However, with respect to industrial practices specifically, no significant differences between PDO and non-PDO mills have been detected (Table 3). On average, both groups – PDO and non-PDO mills – demonstrate a wide use of optimal practices of reception, processing and storage of olives; paste preparation, pressing and extraction; olive oil extraction; olive oil storage, bottling and transport; and control of quality and hygiene. This highlights the adaptation of the sector to the latest technological innovations. Although all optimal practices positively influence quality, it is important to highlight some, due to their special effect on the quality of the olive oil produced. On average, these key optimal practices are evenly spread, and are always adopted by more than 75% of mills, whether they be PDO or non-PDO: the differentiation between olives from the ground and from trees (86.3%); a system for checking the maturity index and quality of products that arrive at the mill (84.0%); pressing fruit within 24 h of reception (85.9%); and the training of warehouse staff in good practices of hygiene and handling (78.6%). Most of the remaining optimal industrial practices are also widely spread among PDO and non-PDO mills, with on average more than 90% of both groups applying them: appropriate olive reception containers (91.6%) which are systematically cleaned (91.4%); control of temperature and beating time (100.0%); temperature of water below 35ºC (97.9%); permanent cleaning of mills, pipes and mixers, using only hot water under pressure (93.5%), control of washing water (93.3%); extraction of olive oil through a continuous system of two phases (99.2%); separated olive oil stores according to quality (99.2%); systematic and permanent cleaning of olive

oil tanks, pipes and warehouses (97.1%); bottling machinery made of stainless steel and easy to clean (95.7%); tanks and bottles exclusively used for olive oil, and bottles not reused (90.6%); olive bottles, cans and packs not in contact with the ground (90.0%); and analysis of the olive oil for characterisation (92.7%) and to detect phytosanitary traces (91.7%).

However, a small number of optimal practices are less widely adopted and improvements could be made by both groups: evacuation of waste materials from olives in specific containers, which are periodically cleaned (43.5%); regular cleaning of olive boxes with products authorised for the food industry (42.7%); and the existence of a Quality Control Department (62.0%). The management of by-products and debris can also be improved. For example, an important proportion of enterprises store the wastewater in evaporation ponds (76.9%), whereas few mills purify the wastewater in sewage treatment plants located outside (19.0%) or within the mill industry (5.7%). With regard to the by-product (pomace and wet pomace) the enterprises focus on the extraction of crude pomace olive oil (67.9%), though the by-product is also used as fuel (30.5%) and sold to external olive-pomace oil extraction plants (23.1%). Few enterprises use the by-product as a fertilizer, as recommended, or as animal feed (3.8 and 2.2%, respectively).

Table 3. Industrial practices implemented by PDO vs. non-PDO olive oil enterprises

	Absolute frequencies and percentages			Correlation(+)	
	PDO & Non-PDO	PDO	Non-PDO	χ2(d.f.)/Fisher	p(sign.)
Reception, fitting out and storage of olives					
− Right reception containers for fruit circulation and capacity below 20 tonnes (y/n)	93(91.6)/8(8.4)	12(95.0)/1(5.0)	80(91.2)/8(8.8)	F	0.674(n.s.)
− Systematic cleaning of storage containers (y/n)	92(91.4)/9(8.6)	13(100.0)/0(0.0)	79(90.2)/9(9.8)	F	0.274(n.s.)
− Differentiation of olives from soil and tree (y/n)	87(86.3)/14(13.7)	13(100.0)/0(0.0)	74(84.3)/14(15.7)	F	0.125(n.s.)
− System for checking of maturity index and products quality that arrive to the mill (y/n)	85(84.0)/16(16.0)	11(84.9)/2(15.1)	74(83.9)/14(16.1)	F	0.662(n.s.)
− Evacuation of waste materials in specific containers for this, which are cleaned periodically (y/n)	44(43.5)/57(56.5)	5(38.6)/8(61.4)	39(44.2)/49(55.8)	F	0.465(n.s.)
− Periodic cleaning of olive boxes with products authorised for the food industry (y/n)	43(42.7)/58(57.3)	3(23.5)/10(76.5)	40(45.6)/48(54.4)	F	0.109(n.s.)
− Others (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
Paste preparation, pressing and extraction					
− Control of temperature and beating time (y/n)	101(100.0)/0(0.0)	13(100.0)/0(0.0)	88(100.0)/0(0.0)	F	c

− The water temperature for the extraction is below 35ºC (y/n)	99(97.9)/2(2.1)	13(100.0)/0(0.0)	86(97.6)/2(2.4)	F	0.758(n.s.)
− Permanent cleaning of mills, pipes and mixer using only hot water under pressure (y/n)	94(93.5)/7(6.5)	13(100.0)/0(0.0)	81(92.5)/7(7.5)	F	0.369(n.s.)
− Control of washing water (y/n)	94(93.3)/7(6.7)	13(100.0)/0(0.0)	81(92.05)/7(7.95)	F	0.369(n.s.)
− Pressing fruit before 24 hours after its reception (y/n)	85(85.9)/14(14.1)	12(89.9)/1(10.1)	74(85.2)/13(14.8)	F	0.423(n.s.)
− Others (y/n)	1(0.7)/100(99.3)	1(5.0)/12(95.0)	0(0.0)/88(100.0)	F	0.129(n.s.)
Olive oil extraction system					
− Continuous system of two phases (y/n)	100(99.2)/1(0.8)	13(100.0)/0(0.0)	87(99.1)/1(0.9)	F	0.871(n.s.)
− Discontinuous or traditional system (by press) (y/n)	1(1.4)/100(99.2)	0(0.0)/13(100.0)	1(1.6)/86(98.4)	F	0.870(n.s.)
− Continuous system of three phases (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
Olive oil storage, bottling/canning and transport					
− Separating stores depending on its quality (y/n)	100(99.2)/1(0.8)	13(100.0)/0(0.0)	87(99.1)/1(0.9)	F	0.871(n.s.)
− Systematic and permanent cleaning of tanks, pipes and the warehouse (y/n)	98(97.1)/3(2.9)	13(100.0)/0(0.0)	85(96.7)/3(3.3)	F	0.658(n.s.)
− Bottling/canning machinery of stainless steel and easy to be cleaned (y/n)	97(95.7)/4(4.3)	13(100.0)/0(0.0)	84(95.1)/4(4.9)	F	0.571(n.s.)
− Tanks and bottles/cans are exclusively used for olive oil and bottles/cans are not reused (y/n)	92(90.6)/9(9.4)	13(100.0)/0(0.0)	78(89.3)/9(10.7)	F	0.270(n.s.)
− Olive bottles, cans and packs are not in contact with the ground (y/n)	91(90.0)/10(10.0)	13(100.0)/0(0.0)	78(88.5)/10(11.5)	F	0.235(n.s.)
− Others (y/n)	1(1.4)/100(98.6)	0(0.0)/13(100.0)	1(1.6)/86(98.4)	F	0.870(n.s.)
Quality and hygiene control					
− Analysis for olive oil characterisation (y/n)	94(92.7)/7(7.3)	12(95.0)/1(5.0)	81(92.3)/7(7.7)	F	0.726(n.s.)
− Analysis of phytosanitary traces (y/n)	93(91.7)/8(8.3)	13(100.0)/0(0.0)	80(90.5)/8(9.5)	F	0.318(n.s.)
− Training of warehouse staff on good practices of hygiene and handling (y/n)	79(78.6)/22(21.4)	12(95.0)/1(5.0)	67(76.2)/21(23.8)	F	0.170(n.s.)
− Existence of a Quality Control Department (y/n)	63(62.0)/38(38.0)	11(84.9)/2(15.1)	51(58.6)/36(41.4)	F	0.063(n.s.)
− Others (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
Management of by-products and debris					
Liquid debris: wastewater					
− Storage in evaporation ponds (y/n)	78(76.9)/23(23.1)	10(76.5)/3(23.5)	68(76.9)/20(23.1)	F	0.609(n.s.)
− Purification in a sewage treatment plant with a different location to olive mill (y/n)	19(19.0)/82(81)	2(18.5)/11(81.5)	17(19.1)/71(80.9)	F	0.541(n.s.)
− Purification in the olive mill by means of incorporation the sewage treatment plant inside the production system (y/n)	6(5.7)/95(94.3)	1(0.5)/12(95.0)	5(5.8)/83(94.2)	F	0.572(n.s.)
− Others (y/n)	4(3.5)/97(96.5)	1(0.5)/12(95.0)	3(3.3)/85(96.7)	F	0.429(n.s.)
By-product: pomace, wet pomace					
− Extraction of crude pomace olive oil (y/n)	69(67.9)/32(32.1)	8(62.5)/5(37.5)	60(68.7)/27(31.3)	F	0.404(n.s.)
− As fuel (y/n)	31(30.5)/70(69.5)	4(33.6)/9(66.4)	26(30.1)/61(69.9)	F	0.590(n.s.)
− Sale to external enterprises: olive-pomace oil extraction plants (y/n)	23(23.1)/78(76.9)	2(15.1)/11(84.9)	21(24.3)/67(75.7)	F	0.391(n.s.)
− As fertilizer (y/n)	4(3.8)/97(96.2)	0(0.0)/13(100.0)	4(4.4)/84(95.6)	F	0.571(n.s.)
− As animal feed (y/n)	2(2.2)/99(97.8)	0(0.0)/13(100.0)	2(2.6)/86(97.4)	F	0.758(n.s.)

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.) = 1; Pearson χ2 for contingent tables when d.f.> 1; χ2 for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p ≤ 0.01; * 0.01< p ≤ 0.05; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated.*

3.3.2. Marketing practices

In contrast to the afore-mentioned industrial practices, there are some significant differences between the marketing practices of PDO and non-PDO mills (Table 4). However, when it comes

to distribution, no differences are evident. Common forms of distribution are the direct sale of bulk olive oil, which is carried out by all the mills (100.0%), and bottling olive oil, also carried out by the majority (92.1% on average for both groups). Sales via other distribution channels such as superstores, supermarkets, specialised shops, etc., are less frequent (37.2%). Nor is horizontal and vertical integration with other companies into second degree cooperatives very common (11.6%). Information and communication technologies (e-commerce, web page, etc.) are used by 60.4% of the enterprises.

A sales strategy based on quality is the main promotion practice for PDO and non-PDO enterprises, without distinction (89.2%). A sales strategy based on price is also important on average although it is used significantly less by PDO enterprises than non-PDO ones (36.4% vs. 73.0%, respectively). Carrying out promotion campaigns and participating in fresh food fairs is significantly more important for PDO enterprises than for the rest (57.4% vs. 13.6%, respectively). Combination with other products and brands is a promotion and price practice that, on average, is not widely used, and here there is no significant difference between the two groups (2.1%).

Marketing practices related to the olive oil product are generally similar in PDO and non-PDO olive mills. They are mainly targeted towards diversification of the bottle´s appearance (material, size, design, etc.) (81.0% on average) and the type of olive oil sold (quality levels, etc.) (71.2%). Quality labelling of integrated olive oil is implemented by 3.4% of olive mills on average, without significant differences between PDO and non-PDO mills. In contrast, the organic olive oil label is significantly more frequently used in PDO mills' marketing practices than in the rest (20.2% vs. 0.0%, respectively). The remaining marketing practices are seldom adopted in general by either type of mill (by less than 5% on average). These practices include techniques to control fraud, preparation of alternative products, combination with other foodstuffs (e.g. cheese in olive oil), and preparation of new foodstuffs (e.g. pâté) or non-foodstuffs (e.g. cosmetics).

Table 4. Marketing practices implemented by PDO vs. non-PDO olive oil enterprises

	Absolute frequencies and percentages			Correlation(+)	
	PDO & Non-PDO	PDO	Non-PDO	χ2(d.f.)/Fisher	p (sign.)
Distribution					
− Direct sale of bulk olive oil (y/n)	100(100.0)/0(0.0)	12(100.0)/0(0.0)	88(100.0)/0(0.0)	F	c
− Direct sale of bottled olive oil (y/n)	93(92.1)/8(7.9)	13(100.0)/0(0.0)	80(90.9)/8(9.1)	F	0.318(n.s.)
− Use of information and communication technologies (e-commerce, web page, etc.) (y/n)	61(60.4)/40(39.6)	10(78.7)/3(21.3)	51(57.6)/37(42.4)	F	0.158(n.s.)
− Sale via other distribution channels (superstores, supermarkets, specialised shops, etc.) (y/n)	38(37.2)/63(62.8)	4(32.5)/9(67.5)	33(37.9)/55(62.1)	F	0.444(n.s.)
− Horizontal and vertical integration with other companies (e.g. in second degree cooperatives) (y/n)	12(11.6)/89(88.4)	1(10.1)/12(89.9)	10(11.9)/77(88.1)	F	0.565(n.s.)
− Others (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
Promotion and price					
− Sales strategy based on quality (y/n)	90(89.2)/11(10.8)	13(100.0)/0(0.0)	77(87.6)/11(12.4)	F	0.201(n.s.)
− Sales strategy based on price (y/n)	69(68.3)/32(31.7)	5(36.4)/8(63.6)	64(73.0)/24(27.0)	F	0.018(*)
− Promotion campaigns and participation in fresh food fairs (y/n)	19(19.3)/82(80.7)	8(57.4)/6(42.6)	12(13.6)/76(86.4)	F	0.001(**)
− Combination with other products and brands (y/n)	2(2.1)/99(97.9)	1(5.0)/12(95.0)	1(1.7)/86(98.3)	F	0.244(n.s.)
− Others (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
Product					
− Diversification of the bottle presentation (material, size, design, etc.) (y/n)	82(81.0)/19(19.0)	12(89.9)/1(10.1)	70(79.6)/18(20.4)	F	0.248(n.s.)
− Diversification of the type of olive oil (quality, etc.) (y/n)	72(71.2)/29(28.8)	9(68.6)/4(31.4)	64(73.2)/24(26.8)	F	0.512(n.s.)
− Application of techniques to control fraud (mixtures, pollutants, etc.) (y/n)	5(4.6)/96(95.4)	0(0.0)/13(100.0)	3(3.7)/85(96.3)	F	0.658(n.s.)
− Quality labelling: Integrated production (y/n)	3(3.4)/98(96.6)	1(10.1)/12(89.9)	2(2.4)/86(97.6)	F	0.342(n.s.)
− Quality labelling: Organic production (y/n)	3(2.6)/98(97.4)	3(20.2)/10(79.8)	0(0.0)/88(100.0)	F	0.002(**)
− Preparation of alternative products (y/n)	1(0.8)/100(99.2)	0(0.0)/13(100.0)	1(0.9)/87(99.1)	F	0.871(n.s.)
− Preparation of new foodstuffs (e.g. pâté of olive oil) (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
− Preparation of new non foodstuffs (e.g. cosmetics) (y/n)	0(0.0)/101(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c
− Combination with other foodstuffs (e.g. cheese in olive oil) (y/n)	0(0.0)/100(100.0)	0(0.0)/13(100.0)	0(0.0)/88(100.0)	F	c

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.) = 1; Pearson χ2 for contingent tables when d.f.> 1; χ2 for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p ≤ 0.01; * 0.01< p ≤ 0.05; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated.*

4. DISCUSSION

4.1. Adoption of CQS and PDO

The results demonstrate that, in general, the level of adoption of CQS in the Andalusian olive mill sector, including both mill cooperatives and private mills, is not high, thus confirming the first of the research hypotheses. This conclusion is in line with research by Karipidis, et al. (2009) which suggests that the rate of adoption of CQS among small food enterprises cannot be considered satisfactory. In this context, PDO stands out as the most widespread CQS in the olive sector. However, no clear adoption factors for PDO have been identified, since the structural characteristics of mills adopting PDO and the attitudes of their managerial and supervisory staff are very similar to those not adopting it. The reason for this may be that there are other factors behind the decision to adopt PDO. For instance, a higher presence of PDO farmers in less favourable, steeply sloping areas, has been reported (Hinojosa-Rodríguez, et al., 2014). In addition, the major reason for the spread of other CQS in the olive sector in Andalusia, such as organic agriculture, was 'contagion' among farmers due to spatial proximity (Parra-López & Calatrava-Requena, 2005; Parra-López, et al., 2007). This could also be the case for PDO since a high dependence on nearby sources has been confirmed for farmers in previous studies (Hinojosa-Rodríguez, et al., 2014). The current research confirms its importance for olive mill managerial and supervisory staff. This indicates that training and information programmes based on successful PDO case studies for farmers, managerial and supervisory staff, could be a very appropriate policy for encouraging the further spread of PDO. Proving that the costs associated with PDO implementation can be recovered in the medium to long-term (Molina Azorín, et al., 2009) should

be a research priority for the future, since, as our results indicate, economic profit is the main priority of managerial and supervisory staff.

4.2. Management practices

Apart from the stipulation that production, processing and preparation must follow the recognized know-how of a specific geographical area, the management practices implemented are not currently affected by the PDO scheme. Therefore, enterprises adopting PDO have room for manoeuvre in deciding the practices they implement. Our results demonstrate that in general optimal practices are widespread in Andalusian olive mills and that the adoption of PDO is not related to the implementation of better industrial practices, thus confirming the second research hypothesis. The appropriate physical structures (Moyano Fuentes, et al., 2002) and high standards of quality in the practices implemented can be explained by the extraordinary technological advances achieved in the Andalusian olive sector since the early 90s, particularly in the olive mills that have substituted 3-phase extraction systems with 2-phase ones (Alburquerque, et al., 2004). However, it is imperative to encourage a complete reorientation of the olive enterprises´ innovation policies and strategies because there is a low level of innovation in management methods and a lack of collective organisation in the initial stages of the agro-food chain (Sanz Cañada, et al., 1998). Hence, the results demonstrate clearly that there is room for improvement in PDO marketing practices because they are in general still very similar to those implemented in non-PDO enterprises, with the exception that PDO mills have a lower emphasis on price competition and a greater offer of organic olive oil, both of which are appropriate quality strategies. Further marketing developments are also needed: innovative combinations with other products, more robust implementation of standards to avoid fraud, a promotion strategy based on the environment,

a wider presence in the big distribution channels, and horizontal and vertical integration with other companies to form second degree cooperatives.

4.3. Policy implications

PDO can fill a specific market niche based on certified quality. However, the olive sector faces difficulties in extracting maximum added value from such certification. PDO mainly targets local markets close to the production areas, where the intrinsic relationship between the quality of the product and its origin may be more widely appreciated (Albayram, et al., 2014; Sanjuán, et al., 2006). Despite the increase in olive surface area under PDO and in olive oil produced under PDO schemes, only 5.2% of Andalusian extra-virgin olive oil was marketed as PDO (MARM, 2010a, 2010c), which is similar to other producing countries where there is a poor penetration rate and a very low premium on the price for PDO olive oil, even among nearby rural populations (Fotopoulos & Krystallis, 2001; Galluzzo, 2007; Krystallis & Ness, 2005; Roselli, et al., 2009; van der Lans, et al., 2001). Therefore, policies to promote awareness and appreciation of PDO and other certification schemes among consumers are of utmost priority. In addition, PDO should target new markets and embed more consumer-driven added values into the final olive oil product, in addition to just geographical origin. In the context of the increasing importance of the global economy, in which Spain is the premier olive oil exporter in the world (IOC/COI, 2012), to address the new values increasingly demanded in the international marketplace, such as sustainability and environmental care, or to adopt other international quality standards, such as ISO norms and retailer's protocols, could lead to the creation of new business opportunities. In fact, the EU is demanding that the USA and other growth markets recognise and protect the EU's list of geographical indications (Matthews, 2014). Furthermore, focussing on environmental targets

would be in line with the CAP's recognition of the multifunctional role to be played by agriculture and would help to increase public support for PDO. This may be done in two ways: 1) by further extending the regulation of PDO to increase the environmental and quality requirements for PDO farmers and enterprises through stricter controls over farming and industrial practices; and 2) by promoting the joint adoption by PDO farmers and enterprises of other CQS recognised at European or international level such as integrated production, organic agriculture, and others less common in the sector. A change in the mentality of PDO olive mill managerial and supervisory staff with regards to risk-taking and to the implementation of innovative measures for entering new markets is required, as is the pursuit of enhanced olive oil quality and increased respect for the environment. The role of public research organisations and technological centres as catalysts for participation in R&D&I programs - which has to date been very low - and in the training of managerial and supervisory staff, should be reinforced, with the particular aim of achieving public targets on the environment and on sustainable production.

5. CONCLUSIONS

In Andalusia, southern Spain, the leading olive growing region in the world, the expansion of international markets, the increasing segmentation of consumers based on quality considerations and the need to compete with large distributors, has meant that a quality strategy for olive oil production and the adoption of Certified Quality Systems (CQS) have become increasingly important for cooperative and small/medium-sized private olive mills, which comprise the vast majority of olive producers. The results highlight that the level of adoption of CQS in the Andalusian olive mill sector is not high in general, but that PDO is relatively prevalent. The

adoption of PDO seems to result from a contagion effect among industries that are located within less favourable, steeply sloping areas, rather than as a result of the structural characteristics of the olive mills or the attributes, attitudes and opinions of their managerial and supervisory staff. Moreover, the adoption of PDO is not generally related to an implementation of better industrial practices but of marketing practices, since in general the former are already prevalent in Andalusian olive mills. The results obtained have multiple policy and management implications in terms of enhancing economic viability by increasing the spread of PDO, and by improving the practices implemented by PDO enterprises. Key implications are: 1) the high importance of developing further training programs for managerial and supervisory staff based on demonstrations of successful PDO enterprises, with public research organisations and technological centres playing a key role; 2) the need for further research to prove that the costs associated with PDO can be recovered in the medium to long-term; 3) the importance of enhanced efforts to promote awareness of PDO and other certification schemes among consumers; 4) the importance for PDO olive oil of creating, in addition to just geographical origin, new added-values that are increasingly demanded in European and international markets such as sustainability and environmental care, and of adopting other internationally recognised quality schemes; 5) the need to develop new marketing strategies based on innovative product combinations, avoiding fraudulent practices, respecting the environment, and establishing more robust methods of collective organisation and collaboration in the initial stages of the agro-food chain.

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ARTÍCULO CUARTO

STRENGTHENING THE ADOPTION AND GOOD MANAGEMENT PRACTICES OF ISO 9001 IN THE OLIVE OIL INDUSTRY: THE CASE OF SOUTHERN SPAIN

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ARTÍCULO CUARTO: STRENGTHENING THE ADOPTION AND GOOD MANAGEMENT PRACTICES OF ISO 9001 IN THE OLIVE OIL INDUSTRY: THE CASE OF SOUTHERN SPAIN

ABSTRACT

This article examines the factors conditioning the adoption of ISO 9001, including the characteristics of enterprises and their managerial and supervisory staff, in the olive oil industry of Andalusia, the world-leading olive oil producing region in southern Spain. It also examines the influence of ISO 9001 adoption on the management practices implemented by the olive oil industry, differentiating between industrial and marketing practices. The study is based on a stratified survey of the managerial and supervisory staff of 101 olive oil enterprises in the main olive growing provinces of Andalusia. The results reveal a relatively low ISO 9001 adoption rate, although it stands out over other private Certified Quality Systems. The managerial and supervisory staff of enterprises adopting ISO 9001 are younger and more dynamic, highly educated and in touch with new, high-quality sources of information, and also more willing to take risks and less focused on economic profit. Considering the high relevance of information from near sources which has been detected in the sector, they may serve to lead the way for potential adopters through training demonstrations and educational programs. There is a particular need to further investigate and transfer to potential adopters information related to the economic, financial and managerial aspects of implementing ISO 9001. Performance benefits from the internalization of ISO 9000 standards are achieved mainly through the development of human and organizational capital, and

consequent improvements in business processes. Although industrial practices are generally optimal in the Andalusian olive oil industry, there is room for improvement in this area, and even more so in the case of marketing practices. New marketing and business strategies need to be developed by ISO 9001 approved olive oil enterprises, including a deeper horizontal and vertical integration with other companies, innovative collaborative/cooperative strategies with the large-scale retail trade and distribution, and a greater concern on the part of managerial and supervisory staff for optimal planning and commitment to customer service and quality.

Keywords: Food quality assurance; certified quality systems; industrial and marketing practices; adoption factors; ISO; olive oil industry.

1. INTRODUCTION

The globalisation of the world economy and the expansion of international trade have led to rapid processes of quality internationalization as a crucial element of companies' competitiveness (Ruzevicius, 2008). Since the early 1980s, manufacturing industries worldwide have seen a revolution in the way they operate: consumers have become more and more demanding and the key to companies' survival is the acknowledgement of customer satisfaction (Efstratiadis et al., 2000). In the agro-food sector, food quality is an increasingly important attribute not just for consumers in developed countries but also for the upper-middle classes in developing countries (Anania and Pupo D'Andrea, 2008; Mili and Rodríguez Zúñiga, 2001; Sanz Cañada and Macías Vázquez, 2005). However, in the agro-food chain quality can only be imperfectly observed by the end customer (Carriquiry and Bruce, 2007) due to the increasing distances between producers and consumers (Terlaak and King, 2006). Therefore the objective of not just delivering quality but also certifying this through the adoption of a Certified Quality System (CQS) is becoming an increasingly important sales and marketing strategy for competitiveness in the agro-food sector (Jatib, 2003; López Rodríguez et al., 2009). It is being used to ensure the quality of products and services and to eliminate technical barriers in trade (Ruzevicius, 2008). With regard to olive oil, the subject of this research, certified quality will play a key role in the medium to long term. In fact, both in high-income non-traditional markets and in traditional consumer countries a trend can be observed towards a more segmented market based on product quality differentiation (Anania and Pupo D'Andrea, 2008; Mili and Rodríguez Zúñiga, 2001).

Spain is the world leader in olive growing: the most recent data available shows that it had 38.7% of world production and 24.4% of olive surface area in 2013 (FAO, 2015). Andalusia, a region in southern Spain, is the most important olive-growing area in the country and in the world,

representing 75.7% of the olive production and 62.3% of the olive surface area of Spain in 2013 (MAGRAMA, 2014). The Spanish olive oil industry consists basically of: 1) first and second degree cooperative mills which press the olives, bringing together a wide group of small/medium olive growers and accounting for more than 70% of the olive oil produced (Sanz Cañada and Macías Vázquez, 2005); 2) a minority of independent/private mills pertaining to larger farmers, which account for the rest of the olive oil produced; 3) canning and bottling enterprises, which can either be specialised companies or form part of the mills; 4) oil extraction enterprises, specialised in extracting additional oil from olive pomace; and 5) a few refineries, specialised in refining 'lampante' olive oil, a non-marketable olive oil that needs to be refined. The distribution of olive oil is dominated by large distribution enterprises and major bottling companies (Anania and Pupo D'Andrea, 2008; Montegut Salla et al., 2007; Sanz Cañada et al., 1998). Spain is the biggest olive oil exporter in the world (FAO, 2015). More than 60% of Spanish olive oil is destined for exportation, including both the final bottled product and bull olive oil to be subsequently processed and bottled (MARM, 2010b). Moreover, in recent years olive oil exportation has been increasing sharply at a rate of 14.8% per year (MARM, 2010a, b). The main destinations for Spanish exports are other EU-27 countries (74.8% of exports) and emerging markets such as USA and Australia (7.3% and 2.7% respectively) (MARM, 2010b). These markets are increasingly demanding high quality standards (Anania and Pupo D'Andrea, 2008; Mili and Rodríguez Zúñiga, 2001). Furthermore, the recent advent of new olive-producing regions in the world puts additional pressure on the olive oil enterprises of traditional producers such as Spain. Therefore, adopting a CQS demanded by the international markets and large scale distribution are strategies which guarantee standards of quality beyond conventional and mandatory levels and are crucial to the survival and competitiveness of olive oil enterprises (Marbán Flores, 2005).

The study of quality certification in the Andalusian olive oil sector has mainly focused on a few CQS backed by public regulations, mainly Protected Designation of Origin, Integrated Production and Organic Agriculture, putting emphasis on the differential quality of the final product (Hinojosa-Rodríguez et al., 2014b). The adoption processes and management practices associated with these public CQS have been widely studied in the Andalusian olive oil sector (Cendón et al., 2014; Hinojosa-Rodríguez et al., 2014a; Hinojosa-Rodríguez et al., 2014b; Parra-López and Calatrava-Requena, 2005, 2006; Parra-López et al., 2007; Parra-López et al., 2015; Sanz Cañada and Macías Vázquez, 2005, 2008). However, private CQS have been analysed far less despite their increasing relevance. Private CQS include: 1) ISO standards, such as ISO 9001 and ISO 14001, among others; 2) retailer protocols, such as GLOBALGAP, IFS (International Food Standard) and BRC (British Retail Consortium); and 3) Spanish regulations specific to olive oil and R&D management, such as the various UNE norms.

This study focuses on the private CQS that stands out most in the Andalusian olive industry: ISO 9001. This quality system (full name ISO 9001:2008) is part of the ISO 9000 family on quality management, defined by the International Organization for Standardization (ISO). ISO 9000 provides guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer requirements, and that quality is consistently improved (ISO, 2015). ISO 9001 sets out the criteria for a quality management system and is the only standard in the family that can be certified. Third-party certification bodies provide independent confirmation that organizations meet the requirements of ISO 9001. It can be used by any organization, large or small, regardless of its field of activity, and it is one of the most widely acknowledged CQS internationally (Psomas and Fotopoulos, 2010). ISO 9001:2008 is implemented by more than one million companies and organizations in over 170 countries (ISO, 2015). The international literature on ISO 9000/9001 in the olive agro-food system has dealt with

such diverse topics as the demand/knowledge of the norm by olive oil consumers (Galluzzo, 2007), the validity of ISO 9000/9001 as a market strategy for olive cooperatives (Marbán Flores, 2005; Maza et al., 2009; Montegut Salla, 2006; Montegut Salla et al., 2007) and its influence on olive oil quality (Vilar Hernández, 2003; Vilar Hernández et al., 2009). However, the factors underlying its adoption in the olive agro-food sector remain unexplored, both in Andalusia and on a worldwide level. Moreover, another question which has yet to be studied in depth is whether adopting this ISO norm is related to the implementation of better (or more optimal) practices as compared to conventional practices in the olive oil industry. Only a few references to this were identified in the literature and these highlight a positive correlation between ISO 9001 adoption and the use of better practices (Vilar Hernández, 2003; Vilar Hernández et al., 2009).

With all this in mind, this paper aims to contribute to the existing literature by investigating the factors conditioning the adoption of ISO 9001 in the olive oil industry of Andalusia, and by studying the relationship of ISO 9001 with the management practices implemented by the enterprises involved, differentiating between industrial and marketing practices. The specific objectives of this study are: 1) to describe the general status of knowledge and adoption on the part of Andalusian olive oil enterprises of the various private CQS available, including ISO 9001; 2) to define the determining adoption factors of ISO 9001 in the olive oil industry, i.e. the associated characteristics of the enterprises involved and of their managerial and supervisory staff; and 3) to examine the relationship between the adoption of ISO 9001 and the implementation of better management practices by olive oil enterprises. The final purpose of this research is to generate insights for the design of policies and strategies to foster ISO 9001 adoption and improve the management practices implemented by the Andalusian olive oil industry.

2. METHODOLOGY

The theoretical basis for this study is the Diffusion of Innovations paradigm (Rogers, 2003). This paradigm has been widely used to analyse the diffusion of innovations in agriculture. It proposes a framework for establishing relationships between the characteristics and attitudes of individuals (or groups of individuals) and their behaviour with respect to the knowledge and adoption of innovations. It also highlights the importance of investigating the consequences of this adoption for adopters and other individuals.

The empirical work for this study is based on an interview with the managerial and supervisory staff members of 101 olive oil enterprises of the main olive-growing provinces of Andalusia, which are Jaen, Cordoba and Granada (IEA, 2012a, b). The survey was carried out from May 2010 to February 2011 via face-to-face interviews following a structured questionnaire. The objective was to gather information on the personal characteristics, attitudes and opinions of managerial and supervisory staff of olive oil enterprises, the structural characteristics of the enterprises and the management practices implemented. The survey sample was randomly stratified in proportion to the number of olive oil enterprises in five major homogeneous olive-growing zones, which were previously clustered in order to facilitate the implementation of the survey. These zones encompass municipalities that are similar in terms of the proportion of olive surface area to total agricultural surface area, according to the census of the Spanish Olive Oil Agency online database (AAO, 2010). The results were weighted according to the real interviews carried out with reference to the theoretical sample strata. As 101 of a total 697 registered olive oil enterprises (AAO, 2010) were interviewed, a sampling error of 6.32% for extreme proportions ($p=0.9$ and $q=0.1$) and of 10.54% for intermediate proportions ($p=q=0.5$) are assumed for dichotomous variables at a 95% confidence level for the whole sample. The distribution between

ISO 9001 and non-ISO 9001 interviewees was random. In the end, information on 11 ISO 9001 and 90 non-ISO 9001 olive oil enterprises was gathered.

The information gathered and the analyses carried out are in line with the three stated objectives of this research. The purpose, data gathered, and the methods followed for each analysis are as follows:

1. General knowledge and adoption of private CQS:

    1.1. Purpose: To describe the knowledge and adoption level among olive oil enterprises of the various available and potentially viable private Certified Quality Systems.

    1.2. Data gathered: The CQS analysed include: 1) ISO standards, such as 9001, 14001, 19011, and 22000; 2) retailer protocols, such as GLOBALGAP, International Food Standard (IFS) and British Retail Consortium (BRC); 3) Spanish UNE standards for olive oil production, such as 34601, 34605, 34606; and 4) Spanish UNE standards for R&D management, such as 166002.

    1.3. Method of analysis: Descriptive statistical analysis of rates of knowledge, adoption and intention to adopt.

2. Adoption factors of ISO 9001:

    2.1. Purpose: To identify similarities and differences between the personal characteristics, attitudes and opinions of managerial and supervisory staff of ISO 9001 enterprises and the rest, and between the structural characteristics of ISO 9001 enterprises and the rest. The differential characteristics are adoption factors related to and explaining the adoption of ISO 9001.

2.2. Data gathered: The characteristics of managerial and supervisory staff include age, sex, education level and position in the company. Attitudes and opinions are in reference to their engagement in R&D, the innovation sources they use, their objectives in production and innovation, the difficulties they face with regard to innovation and R&D priorities. The structural characteristics of the olive oil enterprises include the type of enterprise, legal status, size and turnover, principal activities, and main suppliers and customers.

2.3. Method of analysis: Bivariate statistical analysis between the characteristics of enterprises and their managerial and supervisory staff, and the adoption of ISO 9001. Statistical tests are based on: (1) Fisher's exact test for contingent tables when degree of freedom (d.f.) = 1; (2) Pearson χ^2 for contingent tables when d.f.>1; (3) χ^2 for bivariate logit when proof for contingent tables is not statistically reliable. More complex multivariate statistical analyses were not carried out due to the limited size of the sample.

3. Management practices associated with ISO 9001:

3.1. Purpose: To identify similarities and differences between the management practices used by industries adopting ISO 9001 and the rest, and determine whether practices associated with this standard are to any extent better (or more optimal). Management practices will be divided into industrial and marketing practices. In order to establish the goodness or optimality of the industrial practices implemented by ISO 9001 and non-ISO 9001 enterprises, they will be compared against the optimal practices proposed by Integrated Production, as regulated in Andalusia by the Order of 12 June 2013 (BOJA no.117). Integrated Production, the adoption of which is voluntary, proposes a set of high-standard practices considered to be optimal from a technical, economic and/or environmental point of view (Parra-López and Calatrava-Requena, 2006). The goodness (or optimality) of ISO

9001 and non-ISO 9001 practices will be determined by the degree of implementation of these optimal practices. 'Better practices' therefore means a wider use of the optimal practices.

3.2. Data gathered: Industrial practices cover the reception and storage of olives; oil extraction, storage, bottling/canning and transport; quality and hygiene control; and management of by-products and residues. Marketing practices relate to distribution; promotion and price; and product strategies.

3.3. Method of analysis: Bivariate statistical analysis between the industrial and marketing practices and the adoption of ISO 9001. Statistical tests are the same as for the adoption factors of ISO 9001.

3. RESULTS

3.1. General knowledge and adoption of private CQS

ISO norms, especially ISO 9001, the focus of this research, and ISO 14001 on environmental management systems, are widely known by the managerial and supervisory staff of olive oil enterprises (66.2% and 55.3% respectively) (Table 1). Specific Spanish norm UNE 34606 on extra-virgin olive oil bottling/canning, ISO 19011 on management systems auditing, and ISO 22000 on food safety, are known by less than 14.4% of interviewees. The remaining CQS are known by less than 10.0% of the managerial and supervisory staff members. With regard to

adoption, the most relevant CQS are again ISO 9001 and ISO 14001, which have been adopted by 10.8% and 7.0% of olive oil enterprises respectively. The remaining CQS, including UNE 34606, ISO 22000, GLOBALGAP and IFS are adopted by less than 1.6% of enterprises.

Table 1. Private CQS knowledge and adoption rates in Andalusian olive oil enterprises

	Knowledge	Adoption	Intention to adopt
ISO standards			
– ISO 9001 - quality management (y/n)	67(66.2)/34(33.8)	11(10.8)/90(89.2)	19(21.4)/71(78.6)
– ISO 14001 - environmental management systems (y/n)	56(55.3)/45(44.7)	7(7.0)/94(93.0)	17(18.2)/77(81.8)
– ISO 22000 - food safety (y/n)	12(12.1)/88(87.9)	1(1.4)/100(98.6)	8(8.1)/90(91.9)
– ISO 19011 - management systems auditing (y/n)	14(14.2)/84(85.8)	0(0.0)/101(100.0)	8(8.1)/90(91.9)
– Other ISO (y/n)	1(1.4)/100(98.6)	0(0.0)/101(100.0)	1(1.4)/100(98.6)
Retailers' protocols			
– GLOBALGAP (y/n)	8(7.7)/93(92.3)	1(0.8)/100(99.2)	6(6.5)/91(93.5)
– International Food Standard - IFS (y/n)	3(2.9)/98(97.1)	1(0.7)/100(99.3)	3(3.2)/94(96.8)
– British Retail Consortium - BRC (y/n)	1(1.4)/100(98.6)	0(0.0)/101(100.0)	1(1.5)/96(98.5)
– Other (y/n)	1(1.4)/100(98.6)	0(0.0)/101(100.0)	1(1.4)/100(98.6)
Spanish extra-virgin olive oil standards			
– Bottling/canning (UNE 34606) (y/n)	14(14.4)/87(85.6)	2(1.6)/99(98.4)	12(12.8)/82(87.2)
– Product (UNE 34601) (y/n)	7(7.2)/94(92.8)	0(0.0)/101(100.0)	6(5.9)/90(94.1)
– Processing (UNE 34605) (y/n)	7(7.2)/94(92.8)	0(0.0)/101(100.0)	6(5.9)/90(94.1)
– Other (y/n)	1(1.4)/100(98.6)	0(0.0)/101(100.0)	1(1.4)/100(98.6)
Spanish R&D management standards			
– UNE 166002 (y/n)	3(2.9)/97(97.1)	0(0.0)/101(100.0)	4(4.0)/89(96)
– Other (y/n)	1(1.4)/100(98.6)	0(0.0)/101(100.0)	1(1.4)/100(98.6)

Note: Figures are absolute frequencies (number of answers) and relative frequencies (% of answers) for yes/no questions. n.a.= not available. Small deviations when adding up numbers are due to rounding in the weighting of the stratification of the survey (see section 2).

Although the knowledge and in particular the adoption rate of private CQS in the Andalusian olive oil industry is not high in general, there is a positive attitude among managerial and supervisory staff towards the future adoption of these systems in the medium to long term. There are high rates of intention to adopt ISO 9001 and 14001 (21.4% and 18.2% respectively), which stands to reason since these norms are already widely known. There is also intention to adopt UNE 34606 on bottling/canning (12.8%), a CQS which is relatively well-known but has scarcely been adopted until now. The rate of intention to adopt other quality systems is less than 10.0%.

3.2. Adoption factors of ISO 9001

3.2.1. Personal characteristics, attitudes and opinions of managerial and supervisory staff

There are few significant differences between the personal characteristics of the managerial and supervisory staff of ISO 9001 adopters and the rest. The only difference is age, as they are younger than the non-adopters. Hence 39.8% of ISO 9001 adopters are 18 to 35 years old, versus 12.7% of non-adopters (Table 2). In the rest of their characteristics they are very similar. Their position in the company is mainly manager (more than 33.2% in both cases) and members of the management team (>13.2%), with no significant variations between ISO 9001 and non-ISO 9001 enterprises. They are mostly men (>87.7%), and their education level is mainly primary or secondary level (>41.9%) and Bachelor level graduate (>30.3%).

Table 2. Personal characteristics, attitudes and opinions of ISO 9001 vs. non-ISO 9001 managers and supervisory staff of olive oil enterprises

	Absolute frequencies and percentages		Correlation(+)	
	ISO 9001	Non-ISO 9001	χ2 (d.f)/Fisher	p (sign.)
PERSONAL CHARACTERISTICS				
Position in the enterprise			0.047(1)	0.829(n.s.)
− Manager	4(34.0)	30(33.2)		
− Member of the management team	3(26.3)	12(13.2)		
− President	0(0.0)	8(8.7)		
− Technical personnel	1(7.4)	10(10.8)		
− Other	4(32.4)	31(34.1)		
Age			6.563(1)	0.010(**)
− 18-25	1(13.2)	0(0.0)		
− 26-35	3(26.6)	11(12.7)		
− 36-45	2(20.5)	23(26.2)		
− 46-55	4(39.7)	36(41.1)		
− 56-65	0(0.0)	16(18.1)		
− More 65	0(0.0)	2(1.8)		
Sex			F	0.262(n.s.)
− Male	11(100.0)	79(87.7)		
− Female	0(0.0)	11(12.3)		
Education level			1.094(1)	0.296(n.s.)
− No studies	0(0.0)	6(6.4)		
− Vocational training	0(0.0)	10(11.4)		
− Primary education	1(13.2)	25(28.0)		
− Secondary education	4(33.7)	12(13.9)		
− Graduate – Bachelor's or equivalent	4(34.0)	27(30.3)		
− Graduate – Master's or equivalent	2(19.2)	9(10.0)		
ATTITUDES AND OPINIONS				
Participation in R&D plans				
− Regional plans (y/n)	1(6.0)/10(94.0)	1(0.9)/89(99.1)	F	0.207(n.s.)
− R&D national plan and other national plans (y/n)	0(0.0)/11(100.0)	3(3.2)/87(96.8)	F	0.705(n.s.)
− EU plans (y/n)	1(0.0)/11(100.0)	2(2.7)/88(97.3)	F	0.793(n.s.)
− Other international plans (y/n)	0(0.0)/11(100.0)	0(0.0)/90(100.0)	F	c
Innovation sources in the enterprise				
− Suppliers (y/n)	10(86.8)/1(13.2)	71(79.1)19(20.9)	F	0.313(n.s.)
− Internet (y/n)	9(79.2)/2(20.8)	28(31.6)/62(68.4)	F	0.002(**)
− Conferences, fairs, exhibitions, etc. (y/n)	7(66.3)/4(33.7)	65(72.6)/25(27.4)	F	0.391(n.s.)
− Newspapers, radio and television (y/n)	5(48.4)/6(51.6)	38(41.9)/52(58.1)	F	0.542(n.s.)
− Professional and sector associations (y/n)	4(39.7)/7(60.3)	44(48.4)/46(51.6)	F	0.323(n.s.)
− Universities, higher education centres (y/n)	4(32.4)/7(67.6)	2(2.7)/88(97.3)	F	0.001(*)
− Public research organisations (y/n)	3(26.6)/8(73.4)	20(22.8)/70(77.2)	F	0.479(n.s.)
− Customers (y/n)	2(20.5)9(79.5)	5(5.2)/85(94.8)	F	0.167(n.s.)
− Scientific journals and publications (y/n)	2(14.8)/9(85.2)	5(6.1)/85(93.9)	F	0.167(n.s.)
− Competitors or other enterprises with the same activity (y/n)	1(13.4)/9(86.6)	4(4.9)/86(95.1)	F	0.416(n.s.)
− Consultants, commercial laboratories, private R&D institutes (y/n)	1(13.2)/10(86.8)	1(1.6)/89(98.4)	F	0.207(n.s.)
− Technological centres (y/n)	0(0.0)/11(100.0)	1(0.9)/89(99.1)	F	0.891(n.s.)
− R&D department (y/n)	0(0.0)/11(100.0)	0(0.0)/90(100.0)	F	c
− Other sources (y/n)	2(19.2)/9(80.8)	27(30.5)/63(69.5)	F	0.334(n.s.)
Objectives of innovation			0.362(1)	0.547(n.s.)
− Greater production capacity	5(45.8)	6(6.3)		
− Greater market share and entering new markets	2(20.5)	7(7.7)		
− Lower labour costs per unit of product	1(13.2)	33(36.7)		
− Greater olive oil quality	1(13.2)	8(8.5)		
− Replacement of old processes and products	1(7.4)	21(23.8)		
− Lower energy consumption per unit of olive oil produced	0(0.0)	7(7.6)		
− Fostering respect for the environment	0(0.0)	6(6.3)		
− Improving work conditions	0(0.0)	1(1.6)		
− Improving health and safety conditions	0(0.0)	1(1.6)		
Factors that hinder innovation			0.045(1)	0.831(n.s.)
− Lack of in-enterprise funds	5(47.1)	42(47.5)		
− Lack of ex-enterprise funds	3(26.3)	8(8.7)		
− Costs too high	1(7.4)	31(35.0)		
− Other cost factors	1(13.2)	5(5.6)		
− Dominance of established enterprises	0(0.0)	2(2.4)		

− Lack of qualified staff	1(6.0)	0(0.0)		
− Other knowledge factors	0(0.0)	1(0.7)		
Priorities when producing				
− Obtaining healthy products (None/low/medium/high/very high)	0(0.0)/0(0.0)/0(0.0) /2(19.5)/9(80.5)	0(0.0)/0(0.0)/0(0.0) /25(28.0)/65(72.0)	0.382(1)	0.537(n.s.)
− Economic profit (None/low/medium/high/very high)	0(0.0)/0(0.0)/2(20.5) /1(6.0)/8(73.4)	0(0.0)/0(0.0)/0(0.0) /5(5.6)/85(94.4)	7.671(1)	0.006(**)
− Personal prestige (None/low/medium/high/very high)	0(0.0)/0(0.0)/1(13.4) /1(13.4)/ 8(73.2)	0(0.0)/1(0.7)/1(0.7) /29(31.8)/60(66.7)	0.069(1)	0.793(n.s.)
− Respect for the environment (None/low/medium/high/very high)	0(0.0)/0(0.0)/1(7.4) /3(25.2)/7(67.4)	0(0.0)/1(0.7)/3(3.1) /29(32.0)/58(64.2)	0.000(1)	0.988(n.s.)
− Keeping risk levels low (None/low/medium/high/very high)	0(0.0)/3(26.3)/1(6.0) /3(26.6)/4(41.4)	0(0.0)/0(0.0)/4(3.9) /32(35.1)/55(61.0)	8.573(1)	0.003(**)
Demanded research topics			0.002(1)	1.000(n.s.)
− Biotechnology for determination of fraud by mixture of oils	8(73.2)	64(71.2)		
− Use of extra virgin olive oil as a substitute for other fats in the diet	1(13.4)	2(2.4)		
− Olive oil and cancer	1(7.4)	0(0.0)		
− New olive leaf products	1(6.0)	1(0.9)		
− Detection of fraud by mixing 'deodorised' olive oil with virgin olive oil	0(0.0)	6(6.8)		
− Olive oil in non-traditional consumer countries	0(0.0)	6(6.1)		
− Determination of pollutants in olive oil. Regulation of pesticides	0(0.0)	5(5.9)		
− Differentiation factors of olive oil: the role of marketing	0(0.0)	2(2.5)		
− Rules for olive oil tasting	0(0.0)	2(1.8)		
− Potential demand for new products that contain olive oil and demand of by-products	0(0.0)	1(0.9)		
− Consumer behaviour in the international markets	0(0.0)	1(0.7)		
− Olive oil micro-components and their influence on health	0(0.0)	1(0.7)		

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.)=1; Pearson χ2 for contingent tables when d.f.>1; χ2for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p≤0.01; * 0.01<p≤0.05; n.s.=not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated. Small deviations when adding up numbers are due to rounding in the weighting of the stratification of the survey (see section 2).*

With respect to their attitudes and opinions some significant differences arose. Although their participation in R&D is very low in both cases (more than 94.0% of enterprises do not participate in any regional, national or EU plan), ISO 9001 adopters make more use of the Internet (79.2% of ISO vs. 31.6% of non-ISO enterprises) and universities and higher education centres (32.4% vs. 2.7) as sources of innovation (Table 2). The other sources used in order to be aware of and adopt innovations are similar in the two cases. Hence they both mainly rely on their suppliers (>79.1%), on conferences, fairs and exhibitions (>66.3%), and on professional and sectorial associations (>39.7%). These sources highlight the importance of personal contact and proximity for fostering innovation. They also use newspapers, radio and television as sources (>41.9%) and, to a lesser extent, public research organisations (>22.8%). There is no dedicated R&D department

in any of the enterprises. With regard to the objectives that innovation should pursue, these are mostly related to economic issues such as lowering labour costs per unit of product (>13.2% in both cases), and increasing olive oil quality (>13.2%). With respect to fostering respect for the environment, and improving work, sanitary and safety conditions, these are not perceived as important objectives for innovation in either case. The main factor hindering innovation is financial in both cases: lack of funds within the enterprise itself (>47.1%). The most demanded research topic is related to technical issues in both cases: biotechnology for uncovering fraudulent mixtures of oils (>71.2%). Surprisingly, research into new markets, demand analysis and marketing are not considered very relevant.

In terms of differential aspects, the preponderance of financial concerns is lower for the managerial and supervisory staff of ISO 9001 olive oil enterprises than for the rest. Thus they attribute less importance to economic profit (cited by 73.4% of ISO 9001 as an area of major importance vs. 94.4% of non-ISO 9001) and to keeping risk levels low (41.4% of ISO 9001 vs. 61.0% of non-ISO 9001). Other issues are also very important to managerial and supervisory staff, to a similar extent for both types of enterprises, such as producing healthy products (>72.0% in both cases), personal prestige (>66.7%) and respecting the environment (>64.2%).

3.2.2. Structural characteristics of the olive oil enterprises

There are few significant differences between the structural characteristics of ISO 9001 adopters and non-adopters. Most of the enterprises are, in both cases, first degree cooperative mills (>45.5%) and independent olive oil mills (>43.8%) (Table 3). They are mainly located in rural areas (>64.4%). Their legal status is commonly in the form of cooperative societies (>45.5%), private limited companies (>22.1%) and public limited companies (>10.7%). With regard to size,

on average olive oil enterprises are of a small to medium size, both in terms of 1) number of employees: >48.4% have up to 9 employees and >26.9% have 10-49 employees; and 2) annual turnover: less than 2 million Euros per year for >48.4% of enterprises, and 2-10 million Euros per year for >19.2%. ISO 9001 adopters and non-adopters are also similar in the type of olive oil they produce, this being mainly extra-virgin olive oil (>99.1% in both cases), virgin olive oil (>86.8%) and 'lampante' olive oil (>86.8%). Their main customers are also similar: canning and bottling enterprises (>46.8%) and wholesalers at destination (>14.8%), mainly located in Andalusia (>51.3%) and other regions of Spain (>26.6%). Few main customers are located abroad (less than 13.2%)

Table 3. Structural characteristics of ISO 9001 vs. non-ISO 9001 olive oil enterprises

	Absolute frequencies and percentages		Correlation(+)	
	ISO 9001	Non-ISO 9001	χ2 (d.f)/Fisher	p (sign.)
Type of enterprise				
− Independent mills (y/n)	6(54.5)/5(45.5)	39(43.8)/51(56.2)	F	0.348(n.s.)
− First degree cooperative mills (y/n)	5(45.5)/6(54.5)	45(50.0)/45(50.0)	F	0.514(n.s.)
− Canning and bottling enterprises (y/n)	1(13.4)/9(86.6)	1(1.6)/89(98.4)	F	0.191(n.s.)
− Oil extraction enterprises (y/n)	1(6.0)/10(94.0)	0(0.0)/90(100.0)	F	0.109(n.s.)
− Second degree cooperative mills (y/n)	0(0.0)/11(100.0)	6(6.3)/84(93.7)	F	0.491(n.s.)
− Refineries (y/n)	0(0.0)/11(100.0)	0(0.0)/90(100.0)	F	c
− Refineries-bottling enterprises (y/n)	0(0.0)/11(100.0)	0(0.0)/90(100.0)	F	c
Legal status			0.038(1)	0.845(n.s.)
− Cooperative society	5(45.5)	51(57.0)		
− Private limited company	2(22.1)	25(27.3)		
− Public limited company	2(19.2)	10(10.7)		
− Agricultural Transformation Society	1(13.2)	1(0.9)		
− Community of assets	0(0.0)	2(2.5)		
− Group society	0(0.0)	1(0.9)		
− Others	0(0.0)	1(0.7)		
Location			F	0.335(n.s.)
− Rural area	7(77.9)	57(64.4)		
− Urban area	2(22.1)	32(35.6)		
Size				
Nº employees:			2.485(1)	0.115(n.s.)
− Up to 9	5(48.4)	64(71.5)		
− 10-49	5(45.5)	24(26.9)		
− 50-249	1(6.0)	1(1.6)		
− 250 or more	0(0.0)	0(0.0)		
Annual turnover (million €/year):			2.345(1)	0.126(n.s.)
− Up to 2	5(48.4)	44(52.2)		
− More than 2 to 10	2(19.2)	37(43.6)		
− More than 10 to 50	4(32.4)	4(4.2)		
− More than 50	0(0.0)	0(0.0)		
Main activities				
− Pressing olives (y/n)	11(100.0)/0(0.0)	90(100.0)/0(0.0)	F	c
− Bottling/canning of olive oil (y/n)	9(79.5)/2(20.5)	73(81.2)/17(18.8)	F	0.659(n.s.)
− Storing (y/n)	7(66.3)/4(33.7)	85(94.6)/5(5.4)	F	0.008(**)
− Wholesaling at origin (y/n)	6(53.2)/5(46.8)	84(93.5)/6(6.5)	F	0.002(**)
− Refining of olive oil (y/n)	0(0.0)/11(100.0)	8(8.6)/82(91.4)	F	0.384(n.s.)
− Others (y/n)	0(0.0)/11(100.0)	1(0.9)/89(99.1)	F	0.891(n.s.)
Type of olive oil produced or marketed				
− Extra-virgin olive oil (y/n)	11(100.0)/0(0.0)	89(99.1)/1(0.1)	F	0.891(n.s.)
− Virgin olive oil (y/n)	10(86.8)/1(13.2)	90(100.0)/0(0.0)	F	0.109(n.s.)
− Lampante olive oil (y/n)	10(86.8)/1(13.2)	88(98.2)/2(1.8)	F	0.295(n.s.)
− Olive oil (y/n)	0(0.0)/11(100.0)	13(14.7)/77(85.3)	F	0.201(n.s.)
− Olive pomace oil (y/n)	0(0.0)/11(100.0)	1(0.9)/89(99.1)	F	0.891(n.s.)
− Crude olive pomace oil (y/n)	0(0.0)/11(100.0)	1(0.9)/89(99.1)	F	0.891(n.s.)
Main customers			1.709(1)	0.191(n.s.)
− Canning and bottling enterprises	5(46.8)	67(74.8)		
− Wholesaling at destination	4(34.0)	13(14.8)		
− Retailers	1(13.2)	7(7.9)		
− Refineries-bottling enterprises	1(6.0)	0(0.0)		
− Oil extraction enterprises	0(0.0)	1(0.9)		
− Centralised buyers	0(0.0)	1(0.9)		
− Distribution platforms	0(0.0)	1(0.7)		
Main location of customers			1.584(3)	0.663(n.s.)
− Andalusia	7(60.3)	43(51.3)		
− The rest of Spain	3(26.6)	35(41.9)		
− Other EU countries	1(13.2)	5(5.9)		
− Other non-EU countries	0(0.0)	1(1.0)		

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.)=1; Pearson χ2 for contingent tables when d.f.>1; χ2for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p≤ 0.01; * 0.01<p≤0.05; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated. Small deviations when adding up numbers are due to rounding in the weighting of the stratification of the survey (see section 2)*

One significant difference between ISO 9001 and non-ISO 9001 enterprises is the list of their main activities. Although pressing olives and bottling/canning olive oil are carried out to a similar degree by most of the industries (100.0% for pressing olives and >79.5% for bottling/canning in both cases), certain activities are undertaken to a lesser extent by ISO 9001 industries, such as wholesaling at origin (53.2% of ISO 9001 vs. 93.5% of non-ISO 9001 industries) and storing the olive oil (66.3% vs. 94.6%).

3.3. Management practices associated with ISO 9001

3.3.1. Industrial practices

Industrial practices implemented by ISO 9001 adopters are very similar to those of non-adopters. In general, all enterprises in both cases demonstrate a wide use of optimal practices for the reception, processing and storage of olives; paste preparation, pressing and extraction; olive oil extraction; olive oil storage, bottling and transport; and control of quality and hygiene (Table 4). This highlights the high adoption rate in the Andalusian olive oil industry of the latest technological innovations which result in obtaining high-quality olive oil. The optimal practices, which are evenly widespread in the enterprises, whether they be ISO 9001 or non-ISO 9001, are as follows: differentiation of olives from the ground and from trees (>84.7% in both cases), systematic cleaning of storage containers (>86.8%) and a system for checking the ripeness and quality of olives (>83.7%); control of temperature and beating time (100.0%), constant cleaning of mills, pipes and mixers, using only hot water under pressure (>92.6%), control of washing water (>92.6%), with a water temperature of below 35ºC (>86.8%) and pressing fruit within 24 h of reception (>85.0%); extraction of olive oil through a continuous system of two phases (>92.6%);

separate olive oil stores according to quality (>99.1%), systematic and constant cleaning of olive oil tanks, pipes and warehouses (>86.8%) and bottling machinery made of stainless steel and easy to clean (>86.8%). The only significant differences between industrial practices in the two types of enterprise are a higher use of by-products from olive oil extraction as animal feed (20.5% in ISO 9001 vs. 0.0% in non-ISO 9001) and surprisingly, less frequent phytosanitary analysis in ISO 9001 enterprises (66.3% vs. 94.8% for the rest). In any case, both types of enterprises stick to high quality and hygiene control standards, with the training of warehouse staff on good practices of hygiene and handling (>77.6% in both cases), analysis for olive oil characterisation (>79.5%) and the existence of a Quality Control Department (>60.0%).

There are also a few practices that should be improved in both types of enterprise, such as the management of by-products and debris. Many enterprises store the wastewater in evaporation ponds (more than 74.8% in both cases), with its associated problems of environmental pollution and bad smells, rather than purifying the wastewater in sewage treatment plants located elsewhere (less than 21.3%) or within the olive mill (<6.4%). With regard to by-products, few enterprises use them as fertilizer (<20.5%), as is generally recommended.

Table 4. Industrial practices implemented by ISO 9001 vs. non-ISO 9001 olive oil enterprises

	Absolute frequencies and percentages		Correlation(+)	
	ISO 9001	Non-ISO 9001	χ2 (d.f)/Fisher	p (sign.)
Reception, processing and storage of olives				
− Differentiation of olives from soil and tree (y/n)	11(100.0)/0(0.0)	76(84.7)/14(15.3)	F	0.176(n.s.)
− Systematic cleaning of storage containers (y/n)	10(86.8)/1(13.2)	83(92.0)/7(8.0)	F	0.616(n.s.)
− System for checking ripeness and quality of produce entering the mill (y/n)	10(86.8)/1(13.2)	75(83.7)/15(16.3)	F	0.449(n.s.)
− Right reception containers for fruit circulation, of a capacity below 20 tonnes (y/n)	8(73.4)/3(26.6)	85(93.9)/6(6.1)	F	0.055(n.s.)
− Evacuation of waste materials in specific containers for this purpose, which are cleaned periodically (y/n)	5(48.4)/6(51.6)	39(42.9)/51(57.1)	F	0.570(n.s.)
− Regular cleaning of olive boxes with products authorised by the food industry (y/n)	4(33.7)/7(66.3)	39(43.8)/51(56.2)	F	0.458(n.s.)
− Others (y/n)	0(0.0)/11(100.0)	1(0.9)/89(99.1)	F	0.891(n.s.)
Paste preparation, pressing and extraction				
− Control of temperature and beating time (y/n)	11(100.0)/0(0.0)	90(100.0)/0(0.0)	F	c
− Constant cleaning of mills, pipes and mixer using only hot water under pressure (y/n)	10(92.6)/1(7.4)	84(93.6)/6(6.4)	F	0.566(n.s.)
− Control of washing water (y/n)	10(92.6)/1(7.4)	84(93.4)/6(6.6)	F	0.566(n.s.)
− Pressing fruit within 24 hours of reception (y/n)	10(92.6)/1(7.4)	75(85.0)/13(15.0)	F	0.517(n.s.)
− The water temperature for the extraction is below 35ºC (y/n)	10(86.8)/1(13.2)	89(99.3)/1(0.7)	F	0.207(n.s.)
− Others (y/n)	11(100.0)/0(0.0)	1(0.7)/89(99.3)	F	0.891(n.s.)
Olive oil extraction system				
− Continuous system of two phases (y/n)	10(92.6)/1(7.4)	90(100.0)/0(0.0)	F	0.109(n.s.)
− Continuous system of three phases (y/n)	1(7.4)/10(92.6)	0(0.0)/90(100.0)	F	0.109(n.s.)
− Discontinuous or traditional system (by press) (y/n)	0(0.0)/11(100.0)	1(0.7)/89(99.3)	F	0.891(n.s.)
Olive oil storage, bottling/canning and transport				
− Separating stores according to quality (y/n)	11(100.0)/0(0.0)	89(99.1)/1(0.9)	F	0.891(n.s.)
− Systematic and constant cleaning of tanks, pipes and the warehouse (y/n)	10(86.8)/1(13.2)	89(98.4)/1(1.6)	F	0.207(n.s.)
− Bottling/canning machinery made of stainless steel and easy to clean (y/n)	10(86.8)/1(13.2)	87(96.8)/3(3.2)	F	0.374(n.s.)
− Tanks and bottles/cans are exclusively used for olive oil and bottles/cans are not reused (y/n)	9(79.5)/2(20.5)	83(92.0)/7(8.0)	F	0.254(n.s.)
− Olive oil bottles, cans and packs are not in contact with the ground (y/n)	8(73.7)/3(26.3)	83(92.0)/7(8.0)	F	0.076(n.s.)
− Others (y/n)	0(0.0)/11(100.0)	1(1.6)/89(98.4)	F	0.891(n.s.)
Quality and hygiene control				
− Training of warehouse staff on good practices of hygiene and handling (y/n)	10(86.8)/1(13.2)	70(77.6)/20(22.4)	F	0.283(n.s.)
− Analysis for olive oil characterisation (y/n)	9(79.5)/2(20.5)	85(94.3)/5(5.7)	F	0.167(n.s.)
− Existence of a Quality Control Department (y/n)	9(79.5)/2(20.5)	54(60.0)/36(40.0)	F	0.139(n.s.)
− Phytosanitary analysis (y/n)	7(66.3)/4(33.7)	85(94.8)/5(5.2)	F	0.008(**)
− Others (y/n)	1(7.4)/10(92.6)	0(0.0)/90(100.0)	F	0.109(n.s.)
Management of by-products and debris				
Liquid debris: wastewater				
− Storage in evaporation ponds (y/n)	10(94.0)/1(6.0)	67(74.8)/23(25.2)	F	0.208(n.s.)
− Purification in a sewage treatment plant outside the olive mill (y/n)	0(0.0)/11(100.0)	19(21.3)/71(78.7)	F	0.088(n.s.)
− Purification in the olive mill by means of incorporating the sewage treatment plant into the production system (y/n)	0(0.0)/11(100.0)	6(6.4)/84(93.6)	F	0.491(n.s.)
− Others (y/n)	1(6.0)/10(9.4)	3(3.2)/87(96.8)	F	0.374(n.s.)
By-product: pomace, wet pomace				
− Extraction of crude pomace olive oil (y/n)	7(67.4)/4(32.6)	61(68.0)/29(32.0)	F	0.513(n.s.)
− As fuel (y/n)	4(40.0)/7(60.0)	26(29.4)/64(70.6)	F	0.421(n.s.)
− As fertilizer (y/n)	2(20.5)/9(79.5)	2(1.8)/88(98.2)	F	0.058(n.s.)
− As animal feed (y/n)	2(20.5)/9(79.5)	0(0.0)/90(100.0)	F	0.011(*)
− Others (y/n)	1(12.1)/10(87.9)	22(24.5)/68(75.5)	F	0.231(n.s.)

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.)=1; Pearson χ2 for contingent tables when d.f.>1; χ2for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p≤0.01; * 0.01<p≤0.05; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated. Small deviations when adding up numbers are due to rounding in the weighting of the stratification of the survey (see section 2).*

3.3.2. Marketing practices

Some important differences arise when comparing the marketing practices implemented by ISO 9001 enterprises versus the rest (Table 5). Although most of the main channels used to distribute the olive oil produced are similar in both cases, such as the direct sale of bulk olive oil (100.0% of industries in both cases) and the direct sale of bottled olive oil (>79.5%), the use of ICT (Information and Communication Technologies), such as e-commerce, web pages, etc., is significantly more frequent in ISO 9001 enterprises (86.8% vs. 57.2% for non-ISO enterprises). Sales via other distribution channels such as superstores, supermarkets, specialised shops, etc., are less frequent in both types of enterprise (less than 53.2% in both cases). Horizontal and vertical integration with other companies into second degree cooperatives is also very scarce (<13.0%).

Table 5. Marketing practices implemented by ISO 9001 vs. non-ISO 9001 olive oil enterprises

	Absolute frequencies and percentages		Correlation(+)	
	ISO 9001	Non-ISO 9001	χ2 (d.f)/Fisher	p (sign.)
Distribution				
− Direct sale of bulk olive oil (y/n)	11(100.0)/0(0.0)	89(100.0)/0(0.00)	F	c
− Use of ICT (e-commerce, web page, etc.) (y/n)	10(86.8)/1(13.2)	51(57.2)/39(42.8)	F	0.025(*)
− Direct sale of bottled olive oil (y/n)	9(79.5)/2(20.5)	84(93.6)/6(6.4)	F	0.210(n.s.)
− Sale via other distribution channels (superstores, supermarkets, specialised shops, etc.) (y/n)	6(53.2)/5(46.8)	32(35.2)/58(64.8)	F	0.184(n.s.)
− Horizontal and vertical integration with other companies (e.g. in second degree cooperatives) (y/n)	0(0.0)/11(100.0)	12(13.0)/78(87.0)	F	0.230(n.s.)
− Others (y/n)	0(0.0)/11(100.0)	1(0.9)/89(99.1)	F	0.891(n.s.)
Promotion and price				
− Sales strategy based on quality (y/n)	9(79.5)/2(20.5)	81(90.4)/9(9.6)	F	0.342(n.s.)
− Sales strategy based on price (y/n)	9(79.2)/2(20.8)	60(66.9)/30(33.1)	F	0.257(n.s.)
− Promotion campaigns and participation in fresh food fairs (y/n)	2(20.8)/9(79.2)	17(19.1)/73(80.9)	F	0.659(n.s.)
− Combination with other products and brands (y/n)	1(6.0)/10(94.0)	1(1.6)/89(98.4)	F	0.207(n.s.)
− Others (y/n)	0(0.0)/11(100.0)	0(0.0)/90(100.0)	F	c
Product				
− Diversification of the type of olive oil (quality levels, etc.) (y/n)	11(100.0)/0(0.0)	62(69.3)/28(30.7)	F	0.022(*)
− Diversification of the bottle's appearance (material, size, design, etc.) (y/n)	7(66.3)/4(33.7)	75(82.7)/16(17.3)	F	0.141(n.s.)
− Elaboration of alternative products (y/n)	1(7.4)/10(92.6)	0(0.0)/90(100.0)	F	0.109(n.s.)
− Quality labelling: PDO (y/n)	1(6.0)/10(94.0)	12(13.8)/78(86.2)	F	0.571(n.s.)
− Quality labelling: Integrated production (y/n)	1(6.0)/10(94.0)	3(3.1)/87(96.9)	F	0.374(n.s.)
− Quality labelling: Organic agriculture (y/n)	1(6.0)/10(94.0)	2(2.2)/88(97.8)	F	0.295(n.s.)
− Application of techniques to control fraud (mixtures, pollutants, etc.) (y/n)	0(0.0)/11(100.0)	3(3.6)/87(96.4)	F	0.705(n.s.)
− Combination with other foodstuffs (e.g. cheese in olive oil) (y/n)	0(0.0)/11(100.0)	0(0.0)/90(100.0)	F	c

*(+)Fisher's exact test for contingent tables when degree of freedom (d.f.)=1; Pearson χ2 for contingent tables when d.f.>1; χ2for bivariate logit when proof for contingent tables is not statistically reliable. Significance (sign.): ** p≤0.01; * 0.01<p≤ 0.05; n.s. = not significant; y/n = yes/no; F = Fisher's exact test; c = Constant variable, so no statistics calculated. Small deviations when adding up numbers are due to rounding in the weighting of the stratification of the survey (see section 2).*

In the promotion of olive oil, the marketing strategies employed, in both cases and with no significant differences, are focused on quality (more than 79.5% of industries) and price (>66.9%). Carrying out promotion campaigns and participating in fresh food fairs is not very common in either case (less than 20.8%) and combination with other products and brands is a practice which is implemented even less (<6.0%). One differential characteristic is the diversification of the type of olive oil sold (especially based on quality), which is significantly higher in ISO 9001 olive oil enterprises (100.0% vs. 69.3% of non-ISO 9001). The rest of the marketing practices related to the product are similar in both types of enterprise. It is interesting to note that some practices are hardly ever used, such as those of elaborating alternative products (<7.4% in both cases), and fraud control (<3.6%). The joint adoption of ISO 9001 and public CQS such as Integrated Production and Organic Agriculture is not very common in either case (<6%).

4. DISCUSSION

The results show, in general, a limited level of knowledge and adoption of most of the private CQS among the olive oil enterprises of Andalusia, which are mainly SMEs (small and medium enterprises). This is in line with previous research which suggests that the adoption rate of CQS cannot be considered satisfactory among small food enterprises, which constitute an important basis of food production in most EU countries (Karipidis et al., 2009). However, ISO norms, and especially ISO 9001, stand out in the Andalusian olive oil industry as the private CQS with the highest levels of knowledge, adoption and intention to adopt. ISO standards are fairly well known in this sector because they are starting to be seen as part of a differentiation strategy to penetrate or even consolidate certain markets, especially international ones; in fact, the business strategies

most valued by supermarkets are the adoption of ISO standards, followed by products covered by a designation of origin (Marbán Flores, 2005).

The implementation of ISO 9001 may be a challenging task for industries, especially SMEs, because it has a lot of specific requirements (Ferguson, 1996) and is often considered very complicated (Karipidis et al., 2009). According to our results, ISO 9001 olive industries seem to be more dynamic than the rest in some aspects. Their managerial and supervisory staff members are younger, more highly educated, make greater use of the Internet, universities and high education centres as sources of information, and are more willing to take risks as entrepreneurs and less focused on economic profit. Moreover, ISO 9001 olive oil enterprises are more oriented to selling olive oil further and faster to the next agents of the agro-food chain, since they wholesale at origin and store less. They seem to be more agile which may allow them to recover their investments faster. This dynamic profile could serve to guide the design of agricultural policies to foster the adoption of ISO 9001, for instance in defining the profile of potential ISO 9001 adopters to be targeted for training and incentivization and in the use of appropriate channels to engage them. These results, moreover, highlight the importance of policies for the rejuvenation and formal education of the sector.

Despite these differences, the profiles of ISO 9001 adopters and non-adopters are similar in other aspects and this must be also taken into account in policy design. Thus the results highlight the importance of personal contact and the proximity of sources of innovation. This indicates that training and information programmes for managerial and supervisory staff based on successful ISO 9001 olive oil enterprises could be a highly appropriate policy to further encourage the uptake of this ISO norm. The lack of suitable training or educational programs is one important factor hampering the diffusion of CQS (Karipidis et al., 2009). Networking with government bodies and academic institutions and fact-based decision-making should be reinforced, since they are

highlighted as critical success factors for implementing CQS in SMEs (Kumar et al., 2014). Proving that the costs associated with ISO 9001 implementation can be recovered in the medium to long-term should be a priority for future research, since, as our results indicate, economic and financial issues are of the highest priority for managerial and supervisory staff. On one hand, a great part of the literature points to an increase in costs for enterprises adopting a CQS (Karipidis et al., 2009). On the other, some studies suggest that continuous improvements in processes and product quality leads to an increase in revenue, through product reliability and customer satisfaction, and a reduction in costs, through process efficiency (Molina Azorín et al., 2009; Psomas and Fotopoulos, 2010). Improved access to credit, which is a structural problem in the sector (Montegut Salla, 2006), would probably stimulate the adoption of ISO 9001. In any case, given the significant costs and resources involved, it is crucial for managers to assess the extent to which ISO 9000 might benefit their performance before embarking on the implementation process: in general, firms with low technology intensity, low labour productivity and high labour intensity reap more benefit from ISO 9000 adoption (Lo et al., 2013).

Apart from costs and financial issues, it has been pointed out in the literature that corporate culture, time restrictions due to the short operating horizon of the business, a lack of qualified staff, the resistance of higher-level executives and workers to change, and excessive bureaucracy negatively affect the implementation of ISO 9001, especially in small companies (Karipidis et al., 2009; López Rodríguez et al., 2009; Maza et al., 2009), which are in the majority in the Andalusian olive industry. These issues should be tackled in the design of agro-food policies aimed at a wider diffusion of ISO 9001. Better management and methodology, clearer operational and work instructions, more effective cooperation between producers, the market and processors, better access to international markets, improvements in logistics, working conditions and quality performance, and higher productivity and profitability have been noted when ISO 9000/9001 is

effectively implemented (Juntunen and Salo, 1997; Kafetzopoulos and Gotzamani, 2014; Karipidis et al., 2009; Kuo et al., 2009; Legros and Galia, 2012; Maldonado-Siman et al., 2014; Munuzuri et al., 2013; Santos et al., 2013). In other words, these benefits do not come about 'automatically', since they require the appropriate utilisation of the ISO 9001 standard, as well as the effort and motivation of managers and all staff members (Prajogo et al., 2012; Psomas, 2013; Psomas et al., 2013; Urban, 2012). For the system to flourish and provide benefits for the users, sufficient time must be allocated for the organization to change (Krause Jr, 1996). It is necessary, firstly, to create a culture of quality in olive oil enterprises, with managers firmly committed to improving quality and, secondly, to foster cooperation between all staff by training them properly (Moyano Fuentes et al., 2003). Performance benefits from the internalization of ISO 9000 standards are achieved mainly through the development of human and organizational capital, and consequent improvements in business processes (Ataseven et al., 2014).

Our results demonstrate that, in general, optimal industrial practices are widespread in the Andalusian olive oil industry. The high standards of quality in the practices implemented are a direct reflection of the extraordinary technological advances achieved in the Andalusian olive sector since the early 90s (Alburquerque et al., 2004), which led to optimal production and storage structures (Moyano Fuentes et al., 2002). According to our results, the industrial practices implemented by Andalusian ISO 9001 olive oil enterprises are for the most part equal to or more optimal than those of other enterprises, which is in agreement with previous research in the region (Vilar Hernández, 2003; Vilar Hernández et al., 2009). In terms of marketing practices, the differences are clearer according to the results. ISO 9001 enterprises are more reliant on the use of ICT, which facilitates the selling of the product beyond the local market. ICT has been identified as a key enabler for supply chain integration in the olive agro-food sector (Baourakis and Stroe,

2002). A greater diversification of olive oil based on quality has also been detected, which is in increasing demand in the markets (Anania and Pupo D'Andrea, 2008).

However, the results demonstrate that there is also room for improvement in ISO 9001 management practices, especially in terms of marketing: innovative combinations with other products, more robust implementation of standards to avoid fraud, a promotion strategy closer to potential consumers, a wider presence in the big distribution channels, and horizontal and vertical integration with other companies of the olive agro-food chain. Enterprises producing certified quality oil need to put certain strategies into practice of collaboration/cooperation with the large-scale retail trade with the aim of being active players in commercial negotiations, allowing them to set prices at a level which offsets the costs of high quality production and encourages consumers to value food quality more highly (Galluzzo, 2007). In this respect, the public administration should promote mutually beneficial solutions, taking into consideration the imbalance of power between most enterprises, which are SMEs, and the large packaging groups and retailer labels. Our results indicate that ISO 9001 could be more effectively implemented by the enterprises already using it, in which case the differences with regard to conventional practices would probably be greater. This would require a greater concern on the part of the managerial and supervisory staff of these enterprises for optimal planning and commitment to customer service and quality, because achieving this usually entails more measuring and monitoring, as stipulated by ISO 9001 (Maza et al., 2009). In this sense, ISO 9000 has a positive and significant impact on process innovation performance measures such as restructuring and the application of the internal customer concept (Kim et al., 2012; Terziovski and Guerrero, 2014).

Furthermore, the right promotion strategies are essential to educate and inform the end consumer on high quality olive oil, in general, and ISO-certified olive oil, in particular, since consumers from emerging markets and even traditional consumer countries show low levels of

knowledge and perception of quality (Baptista and Biswas, 2010; Galluzzo, 2007; Navarro García et al., 2010). Institutional efforts related to the promotion of olive oil should be redoubled, aiming to position it as a quality product (Moyano Fuentes et al., 2003). Moreover, specific information is needed on the knowledge, acceptance and demand of ISO 9001 olive oil in national and international markets and consumers' willingness to pay, since lack of market acceptance is a major obstacle for the development of agro-food certification (Fan et al., 2009). This information can be decisive for managers and supervisory staff when considering whether to adopt this quality system.

5. CONCLUSIONS

ISO 9001 is a Certified Quality System (CQS) which is commonly requested of the agro-food enterprises by large distribution enterprises and big bottling companies, since the certification of quality is increasingly demanded by international markets. ISO 9001 may give a competitive advantage to enterprises as it guarantees strict controls in the production process in a transparent and verifiable manner. In Andalusia, the most important olive region in Spain, which is the world leader in olive growing, olive oil production and exportation, the adoption rate of this ISO norm among olive oil enterprises stands out over other private CQS, although it still cannot be considered high. So far, the adoption of ISO 9001 in the Andalusian olive industry has been led by dynamic enterprises with managerial and supervisory staff members who are younger, more highly educated, in closer contact with ICT, universities and higher education centres, more willing to take risks and less focused on economic profit. If the objective is a wider diffusion of ISO 9001, this company profile should be used in the design of public agro-food policies to target enterprises

as potential adopters. Policies for the rejuvenation and formal education of the managerial and supervisory staff of the olive industry are of the highest priority. Considering the great importance of personal contact and the proximity of sources in the Andalusian olive industry, the role of public and private R&D organisations should be reinforced, by providing managers with training or educational programs, and acting as a link between potential new adopters and successful ISO 9001 olive oil enterprises which can serve as an example for the rest. Topics of particular interest to the industry which require further research include the economic, financial and managerial aspects of implementing ISO 9001, as although there is plenty of literature on other products to demonstrate its general benefits for company performance brought about by the development of human and organizational capital and consequent improvements in business processes, more specific information on the olive sector is needed. The industrial practices implemented by the Andalusian olive industry are generally optimal and the adoption of ISO 9001 does not entail too many changes. On the other hand, ISO 9001 olive oil enterprises are implementing more innovative marketing practices, such as a more extensive use of ICT and a greater diversification of olive oil based on quality. In any case, there is room for improvement in both industrial and marketing practices in the Andalusian ISO 9001 olive oil enterprises. ISO 9001 could be more effectively implemented by the enterprises which already use it. There is a clear need for new marketing and business strategies based on innovative combinations with other products; a more robust implementation of standards to avoid fraud; a promotion strategy which is closer to potential consumers; a greater presence in the big distribution channels; deeper horizontal and vertical integration with other companies in the olive agro-food chain; new collaborative/cooperative strategies with large-scale retail trade and distribution; a greater concern on the part of the managerial and supervisory staff of the enterprises for optimal planning and commitment to customer service and quality; and promotion strategies to educate and inform end consumers on high quality olive oil.

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CONCLUSIONES GENERALES DE LA INVESTIGACIÓN

CONCLUSIONES GENERALES DE LA INVESTIGACIÓN

En la actualidad, la diferenciación a través de la calidad y su certificación en base a Sistemas de Calidad Certificada (SCC) se ha convertido en una estrategia clave para aumentar la competitividad de las empresas del sector agroalimentario debido, entre otros factores, a la expansión de los mercados internacionales, la creciente segmentación de los mercados y los cambios en el apoyo público a la actividad agraria en la UE. En este contexto, cuestiones como la calidad de los alimentos, la protección del medio ambiente, las buenas prácticas agrarias y la supervivencia del mundo rural, se han ido incorporado en las últimas décadas como demandas de la sociedad a la agricultura, sobre todo en los países desarrollados, principales destinos del aceite de oliva. Esta situación junto con la disponibilidad de nuevas técnicas de producción ha generado un entorno cada vez más competitivo en el sector agroalimentario, en general, y del olivar, en particular, lo que ha propiciado la aparición desde el siglo XX de innovaciones tecnológicas e institucionales, tales como los SCC, como mecanismos de adaptación a las condiciones cambiantes de los mercados y del entorno institucional.

Los resultados de este estudio confirman que en Andalucía el nivel de conocimiento y adopción de los SCC, tanto en el sector productor de aceituna como en el sector agroindustrial del aceite de oliva, es en general bajo. Esto parece ser debido fundamentalmente a que olivicultores e industriales, cuya principal prioridad es el beneficio económico, perciben la adopción de innovaciones como un proceso costoso al que no pueden hacer frente por falta de fondos, situación ante la que surge la necesidad de seguir investigando para demostrar que los costos asociados con la adopción de SCC se pueden recuperar en el medio y largo plazo. El pequeño tamaño de las explotaciones e industrias puede influir también en la baja adopción de SCC, ya que implica una falta de capacidad para adaptarse a los requisitos de implantación y posterior mantenimiento de los mismos. En esta situación, las industrias, mayoritariamente almazaras, tienen que integrarse

horizontal y verticalmente de manera más profunda para poder competir en el mercado. Esta integración contribuiría a fortalecer la estructura organizativa del sector, que a su vez puede conducir a mejoras en la comercialización.

La adopción de SCC en el SAAO de Andalucía está centrada en la Producción Integrada (PI) (16,8% de tasa de adopción) y las DOP (16,1%), en el sector productor de aceituna, y en las DOP (13,0%) y normas ISO 9001 (10,8%), en el sector agroindustrial del aceite de oliva. Algunos de los factores que pueden explicar el éxito relativo de la adopción de estos SCC y que, por tanto, podrían tenerse en cuenta en el diseño de políticas para potenciar su adopción, son las diferencias significativas en relación a las características de olivicultores y empresarios así como de explotaciones olivareras e industrias olivareras adoptantes de estos SCC con respecto a los no adoptantes. En este sentido, los resultados ponen de manifiesto que la adopción de la PI y las DOP por los olivicultores andaluces podría estar determinada principalmente por unas pocas variables explicativas. En el primer caso (PI), los resultados obtenidos a partir del artículo primero indican que los olivicultores presentan una dedicación más completa a la agricultura y unos vínculos más fuertes con asociaciones agrarias que utilizan como fuentes de información sobre nuevas prácticas agrarias y SCC. En el caso de las DOP, según los resultados obtenidos del artículo segundo, presentan una dedicación a la agricultura más prolongada en el tiempo, lo que puede estar relacionado con un nivel de formación agraria más basado en la experiencia práctica y menos en cursos y conferencias, y consideran como principal objetivo de la innovación la obtención de una mayor calidad de las aceitunas y aceite, lo cual resulta lógico en una DOP; sin embargo, llama la atención que concedan menos importancia al respeto al medio ambiente. No obstante, más que por las características anteriores, la adopción de estos dos SCC parece estar más determinada por la presencia de olivar tradicional en zonas de mayor pendiente del terreno como estrategia de supervivencia, ya que en estas zonas marginales, donde la mano de obra está basada en la familia,

los rendimientos son más bajos y la adopción de un SCC puede suponer la única forma para competir en el mercado a través de la certificación de la calidad.

Esta estrategia se extiende al sector agroindustrial, pues los empresarios que han adoptado una DOP, tal y como se desprende de los resultados obtenidos del artículo tercero, no muestran diferencias significativas con respecto al resto de empresarios, y del mismo modo, tampoco existen diferencias entre las características de industrias adoptantes y no adoptantes de una DOP. De nuevo, la adopción de una DOP parece ser el resultado de un efecto de "contagio" entre las industrias que se encuentran dentro de zonas con mayor pendiente, menos favorecidas, más que como resultado de las características estructurales de las industrias, o de las características, actitudes y opiniones de su personal directivo. Lo anterior está de acuerdo con el hecho de que aproximadamente una tercera parte del olivar español se localiza en zonas de montaña y en torno al 30% de la superficie de olivar tanto en España como en Andalucía está inscrita bajo una DOP. Por el contrario, los industriales que han adoptado la normativa ISO 9001, según resultados obtenidos del artículo cuarto, sí son significativamente diferentes al resto: son más jóvenes, están más dispuestos a asumir riesgos y menos centrados en el beneficio económico y más familiarizados con las nuevas TIC (tecnologías de la información y la comunicación) y con fuentes de información externas como universidades y centros de enseñanza superior.

En cuanto a las prácticas de producción, gestión y organización en las explotaciones olivareras, los resultados demuestran un mayor uso de buenas prácticas agrarias por parte de los olivicultores que han adoptado la PI. Sin embargo, algunas buenas prácticas son poco utilizadas por estos olivicultores, lo que se puede explicar porque la normativa sobre PI no es completamente rígida y permite un cierto grado de flexibilidad al establecer prácticas obligatorias, prohibidas y recomendadas. La mayor calidad de la olivicultura en PI es debida a la forma en la que las prácticas agrarias son realmente implementadas dentro de las restricciones que impone la normativa. En cuanto a los olivicultores que han adoptado una DOP, la menor importancia que éstos conceden

al respeto al medio ambiente queda reflejado en las prácticas agrarias que utilizan, las cuales no son muy diferentes, en general, de las utilizadas por el resto de olivicultores, de lo que se deduce que las técnicas de cultivo establecidas en sus correspondientes pliegos de condiciones, no parecen ser muy exigentes desde el punto de vista medioambiental y podrían ser mejoradas.

En cuanto a las prácticas de producción, gestión y organización en las industrias, en general todas las empresas olivareras realizan prácticas adecuadas en relación a la recepción, acondicionamiento y almacenamiento de aceitunas; preparación de la pasta, molturación y extracción; sistema de extracción del aceite; almacenamiento, envasado y transporte; control de calidad e higiene; gestión de subproductos y residuos producidos en la almazara; lo cual tiene como consecuencia la obtención de un aceite de calidad. Esto puede ser debido al gran progreso tecnológico del sector desde los años 90 cuyo cambio más visible fue la introducción del sistema de extracción de dos fases. Así, la adopción de una DOP así como de la norma ISO 9001, no está generalmente relacionada con la implementación de mejores prácticas industriales.

En relación a las prácticas comerciales implementadas en la empresa, cabe destacar que todas venden parte de su aceite a granel y la mayoría también lo vende envasado, siendo la práctica de comercialización más extendida la diversificación del aceite en relación a la forma de presentación del envase. También es importante la diversificación de los tipos de aceites vendidos en cuanto a diferentes calidades. Al contrario que en las prácticas industriales, sí se aprecian algunas diferencias significativas en algunas prácticas comerciales en las industrias adoptantes de SCC, como la menor utilización de estrategias de venta basadas en el precio, más participación en campañas de promoción de alimentos, y mayor utilización del etiquetado de alimentos ecológicos, en el caso de las DOP; y de prácticas comerciales más innovadoras como un uso más extensivo de las tecnologías de la información y comunicación y una mayor diversificación del aceite de oliva por niveles de calidad, en el caso de la norma ISO 9001.

Los resultados obtenidos sugieren como cuestiones prioritarias para potenciar la adopción de los SCC anteriores en el SAAO de Andalucía, la renovación generacional y la profesionalización del sector, mediante el desarrollo de nuevos programas de formación profesional y capacitación, para conseguir una mayor preocupación e implicación de futuros y actuales gerentes de explotaciones y empresas en la planificación de la calidad y en el compromiso con el servicio al cliente. Teniendo en cuenta la gran importancia del contacto personal y la proximidad de las fuentes de información en el sector en general, el papel de las organizaciones de I+D públicas y privadas debería reforzarse, para proporcionar a los gerentes los programas de formación y de aprendizaje adecuados. Sería interesante incluir en estos programas demostraciones de las experiencias exitosas de explotaciones y empresas en la adopción de SCC, ya que pueden servir de ejemplo para los nuevos adoptantes, contando con la participación de asociaciones agrarias puesto que juegan un papel clave como fuentes de información utilizadas entre los SCC más adoptados en el sector.

Los olivicultores en general deberían ser conscientes de la importancia de llevar a cabo buenas prácticas agrarias, sobre todo los que pertenecen a una DOP para los que el respeto al medio ambiente parece ser algo menos prioritario, y ser conscientes del papel multifuncional de la agricultura y de su importante papel para garantizar la sostenibilidad de las zonas rurales marginales a través de ciertos factores como la reducción de la erosión, la protección de la biodiversidad y los recursos naturales, la lucha contra los efectos del cambio climático, etc. Ampliar el valor añadido por una DOP, actualmente exclusivamente garantizando una vinculación al territorio, mediante la incorporación de otros valores ambientales y sociales, representaría un importante paso adelante para satisfacer las nuevas demandas de los mercados y legitimar el apoyo público a este SCC.

Cabe destacar la importancia de la formación del consumidor final de aceite de oliva. En 2013 en España se comercializó como aceite certificado bajo DOP menos del 20% de la producción de aceite de oliva virgen extra protegido, debido fundamentalmente a la baja prima sobre el precio del aceite de oliva con DOP, que no es suficiente para compensar los costes adicionales asociados a dicha certificación, lo que significa una importante pérdida de valor añadido y denota el gran desconocimiento del consumidor sobre estos aceites. Por lo anterior, se hace necesario el desarrollo de nuevas estrategias comerciales de promoción más cercanas a los consumidores potenciales para educarlos e informarlos sobre los aceites de oliva de alta calidad y de calidad certificada. También se ha constatado la necesidad de la aplicación de normas para evitar el fraude y aumentar así la confianza no sólo de los consumidores finales sino también de los propios productores y la industria, de conseguir una mayor presencia en los grandes canales de distribución, y de desarrollar nuevas estrategias de colaboración con el comercio minorista a gran escala y la gran distribución. Finalmente, la I+D+i y la transferencia de información al sector sobre el mercado y la demanda de los SCC en España y en otros países potencialmente consumidores de aceite de oliva, es una cuestión de vital importancia para el futuro del sector.

ANEXOS

ANEXO I

CUESTIONARIO DE LA ENCUESTA A OLIVICULTORES

ANEXO I. CUESTIONARIO DE LA ENCUESTA A OLIVICULTORES

Instituto de Investigación y Formación Agraria y Pesquera
CONSEJERÍA DE AGRICULTURA Y PESCA

INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

Unión Europea
FEDER

Proyecto de Investigación ECOINNOV

Economía de la innovación y dinámica del sistema agroalimentario olivarero de Andalucía: Desarrollo de estrategias para su sostenibilidad y competitividad

ENCUESTA A OLIVICULTORES

"INNOVACIÓN EN LAS PRÁCTICAS DE PRODUCCIÓN, GESTIÓN Y ORGANIZACIÓN"

Nota para el encuestador: La persona entrevistada debe tener atribuciones para tomar decisiones de gestión de la explotación (titular activo en la agricultura, arrendatario/a, asalariado/a, etc.). El destino principal de las aceitunas debe ser la producción de aceite, no aceitunas de mesa exclusivamente

Fecha: _____

1. CARACTERÍSTICAS DE LA EXPLOTACIÓN

1.1. DISTRIBUCIÓN DE LA SUPERFICIE TOTAL DE LA EXPLOTACIÓN (en hectáreas)

	Convencional (ha)	Ecológico o en reconversión (ha)	Integrado (ha)
Olivar			
Otros cultivos (indicar: _____)			

Nota para el encuestador: A partir de aquí, si la explotación consta de más de una parcela de olivar, las preguntas se refieren a la PARCELA más importante

1.2. MUNICIPIO/S Y PROVINCIA/S DEL OLIVAR: _____

1.3. TIPO DE CULTIVO DEL OLIVAR (marcar una X)

☐ Olivar tradicional (>1 pie/árbol ó una densidad de plantación ≤ 140 olivos/ha)
☐ Intensivo (1 pie/árbol y una densidad de plantación >140 olivos/ha)
☐ Súper-intensivo (1 pie/árbol y una densidad de plantación de más de 1.000 olivos/ha)

1.4. RENDIMIENTO PRODUCTIVO MEDIO (Kg. de aceituna/ha): _____ (o marcar una X)

☐ <2.000 ☐ 2.000-4.000 ☐ 4.000-6.000 ☐ 6.000-8.000 ☐ >8.000

1.5. EDAD DEL OLIVAR: _____ (o marcar una X)

☐ <10 años ☐ 10-50 años ☐ 51-100 años ☐ >100 años

1.6. MANO DE OBRA EMPLEADA (marcar una X)

☐ Sólo familiar
☐ Familiar y asalariada eventual
☐ Familiar y asalariada fija
☐ Familiar, asalariada eventual y fija
☐ Sólo asalariada eventual
☐ Sólo asalariada fija
☐ Asalariada eventual y fija

1.7. DESTINO DE LA PRODUCCIÓN (marcar una X)

☐ Aceite ☐ Mesa ☐ Mixto

1.8. PENDIENTE DEL OLIVAR (marcar una X)

☐ Elevada (> 15%) ☐ Media (10-15 %) ☐ Baja (<10%)

1.9. CULTIVO INTERCALAR (otro cultivo entre olivos) (marcar una X)

☐ Sí (indicar cultivo: _____) ☐ No

1.10. MANEJO DE GANADO (pastoreo de ganado entre olivos) (marcar una X)

☐ Sí (indicar ganado y nº de cabezas: _____) ☐ No

1

1.11. PRINCIPALES CLIENTES

1.11.1.Tipos de clientes (indicar % sobre la producción total de aceituna para aceite)

%:	Almazaras independientes	%:	Almacenistas en destino
%:	Almazaras cooperativas de 1er grado	%:	Plataformas de distribución (hipermercados, etc.)
%:	Almazaras cooperativas de 2^{o} grado	%:	Centrales de compra
%:	Envasadoras	%:	Comercios minoristas o pequeños detallistas
%:	Refinerías	%:	Consumidores finales
%:	Refinerías-envasadoras	%:	Otros (indicar: _____)
%:	Extractoras	%: 100	*TOTAL*

1.11.2.Localización de los clientes (indicar % sobre la producción total de aceituna para aceite)

%:	Andalucía	%:	Otros países del mundo (indicar: _____)
%:	Resto de España	%: 100	*TOTAL*
%:	Otros países de la UE (indicar: _____)		

2. PRÁCTICAS AGRONÓMICAS Y SISTEMAS DE CALIDAD CERTIFICADA

2.1. VARIEDADES DE ACEITUNAS CULTIVADAS (indicar como máximo las 3 más importantes, siendo 1 la más importante y 3 la menos importante)

O Picual	O Picudo
O Hojiblanca	O Lechín de Granada
O Lechín de Sevilla	O Otras (indicar: _____)

2.2. MANEJO DEL SUELO (marcar una X)

☐ Suelo desnudo con laboreo convencional (labores continuas todo el año)
☐ Suelo desnudo con no-laboreo (control de malas hierbas con herbicidas)
☐ Suelo desnudo con laboreo reducido y herbicidas bajo las copas o en todo el terreno
☐ Suelo cubierto con vegetación espontánea o con planta cultivada y siega química o mecánica

2.3. RIEGO (marcar una X)

☐ Sí ☐ No (secano)

2.4. SISTEMA DE RIEGO (marcar una X)

☐ Goteo ☐ Aspersión ☐ A manta

2.5. MOMENTO DEL RIEGO (marcar una X)

☐ A calendario fijo ☐ Según recomendaciones de técnicos

2.6. ANÁLISIS DE LA CALIDAD DEL AGUA (marcar una X)

☐ Sí ☐ No

2.7. FERTILIZACIÓN (marcar una X)

☐ Sí ☐ No

2.8. MÉTODO DE FERTILIZACIÓN (marcar una X)

☐ Aplicación directa al suelo ☐ Aplicación foliar
☐ Fertirrigación (con el agua de riego)

2.9. SUSTANCIAS USADAS PARA FERTILIZAR (marcar una X)

☐ Abonos orgánicos (restos de poda, alpeorujo, etc.) ☐ Abonos NPK

2.10. ANÁLISIS PREVIOS ANTES DE FERTILIZAR (marcar una X)

☐ Análisis foliares o de suelo ☐ Ninguno

2.11. TRATAMIENTO FITOSANITARIO (DE PLAGAS Y ENFERMEDADES) (marcar una X)

☐ Sí ☐ No

2.12. TRATAMIENTO DE LA MOSCA (marcar una X)

☐ Trampeo masivo (feromonas + pegamento + piretroide) ☐ Insecticida no biológico
☐ Control biológico (*Opius concolor*)

2.13. TRATAMIENTO DE LA POLILLA (marcar una X)

☐ Control biológico (*Bacillus thurigiensis*) ☐ Tratamiento químico

2.14. TRATAMIENTO DEL REPILO (VIVILLO O CAÍDA DE LAS HOJAS) (marcar una X)

☐ Podas aclareo ☐ Otros tratamientos químicos (indicar productos usados: _____)
☐ Fungicidas cúpricos (de cobre)

2.15. MOMENTO DEL TRATAMIENTO FITOSANITARIO (marcar una X)

☐ A calendario fijo o cuando se manifiestan los primeros síntomas de infestación
☐ Al superar un determinado umbral de población o según asesoramiento técnico

2.16. LOCALIZACIÓN DE LOS TRATAMIENTOS FITOSANITARIOS (marcar una X)

☐ En toda la parcela ☐ En el foco de infección

2.17. CRITERIOS PARA RECOLECCIÓN (marcar una X)

☐ Según índice de madurez ☐ A fecha fija

2.18. MODO DE RECOLECCIÓN – SUELO (marcar una X)

☐ Recogida manual ☐ Recogida mecánica ☐ No recolección

2.19. MODO DE RECOLECCIÓN – VUELO (marcar una X)

☐ Vareo ☐ Vibradores (ramas o tronco) ☐ Ordeño

2.20. SEPARACIÓN DE LAS ACEITUNAS DEL SUELO Y DEL VUELO (marcar una X)

☐ Separación ☐ No separación

2.21. MODO DE TRANSPORTE DESDE LA FINCA A LA ALMAZARA (marcar una X)

☐ Sacos ☐ Directamente en el remolque del tractor o camión
☐ Cajas

2.22. TIPO DE PODA (marcar una X)

☐ Tradicional (severa, cada 1 o 2 años) ☐ Intensidad reducida (cada 3-4 años)

2.23. GESTIÓN DE SUBPRODUCTOS DEL OLIVAR (marcar una o varias X)

- Madera
  - ☐ Fabricación de muebles y objetos de decoración
  - ☐ Combustible
  - ☐ Otros (indicar: _____)
- Restos de poda de pequeño tamaño
  - ☐ Trituración e incorporación al suelo
  - ☐ Quema
  - ☐ Combustible
  - ☐ Alimentación animal
  - ☐ Otros (indicar: _____)
- Hojas
  - ☐ Usos terapéuticos: hipertensión arterial, preparados astringentes, etc.
  - ☐ Combustible
  - ☐ Alimentación animal
  - ☐ Otros (indicar: _____)

3

2.24. SISTEMAS DE CALIDAD CERTIFICADA: NIVEL DE CONOCIMIENTO Y ADOPCIÓN

	¿Lo ha adoptado?					
	Sí		No			
	Año aprox. adopción	Grado de satisfacción (de 1, nada, a 5, muy satisfecho)	¿Lo conoce?		¿Piensa adoptarlo?	
			Sí	No	Sí	No
NORMATIVA ISO						
Sist. gestión de la calidad (ISO 9000)						
Sist. gestión ambiental (ISO 14001)						
Sist. gestión calid. y amb. (ISO 19011)						
Sist. gestión inocuidad de alimentos (Seguridad alimentaria) (ISO 22000)						
Otro (indicar: _____)						
OTROS SISTEMAS DE CERTIFICACIÓN						
GLOBALGAP						
IFS (International Food Standard)						
Nature's Choice: Producción						
Otro (indicar: _____)						

3. ACTITUDES Y OPINIONES HACIA LA I+D+i EN OLIVAR

3.1. FUENTES DE INFORMACIÓN SOBRE NUEVAS PRÁCTICAS AGRONÓMICAS Y SISTEMAS DE CALIDAD CERTIFICADA EN SU OLIVAR (marcar una o varias X)

- Fuentes internas
  - ☐ Su propia experimentación y práctica
- Fuentes de mercado
  - ☐ Proveedores
  - ☐ Clientes
  - ☐ Entidad asociativa agraria (coop., SAT, etc.)
  - ☐ Consultores, laboratorios comerciales o institutos privados de I+D
  - ☐ Otros agricultores
- Fuentes institucionales
  - ☐ Universidades, centros de enseñanza superior
  - ☐ Organismos públicos de investigación
  - ☐ Centros tecnológicos
- Otras fuentes
  - ☐ Internet
  - ☐ Prensa, radio y televisión
  - ☐ Conferencias, ferias comerciales, exposiciones
  - ☐ Revistas científicas y publicaciones
  - ☐ Asociaciones profesionales y sectoriales
  - ☐ Otras (indicar: _____)

3.2. IMPORTANCIA CONCEDIDA A DIVERSOS FACTORES AL PRODUCIR (marcar una X en cada fila)

	1 (ninguna)	2 (poca)	3 (alguna)	4 (bastante)	5 (mucha)
Beneficio económico					
Asumir poco riesgo					
Prestigio personal					
Respeto al medio ambiente					
Obtener productos sanos					
Otros factores (indicar: _____)					

3.3. OBJETIVOS DE LA INNOVACIÓN PARA LA PERSONA ENTREVISTADA (indicar como máximo los 5 más importantes, siendo 1 el más importante y 5 el menos importante)

- O Conseguir una agricultura multifuncional
- O Sustitución de procesos anticuados
- O Producir de forma respetuosa con el medio ambiente
- O Mejorar las condiciones de venta de sus aceitunas
- O Mayor calidad de las aceitunas y aceite
- O Cumplir las normas técnicas del olivar
- O Mayor capacidad de producción
- O Menores costes laborales por unidad producida
- O Mejorar la capacidad en cuanto a tecnologías de la información
- O Mejorar las condiciones de trabajo
- O Satisfacer las exigencias de los clientes
- O Incrementar su prestigio
- O Otros (indicar: _____ _____)

3.4. FACTORES QUE DIFICULTAN LA INNOVACIÓN EN LA EXPLOTACIÓN OLIVARERA (indicar como máximo los 3 más importantes, siendo 1 el más importante y 5 el menos importante)

➢ Factores de coste

- O Falta de fondos en la explotación
- O Falta de financiación de fuentes exteriores, dificultad de acceso al crédito
- O Coste demasiado elevado
- O Otros (indicar: _____)

➢ Factores de conocimiento

- O Falta de personal cualificado
- O Falta de información sobre tecnología
- O Falta de información sobre los mercados
- O Dificultades para encontrar socios para innovar
- O Otros (indicar: _____)

➢ Factores de mercado

- O Mercado dominado por empresas establecidas
- O Incertidumbre respecto a la demanda de bienes y servicios innovadores
- O No existencia de demanda de innovaciones
- O Otros (indicar: _____)

3.5. LÍNEAS DE INVESTIGACIÓN QUE CONSIDERA MÁS IMPORTANTES (indicar como máximo las 3 más importantes, siendo 1 la más importante y 3 la menos importante)

➢ Innovación en la producción olivícola, sostenibilidad y aprovechamiento de los residuos de la cadena oleícola

- O Mejora genética del olivo: Investigación en resistencia a la verticilosis
- O Uso de cubiertas en la desinfección de suelos con Verticilium
- O Riego del olivar, determinación del umbral de riego en periodos críticos. Control de la vecería
- O Otras (indicar: _____)

➢ Comercialización, organización, patrimonio y territorio en el sector oleícola

- O El aceite de oliva en las gastronomías de los países que no son consumidores tradicionales
- O Demanda potencial de nuevos productos que contienen aceite de oliva y de la demanda de subproductos
- O Comportamiento del consumidor en los mercados internacionales de destino de aceite de oliva
- O Factores de diferenciación en el aceite de oliva: implicaciones en materia de marketing
- O Otras (indicar: _____)

4. PERSONA ENTREVISTADA

4.1. NOMBRE Y APELLIDOS (opcional): _____

4.2. EDAD: _____ (o marcar una X)

- ☐ De 18 a 25 años
- ☐ De 26 a 35 años
- ☐ De 36 a 45 años
- ☐ De 46 a 55 años
- ☐ De 56 a 65 años
- ☐ Más de 65 años

4.3. SEXO (marcar una X)

☐ Hombre ☐ Mujer

4.4. ESTADO CIVIL (marcar una X)

☐ Soltero ☐ Viudo
☐ Casado ☐ Otros
☐ Separado

4.5. NIVEL DE ESTUDIOS (marcar una X)

☐ Sin estudios ☐ Formación profesional
☐ Educación primaria ☐ Universitarios medios (diplomado/a)
☐ Educación secundaria (bachillerato) ☐ Universitarios superiores

4.6. DEDICACIÓN A LA AGRICULTURA

4.6.1. Relación jurídica con la explotación de olivar (marcar una X)

☐ Titular activo en la actividad agraria ☐ Asalariado/a
☐ Arrendatario/a o aparcero/a ☐ Otro (indicar: _____)

4.6.2. Años de dedicación a la agricultura: _____ (o marcar una X)

☐ Menos de 10, inclusive ☐ De 21 a 30
☐ De 11 a 20 ☐ 31 o más

4.6.3. Importancia de la actividad agraria en su nivel de ingresos (marcar una X)

☐ Total (sus ingresos proceden fundamentalmente de la agricultura, en ≥ 80%)
☐ Parcial principal (sus ingresos proceden principalmente de la agricultura, en un 50- 80%, y en segundo lugar de una actividad no agraria)
☐ Parcial secundaria (sus ingresos proceden principalmente de una actividad no agraria y, en segundo lugar, de la agricultura en un 20 a 50%)
☐ Marginal (sus ingresos proceden fundamentalmente de una actividad no agraria, la actividad agraria supone ≤ 20%)

4.6.4. Nivel de formación agraria (marcar una X)

☐ Experiencia práctica ☐ Formación universitaria agraria
☐ Cursillos, conferencias, etc. ☐ Otra (indicar: _____)
☐ Formación profesional agraria

4.6.5. Tipo de trabajo realizado en la explotación (marcar una X)

☐ Sólo gestión y administración ☐ Ambos
☐ Sólo trabajo físico

4.6.6. Pertenencia a entidades asociativas o colectivos agrarios (marcar una o varias X)

☐ Cooperativa Agraria ☐ Denominación de Origen
☐ SAT (Sociedad Agraria de Transformación) ☐ Asociación de productores de productos ecológicos
☐ ATRIA (Asociación Tratamiento Integrado) ☐ Otra (indicar: _____)
☐ Sindicato agrario

4.6.7. Perspectivas de continuidad en la actividad olivarera (marcar una X)

☐ Continuaré hasta la jubilación ☐ Dejaré la olivicultura antes de la jubilación

4.6.8. Si las ayudas de la PAC desapareciesen en 2013, cómo afectaría a su continuidad en la olivicultura (marcar una X)

☐ Continuaría de todas formas ☐ Probablemente abandonaría la olivicultura

4.6.9. Futuro de su explotación olivarera (marcar una X)

☐ La venderé ☐ La heredarán mi/s hijo/s
☐ La arrendaré ☐ Otra (indicar: _____)

4.6.10. Razones para vender, arrendar, etc., su explotación olivarera (indicar: _____
_____)

6

ANEXO II

CUESTIONARIO DE LA ENCUESTA A INDUSTRIAS DE ACEITE DE OLIVA

ANEXO II. CUESTIONARIO DE LA ENCUESTA A INDUSTRIAS DE ACEITE DE OLIVA

Instituto de Investigación y Formación Agraria y Pesquera
CONSEJERÍA DE AGRICULTURA Y PESCA

INIA Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

Unión Europea
FEDER

Proyecto de Investigación ECOINNOLI

Economía de la innovación y dinámica del sistema agroalimentario olivarero de Andalucía: Desarrollo de estrategias para su sostenibilidad y competitividad

ENCUESTA A INDUSTRIAS DE ACEITE DE OLIVA

"INNOVACIÓN EN LAS PRÁCTICAS DE PRODUCCIÓN, GESTIÓN Y ORGANIZACIÓN"

Nota para el encuestador: La persona entrevistada debe tener atribuciones en la toma de decisiones de gestión en la empresa

Fecha: _____

1. CARACTERÍSTICAS DE LA EMPRESA

1.1. NOMBRE DE LA EMPRESA: _____

1.2. EDAD O ANTIGÜEDAD DE LA EMPRESA (años): _____

1.3. MUNICIPIO Y PROVINCIA: _____

1.4. TIPO DE ENTIDAD (marcar una o varias X)

- ☐ Almazara independiente
- ☐ Almazara cooperativa de 1er grado
- ☐ Almazara cooperativa de 2^{o} grado
- ☐ Envasadora
- ☐ Refinería
- ☐ Refinería-envasadora
- ☐ Extractora
- ☐ Otra (indicar: _____)

1.5. CONDICIÓN JURÍDICA (marcar una X)

- ☐ Sociedad Cooperativa
- ☐ Sociedad Agraria de Transformación (S.A.T.)
- ☐ Sociedad Anónima (S.A.)
- ☐ Sociedad Limitada (S.L.)
- ☐ Sociedad Colectiva
- ☐ Sociedad Comanditaria
- ☐ Comunidad de Bienes
- ☐ Otra (indicar: _____)

1.6. LOCALIZACIÓN DE LA EMPRESA (marcar una X)

- ☐ Área urbana
- ☐ Área rural

1.7. DIMENSIÓN ECONÓMICA

1.7.1. Nº de empleados: _____ (o marcar una X)

- ☐ Hasta 9
- ☐ De 10 a 49
- ☐ De 50 a 249
- ☐ 250 o más

1.7.2. Volumen de negocio -facturación- anual (marcar una X)

- ☐ Hasta 2 millones de €/año
- ☐ De más de 2 a 10 millones de €/año
- ☐ De más de 10 a 50 millones de €/año
- ☐ Más de 50 millones de €/año

1.7.3. Proporción del ACEITE DE OLIVA en el volumen de negocio (%):_____

Nota para el encuestador: A partir de aquí todas las preguntas se refieren al ACEITE DE OLIVA, no a otras actividades y productos de la empresa

1.8. PRINCIPALES ACTIVIDADES (marcar una o varias X)

- ☐ Molturación
- ☐ Almacenamiento
- ☐ Comercio mayorista en origen
- ☐ Refinado de aceite de oliva
- ☐ Envasado de aceite
- ☐ Otra (indicar: _____)

1.9. TIPOS DE ACEITES DE OLIVA ELABORADOS O COMERCIALIZADOS (marcar una o varias X)

- ☐ Aceite de oliva virgen extra
- ☐ Aceite de oliva virgen
- ☐ Aceite de oliva lampante
- ☐ Aceite de oliva
- ☐ Aceite de orujo de oliva
- ☐ Aceite de orujo crudo

1

1.10. PRINCIPALES PROVEEDORES

1.10.1. Tipos de proveedores (% sobre volumen de negocio de aceite de oliva)

%:	Agricultores	%:	Refinerías
%:	Almazaras independientes	%:	Refinerías-envasadoras
%:	Almazaras cooperativas de 1er grado	%:	Extractoras
%:	Almazaras cooperativas de 2^{o} grado	%:	Otros (indicar: _____)
%:	Envasadoras	%: 100	*TOTAL*

1.10.2. Localización de los proveedores (% sobre volumen de negocio de aceite de oliva)

%:	Andalucía	%:	Otros países del mundo (indicar: _____)
%:	Resto de España	%: 100	*TOTAL*
%:	Otros países de la UE (indicar: _____)		

1.11. PRINCIPALES CLIENTES

1.11.1. Tipos de clientes (% sobre volumen de negocio de aceite de oliva)

%:	Almazaras independientes	%:	Almacenistas en destino
%:	Almazaras cooperativas de 1er grado	%:	Plataformas de distribución (hipermercados, etc.)
%:	Almazaras cooperativas de 2^{o} grado	%:	Centrales de compra
%:	Envasadoras	%:	Comercios minoristas o pequeños detallistas
%:	Refinerías	%:	Consumidores finales
%:	Refinerías-envasadoras	%:	Otros (indicar: _____)
%:	Extractoras	%: 100	*TOTAL*

1.11.2. Localización de los clientes (% sobre volumen de negocio de aceite de oliva)

%:	Andalucía	%:	Otros países del mundo (indicar: _____)
%:	Resto de España	%: 100	*TOTAL*
%:	Otros países de la UE (indicar: _____)		

2. PRÁCTICAS INDUSTRIALES IMPLEMENTADAS EN LA EMPRESA

2.1. RECEPCIÓN, ACONDICIONAMIENTO Y ALMACENAMIENTO DE ACEITUNAS (marcar una o varias X)

- ☐ Diferenciación de aceitunas procedentes del suelo y del vuelo
- ☐ Sistema para la verificación del índice de madurez y la calidad de los productos entrantes
- ☐ Tolvas de recepción que permiten una adecuada circulación del fruto y de capacidad inferior a 20 Tm
- ☐ Limpieza periódica de las cajas en que se entregan las aceitunas con productos autorizados para la industria alimentaria
- ☐ Evacuación de los desechos en recipientes específicos para este fin, que se limpian periódicamente
- ☐ Limpieza sistemática de las tolvas de almacenamiento
- ☐ Otras (indicar: _____)

2.2. PREPARACIÓN DE LA PASTA, MOLTURACIÓN Y EXTRACCIÓN (marcar una o varias X)

- ☐ Molturación del fruto antes de 24 horas después de su recepción
- ☐ Control de la temperatura y tiempo de batido
- ☐ La temperatura del agua para la extracción no sobrepasa los 35ºC
- ☐ Limpieza permanente de molinos, sinfines y batidora utilizando solamente agua caliente a presión
- ☐ Control de la potabilidad del agua de lavado
- ☐ Otras (indicar: _____)

2.3. SISTEMA DE EXTRACCIÓN DEL ACEITE (marcar una o varias X)

- ☐ Sistema discontinuo o tradicional (de prensas)
- ☐ Sistema continuo de tres fases
- ☐ Sistema continuo de dos fases

2.4. ALMACENAMIENTO, ENVASADO Y TRANSPORTE (marcar una o varias X)

- ☐ Depósitos separados según calidades
- ☐ La maquinaria empleada para el envasado del aceite es de acero inoxidable y de fácil limpieza
- ☐ Los envases llenos de aceite, así como las cajas llenas de productos envasados, no están nunca en contacto con el suelo
- ☐ Depósitos construidos en material inerte
- ☐ Depósitos y envases para el aceite utilizados exclusivamente para este fin y los envases no se reutilizan
- ☐ Limpieza sistemática de depósitos y conducciones de aceites, limpieza permanente de la bodega
- ☐ Otras (indicar: _____)

2.5. CONTROL DE CALIDAD E HIGIENE (marcar una o varias X)

- ☐ Existencia en la empresa de un departamento de calidad
- ☐ Análisis para la caracterización del aceite, antes del envasado o ya terminado
- ☐ Análisis de residuos de productos fitosanitarios
- ☐ Formación del personal de almacén en materia de buenas prácticas de higiene y manipulado
- ☐ Otras (indicar: _____)

2.6. GESTIÓN DE SUBPRODUCTOS Y RESIDUOS PRODUCIDOS EN LA ALMAZARA (marcar una o varias X)

- ➢ Residuos líquidos: alpechín o agua de vegetación
  - ☐ Almacenamiento en balsas
  - ☐ Depuración en una planta de tratamiento de aguas residuales con una ubicación distinta a la de la almazara
  - ☐ Depuración en la misma almazara a través de la incorporación de una planta de tratamiento de aguas al sistema de producción
  - ☐ Otros (indicar: _____)
- ➢ Subproductos: orujo, alpeorujo
  - ☐ Extracción de aceite de orujo crudo
  - ☐ Combustible
  - ☐ Abono
  - ☐ Alimentación animal
  - ☐ Otros (indicar: _____)

3. PRÁCTICAS COMERCIALES IMPLEMENTADAS EN LA EMPRESA

3.1. DISTRIBUCIÓN (marcar una o varias X)

- ☐ Venta directa del aceite a granel
- ☐ Venta directa del aceite envasado
- ☐ Venta en otros canales de distribución (hipermercados, supermercados, tiendas especializadas, etc.)
- ☐ Integración horizontal y vertical con otras empresas (p.ej. en cooperativas de segundo grado)
- ☐ Uso de las tecnologías de la información y la comunicación (comercio electrónico, página web, etc.)
- ☐ Otras (indicar: _____)

3.2. PROMOCIÓN Y PRECIO (marcar una o varias X)

- ☐ Estrategia de venta basada en el precio
- ☐ Estrategia de venta basada en la calidad
- ☐ Combinación con otros productos y marcas
- ☐ Realización de campañas y participación en ferias agroalimentarias
- ☐ Otras (indicar: _____)

3.3. PRODUCTO (marcar una o varias X)

- ☐ Diversificación de los tipos de aceite vendidos (diferentes calidades, etc.)
- ☐ Diversificación de la forma de presentación del envase (material, tamaño, diseño, etc.)
- ☐ Etiquetado de calidad: denominación de origen
- ☐ Etiquetado de calidad: producción ecológica
- ☐ Etiquetado de calidad: producción integrada
- ☐ Etiquetado de calidad: calidad certificada
- ☐ Aplicación de técnicas para el control de fraudes (mezcla, contaminantes, etc.)
- ☐ Maridaje con otros productos alimentarios (p.ej. queso en aceite de oliva)
- ☐ Elaboración de nuevos productos alimentarios (p.ej. paté de aceituna)
- ☐ Elaboración de nuevos productos no alimentarios (p.ej. cosméticos)
- ☐ Elaboración de otros productos (indicar: _____)

4. SISTEMAS DE CALIDAD CERTIFICADA IMPLEMENTADOS: NIVEL DE CONOCIMIENTO Y ADOPCIÓN EN LA EMPRESA

	¿Lo ha adoptado?					
	Sí		No			
	Año aprox. adopción	Grado de satisfacción (de 1, nada, a 5, muy satisfecho)	¿Lo conoce?		¿Piensa adoptarlo?	
			Sí	No	Sí	No
NORMATIVA ISO						
Sist. gestión de la calidad (ISO 9000)						
Sist. gestión ambiental (ISO 14001)						
Sist. gestión calidad y ambiental (ISO 19011)						
Sist. gestión inocuidad de alimentos (Seguridad Alimentaria) (ISO 22000)						
Otro (indicar: _____)						
OTROS SISTEMAS DE CERTIFICACIÓN						
GLOBALGAP						
IFS (International Food Standard)						
BRC (British Retail Consortium)						
Otro (indicar: _____)						
NORMATIVA ESPECÍFICA PARA ACEITE DE OLIVA VIRGEN EXTRA						
Especificación de producto (UNE 34601)						
Proceso de transformación (UNE 34605)						
Envasado (UNE 34606)						
Otro (indicar: _____)						
SISTEMAS DE GESTIÓN DE LA INVESTIGACIÓN, DESARROLLO E INNOVACIÓN						
Gestión de la I+D+i (UNE166002)						
Otro (indicar: _____)						

5. ACTITUDES Y OPINIONES HACIA LA I+D+i EN LA EMPRESA

5.1. GASTO EN I+D+i RELACIONADA CON EL ACEITE DE OLIVA (I+D+i en prácticas industriales, prácticas comerciales y sistemas de calidad certificada)

5.1.1. Gasto en I+D+i (€/año o % sobre volumen de negocio de aceite de oliva): _____

5.1.2. Distribución del gasto en I+D+i (%)

%: _____ I+D+i sobre prácticas industriales

%: _____ I+D+i sobre prácticas comerciales

%: _____ I+D+i sobre sistemas de calidad certificada

%: 100 *TOTAL*

5.2. PARTICIPACIÓN EN PROGRAMAS DE I+D+i (marcar una o varias X)

☐ Plan Nacional de I+D y otros programas nacionales

☐ Planes de la Administración Autonómica

☐ Programas de la UE

☐ Otros programas internacionales (indicar: _____)

4

5.3. ORIGEN DE LAS INNOVACIONES EN LA EMPRESA (marcar una o varias X)

- Fuentes internas dentro de la empresa
  - ☐ Departamento de I+D+i
- Fuentes de mercado
  - ☐ Proveedores
  - ☐ Clientes
  - ☐ Competidores u otras empresas de la misma actividad (Coop., SAT, etc.)
  - ☐ Consultores, laboratorios comerciales o institutos privados de I+D
- Fuentes institucionales
  - ☐ Universidades, centros de enseñanza superior
  - ☐ Organismos públicos de investigación
  - ☐ Centros tecnológicos
- Otras fuentes
  - ☐ Internet
  - ☐ Prensa, radio y televisión
  - ☐ Asociaciones profesionales y sectoriales
  - ☐ Conferencias, ferias comerciales, exposiciones
  - ☐ Revistas científicas y publicaciones
  - ☐ Otras (indicar: _____)

5.4. OBJETIVOS DE LA INNOVACIÓN PARA LA EMPRESA (indicar como máximo los 5 más importantes, siendo 1 el más importante y 5 el menos importante)

- O Gama más amplia de productos
- O Sustitución de productos o procesos anticuados
- O Producir de forma respetuosa con el medio ambiente
- O Mayor cuota de mercado y penetración en nuevos mercados
- O Mayor calidad del aceite
- O Menor consumo de energía por unidad de aceite producido
- O Cumplir las normas técnicas de la olivicultura
- O Mejorar la sanidad y la seguridad
- O Mayor capacidad de producción
- O Menores costes laborales por unidad producida
- O Mejorar la capacidad en cuanto a tecnologías de la información
- O Mejorar las condiciones de trabajo
- O Mejorar la comunicación y la interacción entres las distintas actividades de la empresa
- O Intensificar la transferencia de conocimiento con otras organizaciones
- O Satisfacer las exigencias de los proveedores
- O Satisfacer las exigencias de los clientes
- O Incrementar el prestigio de la empresa
- O Otros (indicar: _____ _____)

5.5. FACTORES QUE DIFICULTAN LA INNOVACIÓN EN LA EMPRESA (indicar como máximo los 3 más importantes, siendo 1 el más importante y 3 el menos importante)

- Factores de coste
  - O Falta de fondos en la empresa
  - O Falta de financiación de fuentes exteriores, dificultad de acceso al crédito
  - O Coste demasiado elevado
  - O Otros (indicar: _____)
- Factores de conocimiento
  - O Falta de personal cualificado
  - O Falta de información sobre nuevas tecnologías
  - O Falta de información sobre los mercados
  - O Dificultades para encontrar socios para innovar
  - O Otros (indicar: _____)
- Factores de mercado
  - O Mercado dominado por empresas establecidas
  - O Incertidumbre respecto a la demanda de bienes y servicios innovadores
  - O No hay demanda de innovaciones
  - O Otros (indicar: _____)

5.6. IMPORTANCIA CONCEDIDA A DIVERSOS FACTORES AL PRODUCIR (marcar una X en cada fila)

	1 (ninguna)	2 (poca)	3 (alguna)	4 (bastante)	5 (mucha)
Beneficio económico					
Asumir poco riesgo					
Prestigio personal					
Respeto al medio ambiente					
Obtener productos sanos					
Otros factores (indicar: _____)					

5.7. LÍNEAS DE INVESTIGACIÓN MÁS IMPORTANTES PARA LA EMPRESA (indicar como máximo las 3 más importantes, siendo 1 la más importante y 3 la menos importante)

- Tecnologías de elaboración industrial del aceite

  - O Biotecnología para la determinación de fraudes por mezcla de aceites
  - O Detección del fraude por aceite deodorato en el aceite de oliva virgen
  - O Determinación de contaminantes en el aceite de oliva. Reglamentación del contenido de pesticidas
  - O Nuevos productos de la hoja del olivo
  - O Conservación de los componentes minoritarios de interés en el aceite de oliva
  - O Patrones para la cata del aceite de oliva
  - O Utilización del aceite de oliva virgen extra en alimentación como sustituto de otras grasas
  - O Componentes minoritarios del aceite de oliva y su influencia en la salud
  - O Aceite de oliva y cáncer
  - O Otras (indicar: _____)

- Comercialización, organización, patrimonio y territorio en el sector oleícola

  - O El aceite de oliva en las gastronomías de los países que no son consumidores tradicionales
  - O Demanda potencial de nuevos productos que contienen aceite de oliva y de la demanda de subproductos
  - O Comportamiento del consumidor en los mercados internacionales de destino de aceite de oliva
  - O Factores de diferenciación en el aceite de oliva: implicaciones en materia de marketing
  - O Otras (indicar: _____)

6. PERSONA ENTREVISTADA

6.1. NOMBRE Y APELLIDOS (opcional): _____

6.2. CARGO EN LA EMPRESA (marcar una X)

- ☐ Presidente
- ☐ Gerente
- ☐ Miembro del Comité Directivo
- ☐ Técnico (indicar: _____)
- ☐ Otro (indicar: _____)

6.3. EDAD (marcar una X)

- ☐ De 18 a 25 años
- ☐ De 26 a 35 años
- ☐ De 36 a 45 años
- ☐ De 46 a 55 años
- ☐ De 56 a 65 años
- ☐ Más de 65 años

6.4. SEXO (marcar una X)

- ☐ Hombre
- ☐ Mujer

6.5. NIVEL DE ESTUDIOS (marcar una X)

- ☐ Sin estudios
- ☐ Educación primaria
- ☐ Educación secundaria (bachillerato)
- ☐ Formación profesional
- ☐ Universitarios medios (diplomado/a)
- ☐ Universitarios superiores