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Factors affecting adoption and continuation of environmentally friendly practices in agriculture and forestry

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I fattori che determinano l'adozione e la continuazione di pratiche agricole e forestali eco-compatibili

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Abbreviations and acronyms

AES	Agri-Environmental Scheme
CAP	Common Agricultural Policy
EC	European Community
EEC	European Economic Community
EFA	Ecological Focus Area
EFFP	Environmentally Friendly Farming/Forestry Practice
ES	Ecosystem Service
EU	European Union
FEP	Forest-Environmental Payment
NIPF	Non-Industrial Private Forest
RDP	Rural Development Programme
UAA	Utilized Agricultural Area

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Summary

Agriculture and forestry can heavily affect the rural environment, especially when intensive practices are put in place. To increment environmental conservation, the EU financially supports the adoption of Environmentally Friendly Farming/Forestry Practices (EFFPs). To date, policies aimed at supporting EFFPs adoption in agriculture and forestry are however at a different development stage.

Given this, and considering the strong interconnection between conservation of the rural environment and farmers' and forest owners' choices, it is crucial that policy design takes into account the range of factors affecting EFFPs adoption by farmers and private forest owners. In the case of farmers, while the adoption factors have been largely explored (and research results have shown that the same factor may have opposite effect on the farmers' choices), research is still scarce on the factors affecting EFFPs implementation for a long time. In the case of private forest owners, the main research gap is on factors affecting their willingness to adopt of EFFPs, while those affecting productive choices are more known.

In order to contribute to fill these gaps, this PhD thesis aims to provide the state of the art on factors affecting EFFPs adoption by farmers offering some original insights. In addition, the thesis wants to explore which factors affect private forest owners' willingness to deliver Ecosystem Services (ESs) through EFFPs and to analyse the factors influencing farmers' choices on the continuation of EFFPs for a long time. Finally, the thesis attempts to provide suggestions to policy-makers in developing more effective policy instruments aimed to stimulate EFFPs implementation.

To achieve the first research objective, a qualitative meta-analysis has been carried out on the available literature. Results show that specific geographical and temporal trends help to explain most of the differences emerging in relation to the role played by several factors. These differences reflect the characteristics of the geographical context and show temporal trends linked to the different cohorts of EFFPs adopters.

To reach the second research objective, private forest owners' willingness to provide ESs by adopting EFFPs has been analysed through three different multinomial logit models. The results highlight that private forest owners' willingness increases when they have a high familiarity with the actions needed to provide the analysed ESs. It also emerges that the already high mandatory baseline imposed upon them by the strict Italian regulation framework does not seem to reduce their willingness to provide additional ESs. This should be considered in defining a clearer structure of the policy instruments and a well-defined baseline over which the additionality of forest-environmental payments has to be established.

Referring to the driving forces behind the continuation for a long time of EFFPs by farmers, the results of two diverse duration models show that farmers' choices are affected by a mix of factors evolving over time. Policy design has to take into account these time-dynamics, particularly referring to the effects of farmers' attitudes and motivations and social factors, avoiding the implementation of one-size-fits-all policies. Results place emphasis also on the positive effects played by the accumulation of experience and by the neighbourhood effect.

Finally, in fulfilment of the third research objective, the thesis concludes by delivering some suggestions to policy-makers enabling them to design more effective policy instruments. Given the different development stages achieved by policies in agriculture and forestry, no common policy recommendations are drawn for both sectors. For farmers, more mature EFFPs policies are required aiming to stimulate their participation for a long time, while for private forest owners, more structured and well-defined policy instruments to steer EFFPs adoption are needed.

Sommario

Le attività agricole e forestali possono esercitare una profonda influenza sull'ambiente rurale, specialmente quando vengono messe in atto pratiche di gestione intensive. Di conseguenza gli agricoltori e i proprietari forestali privati possono influenzare profondamente la qualità dell'ambiente e le caratteristiche del paesaggio con le loro scelte gestionali. Allo scopo di incrementare la conservazione dell'ambiente e del paesaggio rurale, l'UE mette a disposizione aiuti economici per gli agricoltori e i proprietari forestali privati volti a favorire l'adozione di pratiche eco-compatibili (in inglese *Environmentally Friendly Farming/Forestry Practices* – EFFPs). Ad oggi, però, gli strumenti politici che regolano gli aiuti concessi dall'UE nei settori agricolo e forestale sono in una fase di sviluppo molto diversa, dovuta al fatto che questi strumenti hanno seguito processi di attuazione inizialmente divergenti, per poi confluire, solo di recente, all'interno dei Piani di Sviluppo Rurale.

Alla luce di ciò e considerando anche la forte interconnessione tra la conservazione dell'ambiente rurale e le scelte degli agricoltori e dei proprietari forestali privati, risulta fondamentale che la progettazione di questi strumenti politici tenga conto dell'ampia gamma di fattori che ne influenzano le scelte riguardo all'adozione delle EFFPs. Nel caso degli agricoltori questi fattori sono stati ampiamente analizzati, anche se i risultati che emergono dalla letteratura evidenziano che lo stesso fattore può avere effetti opposti. Al contrario, la letteratura scientifica è ancora carente in relazione all'analisi dei fattori che influenzano la continuazione delle EFFPs nel lungo periodo. Per quanto riguarda i proprietari forestali privati, invece, contrariamente a quanto avviene per i determinanti delle scelte produttive, il principale *gap* informativo riguarda i fattori che influenzano la scelta di adottare le EFFPs.

Al fine di contribuire a colmare queste lacune, questa tesi si propone di fornire lo stato dell'arte concernente i fattori che influenzano l'adozione delle EFFPs da parte degli agricoltori offrendo alcune interpretazioni originali utili a far luce su alcune evidenze contrastanti. Inoltre, la tesi si propone di analizzare i fattori che influenzano la disponibilità dei proprietari forestali privati a fornire servizi ecosistemici (in inglese *Ecosystem Services* – ESs) attraverso l'adozione delle EFFPs e di analizzare i determinanti che, invece, influenzano le scelte degli agricoltori in relazione alla continuazione delle EFFPs nel lungo periodo. Infine, la tesi vuole fornire alcune linee guida utili ai decisori politici per lo sviluppo di strumenti più efficaci.

Per soddisfare il primo obiettivo, la letteratura scientifica inerente al tema analizzato è stata esaminata attraverso una meta-analisi qualitativa i cui risultati dimostrano che specifici *trend* geografici e temporali contribuiscono a fornire una spiegazione in merito alla maggior parte delle differenze emergenti in relazione al ruolo associato ai diversi fattori. Queste differenze

riflettono le caratteristiche del contesto geografico e seguono tendenze temporali legate alle diverse coorti di agricoltori che adottano le EFFPs.

Passando al secondo obiettivo, la disponibilità dei proprietari forestali privati a fornire gli ESs mediante l'adozione di EFFPs è stata analizzata attraverso tre diversi modelli logistici multinomiali. I risultati ottenuti evidenziano che la disponibilità dei proprietari forestali privati aumenta quando essi hanno un'elevata familiarità con le azioni necessarie per fornire gli ESs analizzati. Inoltre emerge che la già elevata *baseline* obbligatoria imposta dal rigido quadro normativo italiano sembra non ridurre la loro disponibilità a fornire ESs aggiuntivi. Ciò dovrebbe essere preso in considerazione nel definire una struttura più chiara degli strumenti politici e una *baseline* di riferimento ben definita sulla quale stabilire l'addizionalità dei pagamenti silvo-ambientali.

Riferendosi, invece, ai fattori determinanti per la continuazione delle EFFPs da parte degli agricoltori, i risultati di due diversi *duration models* mostrano che le scelte degli agricoltori sono influenzate da un insieme di fattori che evolvono nel tempo. La progettazione degli strumenti politici deve, quindi, tenere in considerazione queste dinamiche temporali, con particolare riferimento agli effetti delle attitudini e delle motivazioni degli agricoltori e dei fattori sociali, andando ad evitare l'implementazione di strumenti indifferenziati. Oltre a ciò, i risultati ottenuti mettono in evidenza l'effetto positivo dell'esperienza maturata nel tempo e dell'imitazione tra agricoltori.

Infine, in risposta al terzo obiettivo, la tesi propone alcune linee guida utili ai decisori politici per la progettazione di strumenti più efficaci. Tuttavia, data la diversa fase di sviluppo raggiunta dagli strumenti politici che supportano l'adozione delle EFFPs nei settori agricolo e forestale, non è possibile fornire raccomandazioni comuni: se per gli agricoltori sono necessari strumenti politici più maturi che mirino a stimolare la continuazione delle EFFPs nel lungo periodo, per i proprietari forestali privati occorrono strumenti politici più strutturati e ben definiti per incoraggiare l'adozione di questo tipo di pratiche.

1. Introduction

In rural areas, agriculture and forestry have shaped and modified the landscape and its connected biodiversity since their origin. Agricultural and forestry production essentially depend on the availability of natural resources and, at the same time, exert an important pressure on them. For this reason, agriculture and forestry heavily influence the rural environment, both positively and negatively: they provide many different services (e.g. climate change mitigation, biodiversity conservation, provision of pleasant and functional landscapes) but, at the same time, threaten ecosystem conservation itself, when intensive management practices are put in place. Considering this strong interconnection between environment and agriculture and forestry, it emerges that farmers and forest owners can heavily affect the quality of the environment and the characteristics of the landscape with their management choices.

In this context, one of the main goal of the Common Agricultural Policy (CAP) – through its first and second Pillars – is to improve the positive impacts of agriculture and forestry and reduce the negative ones. In this regard, the EU has included in Rural Development Programmes (RDPs) systems of financial incentives for farmers and forest owners aimed at supporting the provision of Ecosystem Services (ESs) through the adoption of specific Environmentally Friendly Farming/Forestry Practices (EFFPs).

In agriculture, incentive-based policy instruments aimed at supporting the adoption of EFFPs by farmers have a long and well-defined implementation history. In particular, in the European context, Agri-Environmental Schemes (AESs) are one of the most consolidated policy tools to compensate farmers for adopting more sustainable farming practices. Diversely, in forestry, voluntary measures aimed at stimulating EFFPs adoption by private forest owners to increase the provision of forest ESs are lagging behind. In this regard, Cesaro and Pettenella (2003) highlighted that, since their origin in the early nineties, EU forest 'policies' were strongly conditioned by agricultural development objectives, to the point that they have been defined as "virtual policies" (Flashe, 1998) or "shadow policies" (Pettenella, 1994).

Due to these diverse implementation paths, the issue emerges of accommodating the different languages and terms used to define the policy instruments and the related services and practices for agriculture and forestry. Consequently, a key to consistently identify the main terms used throughout the whole thesis is needed. This is reported Table 1.1.

Table 1.1. Key to identify the main terms used throughout the whole thesis.

	Terms	**Acronyms**
Outcomes	Ecosystem Services	ESs
Practices	Environmentally Friendly Farming/Forestry Practices	EFFPs
Policy instruments for:		
- agriculture	Agri-Environmental Schemes [a]	AESs
- forestry	Forest-Environmental Payments [a]	FEPs

[a] Definitions from EC Regulation n. 1698/2005.

In the Italian context, incentive-based policy instruments aimed at stimulating EFFPs adoption by farmers were introduced in 1992 thanks to the MacSharry reform when AESs started to play a core role in the environmental strategy of the European Community (EC). EEC Regulation n. 2078/1992 "on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside" represents the first legal basis for financially supported AESs voluntary implementation. Whereas this regulation recognised the crucial role played by farmers' for the conservation of the environment and aimed at stimulating participation by offering compensations to cover direct and indirect costs, it resulted in AESs not always achieving the desired adoption rates (EC, 1998). For example, in 1997, 11% of the Italian eligible Utilized Agricultural Area (UAA) joined the scheme, which can be considered a success, since the participation matched with the expectation of what planned by policy-makers, while in the Veneto region, that is the reference case study area for this thesis, UAA under the schemes reached 50% of the intended area – i.e. only 5.9% of the regional UAA (INEA, 1999).

Under Agenda 2000 CAP reform, a broader rural development policy was adopted, based on considering rural areas as able to produce goods and services, linked to the local environment, to the landscape, to culture and to social identity, and AESs were included under it. With EC Regulation n. 1259/1999, some mandatory EFFPs have been included in the CAP first Pillar by introducing the concept of "cross-compliance": member States were delegated to set mandatory environmental requirements for farmers under a common EU framework. Compliance with these mandatory environmental requirements was a prerequisite for accessing the direct payments. In parallel, under the CAP second Pillar, EC Regulation 1257/1999 financially supported AESs for the voluntary adoption of several EFFPs above the minimum mandatory requirements. The payments connected to these schemes aimed to: i) the protection and improvement of the environment and the natural resources; ii) the

extensification of the agricultural practices; iii) the preservation of the traditional rural landscape.

Fischler reform in 2003 placed rural development at the core of the CAP, emphasising agriculture's multifunctionality. After this reform, EC Regulation n. 1698/2005 defined the structure of the new RDPs, while the minimum cross-compliance levels were raised.

Under Europe 2020 objectives, the CAP 2014-2020 further improved the process. Farmers receiving direct payments have to fulfil not only the cross-compliance requirements but also those included in the so-called "greening" component of the direct payments (EC Regulation n. 1305/2013). Both these prescriptions raised the mandatory baseline: greening and cross-compliance, indeed, include a set of practices – often perceived by farmers as costly constraints (Schulz et al., 2013) – that were previously paid under voluntary AESs.

Despite more than twenty-five years of implementation, the AESs desired adoption rates are not still achieved (Bartolini et al., 2013; Micha et al., 2015; Pavlis et al., 2016). In this regard, recent analysis by Blazy et al. (2011) and Reimer et al. (2014) highlight that financial support is not enough for a full and effective AESs adoption, which requires instead also a change in farmers' behaviour and attitudes.

Differently than in agriculture, in the Italian context forest ESs provision has traditionally been based only on a command and control approach since the R.D.L. n. 3267/1923. Indeed, the recognition of the economic importance of the national forest resources and of their cultural, social and environmental values often contrasts with the absence of a structured policy similar to what developed for agriculture (Romano, 2017).

The first forestry measures were mainly focused on farmland afforestation, especially in lowlands and in hilly areas, often with intensive plantations, under EEC Regulation n. 867/1990 and EEC Regulation n. 2080/1992. The former co-financed investments in machinery and equipment for forest contractors while the latter allocated the majority of the funds to the afforestation of agricultural land.

With Agenda 2000 and the 2003 CAP mid-term review, the common strategies for the forest sector were better integrated in the rural development policy (Romano et al., 2012). In particular, forest measures were included into the few articles of the EC Regulation n. 1257/1999 connected to environmental protection issues. These measures included also actions connected to the improvement and conservation of forest ecosystems and to the provision of forest ESs that – using the definitions from EC Regulation n. 1698/2005 – are called Forest-Environmental Payments (FEPs). The implementation of this Regulation by the Italian Regions favoured the afforestation measures, while the implementation of FEPs remained limited (Cesaro and Pettenella, 2003).

EC Regulation n. 1257/1999 bypassed a limitation exiting in the past making also private forest owners eligible for the measures. Moreover, it financed not only productive plantations but also protective or multifunctional ones.

Due to the growing awareness of the important role played by forests for maintenance of environmental functionality – also for carbon sequestration and climate change mitigation – FEPs assumed a more autonomous connotation in the 2007-2013 programming period (Romano et al., 2012). However, when implementing each regional RDP, founds were shifted from forestry to agricultural measures due to the difficulties to spend all the resources allocated to FEPs. In Italy, this was explained also with the difficulty to clearly define the mandatory baseline over which the additionality of the measures had to be established (Cesaro and Pettenella, 2013). In addition, the regulatory context of the R.D.L. n. 3267/1923 already set demanding requirements.

Rete Rurale Nazionale proposed national guidelines for criteria and good practices of forest management as a baseline for forestry measures (Romano et al., 2009). However, most of the Regions disregarded these national guidelines in their RDPs on the ground that they had already autonomously defined their local FEPs. As a result, the adoption of these measures remained very limited (Cesaro and Pettenella, 2013).

Currently, EU Regulation n. 1305/2013 has strengthened the FEPs, emphasising the role and functions of forests in relation to the environmental regulation, to the landscape protection and to the creation of opportunities for the socio-economic development of rural and mountain areas. The role of private forest owners in the supply of ESs has been explicitly made equal to the farmers' one (Romano, 2017). Very recently, the national government has issued D.lgs n. 34/2018, which at article 7 delegates Regions to promote FEPs in compliance with the additionality principle. However, regional planning continues to be characterised by a scarce attention to the forest sector and, in particular, to private forest owners that are often not farmers and, therefore, more marginally involved in RDPs, so hindering the effective implementation of FEPs (Secco et al., 2011; Romano, 2017). Consequently, EFFPs implementation by private forest owners still largely depends on their attitudes and behaviours (Matta et al., 2009) rather than on public financial incentives.

This short analysis of the policy evolution clearly shows that incentive-based measures aimed at supporting EFFPs adoption in agriculture and forestry have followed partially diverging implementation processes at their beginning, while more recently they converged under the RDPs; for this reason they are, today, at different development stages.

Considering this aspect and given the strong interconnection between the conservation of the rural environment and farmers' and forest owners' choices, it is crucial that policy design

takes into account the complex range of factors affecting EFFPs adoption by farmers and private forest owners.

Research on factors affecting AESs adoption by farmers is already well advanced. The wide literature available, however, shows often opposite results on the effect of several factors. This is an issue which requires attention and has not been yet thoroughly addressed. In addition, the literature is very scarce in relation to the analysis of the factors affecting the choice to continue with EFFPs for a long time. Given the long AESs implementation history, this is a pivotal research issue, worth considering at the light that AESs need a long period to produce the desired environmental benefits, often beyond the ordinary contract duration (Swetnam et al., 2004).

Diversely, research on factors affecting private forest owners' willingness to provide additional ESs by adopting EFFPs is not very much developed, while research efforts have focused so far on production choices (Amacher et al., 2003; Beach et al., 2005; Domínguez and Shannon, 2011; Blanco et al., 2015; Silver et al., 2015).

Having recognised these gaps, this research has identified the following research questions:

1. Given the contrasting results emerging from literature on the effects of several factors that affect farmers' EFFPs adoption choices, are there specific patterns able to explain such different results?
2. Which factors influence EFFPs adoption when policy-based financial incentives are still in an earlier stage of implementation – as the case of forestry – and which are the driving forces behind a continuation for a long time of EFFPs implementation under public support – as the case of agriculture?
3. How can a better knowledge on attitudes and motivations of farmers and private forest owners guide policy-makers in designing more effective policy instruments?

To provide an answer to these research questions, the specific objectives of PhD thesis are:

1. To draw the state of the art on factors affecting EFFPs adoption by farmers by reviewing the literature and to offer some original insights explaining the contrasting results;
2. To explore which factors affect private forest owners' choices in the willingness to deliver ecosystem services and which factors affect farmers' choices in the willingness to continue AESs for a long time, capturing their temporal dynamics;
3. To use these results in order to offer policy-makers suggestions in developing more effective policy instruments aimed at stimulating the adoption or the continuation of EFFPs.

An important conceptual reference to frame the factors affecting farmers' and private forest owners' behaviour in delivering ESs is the theory of reasoned action and planned behaviour

(Ajzen and Fishbein, 2005), one of the most referential theoretical tools used to understand how individuals' behaviour is influenced by their motivations and attitudes. In this research context, this theory enables to connect farmers' and private forest owners' attitudes and motivations towards EFFPs to their beliefs. These, in turn, are affected by a wide set of background factors that can be grouped into four main categories:

1. Agriculture and forest farm structural and economic factors;
2. Farmer's and private forest owner's socio-economic factors and motivational and attitudinal factors;
3. Informational factors;
4. Social capital factors.

When exploring the behaviour of farmers who continue to implement AESs, the thesis widens the range of factors included in each category in respect to those considered by the literature on adoption. When analysing private forest owners' willingness to provide ESs, thesis considers a more limited number of factors being based on existing dataset.

In order to work in homogeneous socio-economical and institutional context, this research is focused on the Veneto region and based on case studies (Yin, 2012). For studying the continuation choices of farmers, a specific AES of the regional RDP, i.e. planting and maintaining hedgerows and buffer strips along the fields' margins in lowlands and hilly areas, has been chosen for its long implementation history. Going from the EEC Regulation n. 2078/1992 to the following RDP rounds, the selected AES registered an increase of the area under contract: cross-section adoption data report 857 ha in 1997 (INEA, 1999), 1,500 ha in 2005 (Agriconsulting, 2008), 2,944 ha in 2012 (Agriconsulting, 2012) and 3,168 ha in 2015. Other implementation data and the evolution of the scheme over time are extensively reported and discussed in section 4.4.

For private forest owners, the provision of three different ecosystem services – i.e. biodiversity improvement, soil conservation and carbon sequestration – has been considered for their relevance in the analysed context. The forest case study is located in the mountainous areas of the Veneto region, where the largest part of the regional forests is located.

The thesis is based on four papers. The first research question is addressed in Chapter 2, where a published paper presents the state of the art on factors affecting EFFPs adoption by farmers. In particular, a qualitative meta-analysis of the literature shows that geographical and temporal trends may provide a rationale to explain some opposite effects of several factors on EFFPs uptake. The paper disregards the effect of the presence of a payment connected to EFFPs adoption due to the fact that reviewed researches analyse both subsidised and unsubsidised practices. However, this factor could play an important role, also considering that the presence of incentive-based policy instruments could better explain

some geographical differences. Nevertheless, only few papers consider this factor (e.g. Pietola and Lansink, 2001) and highlight its general positive effect, especially in developing or undeveloped countries, like Asia or Africa (Chiputwa et al., 2011 and Haghjou et al., 2014).

The second research question is addressed in Chapters 3, 4 and 5. Chapter 3 reports a submitted paper which analyses the factors affecting private forest owners' willingness to adopt more sustainable forestry practices aimed to provide ESs beyond the minimum legal requirements with or without payment. This analysis is based on 106 face-to-face questionnaire-based interviews with private forest owners referred to in the paper as Non-Industrial Private Forest – NIPF – owners. Chapter 4 includes a published paper which analyses the effects of several factors on the farmers' decision to remain in the selected AES (i.e. planting and maintaining hedgerows and buffer strips) over a long time. In particular, the paper scrutinises the roles played by farmer's and farm structural characteristics, farmer's learning process, neighbourhood effect and changes in the policy design. The obtained results – based only on secondary official data of the overall population of AES adopters in the 2000-2015 period – highlight the positive effect of the efforts made by policy makers in order to adapt the policy design to the situation on the ground. The paper concludes by recommending further research beyond the limited information available in the regional archives, taking into account the effects of the individual farmer's motivations and attitudes and of social factors. Chapter 5 reports a submitted paper that, thanks to the availability of primary data collected through a questionnaire-based survey of 344 farmers, allows to overcome the limitation of the previous paper, enriching the analysis of the spectrum of factors influencing farmers' decision to continue with the selected AES by exploring more in depth the effect of the interplay between time and a wider range of background factors, including farm factors, farmer's socio-demographic characteristics, attitudes and motivations, and social and informational factors.

Finally, Chapter 6 addresses the third research question providing suggestions to policy-makers aimed at steering higher levels of EFFPs implementation, also at the light of the future CAP 2021-2027 directions. The chapter also discusses limitations of this work and future research needs.

References

Agriconsulting (2008). Valutazione del Piano di Sviluppo Rurale 2000–2006 della Regione Veneto. Rapporto di Valutazione ex post (Rev. 1), 456 pp.

Agriconsulting (2012). Valutazione in itinere del Programma di Sviluppo Rurale 2007–2013 della Regione del Veneto. Aggiornamento della relazione di valutazione intermedia (Rev. 1), 245 pp.

Ajzen, I., Fishbein, M.E. (2005). The Influence of Attitudes on Behavior. In The handbook of attitudes; Albarracin, D., Johnson, B. T., Zanna, M. P., Eds.; Lawrence Erlbaum Associates: Mahwah, 2005; pp. 173–221.

Amacher, G.S., Conway, M.C., Sullivan, J., 2003. Econometric analyses of nonindustrial forest landowners: Is there anything left to study? Journal of Forest Economics 164, 137–164. doi: 10.1078/1104-6899-00028.

Bartolini, F., Brunori, G., Fastelli, L., Rovai, M., 2013. Understanding the participation in agri-environmental schemes: evidences from Tuscany Region. In Proceedings of the 53rd ERSA Conference: "Regional Integration: Europe, the Mediterranean and the World Economy". Palermo, pp. 1–19.

Beach, R.H., Pattanayak, S.K., Yang, J.C., Murray, B.C., Abt, R.C., 2005. Econometric studies of non-industrial private forest management: A review and synthesis. Forest Policy and Economics 7, 261–281. doi:10.1016/S1389-9341(03)00065-0.

Blanco, V., Brown, C., Rounsevell, M., 2015. Characterising forest owners through their objectives, attributes and management strategies. European Journal of Forest Research 134, 1027–1041. doi:10.1007/s10342-015-0907-x.

Blazy, J. M., Carpentier, A., and Thomas, A. (2011). The willingness to adopt agri-ecological innovations: Application of choice modelling to Caribbean banana planters. Ecological Economics 72, 140-150.

Cesaro, L., Pettenella, D., 2003. Le misure forestali nei piani di sviluppo rurale. L'Italia Forestale e Montana 2, 71–90.

Cesaro, L., Pettenella, D., 2013. Il settore forestale nella programmazione 2014-2020 dello sviluppo rurale. Agriregionieuropa 9, 73–77.

Chiputwa, B., Langyintuo, A.S., Wall, P., 2011. Adoption of Conservation Agriculture Technologies by Smallholder Farmers in the Shamva District of Zimbabwe: A Tobit application. In Proceedings of the 2011 Meeting of the Southern Agricultural Economics Association (SAEA). p. 28.

Domínguez, G., Shannon, M., 2011. A wish, a fear and a complaint: understanding the (dis)engagement of forest owners in forest management. European Journal of Forest Research 130, 435–450. doi:10.1007/s10342-009-0332-0.

EC, 1998. Stato d'applicazione del regolamento (CEE) n. 2078/92: valutazione dei programmi agro-ambientali. Documento di lavoro della Divisione Generale Agricoltura.

Flashe, F., 1998. Formal aspects of the near future development of the «virtual» European forestry policy. In Proceedings of the IUFRO, EFI Conference: "Future forest policies in Europe – Balancing Economics and Ecological Demands".

Haghjou, M., Hayati, B., Momeni Choleki, D., 2014. Identification of Factors Affecting Adoption of Soil Conservation Practices by Some Rainfed Farmers in Iran. Journal of Agricultural Science and Technology 16, 957–967.

INEA, 1999. Le misure agroambientali in Italia. Analisi e valutazione del reg. CEE 2078/92 nel quadriennio 1994-97. Rapporto Nazionale, 143 pp.

Matta J. R., Alavalapati J. R., Mercer D. E. 2009. Incentives for biodiversity conservation beyond the best management practices: are forestland owners interested? Land Economics 85(1), 132-143.

Micha, E., Areal, F.J., Tranter, R.B., Bailey, A.P., 2015. Uptake of agri-environmental schemes in the Less-Favoured Areas of Greece: The role of corruption and farmers' responses to the financial crisis. Land Use Policy 48, 144–157. doi:10.1016/j.landusepol.2015.05.016.

Pavlis, E.S., Terkenli, T.S., Kristensen, S.B.P., Busck, A.G., Cosor, G.L., 2016. Patterns of agri-environmental scheme participation in Europe: Indicative trends from selected case studies. Land use policy. doi.org/10.1016/j.landusepol.2015.09.024

Pettenella, D., 1994. EU forest policy and its impacts on the Mediterranean countries. Medit 5(3), 11-15.

Pietola, K.S., Lansink, A.O., 2001. Farmer response to policies promoting organic farming technologies in Finland. European Review of Agriculture Economics 28, 1–15. doi:10.1093/erae/28.1.1

Reimer, A., Thompson, A., Prokopy, L.S., Arbuckle, J.G., Genskow, K., Jackson-Smith, D., Lynne, G., McCann, L., Wright Morton, L., Nowak, P. (2014) People, place, behavior, and context: A research agenda for expanding our understanding of what motivates farmers' conservation behaviors. Journal of Soil and Water Conservation 69, 57A–61A.

Romano, R., 2017. L'evoluzione della materia forestale nelle politiche dello sviluppo rurale. Agriregionieuropa 13, 54–61.

Romano, R., Cesaro, L., Cilli, S., 2009. Criteri e buone pratiche di gestione forestale - baseline per l'attuazione della misura silvo-ambientale. Rete Rurale Nazionale, Task Force Foreste. Roma.

Romano, R., Marandola, D., Cesaro, L., Marchetti, M., 2012. Politiche forestali in Europa e scenari 2020: tra sostenibilità e sviluppo rurale. L'Italia Forestale e Montana 67, 221–236. doi:10.4129/ifm.2012.3.01.

Schulz, N., Breustedt, G., Latacz-Lohmann, U., 2014. Assessing Farmers' Willingness to Accept "Greening": Insights from a Discrete Choice Experiment in Germany. Journal of Agricultural Economics 65, 26–48. doi:10.1111/1477-9552.12044.

Secco, L., Pettenella, D., Gatto, P., 2011. Forestry governance and collective learning process in Italy: Likelihood or utopia?. Forest Policy and Economics, 13(2), 104-112.

Silver, E.J., Leahy, J.E., Weiskittel, A.R., Noblet, C.L., Kittredge, D.B., 2015. An Evidence-Based Review of Timber Harvesting Behavior among Private Woodland Owners. Journal of Forestry 113, 490–499. doi:10.5849/jof.14-089.

Swetnam, R.D., Mountford, J.O., Manchester, S.J., Broughton, R.K., 2004. Agri-environmental schemes: their role in reversing floral decline in the Brue floodplain, Somerset, UK. J. Environ. Manage. 71 (1), 79–93.

Yin, R.K., 2012. Applications of case study research. Sage Publications, Inc., 231 pp.

2. The Role of Factors Affecting the Adoption of Environmentally Friendly Farming Practices: Can Geographical Context and Time Explain the Differences Emerging from Literature?

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2.1. Abstract

Environmentally Friendly Farming Practices (EFFPs) are tools aimed at providing ecosystem services or mitigating the environmental impacts of intensive agriculture. A large literature has explored the factors affecting the adoption of EFFPs by farmers. However, opposite effects of several factors on uptake have often emerged. We carried out a qualitative meta-analysis of the literature seeking to identify some geographical and temporal trends that can provide a rationale to explain these opposite results. To reach this goal, we analysed the literature and classified the following factors affecting farmers' behaviour according to the theory of reasoned action and planned behaviour: farm, farmer, informational, and social factors. Our perspective in exploring the existing literature shows that the geographical context and the temporal period under analysis, considered as different adopters' cohorts, can explain most of the opposite effects. For example, while the different effects of farm structural factors show specific geographical patterns, those of the management and economic factors follow temporal trends. The impact of some farmers' socio-demographical characteristics and some social factors can be explained in terms of both geographical context and time. The broad trends we found cast light on the importance of further research adopting the same methodological approach in different geographical contexts and under a temporal perspective.

Keywords: Environmentally friendly farming practices; adoption; uptake; factors affecting farmers' behaviour; theory of reasoned action and planned behaviour; geographical context; temporal trend

2.2. Introduction

Environmentally Friendly Farming Practices (EFFPs) can be meant as a set of farming practices aimed at mitigating critical environmental issues connected to intensive agriculture

or at increasing the provision of agricultural ecosystem services. These practices can be directed towards different resources of the farming environment, like soil, water, landscape, habitat, and biodiversity. In recent decades, specific EFFPs have been proposed as a tool for reducing diffuse soil and water pollution, contrasting landscape simplification and loss of habitats and improving ecological quality [1]. In many countries, EFFPs are supported by policy initiatives providing financial incentives to stimulate farmers' participation. However, research in this field [2–7] has shown that a full and effective implementation of EFFPs goes far beyond financial support and needs to be based on a change in farmers' behaviour and intentions. This change, in turn, is affected by a wide range of factors [1].

Understanding the role of these factors is a challenge for agricultural economics research, as shown by the high number of works published in recent decades. Until the turn of the century, studies were mainly focused on the farm structure and farmers' socio-demographic characteristics, while later works have highlighted that the adoption of EFFPs is affected by a much larger number of factors, amongst which motivations and attitudes are very important [8–19]. Recent research has endeavoured to explore the role of social capital [14,20,21], especially the interpersonal relationships amongst farmers and their networks. In addition, spatial modelling techniques are today enabling the inclusion of the spatial attributes of factors and a better understanding of the diffusion patterns on the adoption of EFFPs [22–24].

The rich scientific literature on the factors affecting farmers' behaviours has been reviewed by several authors, who have focused on a single EFFP or on some of them: soil [25–29] and/or water [26,27,30–34] conservation practices, organic farming [35,36], low-input farming systems [37–39], biodiversity protection practices [40], and practices with multiple objectives [41–44].

This literature covers different contexts, e.g., developed and developing countries, areas where financial support for EFFPs is in place or not, etc., and also analyses different time periods. When reviewing it in depth, differences—sometimes even contrasts—in the role played by several factors in affecting farmers' behaviour emerge, i.e., some authors found that a given factor has positive effects on the adoption of EFFPs, while other authors found it has negative effects.

We hypothesise that a rationale for explaining these contrasting results can be found by analysing them in the perspective of different geographical contexts and/or different famers' cohorts of early and late adopters. To this end, our paper has reviewed global literature seeking to identify possible geographical and temporal trends capable of explaining such differences. Our qualitative meta-analysis of the literature aims to understand the effect of factors affecting the adoption of EFFPs under a holistic approach—i.e., independently of the

specific EFFP nature—with an original perspective so far only partially explored, and not by many authors [35,45–48].

2.3. Materials and Methods

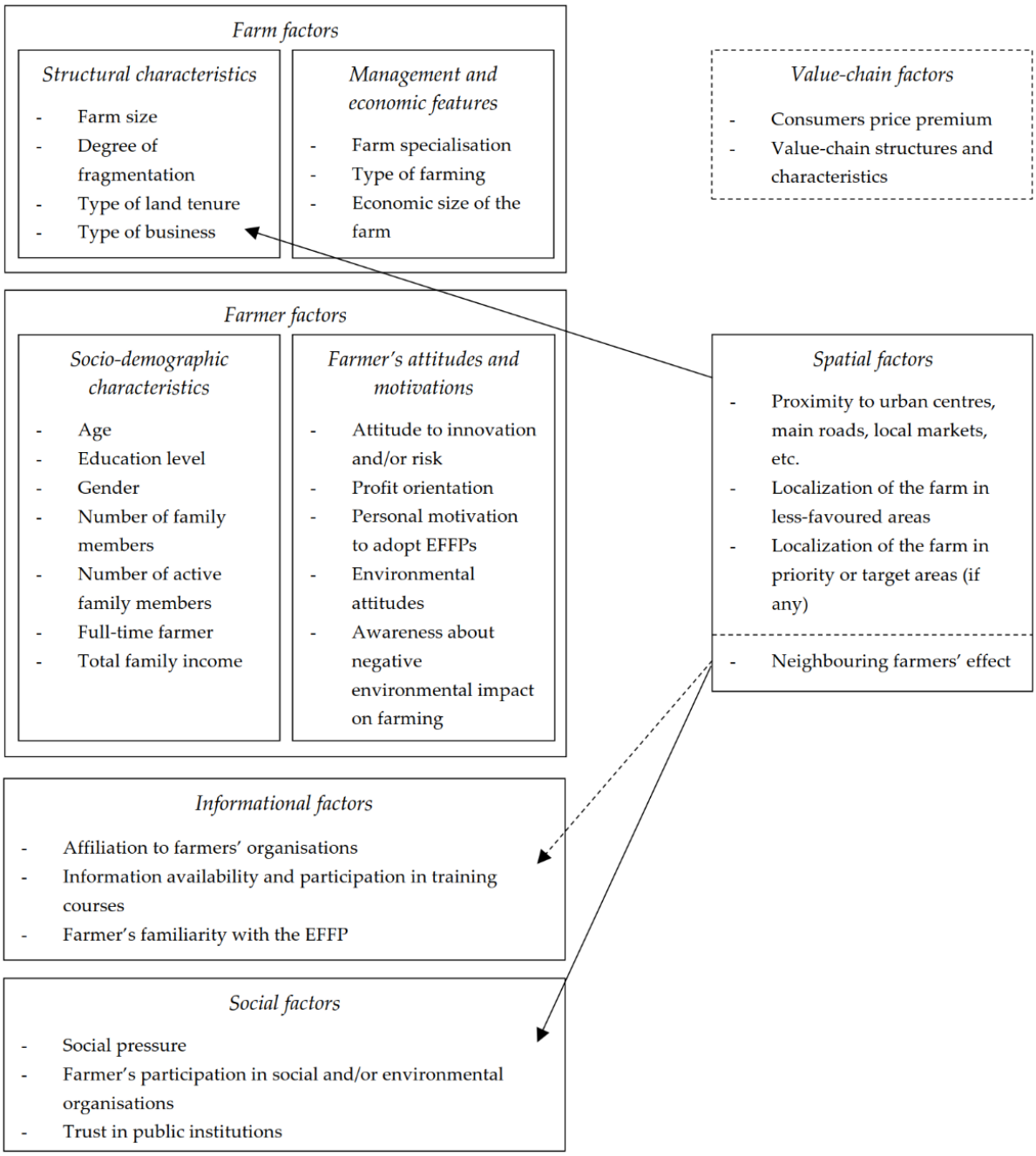
In our analysis, we referred to the theory of reasoned action and planned behaviour [49,50], the most referential theory used to understand how individuals' behaviours can be influenced by their motivations and attitudes. With reference to the context we analysed, this theory postulates that farmers' attitudes and behaviour towards the adoption of EFFPs are related to their beliefs. These, in turn, are affected by a set of background factors [51]. Mettepenningen et al. [52] have distinguished four categories of background factors for the uptake of agri-environment schemes: (i) farm factors; (ii) farmer factors; (iii) informational factors; and (iv) social factors.

We adopted this classification with several adaptations, i.e. we introduced further distinctions within both farm and farmer factors, as reported in Figure 2.1. In addition, we considered some spatial factors influencing the adoption of EFFPs, explored now by an emerging strand of literature—see, for example, [22–24]. We included some of these spatial factors—i.e., farm proximity to, for example, urban centres and main roads, and the localisation of the farm—among the structural characteristics of the farm. Another social factor is the number of neighbouring farms adopting a given EFFP. This is often interpreted as learning from other farmers, receiving information, and sharing experiences grounded on the social network of the farmer, so it may be included among either informational or social factors. Following [53,54], we classified it under social factors (Figure 2.1).

The adopted methodological framework disregards a set of value-chain-related factors which may affect farmers' choices on adoption of some EFFPs when consumers are willing to pay a price premium for agri-food products produced by farmers adopting, for example, organic or low-input farming practices. Price premiums are generally observed when consumers perceive these food products as both healthier and less harmful to the environment than the conventional ones (see [55] for a review), when EFFP-linked products are sold through short chains [56], and/or when territorial-specific alternative value chains are created thanks to EFFPs [57–59]. Nevertheless, the impact of price premiums on farmers' decisions largely depends on several issues, like the structure of the supply chains and the different bargaining power held by firms at the different stages of the chain which affects the magnitude of the value transmission along the chain upwards to the farmers [60]. Moreover, other complex vertical relationships established in the value-chain may affect farmers decisions on some EFFPs adoption, like the effect of public food quality certification schemes (e.g., the Italian regional schemes for integrated pest management), the quality standards, and the code of

practices [61,62] established by the processors and more often by large-scale retailers, generally in a multidimensional buyers power context (see [63–65] for a review). Despite the weight value-chain-related factors may have in farmers' decisions to adopt EFFPs, or at least some of them, no papers including these factors in adoption models were found: hence, we mentioned them in our framework (dashed box in Figure 2.1) but could not include them in our review.

Figure 2.1. Background factors affecting farmers' adoption of Environmentally Friendly Farming Practices (EFFPs).



We extensively reviewed the Scopus, Web of Science, and Google Scholar databases covering the new millennium and the literature of the late 1990s. We scrutinised 350 works, but limited our analysis to those having estimated a model on the adoption of EFFPs and reporting the reference period for the analysed data. After this selection, we ended up with 108 research papers and 17 conference proceedings.

We then attributed the studies to seven areas according to their geographical location: Northern Europe (NE), Southern Europe (SE), North America (NA), Central–South America (SA), Africa (AF), Asia (AS), and Oceania (OC). The distribution of analysed papers according to the geographical areas is the following: NE: 25%; SE: 21%; NA: 10%; SA: 8%; AF: 20%; AS: 11%; and OC: 5%. A more detailed geographical scale for Europe is justified by the higher availability of papers.

Finally, when selecting the factors to be considered in our review, we took into account only those reporting positive or negative effects on the adoption of EFFPs that were statistically significant.

2.4. Results

The outcomes of our qualitative meta-analysis aiming at explaining the contrasting results in terms of geographical context and temporal trends are summarised in Tables 2.1–2.6, while the specific references to the reviewed literature are accounted for in Appendix 2.A. The trends we found are common to all the EFFPs analysed, with very few exceptions.

2.4.1. Farm Factors

2.4.1.1. Structural Characteristics of the Farm

- *Farm size:* The vast majority of the analysed research highlights a positive effect for large-sized farms on the adoption of EFFPs. In AF, and especially for soil and water conservation practices [12,66–70], this positive role is often linked to higher flexibility in terms of decision-making, greater access to resources, and more opportunities to test new practices on small sample plots [71,72]. In NE and SE, however, a negative effect is found in some cases, related to the higher profit-orientation of larger farms compared with smaller ones, or to the ease of management of smaller farms in the case of labour-intensive EFFPs [7,46,73–77].
- *Degree of fragmentation:* In NA and AS, a high degree of fragmentation negatively affects the probability that a farmer will adopt EFFPs [78], due to the increased management complexity [79] or to the requirements of using contiguous plots of farmland for some conservation programmes [80].

- *Ownership of land:* In AF and AS, owners are more willing to adopt EFFPs [81–85] compared with renters. Indeed, in these geographical contexts, well-defined ownership rights [86] and the security of land access [87] are crucial preconditions to the adoption of EFFPs [88]. Meanwhile, in NE, SE, and NA, different results occur depending on the specific EFFP considered.
- *Sole proprietorship farm:* A sole proprietorship structure facilitates farmers' decision-making towards the adoption of EFFPs in AS [79]. Instead, in NE, SE, and NA, more complex business types play a positive role compared with sole proprietorship [89,90] due to a higher managerial ability paired with a lower individual liability [91].
- *Proximity:* Farm proximity to urban centres [66,80,92,93], main roads [84,87], local markets [3,66,83,94], and product aggregation/processing centres [66,95] is explored by the literature. In AF and AS, proximity to local markets and aggregation/processing centres positively affects the uptake of EFFPs, thanks to the technical information and assistance farmers receive there [66,78,83,84,94,96]. However, some opposite results emerge in AF, mainly in relation to main roads [3,66] and urban centres [66], where farmers are more profit-oriented. In NE for organic farming [93,97] and in NA, the majority of papers report a negative proximity effect.
- *Localisation:* In NE and SE, where rural development policies define target areas for many EFFPs, this factor plays a positive role as expected [77,89,90,98–102]. Farm localisation within less-favoured areas has a predominantly positive effect in NE [89,103] and SE [24,100,104–110]; however, some papers highlight negative results in SE [76,99,100,110,111], due to the fact that the scarcity of infrastructures and services—which characterises marginal areas—increases transaction costs and discourages the adoption of EFFPs [95].

Table 2.1. Main results for the structural characteristics of the farm (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central–South America; AS: Asia; AF: Africa; OC: Oceania).

Structural Characteristics of the Farm	**Effect on Adoption of EFFPs**	
	+	**-**
Farm size	NE, SE, NA, AF, AS, OC	NE, SE
Degree of fragmentation		NA, AS
Ownership of land	NE, SE, NA, AF, AS	NE, SE, NA
Sole proprietorship farm	AS	NE, SE, NA
Proximity	AF, AS	NE, NA, AF
Localisation in target areas	NE, SE	
Localisation in less-favoured areas	NE, SE	SE

2.4.1.2. Management and Economic Features of the Farm

- *Farm specialisation and type of farming:* The effect of a high level of specialisation has been analysed particularly in NE and SE. Here, a trend perspective allows us to give a good explanation of the opposite results provided by the literature: taking into account that, in several cases, the adoption of EFFPs implies a farm diversification [112], early EFFP adopters are generally mixed farms [14,75,99,103,111,113,114], while late adopters are more specialised [74,106–108,115]. Both in NE and in SE, a specialisation in permanent crops positively affects the adoption of EFFPs [45,114,116–118], while the effect of specialisation in livestock differs between SE farms, where the effect is positive [14,99,106–108,111,114,117–120], and NE farms, where the effect is negative [93,103,113].
- *Economic size of the farm:* This factor also has been analysed almost solely in NE and SE. In both geographical areas, a temporal trend is detected: early adopters are represented by large farms in economic terms [103,106–108,121], while more recent adoption of EFFPs is particularly diffuse among farms in smaller economic size classes [14,76,99,111].

Table 2.2. Main results for the management and economic features of the farm (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central-South America; AS: Asia; AF: Africa; OC: Oceania).

Management and Economic Features of the Farm	**Effect on Adoption of EFFPs**	
	+	**-**
Farm specialisation	late adopters: NE, SE	early adopters: NE, SE
Livestock farm	SE	NE
Economic size of the farm	early adopters: NE, SE	late adopters: NE, SE

2.4.2. Farmer Factors

2.4.2.1. Socio-Demographic Characteristics

- *Age:* If we exclude AF, a clear temporal trend in the farmers' age effect is revealed: while younger farmers prevail among the early EFFPs adopters [11,45,73,75,84,90,101,104–108,113,119,121–127], older farmers act as followers—i.e., late adopters [85,89,95,116,117,120,128–134]. In AF, contrasting results emerge, however: younger farmers seem more prone to implement soil and water conservation practices, particularly in recent years [3,4,67–69,81,83,94].
- *Education level:* Regardless of the geographic context, literature agrees on the evidence that farmers who are more educated—and therefore more informed about environmental threats linked to agricultural production—are more inclined to adopt EFFPs [11,67,68,72,75,79,81,85,93,94,100–102,109,114–116,120,121,127,130,131,135–140].

- *Gender:* In NE, SE, and NA, the reviewed works show that female farmers have a higher motivation to adopt EFFPs, especially organic farming [53,73,74,115,141]. In AF, where mostly soil and water conservation practices have been considered, a temporal trend can be detected: while male farmers are mainly early adopters [67,139,142], women are late adopters [3,69,70,94].
- *Number of family members and number of active family members:* These indicators are often used as a proxy of family labour availability within the farm. In NE, the number of family members plays a positive effect in particular for labour-intensive EFFPs like organic farming [46,73,126,141,143]. In AF, the number of active family members has a positive effect only for early adopters [12,67,87,96,144]: this positive effect is explained by literature both in terms of family labour availability and the opportunity of sharing management decisions with other family members, which characterises innovator farmers in this context [125]. Conversely, in SE, SA, and for AF–AS late adopters, the effect of both factors is negative when the adoption of EFFPs implies an extensification of the farming system, which causes a reduction in the need for on-farm labour in contexts where off-farm job opportunities are limited [13,14,111,139,145,146]. Authors explain the negative effect of family size for AF–AS late adopters also with the fact that farmers perceive EFFPs as restrictions they impose on the future management of their farms [12,70,78,127,132] or on their heirs [147].
- *Full-time farmer:* A clear temporal trend is observed for NE, SE, and NA. This factor has a positive effect for early adopters [92,99,101,116,124,148], as EFFPs require operational and managerial skills, and a negative one for the followers [77,98,100,131], especially for organic farming. A positive effect is observed also in SA and AF [81,94,143], regardless of the time period.
- *Total family income and off-farm income:* Total family income shows mixed effects that can be explained when taking into account geographical context. In NE and SE, where in the majority of cases the adoption of EFFPs is financially supported by specific policies, low family income plays in favour of the adoption of EFFPs [97,113,120]. Conversely, in AF, a high total family income facilitates the adoption of EFFPs which negatively impact on the farm income, like soil conservation practices [12,83,96], or low-input farming systems [149]. Regardless of geographical context, most of the authors explain the positive effect of total family income by considering that income from off-farm activities reduces the risk from adopting EFFPs [13,113,134,150].

Table 2.3. Main results for socio-demographic characteristics of farmer (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central–South America; AS: Asia; AF: Africa; OC: Oceania).

Socio-Demographic Characteristics of Farmer	**Effect on Adoption of EFFPs**	
	+	**-**
Age	AF; late adopters: NE, NA, SA, AS	AF; early adopters: NE, SE, SA, AS
Education level	NE, SE, NA, SA, AF, AS, OC	
Gender (female)	NE, SE, NA; late adopters: AF	early adopters: AF
Number of family members	NE	late adopters: AF, AS
Number of active family members	early adopters: AF	SE, SA; late adopters: AF
Full-time farmer	SA, AF; early adopters: NE, SE, NA	late adopters: NE, SE, NA
Total family income and off-farm income	AF	NE, SE

2.4.2.2. Attitudes and Motivations

- *Attitude to innovation and/or risk:* The literature has analysed the effect of farmers' attitudes to introducing innovation using proxies like the use of the internet and software for farm management [95,114,126,131], or farmers' willingness to try new farming technologies [79]. The positive effects on the adoption of EFFPs of both an attitude towards innovation [73,79,95,114,120,126,130,131,151] and risk-oriented management [7,46,77,115,151–153] emerges regardless of geographical context.
- *Profit orientation:* Profit-oriented farmers are generally more prone to adopting EFFPs in any geographical context [54,74,110,116,153–155]. Few opposite results emerge only in NE and SE for organic farming [46,93,110].
- *Personal motivations to adopt EFFPs*: These factors are often proxied by unobserved factors identified through factor analysis or principal component analysis (see, for example, Micha et al. [110]). Personal motivations include, for example, health or financial concerns; the farmer's inclination to produce in a more sustainable way or, in general, to test new farming techniques; or the farmer's desire to implement farming systems more fitted to his/her beliefs. The positive effect of personal motivations is widely recognised [2,20,53,93,110,127,141,156–160], independently of geographical context and reference period.
- *Environmental attitudes:* Proxies of environmental attitudes (e.g., concerns about local or global environmental threats, awareness of the need to protect endangered natural habitats or the positive environmental impact of EFFPs, and simultaneous adoption of more than one EFFP) are particularly explored in NE and SE, where they positively affect the adoption of EFFPs [7,11,46,53,73,77,90,93,116,119,120,129,130,156,157,161]; similar results are observed also in NA, AF, AS, and OC [16,79,92,151,162–164].

- *Awareness about negative environmental impact on farming:* This factor has been particularly analysed in NA, AF, and AS for soil and water conservation practices [6,12,20,72,79,81,83,94,125,153] and in SE for organic farming. Our review shows that farmers are more prone to adopting EFFPs when they are more conscious that their farming may be threatened by environmental problems.

Table 2.4. Summary of the main results for attitudes and motivations of farmer (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central–South America; AS: Asia; AF: Africa; OC: Oceania).

Attitudes and Motivations of Farmer	**Effect on Adoption of EFFPs**	
	+	**-**
Attitude to innovation and/or risk	NE, SE, NA, AF, AS, OC	
Profit orientation	NE, SE, NA, AF, OC	NE
Personal motivations to adopt EFFPs	NE, SE, AF, AS, OC	
Environmental attitudes	NE, SE, NA, AF, AS, OC	
Awareness about negative environmental impact on farming	SE, NA, AF, AS	

2.4.3. Informational Factors

- *Affiliation to farmers' organisations*, e.g., farmers' unions and producers' organisations: The information and technical advice these organisations provide generally plays a positive role in the adoption of EFFPs regardless of geographical context. However, some opposite results are found for early organic farming adopters in NE [73,141] and in some SE countries [111,130].
- *Information availability and participation in training courses:* The former triggers the adoption of EFFPs [3,20,68,75,81–83,94,104,120,139,144,149,158,165–167] independently of geographical and temporal context. The latter provides similar results [5,72,86,168], training courses being necessary capacity building tools for EFFPs requiring more expertise [79].
- *Farmer's familiarity with the EFFP:* This factor is proxied by several variables, for example, the number of years the farmer has been aware of another adopter in the area [137,167], the number of years since he/she firstly adopted the EFFP [78,90], or, more generally, his/her experience of EFFPs [11–14,45,100,113,120,124,135,142,163]. The largest majority of the reviewed papers reports a positive effect for this factor.

Table 2.5. Summary of the main results for informational factors (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central–South America; AS: Asia; AF: Africa; OC: Oceania).

Informational Factors	**Effect on Adoption of EFFPs**	
	+	**-**
Affiliation to farmers' organisations	SE, AF, AS	NE, SE
Information availability and participation in training courses	NE, SE, SA, AF, AS, OC	
Farmer's familiarity with the EFFP	NE, SE, AF, AS, OC	

2.4.4. Social Factors

- *Social pressure:* According to the theory of reasoned action and planned behaviour, social pressure also affects individual behaviour [169]. In the context of our analysis, few papers study this factor, and they use different proxies, i.e., farmer's perception of his/her role in the society [134,156,170], the influence of peers [115,159,170], and appreciation by neighbours [143]. These few papers find positive effects on the adoption of EFFPs in NE, SE, SA, and AS [115,134,143,156]. In OC [159], influence by peers negatively affects the willingness to adopt EFFPs only among those farmers whose behaviour is mainly driven by stewardship, lifestyle, and social motivations. In NA, one paper [170] explores social pressure in a time perspective, showing the positive effect of community pressure on the adoption of EFFPs for late rather than for early adopters.
- *Farmer's participation in social and/or environmental organisations*: Regardless of the analysed geographical context, this factor—as a proxy of farmers' willingness to network—acts as a catalyst for the adoption of EFFPs by farmers [14,133,143,157] thanks to the social support they receive. However, in AS, this occurs only when farmers are men [127].
- *Trust in public institutions:* Few recent studies consider this factor. Even though Polman and Slangen [21] highlight its general positive effect on the adoption of EFFPs, opposite results are reported for organic farming in one SE country [110] and in AF [3,83], where EFFPs are mostly promoted by private institutions, which are perceived as less corrupted.
- *Neighbouring farmers' effect*, proxied by the number of neighbouring farms that adopt the EFFP: a nascent group of studies agrees on the positive effect of the adoption of EFFPs by neighbouring farms on the farmers' EFFP uptake. This effect is explained as a consequence of learning from other farmers, receiving information, sharing experiences, and imitation among neighbouring farmers [20,24,53,121]. This proximity effect is positive regardless of geographical context [70,89,90,165].

Table 2.6. Summary of the main results for social factors (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central–South America; AS: Asia; AF: Africa; OC: Oceania).

Social Factors	**Effect on Adoption of EFFPs**	
	+	**-**
Social pressure	NE, SE, SA, AS; late adopters: NA	OC; early adopters: NA
Farmer's participation in social and/or environmental organisations	NE, SA, AS	AS
Trust in public institutions		SE, AF
Neighbouring farmers' effect	NE, SE, SA, AF, AS	

2.5. Discussion and Conclusions

The large strand of literature on factors affecting the adoption of EFFPs by farmers often reports contrasting results on their effects. This paper analyses these opposite results under a comprehensive approach which includes a large range of EFFPs and provides a rationale for explaining most of the observed differences by taking into account the geographical contexts and temporal periods under analysis.

For farm structural factors, geographical context can explain more than one difference. For example, on a worldwide basis, larger farms are more prone to adopting EFFPs, but this does not occur in Northern and Southern Europe for labour-intensive EFFPs. Ownership of land and sole proprietorship are positive crucial factors in developing and recently developed countries in Africa and Asia, where well-defined ownership rights and the security of land access are essential prerequisites to the adoption of EFFPs. Conversely, in developed countries in Northern and Southern Europe and North America, more complex business types facilitate the adoption of EFFPs. In terms of temporal dynamics, our results highlight that this category of factors does not show clear time differences, and this might be explained by the difficulty of modifying farm structures in the short run.

Mainly in the European context, a temporal perspective can explain differences in the effect of management and economic features of farms: while early EFFPs adopters manage unspecialised and more flexible farms with a higher turnover, later adoption of EFFPs is more common in more difficult or risky situations, i.e., in specialised and smaller farms. This may find an explanation in the attempt to fine-tune policy over time.

Overall, geographical and temporal trends vary according to the factor considered in the case of socio-demographic characteristics of the farmer. Amongst others, age shows a clear temporal trend worldwide, except for in African countries: early adopters are generally young farmers while older ones act as followers. High education level of farmers and being female are two factors that, in general, positively affect the adoption of EFFPs without any geographical differentiation or temporal trend. However, we have noticed that in Africa, male

farmers are early adopters. A higher availability of family labour, as well as a full-time type of farming, plays a positive role in adoption in all geographical contexts. Only in Southern Europe for full-time farmers and in Africa for family labour availability does a temporal trend emerge, with the positive effect prevailing amongst early adopters.

General temporal trends could not be revealed regarding the attitudes and motivations of farmers on the adoption of EFFPs. The homogeneous positive results reported by the literature can be explained by considering that attitudes and motivations are embedded in the individuals and therefore change only over the very long term. We expected many more geographical differences for this category of factors due to their connection with cultural context, but we found only one opposite result: in the Northern and Southern European context, farmers' attitudes to adopting EFFPs show a negative effect when their decisions are driven mainly by economic motivations.

In general, the crucial positive role of informational factors in affecting the adoption of EFFPs is widely undisputed in all geographical areas considered in our review, and remains unchanged also from a time perspective. The few opposite results are linked to the quality of information provided and the difficulty in implementing a specific EFFP.

There is still limited information for social factors, considered from the fewer number of works when compared with the other factor categories. Amongst social factors, a clear distinction emerges between the factors strictly connected to individual beliefs, i.e., social pressure, trust in government, and participation in social and/or environmental organisations, and the factor expressing the neighbouring farmers' effect, represented by the number of neighbouring farms adopting EFFPs. For the former, geographical differences can be easily explained in terms of different social contexts. For the latter, a positive role is common to all geographical contexts.

Our qualitative meta-analysis shows that geographical context and time are relevant perspectives that can help to explain several differences in the role of factors affecting the adoption of EFFPs emerging from literature. Geographical differences often reflect background, structural, social, and economic factors that are rooted in local society and its institutions. These differences are, however, not static but evolve over time, showing converging or diverging trends that are interesting to study. Unlike most of the existing literature which is based on case studies, our analysis adopts a global perspective that goes beyond single EFFPs; thanks to this, it can provide fruitful suggestions on how to orient policy design in specific geographical areas and time periods. There are, however, some caveats to our approach that need to be acknowledged, the main one being linked to the different methodological approaches adopted by the papers we have reviewed. A second limitation lies in the gaps existing in the literature: with reference to the various geographical contexts and

time periods, not all the papers have considered an identical set of factors, so data availability is patchy. The broad trends we found open the way for further research adopting a common methodological approach for considering different geographical contexts and cohorts of EFFPs adopters.

Finally, it has to be recalled that the literature on factors affecting the adoption of EFFPs by farmers that we reviewed omits consideration of the increasing role of value-chain-related factors in affecting farmers' decisions about EFFP uptake when the latter affects food quality attributes valued by consumers and/or required by the processors and the retailers. This limitation opens the door to further research integrating, under the theory of reasoned action and planned behaviour, such factors into the constellation of background factors explaining farmers' decisions on adoption of EFFPs.

Author contributions: Daniele Mozzato, Paola Gatto, Edi Defrancesco, Lucia Bortolini, Francesco Pirotti, Elena Pisani and Luigi Sartori collected the literature; Daniele Mozzato, Paola Gatto and Edi Defrancesco designed the structure of the review, analysed the literature and wrote the paper.

Appendix 2.A: Geographical and temporal analysis of the effect of the factors considered in the reviewed research papers (NE: Northern Europe; SE: Southern Europe; NA: North America; SA: Central–South America; AS: Asia; AF: Africa; OC: Oceania – the period of reference for the analysed data is reported before the citations).

Background Factors	Effect on Adoption of EFFPs	
	+	-
Structural Characteristics of the Farm		
Farm size	**NE:** 1994 [103]; 1994–97 [171]; 1995–2010 [113]; 2003 [93]; 2004 [89]; 2006 [116]	**NE:** 1996 [73]; 1999 [11]; 2004–08 [74]; 2008 [7,46]
	SE: 2000–15 [90]; 2004 [119]; 2010 [100,114]	**SE:** 2000–03 [172]; 2003 [105]; 2008 [77]; 2008–09 [109]; 2010 [76]
	NA: 1996 [101]; 1997 [6]; 1999 [80]; 2003 [5,92]; 2007–09 [131]	**NA:** 2004 [95]
	SA: 1996 [173]; 2002 [86]; 2007 [165]	**SA:** 2008 [1]
	AF: 1996–2000 [66]; 2000 [12]; 2002 [67]; 2002–03 [71]; 2003 [68]; 2003–04 [72]; 2008–11 [69]; 2012 [70]	**AF:** 2010 [83]
	AS: 2006 [78]; 2007 [20]; 2010 [79,133]	**AS:** 2012 [140]
	OC: 2003 [137]; 2005 [168]	
Degree of fragmentation		**NA:** 1999 [80]
		AS: 2006 [78]; 2010 [79]

Background Factors	Effect on Adoption of EFFPs	
	+	-
Ownership of land	**NE:** 1994 [103]	**NE:** 1997 [122]; 2014 [98]
	SE: 2003 [105]; 2004 [119]; 2005–06 [13]	**SE:** 2005 [106–108]; 2006 [99]
	NA: 1991/96/2001/06 [91]; 2006–07 [154]	**NA:** 2006–07 [154]
	AF: 2002 [81]; 2008 [82]; 2010 [83]	
	AS: 1995 [84]; 2001–02 [85]	
Sole proprietorship farm	**AS:** 2010 [79]	**NE:** 2004 [89]
		SE: 2000–15 [90]
		NA: 1991/96/2001/06 [91]
Proximity to urban centres, main roads, local markets, etc.	**NE:** 2003 [93]	**NE:** 2007 [97]; 2014 [98]
	NA: 2003 [92]	**NA:** 1999 [80]; 2003 [92]; 2004 [95]
	SA: 2007 [143]	**SA:** 1997 [87]
	AF: 1996–2000 [66]; 1999–2000 [96]; 2009–10 [94]; 2010 [83]	**AF:** 1996–2000 [66]; 2010 [3]
	AS: 1995 [84]; 2006 [78]	
Farm localisation within priority or target areas (if any)	**NE:** 2004 [89]; 2014 [98]	
	SE: 2000–15 [90]; 2006 [99]; 2008 [77]; 2010 [100]	
	NA: 1996 [101]	
	SA: 1999 [102]	
Farm localisation within less-favoured areas	**NE:** 1994 [103]; 2004 [89]	**SE:** 2006 [99]; 2009 [111]; 2010 [76,100]; 2012 [110]
	SE: 1994–2004 [104]; 2003 [105]; 2005 [106–108]; 2008 [24]; 2008–09 [109]; 2010 [100]; 2012 [110]	**AF:** 2008–11 [69]
	NA: 1996 [101]	
	AF: 2007 [142]	
Management and Economic Features of the Farm		
Farm specialisation	**NE:** 2004–08 [74]	**NE:** 1994 [103]; 1995–2010 [113]
	SE: 2005 [106–108]; 2008–09 [115]	**SE:** 1996–97 [75]; 2006 [14,99]; 2009 [111]; 2010 [114]
		SA: 2008 [1]
Type of farming		
Permanent crops	**NE:** 2006 [116]	
	SE: 2004–10 [117,118]; 2010 [114]	
Annual crops	**NE:** 1994 [103]	**SE:** 2006–07 [120]
	SE: 2010 [114]	
	NA: 2003 [92]	
	AF: 1996–2000 [66]	
Fodder crops	**SE:** 2003 [105]; 2006–07 [120]	**NE:** 1994 [103]
	NA: 2003 [92]	

Background Factors	Effect on Adoption of EFFPs	
	+	-
Livestock farm	**SE:** 2004 [119]; 2004–10 [117,118]; 2005 [106–108]; 2006 [14,99]; 2006–07 [120]; 2009 [111]; 2010 [114]	**NE:** 1994 [103]; 1995–2010 [113]; 2003 [93]
	NA: 1998 [125]; 2003 [5]; 2007–09 [131]	**NA:** 2003 [92]
Economic size of the farm	**NE:** 1994 [103]	**SE:** 2006 [14,99]; 2009 [111]; 2010 [76]
	SE: 1997 [121]; 2005 [106–108]	
Socio-Demographic Characteristics of Farmer		
Age	**NE:** 2004 [89]; 2006 [116]; 2008 [117,128]; 2011–12 [129]	**NE:** 1995–2010 [113]; 1996 [73]; 1997 [122]; 1998 [123]; 1999 [11]; 2004–08 [74]; 2008 [46]
	SE: 2005–06 [130]; 2006–07 [120]	**SE:** 1994–2004 [104]; 1996–97 [75]; 1997 [121]; 2000–15 [90]; 2003 [105]; 2004 [119,124]; 2005 [106–108]; 2006 [14,99]; 2008 [77]; 2008–09 [109]; 2009 [111]; 2010 [114]
	NA: 1991/96/2001/06 [91]; 2004 [95]; 2007–09 [131]	**NA:** 1996 [101]; 1998 [125]; 2003–04 [126]
	SA: 2007 [143]	**SA:** 2004 [136]; 2008 [1]
	AF: 1999–2000 [96]; 2002–03 [71]; 2004–08 [138]; 2006 [139]; 2008 [82]; 2011–12 [149]	**AF:** 1994 [144]; 2002 [67,81]; 2003 [68]; 2008–11 [69]; 2009–10 [4,94]; 2010 [83]; 2013 [3]
	AS: 2001–02 [85]; 2006 [132]; 2010 [133]; 2014 [134]	**AS:** 1995 [84]; 1998 [127]
Education level	**NE:** 1999 [11]; 2003 [93]; 2006 [116];	**NE:** 1996 [53]
	SE: 1996–97 [75]; 1997 [121]; 1998 [135]; 2005–06 [130]; 2006–07 [120]; 2008–09 [109,115]; 2010 [100,114]	**AF:** 2009–10 [4]; 2010 [83]
	NA: 1996 [101]; 2007–09 [131]; 2008 [16]	**AS:** 1998 [127]; 2007 [20]; 2014 [134]
	SA: 1999 [102]; 2002 [86]; 2004 [136]; 2007 [165]	
	AF: 1996–2000 [66]; 2002 [67,81]; 2003 [68]; 2003–04 [72]; 2004–08 [138]; 2006 [139]; 2007 [166]; 2008 [82]; 2009–10 [94]; 2011–12 [149]	
	AS: 1995 [84]; 1998 [127]; 2001–02 [85]; 2010 [79]; 2012 [140]; 2014 [174]	
	OC: 2003 [137]	

Background Factors	Effect on Adoption of EFFPs	
	+	-
Gender (female)	**NE:** 1996 [53,73,141]; 2004–08 [74]	**SA:** 2007 [165]
	SE: 2008–09 [115]	**AF:** 2006 [139]; 2007 [67,142]
	NA: 1991/96/2001/06 [91]	
	AF: 2002 [81]; 2008–11 [69]; 2009–10 [94]; 2010 [3]; 2012 [70]	
	AS: 1998 [127]	
Family		
Number of family members	**NE:** 1995–2010 [175]; 1996 [73,141]; 2008 [46]	**AF:** 1999–2000 [96]; 2000 [12]; 2009–10 [94]; 2010 [3,83]
	SA: 2007 [143]	**AS:** 1998 [127]; 2006 [78,132]
	AF: 2008–11 [69]; 2009–10 [94]; 2010 [83]; 2012 [70]	
	AS: 2007 [20]	
Number of active family members	**SA:** 1997 [87]	**AF:** 2006 [139]; 2010 [83]
	AF: 1994 [144]; 1999–2000 [96]; 2000 [12]; 2002 [67]	
Labour		
Full-time farmer	**NE:** 2006 [116]	**NE:** 2014 [98]
	SE: 2000 [148]; 2004 [124]; 2006 [99]; 2009 [111]; 2010 [76,114]	**SE:** 2008 [77]; 2010 [100]
	NA: 1996 [101]; 2003 [92]	**NA:** 2007–09 [131]
	SA: 2007 [143]	
	AF: 2002 [81]; 2009–10 [94]	
On-family labour		**SE:** 2004–10 [117,118]; 2005–06 [13]; 2006 [14,99]; 2009 [111]
		SA: 2002 [86]
Off-family labour	**NE:** 2014 [98]	**SE:** 2006 [99]
	SE: 2003 [105]; 2006 [99]; 2009 [111]; 2010 [114]	
Income		
Total family income	**SA:** 2007 [165]	**NE:** 1995–2010 [113]; 2007 [97]
	AF: 1999–2000 [96]; 2000 [12]; 2010 [83]; 2011–12 [149]	**SE:** 2006–07 [120]
	AS: 2014 [174]	**NA:** 1997 [170]
		SA: 1999 [102]
		AF: 2006 [139]
Importance of the off-farm income on the total household income	**NE:** 1995–2010 [113]; 2006 [116]	**NE:** 2006 [116]; 2013 [157]
	SE: 1996–97 [75]; 2004 [119]; 2004–10 [117,118]; 2008 [77]	**NA:** 1999 [80]; 2003 [5]
	SA: 1999 [102]; 2002 [86]	**SA:** 2002 [86]
	AF: 2002 [67]; 2010 [3]	**AF:** 1999–2000 [96]
	AS: 2014 [134]	**OC:** 2005 [168]

Background Factors	Effect on Adoption of EFFPs	
	+	-
Attitudes and Motivations of Farmer		
Innovation attitude	**NE:** 1996 [73]	
	SE: 2005–06 [130]; 2006–07 [120]; 2010 [114]	
	NA: 2003–04 [126]; 2004 [95]; 2007–09 [131]	
	AS: 2010 [79]	
	OC: 2006 [151]	
Risk attitude	**NE:** 1981–2008 [7]; 1990–99 [152]; 2008 [46]	
	SE: 2008 [77]; 2008–09 [115]	
	AF: 1996 [153]	
	OC: 2006 [151]	
Profit orientation	**NE:** 2004–08 [74]; 2006 [116]; 2008 [54]	**NE:** 2003 [93]; 2008 [46]
	SE: 2010 [76]	**SE:** 2012 [110]
	NA: 2006–07 [154]	**NA:** 2003 [92]
	AF: 1996 [153]	
	OC: 2006 [151]	
Personal motivation to adopt EFFPs	**NE:** 1996 [53,141]; 2003 [93]; 2009 [156]; 2013 [157]	
	SE: 2012 [110]	
	AF: 2009 [2]	
	AS: 1998 [127]; 2007 [20]; 2008 [158]	
	OC: 2013 [159]	
Environmental attitudes	**NE:** 1981–2008 [7]; 1996 [53,73]; 1999 [11]; 2003 [93]; 2006 [116]; 2008 [46]; 2009 [156]; 2011–12 [129]; 2013 [157]	**NA:** 1997 [170]
	SE: 2000–15 [90]; 2004 [119]; 2005–06 [130]; 2006–07 [120]; 2008 [77]; 2010 [161]	
	NA: 2003 [92]; 2008 [16]	
	AF: 2008 [162]; 2013–14 [163]	
	AS: 2008 [164]; 2010 [79]	
	OC: 2006 [151]	
Awareness about negative environmental impact on farming	**NE:** 2006 [116]	**NE:** 1996 [53]
	SE: 1996–97 [75]; 2005–06 [130]; 2008 [77]	
	NA: 1997 [6]; 1998 [125]	
	AF: 1996 [153]; 2000 [12]; 2002 [81]; 2003–04 [72]; 2009–10 [94]; 2010 [83]	
	AS: 2007 [20]; 2010 [79]	
	OC: 2005 [168]	

Background Factors	Effect on Adoption of EFFPs	
	+	-
Informational Factors		
Affiliation to farmers' organisations	**SE:** 2005 [106–108]; 2006 [14]; 2006–07 [120]	**NE:** 1996 [73,141]
	SA: 2007 [165]	**SE:** 2005–06 [130]; 2009 [111]
	AF: 2002 [81]; 2003–04 [72]; 2009–10 [4,94]; 2010 [3,83]	
	AS: 1995 [84]; 2010 [79,133]	
Information availability and participation in training courses	**NE:** 2013 [157]	
	SE: 1994–2004 [104]; 1996–97 [75]; 2006–07 [120]	
	SA: 2002 [86]; 2007 [165]	
	AF: 1994 [144]; 2002 [81]; 2003 [68]; 2006 [139]; 2007 [166]; 2008 [82]; 2009–10 [94]; 2010 [3,83]; 2011–12 [149]	
	AS: 2007 [20]; 2008 [158]	
	OC: 1983–2003 [167]	
Farmer's familiarity with the EFFP	**NE:** 1995–2010 [113]; 1999 [11]	**NA:** 2006 [16]
	SE: 1998 [135]; 2000–15 [90]; 2004 [124]; 2004–10 [145]; 2005 [106–108]; 2005–06 [13]; 2006 [14]; 2006–07 [120]; 2010 [100]; 2012 [110]	
	AF: 2000 [12]; 2003–04 [72]; 2007 [142]; 2013–14 [163]	
	AS: 2006 [78]; 2008 [164]; 2008–09 [176]	
	OC: 1983–2003 [167]; 2003 [137]	
Social Factors		
Social pressure	**NE:** 2009 [156]	**OC:** 2013 [159]
	SE: 2008–09 [115]	
	NA: 1997 [170]	
	SA: 2007 [143]	
	AS: 2014 [134]	
Farmer's participation in social and/or environmental organisations	**NE:** 1996 [73]; 2013 [157]	**AS:** 1998 [127]
	SA: 1999 [102]; 2007 [143]	
	AS: 1998 [127]; 2010 [133]	
Trust in public institutions		**SE:** 2012 [110]
		AF: 2010 [3,83]
Neighbouring farmers' effect	**NE:** 2004 [89]	
	SE: 1994–2004 [104]; 2000–15 [90]	
	SA: 2007 [165]	
	AF: 2012 [70]	

2.6. References

1. Blazy, J.-M.; Carpentier, A.; Thomas, A. The willingness to adopt agro-ecological innovations: Application of choice modelling to Caribbean banana planters. *Ecol. Econ.* **2011**, *72*, 140–150, doi:10.1016/j.ecolecon.2011.09.021.
2. Friedlander, L.; Tal, A.; Lazarovitch, N. Technical considerations affecting adoption of drip irrigation in sub-Saharan Africa. *Agric. Water Manag.* **2013**, *126*, 125–132, doi:10.1016/j.agwat.2013.04.014.
3. Teklewold, H.; Kassie, M.; Shiferaw, B. Adoption of multiple sustainable agricultural practices in rural Ethiopia. *J. Agric. Econ.* **2013**, *64*, 597–623, doi:10.1111/1477-9552.12011.
4. Nyanga, P.H. Factors Influencing Adoption and Area under Conservation Agriculture: A Mixed Methods Approach. *Sustain. Agric. Res.* **2012**, *1*, 27, doi:10.5539/sar.v1n2p27.
5. Yiridoe, E.K.; Atari, D.O.A.; Gordon, R.; Smale, S. Factors influencing participation in the Nova Scotia Environmental Farm Plan Program. *Land Use Policy* **2010**, *27*, 1097–1106, doi:10.1016/j.landusepol.2010.02.006.
6. Upadhyay, B.M.; Young, D.L.; Wang, H.H.; Wandschneider, P. How do farmers who adopt multiple conservation practices differ from their neighbors? In Proceedings of the AAEA and WAEA 2002 Annual Meeting, Long Beach, CA, USA, 28–31 July 2002; p. 21.
7. Läpple, D. Adoption and Abandonment of Organic Farming: An Empirical Investigation of the Irish Drystock Sector. *J. Agric. Econ.* **2010**, *61*, 697–714, doi:10.1111/j.1477-9552.2010.00260.x.
8. Beedell, J.; Rehman, T. Using social-psychology models to understand farmers' conservation behaviour. *J. Rural Stud.* **2000**, *16*, 117–127, doi:10.1016/S0743-0167(99)00043-1.
9. Wilson, G.A.; Hart, K. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environ. Plan. A* **2000**, *32*, 2161–2185, doi:10.1068/a3311.
10. Wilson, G.A.; Hart, K. Farmer Participation in Agri-Environmental Schemes: Towards Conservation-Oriented Thinking? *Sociol. Rural.* **2001**, *41*, 254–274, doi:10.1111/1467-9523.00181.
11. Vanslembrouck, I.; Huylenbroeck, G.; Verbeke, W. Determinants of the Willingness of Belgian Farmers to Participate in Agri-environmental Measures. *J. Agric. Econ.* **2002**, *53*, 489–511, doi:10.1111/j.1477-9552.2002.tb00034.x.
12. Tadesse, M.; Belay, K. Factors influencing adoption of soil conservation measures in Southern Ethiopia: The case of Gununo area. *J. Agric. Rural Dev. Trop. Subtrop.* **2004**, *105*, 49–62.
13. Defrancesco, E.; Gatto, P.; Runge, F.; Trestini, S. Factors affecting farmers'participation in agri-environmental measures: A northern Italian perspective. *J. Agric. Econ.* **2008**, *59*, 114–131, doi:10.1111/j.1477-9552.2007.00134.x.
14. Pascucci, S.; De-Magistris, T.; Dries, L.; Adinolfi, F.; Capitanio, F. Participation of Italian farmers in rural development policy. *Eur. Rev. Agric. Econ.* **2013**, *40*, 605–631, doi:10.1093/erae/jbt005.

15. Emery, S.B.; Franks, J.R. The potential for collaborative agri-environment schemes in England: Can a well-designed collaborative approach address farmers' concerns with current schemes? *J. Rural Stud.* **2012**, *28*, 218–231, doi:10.1016/j.jrurstud.2012.02.004.
16. Ma, S.; Swinton, S.M.; Lupi, F.; Jolejole-Foreman, C. Farmers' Willingness to Participate in Payment-for-Environmental-Services Programmes. *J. Agric. Econ.* **2012**, *63*, 604–626, doi:10.1111/j.1477-9552.2012.00358.x.
17. Home, R.; Balmer, O.; Jahrl, I.; Stolze, M.; Pfiffner, L. Motivations for implementation of ecological compensation areas on Swiss lowland farms. *J. Rural Stud.* **2014**, *34*, 26–36, doi:10.1016/j.jrurstud.2013.12.007.
18. Price, J.C.; Leviston, Z. Predicting pro-environmental agricultural practices: The social, psychological and contextual influences on land management. *J. Rural Stud.* **2014**, *34*, 65–78, doi:10.1016/j.jrurstud.2013.10.001.
19. Ruto, E.; Garrod, G. Investigating farmers' preferences for the design of agri-environment schemes: A choice experiment approach. *J. Environ. Plan. Manag.* **2009**, *52*, 631–647, doi:10.1080/09640560902958172.
20. Azizi Khalkheili, T.; Zamani, G.H. Farmer participation in irrigation management: The case of Doroodzan Dam Irrigation Network, Iran. *Agric. Water Manag.* **2009**, *96*, 859–865, doi:10.1016/j.agwat.2008.11.008.
21. Polman, N.B.P.; Slangen, L.H.G. Institutional design of agri-environmental contracts in the European Union: The role of trust and social capital. *NJAS Wagening. J. Life Sci.* **2008**, *55*, 413–430, doi:10.1016/S1573-5214(08)80029-2.
22. Bjørkhaug, H.; Blekesaune, A. Development of organic farming in Norway: A statistical analysis of neighbourhood effects. *Geoforum* **2013**, *45*, 201–210, doi:10.1016/j.geoforum.2012.11.005.
23. Jongeneel, R.A.; Polman, N.B.P.; Slangen, L.H.G. Why are Dutch farmers going multifunctional? *Land Use Policy* **2008**, *25*, 81–94, doi:10.1016/j.landusepol.2007.03.001.
24. Raggi, M.; Viaggi, D.; Bartolini, F.; Furlan, A. The role of policy priorities and targeting in the spatial location of participation in Agri-Environmental Schemes in Emilia-Romagna (Italy). *Land Use Policy* **2015**, *47*, 78–89, doi:10.1016/j.landusepol.2015.03.005.
25. Knowler, D.; Bradshaw, B. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy* **2007**, *32*, 25–48, doi:10.1016/j.foodpol.2006.01.003.
26. de Graaff, J.; Amsalu, A.; Bodnár, F.; Kessler, A.; Posthumus, H.; Tenge, A. Factors influencing adoption and continued use of long-term soil and water conservation measures in five developing countries. *Appl. Geogr.* **2008**, *28*, 271–280, doi:10.1016/j.apgeog.2008.05.001.
27. Pannell, D.J.; Marshall, G.R.; Barr, N.; Curtis, A.; Vanclay, F.; Wilkinson, R. Understanding and promoting adoption of conservation practices by rural landholders. *Aust. J. Exp. Agric.* **2006**, *46*, 1407–1424, doi:10.1071/EA05037.
28. Prager, K.; Posthumus, H. Adopting sustainable soil management: The role of socio-economic factors. In Proceedings of the 16th Annual International Sustainable Development Research Conference, Hong Kong, China, 30 May–1 June 2010; pp. 1–32.

29. McKeever, E.; Anderson, A.; Jack, S. Entrepreneurship and mutuality: Social capital in processes and practices. *Entrep. Reg. Dev.* **2014**, *26*, 453–477, doi:10.1080/08985626.2014.939536.
30. Blackstock, K.L.; Ingram, J.; Burton, R.; Brown, K.M.; Slee, B. Understanding and influencing behaviour change by farmers to improve water quality. *Sci. Total Environ.* **2010**, *408*, 5631–5638, doi:10.1016/j.scitotenv.2009.04.029.
31. Quinn, C.; Burbach, M.E. Personal characteristics preceding pro-environmental behaviors that improve surface water quality. *Great Plains Res.* **2008**, *18*, 103–114.
32. Prokopy, L.S.; Floress, K.; Klotthor-Weinkauf, D.; Baumgart-Getz, A. Determinants of agricultural best management practice adoption: Evidence from the literature. *J. Soil Water Conserv.* **2008**, *63*, 300–311, doi:10.2489/jswc.63.5.300.
33. Baumgart-Getz, A.; Prokopy, L.S.; Floress, K. Why farmers adopt best management practice in the United States: A meta-analysis of the adoption literature. *J. Environ. Manag.* **2012**, *96*, 17–25, doi:10.1016/j.jenvman.2011.10.006.
34. Wauters, E.; Mathijs, E. The adoption of farm level soil conservation practices in developed countries: A meta-analytic review. *Int. J. Agric. Resour. Gov. Ecol.* **2014**, *10*, 78–102, doi:10.1504/IJARGE.2014.061058.
35. Padel, S. Conversion to Organic Farming: A Typical Example of the Diffusion of an Innovation? *Sociol. Rural.* **2001**, *41*, 40–61, doi:10.1111/1467-9523.00169.
36. Lamine, C.; Bellon, S. Conversion to organic farming: A multidimensional research object at the crossroads of agricultural and social sciences. A review. *Agron. Sustain. Dev.* **2009**, *29*, 97–112, doi:10.1051/agro:2008007.
37. Kabii, T.; Horwitz, P. A review of landholder motivations and determinants for participation in conservation covenanting programmes. *Environ. Conserv.* **2006**, *33*, 11–20, doi:10.1017/S0376892906002761.
38. Smith, P.; Martino, D.; Cai, Z.; Gwary, D.; Janzen, H.; Kumar, P.; McCarl, B.; Ogle, S.; O'Mara, F.; Rice, C.; et al. Policy and technological constraints to implementation of greenhouse gas mitigation options in agriculture. *Agric. Ecosyst. Environ.* **2007**, *118*, 6–28, doi:10.1016/j.agee.2006.06.006.
39. Liu, T.; Bruins, R.; Heberling, M. Factors Influencing Farmers' Adoption of Best Management Practices: A Review and Synthesis. *Sustainability* **2018**, *10*, 432, doi:10.3390/su10020432.
40. Greiner, R.; Lankester, A. On-farm biodiversity conservation in Australia's tropical savannas: Production trade-offs, impediments, motivators and policy approaches. In Proceedings of the Resource Economics Workshop, Rockhampton, Australia, 28 October 2005; p. 20.
41. Lastra-Bravo, X.B.; Hubbard, C.; Garrod, G.; Tolón-Becerra, A. What drives farmers' participation in EU agri-environmental schemes?: Results from a qualitative meta-analysis. *Environ. Sci. Policy* **2015**, *54*, 1–9, doi:10.1016/j.envsci.2015.06.002.
42. Burton, R.J.F.; Schwarz, G. Result-oriented agri-environmental schemes in Europe and their potential for promoting behavioural change. *Land Use Policy* **2013**, *30*, 628–641, doi:10.1016/j.landusepol.2012.05.002.

43. Morrison, M.; Greig, J. *Encouraging Participation in Market Based Instruments and Incentive Programs: Literature Review*; Impediments to the Uptake of Market Based Instruments; Land & Water Australia: Camberra, Australia 2006.
44. Riley, M. Turning Farmers into Conservationists? Progress and Prospects. *Geogr. Compass* **2011**, *5*, 369–389, doi:10.1111/j.1749-8198.2011.00423.x.
45. Zimmermann, A.; Britz, W. European farms' participation in agri-environmental measures. *Land Use Policy* **2016**, *50*, 214–228, doi:10.1016/j.landusepol.2015.09.019.
46. Läpple, D.; Rensburg, T. Van Adoption of organic farming: Are there differences between early and late adoption? *Ecol. Econ.* **2011**, *70*, 1406–1414, doi:10.1016/j.ecolecon.2011.03.002.
47. Brown, P.; Hart, G.; Small, B.; de Oca Munguia, O.M. Agents for diffusion of agricultural innovations for environmental outcomes. *Land Use Policy* **2016**, *55*, 318–326, doi:10.1016/j.landusepol.2016.04.017.
48. Varble, S.; Secchi, S.; Druschke, C.G. An Examination of Growing Trends in Land Tenure and Conservation Practice Adoption: Results from a Farmer Survey in Iowa. *Environ. Manag.* **2016**, *57*, 318–330, doi:10.1007/s00267-015-0619-5.
49. Ajzen, I. From intentions to action: A theory of planned behavior. In *Action Control: From Cognition to Behavior*; Kuhl, J., Beckmann, J., Eds.; Springer: Heidelberg, Germany, 1985; pp. 11–39, ISBN 978-3-642-69748-7.
50. Fishbein, M.E.; Ajzen, I. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*; Addison-Wesley: Reading, MA, USA, 1975; ISBN 9780201020892.
51. Ajzen, I.; Fishbein, M. The Influence of Attitudes on Behavior. In *The Handbook of Attitudes*; Albarracin, D., Johnson, B.T., Zanna, M.P., Eds.; Lawrence Erlbaum Associates: Mahwah, NJ, USA, 2005; pp. 173–221, ISBN 9780805844931.
52. Mettepenningen, E.; Vandermeulen, V.; Delaet, K.; Van Huylenbroeck, G.; Wailes, E.J. Investigating the influence of the institutional organisation of agri-environmental schemes on scheme adoption. *Land Use Policy* **2013**, *33*, 20–30, doi:10.1016/j.landusepol.2012.12.004.
53. Burton, M.; Rigby, D.; Young, T. Modelling the adoption of organic horticultural technology in the UK using duration analysis. *Aust. J. Agric. Resour. Econ.* **2003**, *47*, 29–54, doi:10.1111/1467-8489.00202.
54. Läpple, D.; Kelley, H. Understanding the uptake of organic farming: Accounting for heterogeneities among Irish farmers. *Ecol. Econ.* **2013**, *88*, 11–19, doi:10.1016/j.ecolecon.2012.12.025.
55. Defrancesco, E.; Perito, M.; Bozzolan, I.; Cei, L.; Stefani, G. Testing Consumers' Preferences for Environmental Attributes of Pasta. Insights from an ABR Approach. *Sustainability* **2017**, *9*, 1701, doi:10.3390/su9101701.
56. Levidow, L.; Psarikidou, K. Food Relocalization for Environmental Sustainability in Cumbria. *Sustainability* **2011**, *3*, 692–719, doi:10.3390/su3040692.
57. Schaller, L.; Targetti, S.; Villanueva, A.J.; Zasada, I.; Kantelhardt, J.; Arriaza, M.; Bal, T.; Fedrigotti, V.B.; Giray, F.H.; Häfner, K.; et al. Agricultural landscapes, ecosystem services and regional

competitiveness—Assessing drivers and mechanisms in nine European case study areas. *Land Use Policy* **2018**, *76*, 735–745, doi:10.1016/j.landusepol.2018.03.001.

58. Dupré, M.; Michels, T.; Le Gal, P.-Y. Diverse dynamics in agroecological transitions on fruit tree farms. *Eur. J. Agron.* **2017**, *90*, 23–33, doi:10.1016/j.eja.2017.07.002.
59. Zasada, I.; Häfner, K.; Schaller, L.; van Zanten, B.T.; Lefebvre, M.; Malak-Rawlikowska, A.; Nikolov, D.; Rodríguez-Entrena, M.; Manrique, R.; Ungaro, F.; Zavalloni, M.; et al. A conceptual model to integrate the regional context in landscape policy, management and contribution to rural development: Literature review and European case study evidence. *Geoforum* **2017**, *82*, 1–12, doi:10.1016/j.geoforum.2017.03.012.
60. Bonnet, C.; Bouamra-Mechemache, Z. Organic Label, Bargaining Power, and Profit-sharing in the French Fluid Milk Market. *Am. J. Agric. Econ.* **2016**, *98*, 113–133, doi:10.1093/ajae/aav047.
61. Marette, S. Quality, market mechanisms and regulation in the food chain. *Bio-based Appl. Econ.* **2017**, *5*, 217–235, doi:10.13128/BAE-18766.
62. Schmitt, E.; Barjolle, D.; Tanquerey-Cado, A.; Brunori, G. Sustainability comparison of a local and a global milk value chains in Switzerland. *Bio-based Appl. Econ.* **2016**, *5*, 79–102, doi:10.13128/bae-17140.
63. Aramyan, L.H.; Kuiper, M. Analyzing price transmission in agri-food supply chains: An overview. *Meas. Bus. Excel.* **2009**, *13*, 3–12, doi:10.1108/13683040910984275.
64. Routroy, S.; Behera, A. Agriculture supply chain: A systematic review of literature and implications for future research. *J. Agribus. Dev. Emerg. Econ.* **2017**, *7*, 275–302, doi:10.1108/JADEE-06-2016-0039.
65. Bonanno, A.; Russo, C.; Menapace, L. Market power and bargaining in agrifood markets: A review of emerging topics and tools. *Agribusiness* **2018**, *34*, 6–23, doi:10.1002/agr.21542.
66. Staal, S.J.; Baltenweck, I.; Waithaka, M.M.; DeWolff, T.; Njoroge, L. Location and uptake: Integrated household and GIS analysis of technology adoption and land use, with application to smallholder dairy farms in Kenya. *Agric. Econ.* **2002**, *27*, 295–315, doi:10.1111/j.1574-0862.2002.tb00122.x.
67. Marenya, P.P.; Barrett, C.B. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. *Food Policy* **2007**, *32*, 515–536, doi:10.1016/j.foodpol.2006.10.002.
68. Anley, Y.; Bogale, A.; Haile-Gabriel, A. Adoption decision and use intensity of soil and water conservation measures by smallholder subsistence farmers in Dedo District, Western Ethiopia. *Land Dégrad. Dev.* **2007**, *18*, 289–302, doi:10.1002/ldr.775.
69. Pedzisa, T.; Rugube, L.; Winter-Nelson, A.; Baylis, K.; Mazvimavi, K. Abandonment of Conservation Agriculture by Smallholder Farmers in Zimbabwe. *J. Sustain. Dev.* **2015**, *8*, 69–82, doi:10.5539/jsd.v8n1p69.
70. Turinawe, A.; Mugisha, J.; Drake, L. Soil and water conservation agriculture in subsistence systems: Determinants of adoption in southwestern Uganda. *J. Soil Water Conserv.* **2015**, *70*, 133–142, doi:10.2489/jswc.70.2.133.

71. Amsalu, A.; de Graaff, J. Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Ecol. Econ.* **2007**, *61*, 294–302, doi:10.1016/j.ecolecon.2006.01.014.
72. Sidibé, A. Farm-level adoption of soil and water conservation techniques in northern Burkina Faso. *Agric. Water Manag.* **2005**, *71*, 211–224, doi:10.1016/j.agwat.2004.09.002.
73. Burton, M.; Rigby, D.; Young, T. Analysis of the determinants of adoption of organic horticultural techniques in the UK. *J. Agric. Econ.* **1999**, *50*, 47–63.
74. Mala, Z.; Maly, M. The determinants of adopting organic farming practices: A case study in the Czech Republic. *Agric. Econ. Zemed. Èkon.* **2013**, *59*, 19–28.
75. Genius, M.; Pantzios, C.J.; Tzouvelekas, V. Information Acquisition and Adoption of Organic Farming Practices. *J. Agric. Resour. Econ.* **2006**, *31*, 93–113.
76. Juvančič, L.; Travnikar, T.; Glavan, M.; Cvejić, R.; Pintar, M. Targeting and Spatial Impacts of Agri-Environmental Support–Spatial Econometric Analysis of Agri–Environmental Measures in Slovenia. In Proceedings of the 132nd Seminar of the EAAE "Is Transition in European Agriculture Really Over?", Skopje, Republic of Macedonia, 25–27 October 2012; pp. 1–16.
77. Kallas, Z.; Serra, T.; Gil, J.M. Farmers' objectives as determinants of organic farming adoption: The case of Catalonian vineyard production. *Agric. Econ.* **2010**, *41*, 409–423, doi:10.1111/j.1574-0862.2010.00454.x.
78. Démurger, S.; Pelletier, A. Volunteer and satisfied? Rural households' participation in a payments for environmental services programme in Inner Mongolia. *Ecol. Econ.* **2015**, *116*, 25–33, doi:10.1016/j.ecolecon.2015.04.012.
79. Haghjou, M.; Hayati, B.; Momeni Choleki, D. Identification of Factors Affecting Adoption of Soil Conservation Practices by Some Rainfed Farmers in Iran. *J. Agric. Sci. Technol.* **2014**, *16*, 957–967.
80. Lynch, L.; Lovell, S.J. Combining Spatial and Survey Data to Explain Participation in Agricultural Land reservation Programs. *Land Econ.* **2003**, *79*, 259–276.
81. Tenge, A.J.; De Graaff, J.; Hella, J.P. Social and economic factors affecting the adoption of soil and water conservation in West Usambara highlands, Tanzania. *Land Dégrad. Dev.* **2004**, *15*, 99–114, doi:10.1002/ldr.606.
82. Tafa, K.; Beshah, T.; Amsalu, A.; Resource, N.; Berehan, D.; Berehan, D.; Extension, A.; Dawa, D. Determinants of Physical Soil and Water Conservation Practices in Ethiopia's Semi-Arid Tropics: The Case of Bati District. *Soc. Basic Sci. Res. Rev.* **2009**, *2*, 525–541.
83. Kassie, M.; Jaleta, M.; Shiferaw, B.; Mmbando, F.; Mekuria, M. Adoption of interrelated sustainable agricultural practices in smallholder systems: Evidence from rural Tanzania. *Technol. Forecast. Soc. Chang.* **2013**, *80*, 525–540, doi:10.1016/j.techfore.2012.08.007.
84. Lapar, M.L.; Pandey, S. Adoption of soil conservation: The case of the Philippine uplands. *Agric. Econ.* **1999**, *21*, 241–256, doi:10.1016/S0169-5150(99)00028-6.
85. Cramb, R.A. The role of social capital in the promotion of conservation farming: The case of `landcare' in the southern Philippines. *Land Dégrad. Dev.* **2006**, *17*, 23–30, doi:10.1002/ldr.691.

86. Zbinden, S.; Lee, D.R. Paying for Environmental Services: An Analysis of Participation in Costa Rica's PSA Program. *World Dev.* **2005**, *33*, 255–272, doi:10.1016/j.worlddev.2004.07.012.
87. Neill, S.P.; Lee, D.R. Explaining the Adoption and Disadoption of Sustainable Agriculture: The Case of Cover Crops in Northern Honduras. *Econ. Dev. Cult. Chang.* **2001**, *49*, 793–820, doi:10.1086/452525.
88. Arellanes, P.; Lee, D.R. The Determinants of Adoption of Sustainable Agriculture Technologies: Evidence from the Hillsides of Honduras. In Proceedings of the 25th International Conference of Agricultural Economists (IAAE), Durban, South Africa, 16–22 August 2003; pp. 693–699.
89. Allaire, G.; Cahuzac, E.; Simioni, M. Spatial diffusion and adoption determinants of European agri-environmental supports related to extensive grazing in France. In Proceedings of the *5èmes Journées De Recherche En Sciences Sociales*; Dijon, France, 8-9 December 2011; pp. 1–25.
90. Defrancesco, E.; Gatto, P.; Mozzato, D. To leave or not to leave? Understanding determinants of farmers' choices to remain in or abandon agri-environmental schemes. *Land Use Policy* **2018**, *76*, 460–470, doi:10.1016/j.landusepol.2018.02.026.
91. Davey, K.A.; Furtan, W.H. Factors that affect the adoption decision of conservation tillage in the prairie region of Canada. *Can. J. Agric. Econ.* **2008**, *56*, 257–275, doi:10.1111/j.1744-7976.2008.00128.x.
92. Duke, J.M. Participation in Agricultural Land Preservation Programs: Parcel Quality and a Complex Policy Environment. *Agric. Resour. Econ. Rev.* **2004**, *33*, 34–49.
93. Koesling, M.; Flaten, O.; Lien, G. Factors influencing the conversion to organic farming in Norway. *Int. J. Agric. Resour.* **2008**, *7*, 78–95.
94. Nkegbe, P.K.; Shankar, B.; Ceddia, G.M. Smallholder Adoption of Soil and Water Conservation Practices in Northern Ghana. In Proceedings of the EAAE 2011 Congress Change and Uncertainty Challenges for Agriculture, Food and Natural Resources, Zurich, Switzerland, 30 August–2 September 2011; pp. 1–12.
95. Khaledi, M.; Weseen, S.; Sawyer, E.; Ferguson, S.; Gray, R. Factors Influencing Partial and Complete Adoption of Organic Farming Practices in Saskatchewan, Canada. *Can. J. Agric. Econ. Rev. Can. D'agroecon.* **2010**, *58*, 37–56, doi:10.1111/j.1744-7976.2009.01172.x.
96. Ngombe, J.; Kalinda, T.; Tembo, G.; Kuntashula, E. Econometric Analysis of the Factors that Affect Adoption of Conservation Farming Practices by Smallholder Farmers in Zambia. *J. Sustain. Dev.* **2014**, *7*, 124–138, doi:10.5539/jsd.v7n4p124.
97. Schmidtner, E.; Lippert, C.; Engler, B.; Haring, A.M.; Aurbacher, J.; Dabbert, S. Spatial distribution of organic farming in Germany: Does neighbourhood matter? *Eur. Rev. Agric. Econ.* **2012**, *39*, 661–683, doi:10.1093/erae/jbr047.
98. Yang, A.L.; Rounsevell, M.D.A.; Wilson, R.M.; Haggett, C. Spatial analysis of agri-environmental policy uptake and expenditure in Scotland. *J. Environ. Manag.* **2014**, *133*, 104–115, doi:10.1016/j.jenvman.2013.11.038.
99. Pascucci, S.; Capitanio, F.; Adinolfi, F.; De-Magistris, T. Factors Affecting Participation of Italian Farmers in Rural Development Policy. In Proceedings of the 122nd EAAE Seminar "Evidence-

Based Agricultural and Rural Policy Making: Methodological and Empirical Challenges of Policy Evaluation", Ancona, Italy, 17–18 February 2011; Volume 40, pp. 605–631.

100. Boncinelli, F.; Bartolini, F.; Brunori, G.; Casini, L. Spatial analysis of the participation in agri-environment measures for organic farming. *Renew. Agric. Food Syst.* **2016**, *31*, 375–386, doi:10.1017/S1742170515000307.
101. Soule, M.J.; Tegene, A.; Weibe, K.D. Land Tenure and the Adoption of Conservation Practices. *Am. J. Agric. Econ.* **2000**, *82*, 993–1005.
102. Swinton, S.M. More Social Capital, Less Erosion: Evidence from Peru's Altiplano. In Proceedings of the Annual Meeting of the American Agricultural Economics Association, Tampa, FL, USA, 30 July–2 August 2000; p. 19.
103. Crabtree, B.; Chalmers, N.; Barron, N.-J. Information for Policy Design: Modelling Participation in a Farm Woodland Incentive Scheme. *J. Agric. Econ.* **1998**, *49*, 306–320, doi:10.1111/j.1477-9552.1998.tb01274.x.
104. Genius, M.; Koundouri, P.; Nauges, C.; Tzouvelekas, V. Information Transmission in Irrigation Technology Adoption and Diffusion: Social Learning, Extension Services, and Spatial Effects. *Am. J. Agric. Econ.* **2014**, *96*, 328–344, doi:10.1093/ajae/aat054.
105. Scorzelli, D. *La partecipazione Degli Agricoltori alle Misure Agroambientali—Un'analisi Socioeconomica Attraverso le Aziende RICA del Veneto*; INEA, Rome, Italy, 2007.
106. Bertoni, D.; Cavicchioli, D.; Pretolani, R.; Olper, A. Agri-Environmental Measures Adoption: New Evidence From Lombardy Region. In Proceedings of the 109th EAAE Seminar "The CAP after the Fischle Reform: National implementations, Impact Assessment and the Agenda for Future Reforms", Viterbo, Italy, 20–21 November 2008; p. 20.
107. Bertoni, D.; Cavicchioli, D.; Pretolani, R.; Olper, A. Agri-environmental measures adoption in Lombardy: Farm, territorial and institutional contraints. In Proceedings of the XLVI Convegno di Studi "Cambiamenti Nel Sistema Alimentare: Nuovi Problemi, Strategie, Politiche", Piacenza, Italy, 16–19 September 2009; pp. 1–18.
108. Bertoni, D.; Cavicchioli, D.; Pretolani, R.; Olper, A. Determinants of agri-environmental measures adoption: Do institutional constraints matter? *Environ. Econ.* **2012**, *3*, 8–19.
109. Finger, R.; Lehmann, B. Adoption of Agri-environmental Programmes in Swiss Crop Production. *EuroChoices* **2012**, *11*, 28–33, doi:10.1111/j.1746-692X.2012.00222.x.
110. Micha, E.; Areal, F.J.; Tranter, R.B.; Bailey, A.P. Uptake of agri-environmental schemes in the Less-Favoured Areas of Greece: The role of corruption and farmers' responses to the financial crisis. *Land Use Policy* **2015**, *48*, 144–157, doi:10.1016/j.landusepol.2015.05.016.
111. Capitanio, F.; Adinolfi, F.; Malorgio, G. What explains farmers' participation in Rural Development Policy in Italian southern region? An empirical analysis. *New Medit* **2011**, *10*, 19–24.
112. Meraner, M.; Heijman, W.; Kuhlman, T.; Finger, R. Determinants of farm diversification in the Netherlands. *Land Use Policy* **2015**, *42*, 767–780, doi:10.1016/j.landusepol.2014.10.013.
113. Murphy, G.; Hynes, S.; Murphy, E.; O'Donoghue, C. An investigation into the type of farmer who chose to participate in Rural Environment Protection Scheme (REPS) and the role of

institutional change in influencing scheme effectiveness. *Land Use Policy* **2014**, *39*, 199–210, doi:10.1016/j.landusepol.2014.02.015.

114. Scozzafava, G.; Pagnotta, G.; Contini, C.; Casini, L. What Farm Features determine the Granting of RDP Funding? The Case of Measures 121 and 214 in Tuscany. *Qual. Access Success* **2014**, *15*, 74–78.
115. Mzoughi, N. Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? *Ecol. Econ.* **2011**, *70*, 1536–1545, doi:10.1016/j.ecolecon.2011.03.016.
116. Grammatikopoulou, I.; Pouta, E.; Myyrä, S. Exploring the determinants for adopting water conservation measures. What is the tendency of landowners when the resource is already at risk? *J. Environ. Plan. Manag.* **2015**, 1–22, doi:10.1080/09640568.2015.1050551.
117. Unay Gailhard, I.; Bavorová, M.; Pirscher, F. Adoption of Agri-Environmental Measures by Organic Farmers: The Role of Interpersonal Communication. *J. Agric. Educ. Ext.* **2014**, *21*, 127–148, doi:10.1080/1389224X.2014.913985.
118. Unay Gailhard, I.; Bojnec, Š. Farm size and participation in agri-environmental measures: Farm-level evidence from Slovenia. *Land Use Policy* **2015**, *46*, 273–282, doi:10.1016/j.landusepol.2015.03.002.
119. Borsotto, P.; Henke, R.; Macrì, M.C.; Salvioni, C. Participation in rural landscape conservation schemes in Italy. *Landsc. Res.* **2008**, *33*, 347–363, doi:10.1080/01426390802046044.
120. Barreiro-Hurlé, J.; Espinosa-Goded, M.; Dupraz, P. Does intensity of change matter? Factors affecting adoption of agri-environmental schemes in Spain. In Proceedings of the 107th EAAE Seminar "Modelling of Agricultural and Rural Development Policies"; Sevilla, Spain, 29 January–1 February 2008; Volume 53, pp. 891–905.
121. Damianos, D.; Giannakopoulos, N. Farmers' participation in agri-environmental schemes in Greece. *Br. Food J.* **2002**, *104*, 261–273, doi:10.1108/00070700210425705.
122. Wynn, G.; Crabtree, B.; Potts, J. Modelling Farmer Entry into the Environmentally Sensitive Area Schemes in Scotland. *J. Agric. Econ.* **2001**, *52*, 65–82, doi:10.1111/j.1477-9552.2001.tb00910.x.
123. Söderqvist, T. Are farmers prosocial? Determinants of the willingness to participate in a Swedish catchment-based wetland creation programme. *Ecol. Econ.* **2003**, *47*, 105–120, doi:10.1016/j.ecolecon.2002.09.004.
124. Calatrava Leyva, J.; Franco Martínez, J.A.; González Roa, M.C. Analysis of the adoption of soil conservation practices in olive groves: The case of mountainous areas in southern Spain. *Span. J. Agric. Res.* **2007**, *5*, 249–258.
125. Habron, G.B. Adoption of conservation practices by agricultural landowners in three Oregon watersheds. *J. Soil Water Conserv.* **2004**, *59*, 109–115.
126. Anderson, J.B.; Jolly, D.A.; Green, R. Determinants of farmer adoption of organic production methods in the fresh-market produce sector in California: A logistic regression analysis. In Western Agricultural Economics Association Annual Meeting, San Francisco, CA, USA, 6–8 July 2005; p. 25.
127. Neupane, R.P.; Sharma, K.R.; Thapa, G.B. Adoption of agroforestry in the hills of Nepal: A logistic regression analysis. *Agric. Syst.* **2002**, *72*, 177–196, doi:10.1016/S0308-521X(01)00066-X.

128. Unay Gailhard, I.; Bavorova, M.; Pirscher, F. The Influence of Communication Frequency with Social Network Actors on the Continuous Innovation Adoption: Organic Farmers in Germany. In Proceedings of the 131st EAAE Seminar "Innovation for Agricultural Competitiveness and Sustainability of Rural Areas", Prague, Czech Republic, 18–19 September 2012; pp. 1–19.
129. Lokhorst, A.M.; Hoon, C.; le Rutte, R.; de Snoo, G. There is an I in nature: The crucial role of the self in nature conservation. *Land Use Policy* **2014**, *39*, 121–126, doi:10.1016/j.landusepol.2014.03.005.
130. Giovanopoulou, E.; Nastis, S.A.; Papanagiotou, E. Modeling farmer participation in agri-environmental nitrate pollution reducing schemes. *Ecol. Econ.* **2011**, *70*, 2175–2180, doi:10.1016/j.ecolecon.2011.06.022.
131. Mishra, A.K.; Khanal, A.R. Is participation in agri-environmental programs affected by liquidity and solvency? *Land Use Policy* **2013**, *35*, 163–170, doi:10.1016/j.landusepol.2013.05.015.
132. Chen, X.; Lupi, F.; An, L.; Sheely, R.; Viña, A.; Liu, J. Agent-based modeling of the effects of social norms on enrollment in payments for ecosystem services. *Ecol. Model.* **2012**, *229*, 16–24, doi:10.1016/j.ecolmodel.2011.06.007.
133. Karki, L.; Schleenbecker, R.; Hamm, U. Factors influencing a conversion to organic farming in Nepalese tea farms. *J. Agric. Rural Dev. Trop. Subtrop.* **2011**, *112*, 113–123.
134. Yuan, Y.; Liu, Y.; Hu, Y.; Chen, X.; Peng, J. Identification of Non-economic Influencing Factors Affecting Farmer's Participation in the Paddy Landto-Dry Land Program in Chicheng County, China. *Sustainability* **2017**, *9*, 366, doi:10.3390/su9030366.
135. Dimara, E.; Skuras, D. Adoption of agricultural innovations as a two-stage partial observability process. *Agric. Econ.* **2003**, *28*, 187–196, doi:10.1016/S0169-5150(03)00003-3.
136. Hattam, C. Adopting Organic Agriculture: An Investigation Using the Theory of Planned Behaviour. In Proceedings of the International Association of Agricultural Economics Conference, Gold Coast, Australia, 12–19 August 2006; p. 16.
137. D'Emden, F.H.; Llewellyn, R.S.; Burton, M.P. Factors influencing adoption of conservation tillage in Australian cropping regions. *Aust. J. Agric. Resour. Econ.* **2008**, *52*, 169–182, doi:10.1111/j.1467-8489.2008.00409.x.
138. Arslan, A.; McCarthy, N.; Lipper, L.; Asfaw, S.; Cattaneo, A. Adoption and intensity of adoption of conservation farming practices in Zambia. *Agric. Ecosyst. Environ.* **2014**, *187*, 72–86, doi:10.1016/j.agee.2013.08.017.
139. Chiputwa, B.; Langyintuo, A.S.; Wall, P. Adoption of Conservation Agriculture Technologies by Smallholder Farmers in the Shamva District of Zimbabwe: A Tobit application. In Proceedings of the 2011 Meeting of the Southern Agricultural Economics Association (SAEA), Corpus Christi, TX, USA, 5–8 February 2011; p. 28.
140. Lee, S.; Nguyen, T.; Poppenborg, P.; Shin, H.-J.; Koellner, T. Conventional, Partially Converted and Environmentally Friendly Farming in South Korea: Profitability and Factors Affecting Farmers' Choice. *Sustainability* **2016**, *8*, 704, doi:10.3390/su8080704.

141. Tiffin, R.; Balcombe, K. The determinants of technology adoption by UK farmers using Bayesian model averaging: The cases of organic production and computer usage. *Aust. J. Agric. Resour. Econ.* **2011**, *55*, 579–598, doi:10.1111/j.1467-8489.2011.00549.x.
142. Mazvimavi, K.; Twomlow, S. Socioeconomic and institutional factors influencing adoption of conservation farming by vulnerable households in Zimbabwe. *Agric. Syst.* **2009**, *101*, 20–29, doi:10.1016/j.agsy.2009.02.002.
143. Wollni, M.; Andersson, C. Spatial patterns of organic agriculture adoption: Evidence from Honduras. *Ecol. Econ.* **2014**, *97*, 120–128, doi:10.1016/j.ecolecon.2013.11.010.
144. Thangata, P.H.; Alavalapati, J.R.R. Agroforestry adoption in southern Malawi: The case of mixed intercropping of Gliricidia sepium and maize. *Agric. Syst.* **2003**, *78*, 57–71, doi:10.1016/S0308-521X(03)00032-5.
145. Unay Gailhard, I.; Bojnec, Š. Farmland use size and the adoption of agri-environmental measures: Farm-level evidence from Slovenia. In Proceedings of the 17th European Roundtable on Sustainable Consumption and Production, Portorož, Slovenia, 14–16 October 2014; p. 315.
146. Zanella, M.A.; Schleyer, C.; Speelman, S. Why do farmers join Payments for Ecosystem Services (PES) schemes? An Assessment of PES water scheme participation in Brazil. *Ecol. Econ.* **2014**, *105*, 166–176, doi:10.1016/j.ecolecon.2014.06.004.
147. Luzar, E.J.; Diagne, A. Participation in the next generation of agriculture conservation programs: The role of environmental attitudes. *J. Socio-Econ.* **1999**, *28*, 335–349, doi:10.1016/S1053-5357(99)00021-9.
148. Bartolini, F.; Raggi, M.; Viaggi, D. A spatial analysis of participation in RDP measures: A case study in Emilia Romagna Region. In Proceedings of the 1st AIEAA Conference "Towards a Sustainable Bio-economy: Economic Issues and Policy Challenges", Trento, Italy, 4–5 June 2012; p. 13.
149. Gebrelibanos, T.; Assen, M. Farmers' attitudes towards land resource conservation and its implication for sustainable land management in the Hirmi watershed, Northern Highlands of Ethiopia. *J. Sustain. Dev. Africa* **2013**, *15*, 43–55.
150. Bartolini, F.; Latruffe, L.; Viaggi, D. Assessing the effect of the CAP on farm innovation adoption. An analysis in two French regions. In Proceedings of the 122nd EAAE Seminar "Evidence-Based Agricultural and Rural Policy Making: Methodological and Empirical Challenges of Policy Evaluation", Ancona, Italy, 17–18 February 2011; p. 13.
151. Greiner, R.; Patterson, L.; Miller, O. Motivations, risk perceptions and adoption of conservation practices by farmers. *Agric. Syst.* **2009**, *99*, 86–104, doi:10.1016/j.agsy.2008.10.003.
152. Gardebroek, C. Comparing risk attitudes of organic and non-organic farmers with a Bayesian random coefficient model. *Eur. Rev. Agric. Econ.* **2006**, *33*, 485–510, doi:10.1093/erae/jbl029.
153. Baidu-Forson, J. Factors influencing adoption of land-enhancing technology in the Sahel: Lessons from a case study in Niger. *Agric. Econ.* **1999**, *20*, 231–239, doi:10.1016/S0169-5150(99)00009-2.

154. Tosakana, N.S.P.; Van Tassell, L.W.; Wulfhorst, J.D.; Boll, J.; Mahler, R.; Brooks, E.S.; Kane, S. Determinants of the adoption of conservation practices by farmers in the Northwest Wheat and Range Region. *J. Soil Water Conserv.* **2010**, *65*, 404–412, doi:10.2489/jswc.65.6.404.
155. Mathijs, E. Social capital and farmers' willingness to adopt countryside stewardship schemes. *Outlook Agric.* **2003**, *32*, 13–16, doi:10.5367/000000003101294217.
156. Guillem, E.E.; Barnes, A. Farmer perceptions of bird conservation and farming management at a catchment level. *Land Use Policy* **2013**, *31*, 565–575, doi:10.1016/j.landusepol.2012.09.002.
157. Dedeurwaerdere, T.; Polard, A.; Melindi-Ghidi, P. The role of network bridging organisations in compensation payments for agri-environmental services under the EU Common Agricultural Policy. *Ecol. Econ.* **2015**, *119*, 24–38, doi:10.1016/j.ecolecon.2015.07.025.
158. Rezvanfar, A.; Samiee, A.; Faham, E. Analysis of Factors Affecting Adoption of Sustainable Soil Conservation Practices among Wheat Growers. *World Appl. Sci. J.* **2009**, *6*, 644–651.
159. Greiner, R. Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts. *Agric. Syst.* **2015**, *137*, 154–165, doi:10.1016/j.agsy.2015.04.005.
160. Page, G.; Bellotti, B. Farmers value on-farm ecosystem services as important, but what are the impediments to participation in PES schemes? *Sci. Total Environ.* **2015**, *515–516*, 12–19, doi:10.1016/j.scitotenv.2015.02.029.
161. Pérez Urdiales, M.; Lansink, A.O.; Wall, A. Eco-efficiency Among Dairy Farmers: The Importance of Socio-economic Characteristics and Farmer Attitudes. *Environ. Resour. Econ.* **2016**, *64*, 559–574, doi:10.1007/s10640-015-9885-1.
162. Van Eeden, M.; Korsten, L. Factors determining use of biological disease control measures by the avocado industry in South Africa. *Crop Prot.* **2013**, *51*, 7–13, doi:10.1016/j.cropro.2013.03.011.
163. Van Hulst, F.J.; Posthumus, H. Understanding (non-) adoption of Conservation Agriculture in Kenya using the Reasoned Action Approach. *Land Use Policy* **2016**, *56*, 303–314, doi:10.1016/j.landusepol.2016.03.002.
164. Chouichom, S.; Yamao, M. Comparing Opinions and Attitudes of Organic and Non-Organic Farmers Towards Organic Rice Farming System in North-Eastern Thailand. *J. Org. Syst.* **2010**, *5*, 25–35.
165. Salazar, C.; Rand, J. Production risk and adoption of irrigation technology: Evidence from small-scale farmers in Chile. *Latin Am. Econ. Rev.* **2016**, *25*, doi:10.1007/s40503-016-0032-3.
166. Fentie, D.; Fufa, B.; Bekele, W. Determinants of the Use of Soil Conservation Technologies by Smallholder Farmers: The Case of Hulet Eju Enesie District, East Gojjam Zone, Ethiopia. *Asian J. Agric. Food Sci.* **2013**, *1*, 2321–1571.
167. D'Emden, F.H.; Llewellyn, R.S.; Burton, M.P. Adoption of conservation tillage in Australian cropping regions: An application of duration analysis. *Technol. Forecast. Soc. Chang.* **2006**, *73*, 630–647, doi:10.1016/j.techfore.2005.07.003.
168. Asafu-Adjaye, J. Factors Affecting the Adoption of Soil Conservation Measures: A Case Study of Fijian Cane Farmers. *J. Agric. Resour. Econ.* **2008**, *33*, 99–117.

169. Ajzen, I.; Fishbein, M.E. *Understanding Attitudes and Predicting Social Behavior*; Prentice Hall: Englewood Cliffs, NJ, USA; New York, NY, USA, 1980;.
170. Welch, E.W.; Marc-Aurele, F.J. Determinants of Farmer Behavior: Adoption of and Compliance with Best Management Practices for Nonpoint Source Pollution in the Skaneateles Lake Watershed. *Lake Reserv. Manag.* **2001**, *17*, 233–245, doi:10.1080/07438140109354133.
171. Pietola, K.S.; Lansink, A.O. Farmer response to policies promoting organic farming technologies in Finland. *Eur. Rev. Agric. Econ.* **2001**, *28*, 1–15, doi:10.1093/erae/28.1.1.
172. Mann, S. Farm Size Growth and Participation in Agri-environmental Schemes: A Configural Frequency Analysis of the Swiss Case. *J. Agric. Econ.* **2005**, *56*, 373–384, doi:10.1111/j.1477-9552.2005.00024.x.
173. Arriagada, R.A.; Sills, E.O.; Pattanayak, S.K.; Ferraro, P.J. Combining Qualitative and Quantitative Methods to Evaluate Participation in Costa Rica's Program of Payments for Environmental Services. *J. Sustain. For.* **2009**, *28*, 343–367, doi:10.1080/10549810802701192.
174. Van Thanh, N.; Yapwattanaphun, C. Banana Farmers' Adoption of Sustainable Agriculture Practices in the Vietnam Uplands: The Case of Quang Tri Province. *Agric. Agric. Sci. Procedia* **2015**, *5*, 67–74, doi:10.1016/j.aaspro.2015.08.010.
175. Murphy, G.; Hynes, S.; Murphy, E.; O'Donoghue, C.; Green, S. Assessing the compatibility of farmland biodiversity and habitats to the specifications of agri-environmental schemes using a multinomial logit approach. *Ecol. Econ.* **2011**, *71*, 111–121, doi:10.1016/j.ecolecon.2011.08.010.
176. Timprasert, S.; Datta, A.; Ranamukhaarachchi, S.L. Factors determining adoption of integrated pest management by vegetable growers in Nakhon Ratchasima Province, Thailand. *Crop Prot.* **2014**, *62*, 32–39, doi:10.1016/j.cropro.2014.04.008.

3. What makes private forestland owners willing to deliver forest ecosystem services? Insights from an alpine case

Details: Gatto, P., Defrancesco, E., Mozzato, D., Pettenella, D. (submitted to European Journal of Forest Research). What makes private forestland owners willing to deliver forest ecosystem services? Insights from an alpine case.

3.1. Abstract

Given the large share of private-owned forests in Europe, the delivery of forest ecosystem services depends greatly on the management choices of private forest landowners. There is a wealth of forest economics literature studying why forest owners are willing to provide ecosystem services, but mostly in northern Europe or North America and with a timber production or amenity consumption focus. This paper wants to contribute to this literature with a perspective focused on southern Europe, specifically in the alpine region of Veneto (northeastern Italy), where forest management models are mostly multifunctional, and on social ecosystem services such as biodiversity improvement, soil conservation, carbon sequestration. The willingness of forest owners to provide ecosystem services beyond the minimum legal requirements in return for a payment or without payment has been explored by means of multinomial logit models on a sample of 106 private forest owners. While generally concurring with the literature indicating that many private forest owners maximise utility and not profit, our results show that a large share of private forest owners in the region have a clear perception of the social role of forests and are willing to deliver additional ecosystem services, notwithstanding the high mandatory baseline. Additionally, our models show that a market orientation of forest management negatively influences the willingness to deliver ecosystem services without a payment, while forest owners want to deliver ES without payment where sentimental and bequest values prevail. These results provide useful indications for forest policy design in the alpine context.

Keywords: NIPFs owners; forest ecosystem services; multinomial logit; forest owners' management decisions; forest multifunctionality; forest payments

3.2. Introduction

With a large share of the European woodland area privately owned[1] (Pulla et al. 2013), on the continent, the delivery of a whole range of forest ecosystem services (ESs) – either supporting, provisioning, regulating or cultural services (Millennium Ecosystem Assessment 2005) – depends greatly upon the willingness of private forest landowners and their forest management choices (Matta et al. 2009). Studying the conditions for forest ESs delivery is an established field of forest economics research, with a body of literature rich in cases and review studies dealing with provisioning ESs such as timber and wood products. Today, however, demand shift towards ESs with a more relevant social dimension – such as supporting, regulating and cultural ESs (Croitoru 2007; Górriz-Mifsud et al. 2016) – is leading to a reconsideration of traditional forest management models and forest owners' choices. In parallel, new research insights are needed to understand what orients forest owners' decisions towards more social forest management objectives.

The analysis of forest owners' choices in this respect is a rapidly growing field of research, which discusses, for example, whether and to what extent financial incentives increase the delivery of habitat services from forests (Boon et al. 2010). The emerging research has in some ways confirmed the findings of the literature addressing more traditional provisioning ESs but has cast new light on the great heterogeneity of forest owners' decisions and their ESs delivery. It has shown, for example, that providing cultural and regulating ESs from private forests goes far beyond a matter of public policy or support but stretches across a broad range of contextual, personal and structural factors (Amacher et al. 2003; Song et al. 2014), in turn connected to socio-economic, environmental, cultural and institutional contexts (Rodríguez-Vicente and Marey-Pérez 2010). With this complexity, understanding what makes forest owners willing to deliver ESs to society is a challenging task that has not yet been fully explored despite the growing literature.

A first gap is connected to the type of ES; because of their private-consumption dimension, cultural ESs such as amenity and recreation have been more explored than others that have a more pronounced social dimension such as supporting and regulating ESs, including biodiversity conservation, carbon sequestration and soil erosion prevention.

A second gap is connected to the heterogeneous geographical distribution of research papers: a northern American and northern-central European focus dominates (Beach et al. 2005; Bengston et al. 2010; Urquhart et al. 2012; Blanco et al. 2015). In contrast, motivations and attitudes of southern European owners are scarcely known or documented (Domínguez and

[1] Not considering countries where forestland is exclusively owned by the state, i.e. the European part of the Russian Federation, Ukraine, Belarus and Georgia, the percentage of privately-owned forest area in Europe is 55% (Pulla et al. 2013)

Shannon 2011). In their recent review of forest manager typologies and decision-making patterns, Blanco et al. 2015 quote only one paper from Portugal and none from Italy, Spain or France. Similarly, the more recent review on private forest owner typology by Ficko et al. (2017) reports very few studies from southern Europe. However, the richness of situations and motivations offered by the highly diverse character of southern European forest ecosystems (Martínez-Jauregui et al. 2016) makes them a stimulating and challenging research case, potentially adding novel and original insights to a body of literature still mostly inspired by analyses of productive-oriented models such as those of northern European countries.

However, there is another important reason for a southern European research focus. In southern European countries – and Italy is no different – private forestry is often characterised by the inaction of forest owners (FAO 2013). Vast research points out that a lack of forest management is associated with high environmental risk (FAO 2013), with vulnerability to biotic and abiotic factors now exacerbated by climate and global change (Lindner et al. 2010). Hence, contrasting abandonment and having more vital forests in those countries is crucial, and private forest owners should be at the nexus of actions aimed at including social dimensions in forest management models. Understanding the reasons for choices in that direction is thus compelled by the need for increasing forest ecosystem resilience and integrating it into policy making, both through regulatory baselines and voluntary instruments over such baselines.

Based on these premises, this paper intends to shed light on whether non-industrial private forest (NIPF) owners in a southern European context would be willing to deliver additional – i.e., beyond the minimum legal requirements – ESs in return for a payment or without payment, and what determines such intentions. Three forest ESs with a typical social dimension and of the supporting or regulating type have been considered: biodiversity improvement, soil conservation, and carbon sequestration. The study has been carried out in an alpine area of Veneto, northeastern Italy.

The paper is organised as follows: in the next section, relevant literature findings are presented, followed by a section describing the forest ownership context of the country and the region. Then, materials and methods are illustrated. The results are presented and discussed with reference to the three models considered. The final section includes the implications of our results for forest policy design in a southern European context.

3.3. Understanding private forest owners' decisions: literature review

Forestland owners are faced with a large range of decisions when managing their land and forests, regarding, for example, choices on land-use changes, e.g., whether to reforest after

harvesting (Hardie and Parks 1996) or to afforest farmland (Duesberg et al. 2014); on harvesting levels and timing (Joshi and Arano 2009; Lidestav and Ekström 2000; Petucco et al. 2015; Rodríguez-Vicente and Marey-Pérez 2009); on implementing conservation practices (Kline et al. 2000); or on participating in voluntary policy programmes (Vedel et al. 2015).

There is a wealth of literature addressing the reasons for forest owners' choices regarding traditional productive choices and connecting them to individual profiles, behaviour, motivations, and attitudes towards owning a forest. Comprehensive reviews and meta-analyses by Amacher et al. (2003), Beach et al. (2005), Domínguez and Shannon (2011), Silver et al. (2015) and Blanco et al. (2015) show how research interest in this field has never faded away; forest owners' decisions evolve and expand (Joshi and Arano 2009; Domínguez and Shannon 2011) and so does the research.

A large number of studies deal with NIPF owners. As they hold a large share of forestland in North America (Joshi and Arano 2009; Côté et al. 2015) and in several northern (Silver et al. 2015, Ingemarson et al. 2006), central, western and southern European countries (Brandl 2007), NIPF owners' decisions may have a substantial impact on the forest-wood sector (Lind-Riehl et al. 2015); therefore, they have considerable interest for research and policy-making. However, NIPF is a broad concept that can embrace very diverse ownerships and owners, both characterised by a wide set of features and patterns (Harrison et al. 2002). This heterogeneity has been addressed by research; however, the research is more often with foci on private dimensions of forest management than on the motives mirroring NIPF owners' management decisions towards delivering ESs in a broader social perspective.

A strand of the literature has concentrated on identifying NIPF owners' typologies. Classifications have been proposed which look at whether NIPF owners privilege production or consumption goals (Boon et al. 2004, Kendra and Hull 2005, Serbruyns and Luyssaert 2006, Butler et al. 2007). This literature has shown that consumption-oriented NIPF owners are a multifaceted category, with several multifunctional objectives (Ní Dhubháin et al. 2007, Howley 2013), recently reconceptualised as "ecosystem-centered" (Feliciano et al. 2017). When trying to understand forest owners' willingness to deliver public ESs, this complexity needs to be explored beyond typologies to better understand individual features, motivations, attitudes and external factors affecting multifunctional NIPF owners' management choices.

Early studies on factors affecting forest owners' choices have pointed out the importance of determinants such as the structural characteristics of the property such as forest size and composition, growing stock or infrastructure levels (Eggers et al. 2014, Beach et al. 2005). More recent studies have highlighted the need to include owners' attributes such as age; education; family composition, e.g., number of children; time into ownership (Rickenbach and Kittrege 2009); and reasons for ownership (Bengston et al. 2011). Research has shown that

dependence on forest income negatively affects inclination towards delivering ESs (Bjärstig and Kvastegård 2016), as well as older ages (Uliczka et al. 2004). Bequest values in terms of legacy to offspring also enter the spectrum of reasons underlying NIPF owners' multifunctional decisions (Côté et al. 2015; Lind-Riehl et al. 2015). Motivations related to family privacy, rural lifestyle experience and recreational enjoyment, leisure, amenity and biodiversity conservation have been found in the US (Sorice et al. 2014), northern European countries (Nordlund and Westin 2011; Eggers et al. 2014), Spain (Campos et al. 2009) and Portugal (Martínez-Jauregui et al. 2016).

A review of the literature shows how most recent studies on determinants have further progressed, endeavouring to consider behavioural and attitudinal reasons for NIPF owners' choices. This field of investigation grounds mostly in the theory of reasoned action and planned behaviour (Ajzen and Fishbein 2005), which explains human behaviour on the basis of individuals' values and perceptions. The theory has been widely employed in agricultural economics research where it has substantially contributed to explaining the reasons for farmers' land-use changes and adoption of specific practices, including several cases of conservation actions and adoption of agri-environmental measures (Beedel and Rehman, 2000; Defrancesco et al., 2008; Mettepenningen et al. 2013). It has also been applied to the analysis of NIPF owners' decisions determinants, where it has cast light on why NIPF owners may adopt close-to-nature forest management models (Bieling 2004) or pursue conservation objectives (Sorice and Conner 2010). Information and knowledge available to forest owners have been found as essential in the perspective of delivering ESs to society. For example, if forest owners have (or perceive to have) little knowledge and information on the value of social dimensions of forests, then they are also less prone to deliver ESs (Bjärstig and Kvastegård 2016), while perceiving to possess knowledge about conservation and forest species determines a positive attitude towards nature conservation (Uliczka et al. 2004).

Determinants of NIPF owners' choices, however, do not include only internal (i.e., owner's and ownership) factors but also external ones. For example, contextual socio-economic factors such as the status of the local forest economy and type of rural area (Canadas and Novais 2014) as well as market drivers (Rodríguez-Vicente and Marey-Pérez, 2009, 2010) have been reported as relevant in NIPF owners' decisions. Where they exist, the effect of specific policy initiatives and measures aiming at inducing forest owners to deliver ESs has also been deemed relevant amongst determinants of NIPF owners' choices (Serbruyns and Luyssaert 2006, Matta et al. 2009). Research has shown that, in some cases, NIPF owners need compensation for giving up wood harvesting and adopting management practices aimed at habitat conservation (Kline et al. 2000) or carbon sequestration (Thompson and Hansen 2012). However, compensation alone is not enough to explain such willingness; responses

are also (negatively) related to NIPF owners' degree of activity and size of forest ownership (Lindhjem and Mitani 2012). Conversely, being young, female and owning land has been found to positively affect intentions to set aside forestland as a response to financial compensation (Boon et al. 2010). Forest owners are also sensitive to the degree of additionality implied in the adoption of ES-oriented management models and require being paid accordingly (Vedel et al. 2015). The timing of payments, duration of contracts, restrictions and cancellation policies also affect responses to forest biodiversity conservation policies (Horne 2006), while the availability of incentive programs in other fields (e.g., in supporting the development of wood and the woodfuel market) often serves as a barrier in the provision of ESs (Urquhart et al. 2012).

In conclusion, it can be determined, in line with most of the literature, that NIPF owners are utility-maximisation rather than just profit-maximisation agents (Amacher et al. 2003; Conway et al. 2003; Domínguez and Shannon 2011). To this end, even if personal experience remains in the foreground of reasons for owning and managing a forest, NIPF owners may intentionally decide to also provide an ES with a social dimension through specific forest management practices. This might be induced by financial or other types of motivations, which is what our paper aims to investigate, with a focus on a southern European context, where the literature is still scarce.

3.4. Case-study context: social demand of ESs, provision by forests, and forest ownership

With nearly 35% of its total land area under forests and other wooded land – i.e., close to 11 million hectares according to the last national forest inventory (Gasparini 2014) – Italy is today a forest-rich country. However, this high forest cover is the result of widespread abandonment of agricultural, forestry and pastoral activities (Cocca et al. 2012). The importance of forests as productive sources of timber and other wood products has declined in the country, as shown by the halving of the quantity of wood harvested in the last thirty years. With approximately 65% private forestland (EUROSTAT 2013), the forest system structure in Italy is largely based on NIPF owners whose number, according to the most recent available data, is slightly more than 606 thousand (ISTAT 2000)[2,3]. The average size of a forest holding is 7.5 hectares, meaning that each owner holds a small portion of forestland.

[2] This number excludes owners of poplar and other fast-growing plantations, mostly occurring inside farms and on agricultural land.

[3] The only national data on the number of forest owners in Italy are available through the Agricultural Census, as the forestland statistics and forest inventories do not collect data on the basis of the property unit. However, the focus of the Agricultural Census is on farms. Until 2000, the Census collected data on all farms, including those owning or exclusively managing forestland. In the subsequent 2010

Almost three quarters of Italian forestland is in mountainous and hilly areas, vulnerable social-ecological systems characterised by difficult environmental conditions, lack of infrastructure, and isolation (Pettenella and Romano 2016). The fragility of mountainous territory in terms of soil erosion, its importance as water reservoir, and its high ecological, landscape and carbon-stock values have always required active forest management. Forest overgrowth due to scarce or absent forest management and harvesting is today a threat to forest ecosystem resilience and a cause of vulnerability to abiotic and biotic disturbances, especially forest fires. It also brings about ES losses such as decreases in biodiversity, amenity and landscape values and the simplification of cultural richness (FAO 2013).

In Veneto (northeastern Italy), the forest area has also been growing in the last decades: forests were across 390 thousand hectares in 1980, while today they cover approximately 450 thousand hectares (Regione Veneto 2009, 2013). The largest part of the regional forests is located in the alpine areas of the region. Unlike the rest of Italy, here, there are still signs of active forest management and a vital local timber market fed by approximately 475 thousand cubic metres of timber and firewood each year (Regione Veneto 2013). Approximately 45% of alpine forests are coniferous high forests of spruce, fir, larch and pines, located in the upper phytoclimatic zones where slopes are steeper. The remaining 55% is broadleaved forests of mostly beech, oaks, maples, hornbeam, and chestnuts located in the lower phytoclimatic zones and managed as both high forests or coppices for firewood. Both conifers and broadleaved forests make relevant contributions towards conserving biodiversity, protect soil from erosion, are a significant carbon sink (an essential component of the landscape) and are a valuable asset for the tourist sector (Gatto et al. 2014).

For a long time, the approach to forest management in Veneto (as well as in Italy) has been mostly based on mandatory instruments (Secco et al. 2011), justified by the urgent need to secure soil from erosion in steep slopes and landscape conservation; voluntary financial measures based on incentives or payments for ecosystem services are still scarce in the forest sector.

Any forest policy measure aimed at supporting local timber markets and active forest management and the related ESs has to confront the fragmented structure of private forest landownership: 60% of forestland is owned by 42 thousand individual private forest owners (ISTAT 2000), of which 32% own less than 2 hectares. These forest owners are immersed in a complex regulatory framework, with limited forest management rights (Nichiforel et al. 2018). Land-use change from forests to other uses is admitted only in exceptional cases;

edition, it excluded units with forestland only and counted only those units having solely agricultural land or agricultural and forest. For this reason, the data available on forest owners in Italy are partial and not updated.

forest harvesting beyond self-consumption thresholds [4] needs to be authorised. The predominant management model is multifunctional continuous-cover forestry with selection cutting, while clear cutting is not authorised. Such regulatory framework represents the baseline against which we aim to test forest owners' willingness to deliver additional ESs for free or in return for a payment

3.5. Data and Methods

A structured questionnaire was administered through face-to-face interviews to a stratified sample of individual forest owners in the alpine areas of Veneto. The sample was extracted from the regional database of 36,749 private forest owners applying for forest harvesting authorisation in the period 1997-2011. The stratification aimed at representing the different alpine areas of the region, from west to east. To also capture forest owners who did not ask for forest harvesting authorisation in the considered period, the sample was integrated through a snow-ball technique. In total, 106 NIPF owners were interviewed.

The exploration of factors affecting willingness towards ESs delivery is carried out through multinomial logit models (Greene 2000; Eggers et al. 2014; Mudaca et al. 2015) under two mutually exclusive options: i) additional delivery of forest ESs in return for a payment and ii) additional delivery of forest ESs without payment, where 'additional' means beyond the legal baseline. The reference category is represented by the unwillingness to deliver the ES, regardless of payment. Three models are estimated, one per ES considered: i) biodiversity improvement, expressed as a higher number of endangered animal and plant species on the property; ii) soil conservation, expressed as reducing erosion; and iii) carbon sequestration, meaning more carbon stocked in the forest following a decrease in harvesting.

For each ES, the log-odds of j-1 responses η_{ij} (I = 106; J = 1, 2) are linear combinations of a set of k predictors X:

$$\eta_{ij} = \ln\left(\frac{P_{ij}}{P_{i0}}\right) = \alpha_j + \boldsymbol{X}_i'\boldsymbol{\beta}_j$$

where J = 0 is the baseline, i.e., the forest owner is unwilling to improve the delivery of the ES, regardless of any payment; J = 1: the forest owner is willing to improve the delivery of the ES only in return for a payment; J = 2: the forest owner is willing to improve the delivery of the ES without payment;

The observed outcomes of the willingness to deliver each ES by each one of the three options are reported in Table 3.1.

[4] In the case of Veneto, the threshold is established at 100 cubic metres for high forests or at a harvesting area wider than 2.5 hectares for coppices.

Table 3.1. Forest owners' willingness to provide the ES by option (observed outcomes - %)

	ES		
Options	**Biodiversity improvement**	**Soil conservation [a]**	**Carbon sequestration**
Unwillingness to improve the delivery of the ES, regardless of payment	26.4	29.5	59.4
Willingness to improve the delivery of the service only in return for a payment	22.6	34.3	30.2
Willingness to improve the delivery of the service without payment	50.9	36.2	10.4

[a] For this ES, n=105, as one forest owner refused to answer

In accordance with the literature, we assume that NIPF owners' decision-making in delivering the three ESs is affected by a number of factors *X*, grouped into three categories:

a. *The property structural factors*: i) the forest composition (F_TYPE), which refers to whether the forest trees are mainly conifers or mainly broadleaved or mixed forests and ii) the existence of landslide issues on the property (LANDSLIDE), as we hypothesise that an owner with a property affected by landslides would be sensitive to this issue;
b. *The owner's objective attributes*: i) the owner's age (AGE), ii) his/her level of education (EDUC), iii) the number of children (CHILD) and iv) the time into ownership, expressed as number of years of ownership of the property (OWN_TIME);
c. *The forest management factors*: i) the orientation of forest management which is defined according to the destination of the harvest of the previous year, i.e., whether the harvest is fully self-consumed (NO_SALES); ii) the owner's perception on whether the property is already delivering the ES because of the adopted forest management practices (MANAGE_SERV); iii) the owner's perception of the economic value of the property (ECON_VALUE); and iv) the owner's perception of the sentimental value of the property (SENT_VALUE). Both of the last two factors are measured on a 1 to 4 points scale.

The summary statistics of the independent variables included in the final models are reported in Table 3.2. We did not include variables such as the forest size or dependence on forest income because of their scarce relevancy given the small-scale structure of private forest ownership in the area; similarly, we did not consider policy variables, as we are not assessing the impact of a specific policy measure but rather a broad willingness by the forest owner to deliberately improve the delivery of ESs beyond the existing legal requirements.

Table 3.2. Summary statistics of the variables included in each ES model

Variables	Ecosystem Services		
	Biodiversity improvement	**Soil conservation**	**Carbon sequestration**
Property structural characteristics			
Forest composition (F_TYPE)			
0 = Mainly mixed or broadleaved forest	56.6	56.2	56.6
1 = Mainly coniferous forest	43.4	43.8	43.4
Existence of landslide issues on the property (LANDSLIDE)			
0 = No		55.2	
1 = Yes		44.8	
Owner's objective attributes			
Owner's age (AGE)			
Mean	59.87	59.70	59.87
Standard deviation	12.35	12.29	12.35
Owner's education level (EDUC)			
0 = Primary school	50.9	50.5	50.9
1 = Secondary school or above	49.1	49.5	49.1
Number of children (CHILD)			
Mean	1.52	1.51	1.52
Standard deviation	1.08	1.08	1.08
Time into ownership (n. of years) (OWN_TIME)	89.19	89.28	89.19
Mean	55.48	55.74	55.48
Standard deviation			
Forest management factors			
Destination of previous year harvest (NO_SALES)	17.0	17.1	17.0
0 = Fully or partially sold	83.0	82.9	83.0
1 = Fully self-consumed			
Forest perceived as already delivering the ES (MANAGE_SERV)			
0 = No	18.9	21.0	28.3
1 = Yes	81.1	79.0	71.7
Forest perceived as having an economic value (1 to 4 points scale) (ECON_VALUE)			
Mean	1.75	1.76	1.75
Standard deviation	0.90	0.90	0.90
Forest perceived as having sentimental value (1 to 4 points scale) (SENT_VALUE)			
Mean	3.24	3.23	3.24
Standard deviation	0.80	0.80	0.80

3.6. Results and discussion

For each considered ES, the model estimates are reported in Table 3.3.

Table 3.3. Multinomial logit models estimated coefficients [a]

	Ecosystem Service		
Variables	**Biodiversity improvement**	**Soil conservation**	**Carbon sequestration**
Willingness to deliver the ES only in return for a payment			
INTERCEPT	-5.632 (2.533) **	-3.437 (1.987) *	-3.304 (1.924) *
F_TYPE = 1	0.866 (0.713)	1.091 (0.620) *	1.409 (0.582) ***
LANDSLIDE = 1		1.494 (0.643) **	
AGE	-0.036 (0.032)	-0.023 (0.027)	-0.002 (0.022)
EDUC = 1	-1.528 (0.756) **	0.063 (0.632)	0.165 (0.558)
CHILD	0.501 (0.362)	0.076 (0.310)	0.301 (0.283)
OWN_TIME	0.004 (0.007)	-0.004 (0.005)	-0.006 (0.005)
NO_SALES = 1	1.189 (0.857)	2.334 (0.896) ***	-0.194 (0.647)
MANAGE_SERV = 1	1.486 (0.923) *	2.222 (0.920) ***	2.564 (1.159) **
ECON_VALUE	0.728 (0.409) *	-0.102 (0.344)	-0.226 (0.305)
SENT_VALUE	0.632 (0.445)	0.152 (0.415)	0.164 (0.347)
Willingness to deliver the ES without payment			
INTERCEPT	-4.217 (2.143) **	-1.871 (2.133)	-7.230 (3.922) *
F_TYPE = 1	0.536 (0.623)	-1.242 (0.657) *	-2.560 (1.220) **
LANDSLIDE = 1		1.881 (0.632) ***	
AGE	-0.032 (0.027)	0.013 (0.029)	0.093 (0.051) *
EDUC = 1	-1.148 (0.638) *	-1.238 (0.621) **	1.006 (0.912)
CHILD	0.517 (0.298) *	0.193 (0.284)	0.015 (0.424)
OWN_TIME	0.011 (0.006) *	-0.004 (0.006)	-0.016 (0.009)*
NO_SALES = 1	1.269 (0.710) *	-0.281 (0.779)	-0.191 (1.086)
MANAGE_SERV = 1	1.629 (0.740) **	1.535 (0.758) **	1.653 (1.157)
ECON_VALUE	-0.215 (0.388)	-0.080 (0.353)	0.273 (0.498)
SENT_VALUE	0.770 (0.369) **	-0.132 (0.409)	0.166 (0.561)
-2 Log L	*178.292*	*175.688*	*142.853*
p	*0.002*	*0.000*	*0.000*
N	*106*	*105*	*106*
McFadden pseudo R^2	*0.185*	*0.236*	*0.256*

3.6.1. Biodiversity improvement

In this case, the forest owner was asked whether he/she was willing to adopt forest management practices that would improve biodiversity, meaning increasing the number of some specific endangered animal or plant species on the property.

Our model estimates show that some factors played a similar role in the willingness to deliver the service irrespective of payment: a lower level of education (EDUC) had a positive effect on ES provision if compared to the baseline. This result is consistent with the findings by Beach et al. 2005 who, in their review, found similar results for multi-objective owners, but

contrasts with the finding by Matta et al. (2009) and Belin et al. (2005); however, these authors considered different contexts than southern Europe. In addition, when the forest owner perceives that his/her forest management is already delivering the service (MANAGE_SERV), he/she is more willing to provide additional quantities: this result is in line with the findings of Beach et al. 2005, who highlight that delivery is positively affected by a certain level of biodiversity already existing in the forest. Additionally, Belin et al. (2005) found that the presence of small scale ecological issues in the property, such as wetlands or endangered species, makes forest owners more sympathetic towards ecosystem-based management.

Distinguishing between forest owners willing to deliver in return for a payment and those willing to deliver without payment, as expected, the former are found to have a higher perception of the economic value of their property (ECON_VALUE), while the latter are more inclined towards self-consumption (NO_SALES), have owned the property for a longer time (OWN_TIME), have a higher number of children (CHILD – the number of children being assumed as a proxy of a bequest value attributed to the property) and attach to their forest estate sentimental value (SENT_VALUE). In line with the findings by Campos et al. (2009) for Spain, these results indicate that sentimental motivations can facilitate the acceptance of opportunity costs by the owner connected to the adoption of a less productive management model and can be explained with the self-consumption of amenity values by the owner and his/her family. Thus, the willingness by NIPF owners to deliver biodiversity services in the alpine forests of Veneto can be interpreted as the fulfilment of the owners' objectives of biodiversity self-consumption rather than of public good provision. Biodiversity for the wider society would hence remain a by-product of the forest owner's utility maximisation choices (Amacher et al. 2003; Conway et al. 2003; Domínguez and Shannon 2011). This attitude is strengthened by bequest values and a vision of forests as legacy (Coté et al. 2015), as shown by the positive coefficients of our variable CHILD and by the time into ownership (OWN_TIME).

3.6.2. Soil conservation

In this case, owners were asked to state their willingness to deliver soil conservation services against erosion through specific forest management measures such as stricter continuous cover forestry practices, or through the reduction of harvesting rates on steeper slopes. The Italian territory is very fragile and subjected to high soil erosion risk, and forests are expected to play a strong role in soil protection, so the forest law, in force since 1923, defines mandatory restrictions on forest owners' management rights that are amongst the highest in

Europe (Nichiforel et al. 2018). Consequently, Italian forest owners are familiar with such issues.

However, the literature on willingness to provide soil conservation services is less rich in respect to that on biodiversity or carbon, indicating perhaps a scarcer interest towards this issue in other parts of Europe or the world.

Our findings confirm the hypothesis that the existence of landslides on the property (LANDSLIDE) positively drives the willingness to provide soil conservation service for both options, with or without payment. This result might be interpreted as a signal of the necessity to conserve the forest estate, so by reasons internal to the owner's utility function rather than by the explicit willingness to deliver a flow of services to society. This behaviour is strengthened by the perception that forest management already targets averting erosion (MANAGE_SERV), indicating that the forest owner is perhaps more at ease and prepared with the actions required by the provision of this service.

Analysing in detail the position of forest owners asking for payment in return for the ES, it appears that they own forests where conifers predominate over broadleaves (while there is a parallel negative sign for F_TYPE for the option of ES delivering without payment). Being located at higher altitudes, where slopes are steeper, conifer forests have stricter legal requirements in terms of soil protection, so any additional ES delivery must be facilitated by financial support. Different than in the biodiversity model, the forest owners willing to deliver only in return for a payment are more oriented towards self-consumption than the baseline (NO_SALES).

In regard to the level of education (EDUC), our results confirm those of the previous biodiversity model only for forest owners willing to provide ES without payment, who have a lower education level with respect to the baseline.

3.6.3. Carbon sequestration

In this case, the possibility of stocking more carbon in the forest was presented to the forest owner in exchange for a reduction of forest harvesting intensity. The results of this model show that owners willing to provide carbon sequestration services only if paid have a forest where conifers predominate (F_TYPE), while having conifers negatively affects willingness to provide the service without payment (F_TYPE). Moreover, those who ask for a payment perceive that they are already contributing in this regard through their forest management activity (MANAGE_SERV). Similarly, landowners who have owned the property for fewer years (OWN_TIME) are slightly more likely to engage in providing the service without payment; this result concurs with what was found by Rickenbach and Kittredge (2009), who claim that shorter durations of ownership positively affect management objectives other than

productive ones. Additionally, owners willing to provide the service without payment are generally older (AGE) than the unwilling ones; however, the impact of age on ES provision is a matter of controversy in the literature, with findings stating both its positive (Beach et al. 2005) and negative effects (Joshi and Arano 2009).

In comparison with the two previous models, this model has provided less statistically significant coefficients and therefore less satisfactory results: an explanation might be that the interviewees had difficulty in determining exactly the importance of the service and its implications, as forest owners in Italy have less familiarity with the idea of carbon sequestration, such service not being part of the traditional forest policy measures in the country.

3.7. The larger picture: conclusions and policy implications

The paper aspires to understand whether NIPFs in a southern European context would agree to deliver additional quantities of three types of ESs beyond the legal requirements and which factors affect such decisions. It posits that the diverse and multifaceted characteristics of southern European forest management models may add new insights on the reasons behind forest owners' choices, broadening the perspective on the factors affecting the provision of ESs and helping to support active forest management focused on NIPF owners.

Broadly speaking, while generally concurring with the results of the literature that NIPFs owners very often maximise utility and not profit, our findings seem to have identified few factors typical of the context analysed in this research. Primarily, NIPFs owners in alpine Veneto seem to have a rather clear perception of the social role of forests and of their contribution to it. The already high mandatory baseline imposed upon them does not seem to undermine their willingness to provide further ESs: the data presented in Table 3.1 show that with the two better-known ESs (biodiversity and soil conservation), only 28% of the sample on average would be unwilling to deliver additional quantities, while as much as 50% would improve the delivery of biodiversity even without payment. Different reasons can be given for this. First, all three of our models have clearly shown that the perception that the property is already delivering a certain quantity of the ES is crucial in encouraging forest owners to further engage in additional provision; this result might be explained with a perceived higher familiarity with the actions needed to provide the ESs. In other words, through decades of coping with the rules of forest management, forest owners have become acquainted with them and are more aware of their role and potentiality. This result is more evident with those ecosystem services that are more consolidated in the cultural environment of the Italian forest owners such as soil conservation and biodiversity improvement while less evident with 'new' ecosystem services such as carbon sequestration (where nearly 60% of the

interviewees declared their unwillingness to provide more quantity of the ES – see Table 3.1). Second, the willingness to deliver an ES is enhanced by being personally affected by problems in the property, as is the case when the owner has experienced landslides on his/her property; this scenario triggers action to minimise damages and avoid further losses, also through improving forest management practices. Third, in contrast with the literature, the 'willing' forest owners in our context are less educated than the 'unwilling' ones; however, it can be contended that the latter are probably more aware of the productive value of their forests and are more sensitive to markets. This different awareness can be viewed as also connected to the age of the forest owners, since forest owners in the higher age classes are less educated and give a lower economic value to their forest. However, our study is restricted to the effect of general education while falling short of addressing the role of forest-specific education, which Uliczka et al. (2004) suggest is a better predictor of the forest owner's willingness to deliver ESs.

Finally, to dissect the willingness to deliver ESs – whether in return for a payment or without payment – our results show that a forest management market orientation negatively influences the willingness to deliver the ES without payment. At the same time, where sentimental and bequest values prevail, forest owners are willing to deliver the ES even without compensation. This result is shared with other southern European literature, such as the results by Domínguez and Shannon (2011), who have shown that forest owners who have received the forest as a legacy in Spain perceive a moral norm to maintain and pass it on to future generations. This evidence responds to patterns of self-consumption of intangible values by the owner and their family.

For its implications in designing incentives or market-based mechanisms to support the provision of ESs and active multifunctional forest management in general, this last finding deserves further future research effort. However, it already provides some useful indications for policy design in the alpine context. As previously stated, NIPF owners are willing to provide additional ESs despite – or at least regardless of – an already high mandatory baseline. However, our results clearly show that there cannot be a one-size-fits-all policy measure. On the one hand, when forest owners are more motivated by sentimental and bequest values, economic incentives do not seem appropriate, while information and communication strategies are more suitable. These moral motivations are more frequently observed amongst consumption-oriented forest owners. On the other hand, production-oriented forest owners require public support covering the direct and indirect costs incurred when delivering additional ESs, in an approach similar to the agri-environmental measures available for farmers under rural development programmes; hence, the discriminating factor

for accessing payments for forest ES granted by public authorities could be represented by the productive orientation of the NIPF owner.

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3.8. References

Ajzen I, Fishbein M (2005) The Influence of Attitudes on Behavior. In: Albarracin D, Johnson BT, Zanna MP (eds) The handbook of attitudes. Lawrence Erlbaum Associates, Mahwah, pp 173–221

Amacher GS, Conway MC, Sullivan J (2003) Econometric analyses of nonindustrial forest landowners: Is there anything left to study? Journal of Forest Economics 164:137–164. doi: 10.1078/1104-6899-00028

Beach RH, Pattanayak SK, Yang JC, et al (2005) Econometric studies of non-industrial private forest management: A review and synthesis. Forest Policy and Economics 7:261–281. doi: 10.1016/S1389-9341(03)00065-0

Beedell J, Rehman T (2000) Using social-psychology models to understand farmers' conservation behaviour. Journal of Rural Studies 16:117–127. doi: 10.1016/S0743-0167(99)00043-1

Belin DL, Kittredge DB, Stevens TH, et al (2005) Assessing Private Forest Owner Attitudes Toward Ecosystem-Based Management. Journal of Forestry 103:28–35

Bengston DN, Asah ST, Butler BJ (2011) The Diverse Values and Motivations of Family Forest Owners in the United States: An Analysis of an Open-ended Question in the National Woodland Owner Survey. Small-scale Forestry 10:339–355. doi: 10.1007/s11842-010-9152-9

Bieling C (2004) Non-industrial private-forest owners: Possibilities for increasing adoption of close-to-nature forest management. European Journal of Forest Research 123:293–303. doi: 10.1007/s10342-004-0042-6

Bjärstig T, Kvastegård E (2016) Forest social values in a Swedish rural context: The private forest owners' perspective. Forest Policy and Economics 65:17–24. doi: 10.1016/j.forpol.2016.01.007

Blanco V, Brown C, Rounsevell M (2015) Characterising forest owners through their objectives, attributes and management strategies. European Journal of Forest Research 134:1027–1041. doi: 10.1007/s10342-015-0907-x

Boon TE, Broch SW, Meilby H (2010) How financial compensation changes forest owners' willingness to set aside productive forest areas for nature conservation in Denmark. Scandinavian Journal of Forest Research 25:564–573. doi: 10.1080/02827581.2010.512875

Boon TE, Meilby H, Thorsen BJ (2004) An Empirically Based Typology of Private Forest Owners in Denmark: Improving Communication Between Authorities and Owners. Scandinavian Journal of Forest Research 19:45–55. doi: 10.1080/14004080410034056

Brandl H (2007) The small-scale forestry group 1986–2006: an overview on the group activities during the last 20 years. Small-scale Forestry 6:1–18. doi: 10.1007/s11842-007-9004-4

Butler BJ, Tyrrell M, Feinberg G, et al (2007) Understanding and reaching family forest owners: Lessons from social marketing research. Journal of Forestry 105:348–357

Campos P, Oviedo JL, Caparrós A, et al (2009) Contingent Valuation of Woodland-Owner Private Amenities in Spain, Portugal, and California. Rangeland Ecology and Management 62:240–252.

Canadas MJ, Novais A (2014) Bringing local socioeconomic context to the analysis of forest owners' management. Land Use Policy 41:397–407. doi: 10.1016/j.landusepol.2014.06.017

Cocca G, Sturaro E, Gallo L, Ramanzin M (2012) Is the abandonment of traditional livestock farming systems the main driver of mountain landscape change in Alpine areas? Land Use Policy 29:878–886. doi: 10.1016/j.landusepol.2012.01.005

Conway MC, Amacher GS, Sullivan J, Wear D (2003) Decisions nonindustrial forest landowners make: an empirical examination. Journal of Forest Economics 9:181–203. doi: 10.1078/1104-6899-00034

Côté M-A, Gilbert D, Nadeau S (2015) Characterizing the profiles, motivations and behaviour of Quebec's forest owners. Forest Policy and Economics 59:83–90. doi: 10.1016/j.forpol.2015.06.004

Croitoru L (2007) How much are Mediterranean forests worth? Forest Policy and Economics 9:536–545. doi: 10.1016/j.forpol.2006.04.001

Defrancesco E, Gatto P, Runge F, Trestini S (2008) Factors affecting farmers'participation in agri-environmental measures: A northern Italian perspective. Journal of Agricultural Economics 59:114–131. doi: 10.1111/j.1477-9552.2007.00134.x

Domínguez G, Shannon M (2011) A wish, a fear and a complaint: understanding the (dis)engagement of forest owners in forest management. European Journal of Forest Research 130:435–450. doi: 10.1007/s10342-009-0332-0

Duesberg S, Upton V, O'Connor D, Dhubháin ÁN (2014) Factors influencing Irish farmers' afforestation intention. Forest Policy and Economics 39:13–20. doi: 10.1016/j.forpol.2013.11.004

Eggers J, Lämås T, Lind T, Öhman K (2014) Factors influencing the choice of management strategy among small-scale private forest owners in Sweden. Forests 5:1695–1716. doi: 10.3390/f5071695

Eurostat (2013) Agriculture, forestry and fishery statistics 2013. European Union, Luxembourg

FAO (2013) State of Mediterranean Forests 2013. FAO, Rome

Feliciano D, Bouriaud L, Brahic E, et al (2017) Understanding private forest owners' conceptualisation of forest management: Evidence from a survey in seven European countries. Journal of Rural Studies 54:162–176. doi: 10.1016/j.jrurstud.2017.06.016

Ficko A, Lidestav G, Ní Dhubháin Á, et al (2017) European private forest owner typologies: A review of methods and use. Forest Policy and Economics 0–1. doi: 10.1016/j.forpol.2017.09.010

Gasparini P (2014) I cambiamenti recenti della superficie forestale: presentazione dei risultati preliminari del terzo Inventario Forestale Nazionale (INFC2015)

Gatto P, Vidale E, Secco L, Pettenella D (2013) Exploring the willingness to pay for forest ecosystem services by residents of the Veneto Region. Bio-based and Applied Economics 3:21–43. doi: 10.13128/BAE-11151

Górriz-Mifsud E, Varela E, Piqué M, Prokofieva I (2016) Demand and supply of ecosystem services in a Mediterranean forest: Computing payment boundaries. Ecosystem Services 17:53–63. doi: 10.1016/j.ecoser.2015.11.006

Greene WH (2000) Econometric Analysis, 5th edn. Pearson Education, Upper Saddle River, New Jersey 07458

Hardie IW, Parks PJ (1996) Program Enrollment and Acreage Response to Reforestation Cost-Sharing Programs. Land Economics 72:248. doi: 10.2307/3146969

Harrison S, Herbohn J, Niskanen A (2002) Non-industrial, Smallholder, Small-scale and Family Forestry: What's in a Name? Small-scale Forest Economics, Management and Policy 1:1–11. doi: 10.1007/s11842-002-0001-3

Horne P (2006) Forest owners' acceptance of incentive based policy instruments in forest biodiversity conservation – A Choice Experiment based approach. Silva Fennica 40:169–178. doi: 10.1016/j.infsof.2008.09.005

Howley P (2013) Examining farm forest owners' forest management in Ireland: The role of economic, lifestyle and multifunctional ownership objectives. Journal of Environmental Management 123:105–112. doi: 10.1016/j.jenvman.2013.03.013

Ingemarson F, Lindhagen A, Eriksson L (2006) A typology of small-scale private forest owners in Sweden. Scandinavian Journal of Forest Research 21:249–259. doi: 10.1080/02827580600662256

ISTAT (2000) V Censimento dell'Agricoltura. ISTAT, Rome

Joshi S, Arano KG (2009) Determinants of private forest management decisions: A study on West Virginia NIPF landowners. Forest Policy and Economics 11:118–125. doi: 10.1016/j.forpol.2008.10.005

Kendra A, Hull RB (2005) Motivations and Behaviors of New Forest Owners in Virginia. Forest Science 51:142–154

Kline JD, Alig RJ, Johnson RL (2000) Fostering the production of nontimber services among forest owners with heterogeneous objectives. Forest Science 46:302–311

Lidestav G, Ekström M (2000) Introducing Gender in Studies on Management Behaviour Among Non-industrial Private Forest Owners. Scandinavian Journal of Forest Research 15:378–386

Lindhjem H, Mitani Y (2012) Forest owners' willingness to accept compensation for voluntary conservation: A contingent valuation approach. Journal of Forest Economics 18:290–302. doi: 10.1016/j.jfe.2012.06.004

Lindner M, Maroschek M, Netherer S, et al (2010) Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. Forest Ecology and Management 259:698–709. doi: 10.1016/j.foreco.2009.09.023

Lind-Riehl J, Jeltema S, Morrison M, et al (2015) Family legacies and community networks shape private forest management in the western Upper Peninsula of Michigan (USA). Land Use Policy 45:95–102. doi: 10.1016/j.landusepol.2015.01.005

Martínez-Jauregui M, Herruzo AC, Campos P, Soliño M (2016) Shedding light on the self-consumption value of recreational hunting in European Mediterranean forests. Forest Policy and Economics 69:83–89. doi: 10.1016/j.forpol.2016.05.002

Matta JR, Alavalapati JRR, Mercer DE (2009) Incentives for Biodiversity Conservation Beyond the Best Management Practices: Are Forestland Owners Interested? Land Economics 85:132–143. doi: 10.3368/le.85.1.132

Mettepenningen E, Vandermeulen V, Delaet K, et al (2013) Investigating the influence of the institutional organisation of agri-environmental schemes on scheme adoption. Land Use Policy 33:20–30. doi: 10.1016/j.landusepol.2012.12.004

Millennium Ecosystem Assessment (2005) Ecosystem and human well-being. Island Press, Washington, DC

Mozzato D, Gatto P, Defrancesco E, et al (2015) Foreste e servizi ecosistemici: un'analisi preliminare dei fattori che orientano le scelte gestionali nelle proprietà collettive e comunali del Veneto. In: Archivio Scialoja Bolla. Milano: Giuffrè, Trento, pp 173–190

Mudaca JD, Tsuchiya T, Yamada M, Onwona-Agyeman S (2015) Household participation in Payments for Ecosystem Services: A case study from Mozambique. Forest Policy and Economics 55:21–27. doi: 10.1016/j.forpol.2015.03.002

Ní Dhubháin Á, Cobanova R, Karppinen H, et al (2007) The Values and Objectives of Private Forest Owners and Their Influence on Forestry Behaviour: The Implications for Entrepreneurship. Small-scale Forestry 6:347–357. doi: 10.1007/s11842-007-9030-2

Nichiforel L, Keary K, Deuffic P, et al (2018) How private are Europe's private forests? A comparative property rights analysis. Land Use Policy 76:535–552. doi: 10.1016/j.landusepol.2018.02.034

Nordlund A, Westin K (2010) Forest Values and Forest Management Attitudes among Private Forest Owners in Sweden. Forests 2:30–50. doi: 10.3390/f2010030

Pettenella D, Romano R (2016) Le foreste delle aree interne: potenzialità di sviluppo dell'economia locale e di offerta di beni pubblici

Pettenella DM, Secco L (2006) Small-scale forestry in the Italian Alps: From mass market to territorial marketing

Petucco C, Abildtrup J, Stenger A (2015) Influences of nonindustrial private forest landowners' management priorities on the timber harvest decision - A case study in France. Journal of Forest Economics 21:152–166. doi: 10.1016/j.jfe.2015.07.001

Pulla P, Schuck A, Verkerk PJ, et al (2013) Mapping the distribution of forest ownership in Europe.

Regione Veneto (2009) Relazione illustrativa del Piano Territoriale Regionale di Coordinamento. Assessorato alle Politiche per il Territorio. Segreteria Regionale Ambiente e Territorio. Direzione Regionale Pianificazione Territoriale e Parchi. Unpublished internal document. Regione Veneto, Venezia

Regione Veneto (2013) Piano regionale delle attività di pianificazione e gestione forestale (Articolo 35 della Legge regionale 13 settembre 1978, n. 52, come modificato dalla Legge regionale 25 luglio 2008, n. 9). Unpublished internal document. Regione Veneto, Venezia

Rickenbach M, Kittredge DB (2009) Time and Distance: Comparing Motivations Among Forest Landowners in New England, USA. Small-scale Forestry 8:95–108. doi: 10.1007/s11842-008-9071-1

Rodríguez-Vicente V, Marey-Pérez MF (2009) Land-use and land-base patterns in non-industrial private forests: Factors affecting forest management in Northern Spain. Forest Policy and Economics 11:475–490. doi: 10.1016/j.forpol.2009.05.008

Rodríguez-Vicente V, Marey-Pérez MF (2010) Analysis of individual private forestry in northern Spain according to economic factors related to management. Journal of Forest Economics 16:269–295. doi: 10.1016/j.jfe.2010.06.001

Secco L, Pettenella D, Gatto P (2011) Forestry governance and collective learning process in Italy: Likelihood or utopia? Forest Policy and Economics 13:104–112. doi: 10.1016/j.forpol.2010.04.002

Serbruyns I, Luyssaert S (2006) Acceptance of sticks, carrots and sermons as policy instruments for directing private forest management. Forest Policy and Economics 9:285–296. doi: 10.1016/j.forpol.2005.06.012

Silver EJ, Leahy JE, Weiskittel AR, et al (2015) An Evidence-Based Review of Timber Harvesting Behavior among Private Woodland Owners. Journal of Forestry 113:490–499. doi: 10.5849/jof.14-089

Song N, Aguilar FX, Butler BJ (2014) Cost-share program participation and family forest owners' past and intended future management practices. Forest Policy and Economics 46:39–46. doi: 10.1016/j.forpol.2014.06.003

Sorice MG, Conner JR (2010) Predicting Private Landowner Intentions to Enroll in an Incentive Program to Protect Endangered Species. Human Dimensions of Wildlife 15:77–89. doi: 10.1080/10871200903551985

Sorice MG, Kreuter UP, Wilcox BP, Fox WE (2014) Changing landowners, changing ecosystem? Land-ownership motivations as drivers of land management practices. Journal of Environmental Management 133:144–152. doi: 10.1016/j.jenvman.2013.11.029

Thompson DW, Hansen EN (2012) Factors Affecting the Attitudes of Nonindustrial Private Forest Landowners Regarding Carbon Sequestration and Trading. Journal of Forestry 110:129–137. doi: 10.5849/jof.11-010

Uliczka H, Angelstam P, Jansson G, Bro A (2004) Non-industrial private forest owners' knowledge of and attitudes towards nature conservation. Scandinavian Journal of Forest Research 19:274–288. doi: 10.1080/02827580410029318

Urquhart J, Courtney P, Slee B (2010) Private ownership and public good provision in english woodlands. Small-scale Forestry 9:1–20. doi: 10.1007/s11842-009-9098-y

Urquhart J, Courtney P, Slee B (2012) Private woodland owners' perspectives on multifunctionality in English woodlands. Journal of Rural Studies 28:95–106. doi: 10.1016/j.jrurstud.2011.08.006

Vedel SE, Jacobsen JB, Thorsen BJ (2015) Forest owners' willingness to accept contracts for ecosystem service provision is sensitive to additionality. Ecological Economics 113:15–24. doi: 10.1016/j.ecolecon.2015.02.014

4. To leave or not to leave? Understanding determinants of farmers' choices to remain in or abandon agri-environmental schemes

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4.1. Abstract

Effectiveness of Agri-Environmental Schemes (AESs) as tools to enhance the rural environment can be achieved not only by increasing uptake rates, but also by avoiding participating farmers abandoning the scheme once they are in. For this reason, it is important to also consider what affects farmers' decisions to remain in the scheme rather than leave it at the end of the contractual obligation. However, up to now, there has been very little on this issue in the literature. The paper offers a contribution to this by revealing the role of determinants like the farmer's and farm structural characteristics, farmer's learning process, neighbourhood effect and the impact of changes in the policy design on the farmer's decision to remain in the scheme over a long time scale. This is examined in a long-standing scheme in the case study area, the Veneto Region of Italy. The paper uses duration analysis and is based on longitudinal panel-data of the entire population of 2000–2015 adopters. By using only data available in official regional records, it also provides regional policy-makers with an operational tool that is useful to analyse the impact of their AES design changes. The results of the duration models show that a larger farm size, a younger farmer age, the succession in the family farm, and the farmer's positive attitude towards the environment, trigger longer durations in AES. Similarly, the impact of the accumulation of the farmer's experience in the scheme management, as well as the neighbourhood effect increase the probability of remaining. Lastly, the changes in policy tailoring and targeting also have a positive impact on maintaining the farmer in the scheme. The paper concludes by noting that duration analysis can deliver useful results in order to guide policy-makers in the effort to steer higher levels of farmers' persistence in the scheme and provides some recommendations for a more mature agro-environmental policy design.

Keywords: AES; duration analysis; policy design; disadoption; agri-environmental programmes; longitudinal panel-data

4.2. Introduction

Over the last four decades, the importance of EU Agri-Environmental Schemes (AESs) as voluntary tools aimed to enhance the rural environment beyond legal requirements has greatly increased, in terms of both expenditure and participation (Riley, 2016). After a few voluntary initiatives by individual countries in the 1980s (Ducos et al., 2009), AESs gained momentum with the introduction of the first EU-wide Regulation 2078/92; since then, AESs have regularly been proposed to farmers in three consecutive EU Rural Development rounds. Prompted by the need to improve policy outcomes, research in the field of AES adoption has grown in parallel (Wilson and Hart, 2001) and a large body of literature now provides scientific evidence of the role of farm structural factors, farmers' characteristics, motivations and attitudes, and institutional elements as determinants of participation (see Mettepenningen et al., 2013; Reimer et al., 2014; Lastra-Bravo et al., 2015 for updated reviews).

In recent times, stimulated by a growing availability of participation data and emerging concern about AESs' effectiveness in the long-term, there has been a debate on the temporal dynamics of participation (Ingram et al., 2013). It has been argued that AESs sometimes need a long period to produce the desired environmental benefits, often beyond the ordinary contract duration (Swetnam et al., 2004). In addition, they may require relevant changes to farming practices, resulting in more complex and lengthy decision-making patterns (Gamon and Scofield, 1998; Jackson-Smith et al., 2010; Karali et al., 2014, Pedzisa et al., 2015). Once accomplished, adoption should hence be accompanied by steady behavioural changes (Reimer et al., 2014), while early withdrawals from the schemes may jeopardize or even nullify the AESs' long-term success (Wilson and Hart, 2001; Burton and Paragahawewa, 2011; Riley, 2016).

These arguments point out that there is a need to better understand the determinants of farmers' choices over a longer time scale than that of a single contract; they also indicate that looking at AES from a single perspective that considers only adoption determinants would not fully capture the impact of the policy design, hindering any understanding of the reasons why a farmer would decide to remain in the scheme, signing a new contract, or leave it when the opting-out opportunity is available at the end of the contract. Attentively considering the patterns of the decision to remain in a medium-long-term perspective would feed a policy design better oriented towards persistent sustainable environmental change (Morris, 2004). Yet, given the recent attention to AESs' time dynamics, and a persisting scarcity of longitudinal data at farm level (Moser and Barrett, 2006, Kallas et al., 2010), the research on farmers' choices regarding continuation or disadoption of AESs over long time periods is in an early stage and still poorly represented in the literature (Riley, 2016).

This paper aims to contribute to the nascent AESs' duration research by considering the role played by the time dimension on the farmers' decision process when he/she faces the option of remaining in the scheme by subscribing a contract again. More specifically, it intends to reveal the effects – over the 'remaining or leaving' option – of determinants such as some static farmer's and farm structural characteristics as well as time-varying aspects affecting the innovation diffusion patterns like the farmer's learning process linked to the duration and neighbourhood effect. The paper also addresses the effects of changes in the policy design, which have up to now been scarcely explored even in the adoption literature (Raggi et al., 2015).

We chose as case study the AES with the longest history in the agri-environmental policy of the Veneto Region [1], Italy: a scheme aimed at supporting planting and/or maintaining hedgerows and buffer strips on farmland; with some policy design changes, the scheme has been on-going in Veneto without interruption since the early 1990s. Analysing such AES gave us the opportunity not only to explore the effect of time on farmers' decisions in a long time perspective, but also to contribute to fill a gap in the literature as, to our knowledge, adoption and disadoption of schemes focused on planting and/or maintaining landscape and habitat elements as hedgerows or buffer strips have been scarcely explored so far.

Additionally, our work provides regional policy-makers with a relatively ready-to-implement tool, useful to analyse the impact of their AES design changes on the decisions of farmers to remain or leave, and to further improve the schemes accordingly. This is possible because only data obtained from official regional records on AES contracts have been used. As this information on participating farms is already possessed by the public authorities, no *ad hoc* costly and time-consuming sample-based data collection is required to perform the analysis.

The study is based on a longitudinal panel dataset of the entire regional population of adopters, i.e. those who have been in the AES for at least one contract period over a time span of sixteen years (2000–2015).

4.3. Related literature

Initial contributions to studying how AES adoption rates have evolved over time come from the agricultural innovation diffusion literature, which has cast light on the factors affecting the entry decision by early, medium and late adopters. Examples include studies of diffusion of organic agriculture (Padel, 2001; Läpple and Van Rensburg, 2011), as well as best management (Brown et al., 2016) and soil conservation practices (Varble et al., 2016). The

[1] The term 'region' is used here with a legal-administrative meaning, rather than a broad geographical one. The regional government in Italy has legal-political jurisdiction over the design of the Rural Development Programmes, hence over AESs.

joint effect of time, space and social capital variables has also been tackled by several studies, showing the effect of physical neighbourhood (Lewis et al., 2011; Chen et al., 2012), peer-to-peer learning (Woolcock and Narayan, 2000) and networks (Berger, 2001; Klerkx and Leeuwis, 2009; Moschitz et al., 2015; Taylor and Van Grieken, 2015) on adoption rates of different agricultural practices.

A series of researches address the issue of why farmers adopt or abandon a certain farming practice in different periods in relation to external changes. Marenya and Barrett (2007), for example, showed how financial factors, technological progress and perception of risk, delay the speed at which Kenyan farmers adopt or abandon soil fertility management practices, while Nyblom et al. (2003) highlighted the role of information in decreasing uncertainty when adopting innovation in Finland. Yet, the literature on the determinants of the remaining or leaving option over time seems hitherto to have mostly concentrated on a broad international focus, with researches addressing cover crops in northern Honduras (Neill and Lee, 2001), agricultural system shifts in western Nigeria (Kolawole et al., 2003), lower-input rice technology adoption and disadoption in Madagascar (Moser and Barrett, 2003), sustainable agricultural technologies in Brazil (De Souza Filho et al., 1999), introduction of technological inputs in Ethiopia (Dadi et al., 2004), no-tillage practices in Australia (D'Emden et al., 2006), or land use changes connected to deforestation in tropical America (Vance and Geoghegan, 2002), while it is still fragmented when it comes to Europe and AESs. Here, published research appears mostly concerned with organic production, specifically horticulture in the UK (Burton et al., 2003), vineyards in Spain (Kallas et al., 2010) and drystock in Ireland (Läpple, 2010). Rural Environment Protection Schemes (REPS) were studied by Hynes and Garvey (2009) and by Murphy et al. (2014), who explored how Irish farmers respond over time to improved scheme design. To our knowledge, very little is available specifically on landscape and habitat features such as hedgerows or buffer strips.

From a methodological perspective, most of the cited studies on adoption, continuation and disadoption dynamics (Marenya and Barrett, 2007; Neill and Lee, 2001; Kolawole et al., 2003; Moser and Barrett, 2003; Murphy et al., 2014) have relied on cross-sectional data and static models. For this reason, they fail to provide information on the temporal dynamics of the diffusion-abandon patterns among farmers (Moser and Barrett, 2006). Authors are generally conscious that the dynamics of innovation adoption 'rather than being an event, is best seen as a process, shaped by a multitude of changing factors and endowments' (Shields et al., 1993). However, the lack of adequate panel-data and the complexity of reconstructing the dataset from official archives at farm level (Marra et al., 2003) or through retrospective sample-based surveys recreating the participation history (Moser and Barrett, 2006), limit

the diffusion of analyses specifically focused on the temporal dynamics of farmer participation (Ingram et al., 2013).

Nonetheless, a few papers have recently highlighted the crucial contribution that duration analysis, long used in biomedical, engineering and social research, can offer. Being based on longitudinal panel-data, duration analysis is a powerful tool for exploring temporal adoption dynamics: thanks to the simultaneous use of cross-sectional and time-varying data, duration analysis allows continuation or disadoption choices to be fully explored from a dynamic perspective, as well as to consider the impact of external variables, for example changes in policy design, and to link them to the moment in which the decision to leave or remain is taken (Läpple, 2010). However, because of the high complexity of data required, there have been few applications of duration analysis so far in agricultural economics, which include the already quoted works by De Souza Filho et al. (1999), Dadi et al. (2004), D'Emden et al. (2006), Hynes and Garvey (2009), Moser and Barrett (2006), Burton et al. (2003), Kallas et al. (2010), and Läpple (2010).

4.4. Case study and policy context

More than half of Veneto, a region in the north-east of Italy, consists of the Po Valley, a large, fertile, intensively farmed area. This vast flat territory has a long colonisation history with many changes to its landscape over time. Until the first third of the 20th century, the typical Veneto Po Valley landscape was formed by farming plots completely surrounded by rows of trees. In the last eighty years, with the expansion of urbanisation, industrialisation and farm mechanisation, the green edges of farmed fields almost completely disappeared, making way for wider fields with no or very few hedgerows (Tempesta, 2010). The remnants of the old forests were cleared and replaced by urban sprawl (Vaz and Nijkamp, 2015). During the 1980s, eutrophication of the Venice lagoon due to high nutrient loads from the intensively-farmed area of the watershed, emerged as an urgent problem (Collavini et al., 2005), inducing the regional authorities to designate the Venice lagoon drainage basin as a priority target area for regulating non-point pollution (Marcomini, 2005).

When the regional authorities began to implement the EU agri-environmental policies in this scenario, attention was paid to improving landscape and ecological connectivity and mitigating the effects of the high nutrient loads in surface and ground waters in the intensively farmed areas. To this end, planting and maintaining hedgerows and (later) buffer strips was one of the earliest measures adopted. In order to reach the highest effectiveness, and considering that farmers looked at hedgerows and buffer strips as a burden for mechanisation of their farms and a receptacle of pests (INEA, 1999), a series of voluntary schemes has been offered to farmers since the early 1990s. Regional initiatives – Regional

Law no. 42/1997 (Regione Veneto, 1997) and *Piano Direttore 2000* for Venice drainage basin (Regione Veneto, 2000) – followed the EU programmes and mimicked their design, providing additional funds to increase farmers' participation in specific target areas.

Before the turn of the millennium, EEC Regulation 2078/92 and the connected regional schemes granted five-year contracts and aid only for pro-actively maintaining existing hedgerows. The whole regional farming area was eligible for participation. The policy was designed according to a geographical criterion that assigned the highest payment tier to farms in flat areas and environmentally-sensitive zones (parks and Venice lagoon drainage basin), medium to farms in hilly areas, and the lowest to farms in mountain areas (Table 4.1). A minimum of 5% and maximum of 10% of the Utilized Agricultural Area (UAA) was allowed per farm under the scheme, the latter to avoid excessive extensification. Initially, the scheme struggled to take off, but applications later grew and doubled in number in 1997, finally registering an overall uptake of 857 ha on 1876 farms, mostly in the lowlands (INEA, 1999).

Table 4.1. Payments granted for hedgerow and buffer strip planting and maintenance under different AES policy designs in the Veneto Region 1994–2015

	Payments - € per m² per year				
	(a) Maintaining existing hedgerows	(b) Planting new hedgerows or buffer strips	(c) Maintaining hedgerows or buffer strips	(d) Maintaining hedgerows or buffer strips from participation in previous AESs	(e) Grass strip
Before 2000	0.10-0.20(**)				
2000-2006		1.50(***)	0.50	0.50	0.13
2007-2014		5.45 until 2010 7.57 from 2011	0.80 until 2010 1.16 from 2011	1.29 until 2010 1.71 from 2011	included in (c) or (d)
2015-2020(*)		8.37	2.42 (****)	2.42 (****)	included in (c) or (d)

(*) At the time of our analysis only one (d)-type call has been published by regional authorities

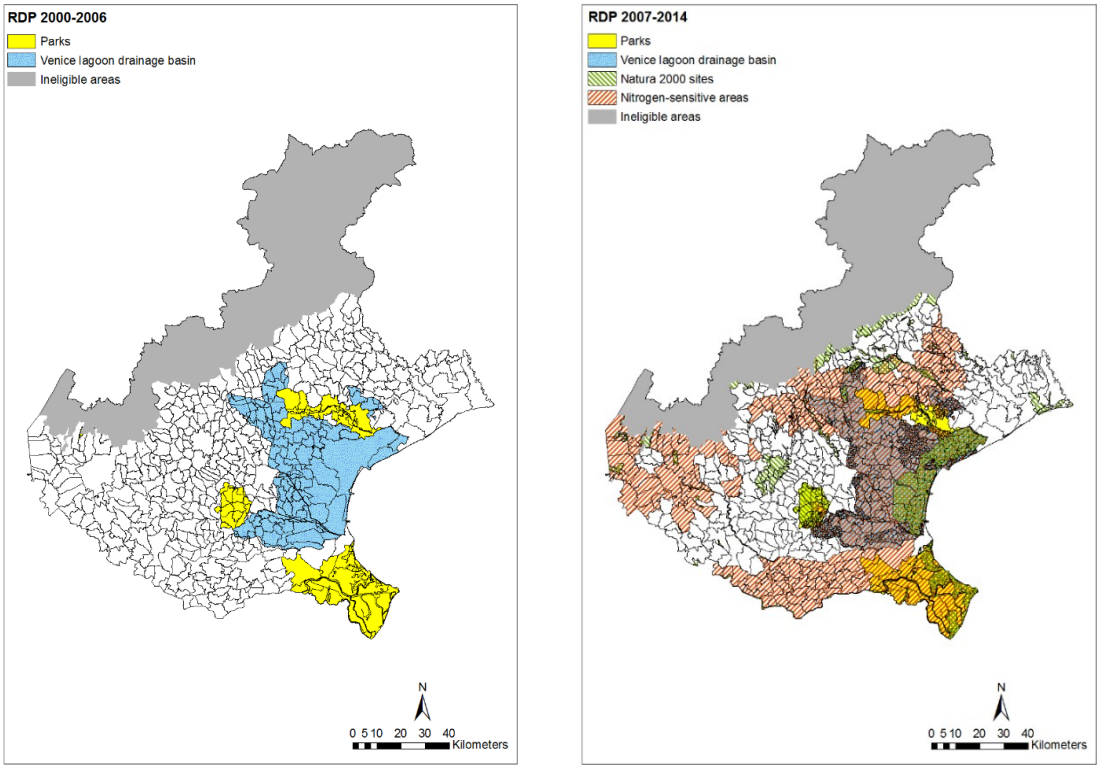
(**) According to geographical location

(***) 5-years flat average payment per year, including planting and maintenance costs

(****) Valid only if the farmer does not fulfil Ecological Focus Areas (EFA) commitments through hedgerows and buffer strips, otherwise payments are substantially lower

In the new millennium, the policy design changed radically after the inclusion of AESs within the framework of the Rural Development Programmes (RDPs). In terms of targeting, farms in mountain areas were no longer eligible, while geographically-differentiated payment tiers were replaced by a system of area-based scores, assigning the highest priority scores to farms located in environmentally-sensitive target areas (Figure 4.1).

Figure 4.1. Target areas for RDP 2000-2006 and RDP 2007-2014 (the target areas do not change in RDP 2015-2020)



Regarding adoption of multiple measures, while in Regulation 2078/92 higher premiums were offered to farmers combining integrated pest management and organic agriculture with hedgerows, in the 2000–2006 RDP these were no more offered. Only few extra ranking points (2/19) were given to farmers who combined participation to more than one AES in the same farm. In the most recent RDPs, i.e. 2007–2014 and the current one, this type of incentive was cancelled. In any case, participation to multiple measures did not occurred very often in the region: for example, in the period 2000–2006, hedgerows were combined with integrated agriculture only in 6,4% of cases and with organic agriculture only in 3,2%.

Tailoring efforts were also made to align the policy design to the situation on the ground, to increase the attractiveness of the scheme to farmers:

- besides maintaining existing hedgerows, support was extended to include the planting of new hedgerows or buffer strips
- a requirement for an additional grass strip to be kept free of cultivation, so to reduce the disturbance on the hedgerow or buffer strip habitat, was introduced. This area was compensated with a payment and facilitated also the mechanical crop management by the farmer. The minimum required width of this grass strip was gradually increased over time

- the upper threshold of farm UAA under contract was increased to 20% for buffer strips, while it remained at 10% for hedgerows
- the pre-existing minimum of 5% of UAA, discouraging participation, was replaced by 0.25 ha until 2008, then reduced to 0.125 ha in 2009.

Payments were also simplified and reshaped (Table 4.1). The most important changes introduced since 2007 have been:

- all costs incurred by farmers participating in the scheme were refunded, based on an average estimate of planting and management costs, of gross-margin lost due to the UAA reduction and of transaction costs
- a progressive increase of payments was introduced in order to take into account i) the impact on opportunity costs of participating connected to the CAP first-pillar area payments gradual decoupling and the dynamics of crop prices and ii) the higher average costs (with respect to the cost estimates used in the RDP 2000–2006) incurred by smaller farms when compared to larger farms
- the payments schedule was better matched to farmers' expenditure-flows over time by passing from a flat average payment over five years to a differentiated payment for planting (*una tantum*) followed by five years for maintenance
- a simplification of both payment structure and its management was introduced, as the payments for the grass strip area – initially managed independently – were unified with the connected hedgerow or buffer strip area
- an incentive to remain in the AES was set up, through an annual payment given to farmers who subscribe a renewal contract higher than that given to new AES adopters.

In return for payments, farmers who subscribed a contract had to actively maintain the functionality of the hedgerows or buffer strips by committing to various maintenance operations including pruning, keeping crown density, controlling undesirable species, replacing dead trees with native species only, and maintaining the grass strip in order to keep the ecological functionality of such complex ecosystems (Sitzia et al., 2013).

The efforts to stimulate participation, and especially to include small farmers, resulted in a successful increase of both area under contract and number of participants: cross-section data of uptake report 1,500 ha on 2026 farms in 2005 (Agriconsulting, 2008), 2,944 ha on 3051 farms in 2012 (Agriconsulting, 2012) and 3,168 ha on 3992 farms in 2015. 98% of the area under contract is localised in the lowlands, where pre-existing hedgerows had almost completely disappeared as a consequence of diffusion of intensive and highly-specialised agricultural systems (Agriconsulting, 2008).

4.5. Model and data

When the AES contract expires at the end of its duration, a farmer has the option of remaining in the scheme by subscribing a renewal contract, or to leave it. Our focus is on this decision, i.e. we want to model the remaining behaviour of a farmer who already was in the AES, while we are not interested in the adoption behaviour of new participants in the scheme. Normally, farmers face this choice every five years, at the end of the regular contract duration; however, longer durations are also observed, when the regional authorities give the opportunity to farmers to extend contracts until the end of the RDP programming period. The contract conditions may remain the same or become more

favourable as pointed out in the previous section. The 'remaining' behaviour can be modelled under a duration analysis approach.

Given this focus, our risk set – the 'population at risk' – is made by all farmers who are under an AES contract in the analysed period (2000–2015) at least for a given spell. This implies that, differently than the consuetudinary duration analysis approach, where the focus is on the event-occurrence – that, in our case, would be represented by not renewing the contract – we modelled the opposite perspective, i.e. the non-occurrence, that is the 'remaining' option. In bio-medical, engineering and social science research, where it has been widely used for decades, duration analysis is usually referred to as survival analysis (Vance and Geoghegan, 2002). Thanks to pioneering work by Lancaster (1979), the method was later introduced in the economic literature and used first to address unemployment duration. The literature proposes a wide range of duration models, ranging from continuous-time parametric (e.g. exponential, Weibull, lognormal, log-logistic distributions) and semi-parametric (e.g. Cox regression) models to discrete-time hazard models (Singer and Willett, 2003). The choice of a continuous or a discrete-time approach largely depends on the continuous or discrete survival time of the process being analysed (DeMaris, 2004; Allison, 2014).

We adopted a discrete-time duration model, dropping the continuous-time approaches for two main reasons: i) the time at which a farmer is first exposed to the risk, i.e. he/she signs an AES contract, is intrinsically discrete, as calls for contract subscription are not issued every year in a given RDP, but depend on policy-makers decisions[2]; ii) even more importantly, the decision to leave shows relevant 'ties' to the duration, as this option is most frequently taken after the five-year regular contract duration (or multiples of it); longer duration ties are also observed. When there are several tied-duration times in the data, as in our case, the continuous-time approach becomes unreliable (Cox and Oakes, 1984; Yamaguchi, 1991).

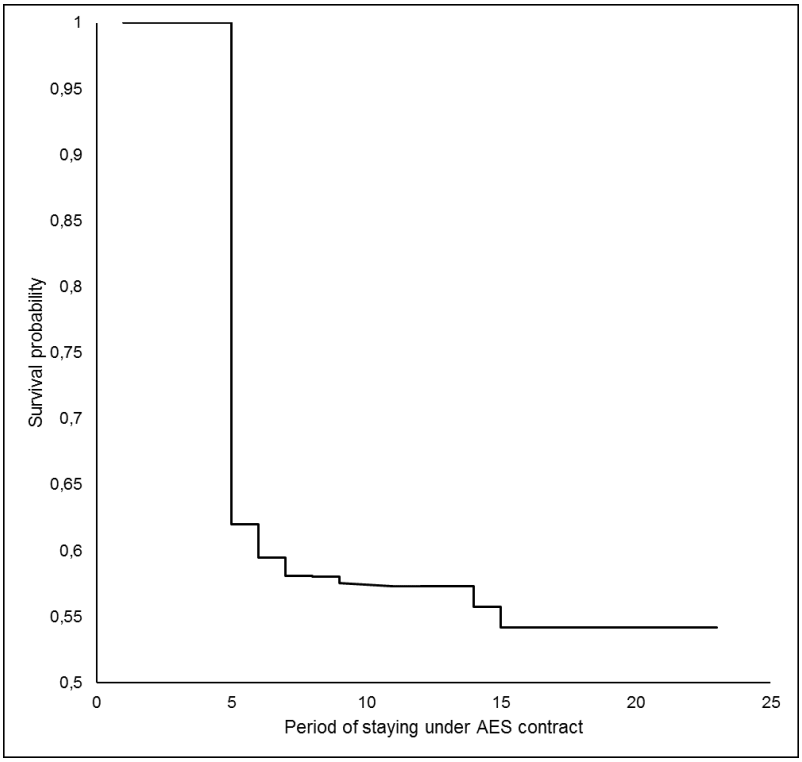
[2] The Veneto Region issued two calls at the beginning of the period for RDP 2000-2006, yearly calls for RDP 2007-2014, and – up to the time of our analysis – one call in 2015 for RDP 2015-2020.

We created a yearly farm-level panel dataset of the entire population of AES participants over a time span of sixteen years by linking together the cross-section official datasets of every AES call during the period. When tracking the Land Register unit code of the land units under contract, two different cases occurred: i) in most cases, the land units did not undergo an ownership change: in this case, the records referring to the same farm over time were joint by means of the farm's fiscal code; ii) conversely, in some other situations, there was a change of ownership or tenure; in these cases, we considered the contract as continuing by a new farmer and not as a new entry. In other words, we followed the history of the land unit remaining or leaving in the AES also in case of change of ownership of the land unit itself. Overall, 5311 farms (4.7% of farms in the eligible areas of the Veneto Region according to the 2010 Census) were under AES contract in the study period, at least for a limited spell; no repeated events were observed – i.e. farmers leaving the AES at a given time in the study period and signing a new contract later.

A crucial aspect to be considered in duration analysis is the censoring problem (Allison, 2014). In our dataset, only right-censoring occurs when a farmer never abandoned the contract during the analysis period; consequently, censored data are observed only in 2015, when a farmer renewed the contract under the first RDP 2015–2020 call. The issue of left-truncation – i.e. the farmer's entry in the risk set prior to the start of the study period – was easily addressed as our dataset reported the farmer's time of first signing under the pre-existing schemes (Reg. 2078/92 or regional initiatives, 4% of farmers in the panel dataset): the number of years under ante-2000 contracts have been incorporated into the individual farmer's AES duration at each time *t* (Singer and Willett, 2003).

Under the discrete approach, the farm-based panel dataset has to be restructured into a farm-year dataset, i.e. a dataset where a separate observational record is created for each year *t* in which the i^{th} farmer is at risk of remaining or leaving the AES (Singer and Willett, 2003). However, the first five-year contract period is mandatory for the farmer, so it is uninformative for our research purpose, being linked to the adoption decision, not to the remain or leave one: therefore, by analogy with Moser and Barrett (2006), we dropped the first five records associated to the first contract signed by the i^{th} farmer in the study period from the farm-period dataset, while the remaining or leaving information from the 6^{th} year is retained. Accordingly, 2922 farms of the initial farm-based panel dataset led to 10745 observations in the farm-year dataset. 42,5% of farmers in the farm-based panel dataset, 11.6% in the farm-year dataset, left the AES during the study period; the median period of staying under the AES contract is 6 years, while the observed maximum is 23 years. Figure 4.2 reports the Kaplan-Meier estimated survival function.

Figure 4.2. Kaplan-Meier estimated survival function



Under a discrete-time approach, the discrete time hazard P_{it} defines the conditional probability that the i^{th} individual faces the target event at the particular time *t,* given that no event occurred to him/her before time *t,* i.e. he/she is in the risk set at that time:

$$P_{it} = P(T_i = t \mid T_i \geq t)$$

where T_i is a discrete time variable that denotes event occurrence for the i^{th} individual. All records in the farm-year dataset are conditionally independent (Singer and Willett, 2003).
The model used most for truly discrete-time hazard is the logit model (Allison, 2014), which explains the log-odds of the event occurrence at time *t* as:

$$\ln \frac{P_{it}}{1 - P_{it}} = \alpha(t) + \mathbf{x}^{\boldsymbol{i'}} \boldsymbol{\beta}$$

where $\alpha(t)$ explains how the log-odds of the event depends on time, while $\mathbf{x}^i$ takes into account the effects of both time-invariant and time-variant predictors.
As we preferred to model event non-occurrence, i.e. the remaining event, rather than the leaving event, in order to more easily analyse the effect of predictors on the remaining option,

the observed dichotomous variable T_i defining the target event occurrence for the i^{th} farmer at each time *t* was set at 1 for remaining and 0 for leaving.

Given the scarcity of duration literature, the independent variables we included in the model were selected according mostly to AES adoption literature. The latter considers that, in line with the theory of reasoned action and planned behaviour (Ajzen and Fishbein, 2005), the behavioural intentions of farmers are directly related to a wide range of background factors: individual factors, including farm and farmer's factors, social factors and informational factors (Mettepenningen et al., 2013). Amongst individual factors, the farm size usually shows a positive impact on AES adoption, with larger farms being more frequent adopters (Wilson and Hart, 2000) or remainers (Läpple, 2010; Hynes and Garvey, 2009); the farmer's age, conversely, generally negatively affects the probability of staying in the scheme (Hynes and Garvey, 2009; Kallas et al., 2010). Social factors like the neighbourhood effect, that is the imitation of neighbour farmer, have also been found playing a positive role into the decision to remain (Moser and Barrett, 2006). Amongst the informational factors, the accumulation of experience by the farmer in the specific AES, that grows with time, has a positive effect on the probability to remain (Hynes and Garvey, 2009; Moser and Barrett, 2006). Nyblom et al. (2003) and Kallas et al. (2010) have shown that fine-tuning of policy design, acting through targeting and tailoring, also affects positively the adoption choices; however, Raggi et al. (2015) have pointed out that these factors are still understudied. In our model, $\alpha(t)$ is a linear and quadratic function of *N_Years,* a time-varying variable describing how many years (including ante-2000 programmes, i.e. Reg. 2078/92 or regional initiatives) the farmer stayed in the risk group (i.e. remained in the AES) until time *t*. In order to facilitate the interpretation of the time effect, *N_Years* was rescaled by subtracting the median of duration as centring constant (Singer and Willett, 2003). In line with referential adoption and disadoption literature (e.g. Hynes and Garvey, 2009; Moser and Barrett, 2006) the accumulation of experience by the farmer in the specific AES is explained by the 'time' variable *N_Years* and we hypothesize that the longer the duration of participation until time *t*, the greater the learning by doing by the farmer: hence the expected sign of this time-increasing effect is positive.

Despite the limited information available for each farm in the official regional records on AES uptake, we were able to include in the model a number of predictors which are consistent with the above-mentioned theoretical approach.

The following covariates capture the changes in AES policy design over time:

- two dummy covariates, treated as time-invariant, defining the AES policy design under which the farmer signs the first contract – *Design07_10* and *Design11_14*, where *Design00_06* is the baseline. Given the increased tailoring efforts to align the policy design

to the situation on the ground and the reshaped and increased payments, we expect that AES adoption under more recent schemes positively influences the log-odds ratio

- a dichotomous variable *Area* that equals 1 if the farmer is located in the target areas when he/she signed the contract (Figure 4.1) and 0 otherwise. The expected sign of this covariate is positive, given the priority scores assigned to target areas.

The background factors are:

- a time-varying variable for farm size (farm UAA in hectares) *F_UAA*
- a dummy variable *AES_Increase* that equals 1 when the farmer has increased the area under AES contract during his/her spell, and 0 otherwise
- a dummy variable *Thickets* that equals 1 if the farmer has also planted or maintained thickets in the spell, and 0 otherwise. In our model, this variable acts as a proxy for the farmer's positive attitude towards environmental protection. Indeed, the role played by farmers' personal motivations and attitudes towards environmental protection on the decision to remain in the AES cannot be explored directly, being constrained by information availability in the official regional database we used. However, other objective and measurable factors may act as proxies for positive environmental attitudes. Defrancesco et al. (2008), for example, used past environment-friendly practices adoption
- a categorical variable *Age_Class* that identifies the age class of the farmer (less than 40; 41–65; and over 65 years) at the time of signing the first AES contract in the case of sole proprietorship, while other business types are considered together[3]. The over 65 age class is the baseline
- a categorical variable *Ch_Owner* that equals 1 in case of ownership or tenure changes during the study period, 0 otherwise. Given the regional farm structure, mostly based on family farms, these changes imply that, in most cases, younger family members take over the farm management[4]
- lastly, a time-varying lagged variable *LAG_Farms%* expressing the percentage of farms under AES at time *t-1* located in the same municipality as the i^{th} individual. Given the unavailability of farm geolocalisation in our dataset, we assume this variable as a proxy for the spatial neighbourhood effect on the decision to remain at each time *t*, in line with e.g. Moser and Barrett (2006). We expect that this spillover effect is positive in the specific

[3] The farm fiscal code provides information on farmer's age only for the sole proprietorship type of business.

[4] This interpretation may appear strained; however it is justified by looking at the farm structure of the region, where according to 2010 Agricultural Census, 93,2% of farms are sole proprietorship family farms. In our dataset, amongst the 9.1% of farms that have changed ownership, 73% have passed from a sole proprietorship to another individual owner; among them, 89.2% passed the farm to a younger owner: in this case, the mean age decrease is 24.4 years, that is approximately a generation

context of our analysis, where hedgerows had nearly completely disappeared and farmers were reluctant to introduce and manage them according to the demanding scheme requirements.

Table 4.2 reports some descriptive statistics of the predictors included in the models.

Table 4.2. Descriptive statistics of the predictors included in the model (n = 2922 farms)

Variables			**Statistic**	**Value**
Number of years under contract (*N_Years*)			Median	6
Farmers participating in the AES for the first time by RDP rounds	RDP 2000–2006 or ante 2000 (*Design00_06)*		%	63.4
	RDP 2007–2014 until 2010 (*Design07_10* = 1)		%	29.0
	RDP 2007–2014 from 2011 (*Design11_14* = 1)		%	7.6
Farms under AES located in target areas in selected years *(Area* = 1)	2000		%	50.9
	2006		%	56.0
	2014		%	90.0
Farm Utilised Agricultural Area (hectares) *(F_UAA)*			Mean[a]	19.68 (221.16)
Farmers increasing the AES area in their spell (*AES_Increase)*	Yes = 1		%	13.8
Farmers who planted or maintained thickets (*Thickets*)	Yes = 1		%	10.5
Farms by type of business and farmer's age class (for sole proprietorship farms only) (*Age_Class*)	Other types of business (=1)		%	8.4
	Sole proprietorship	≤40 years (=2)	%	13.7
		41–65 years (=3)	%	51.2
		>65 years (=4)	%	26.7
Ownership or tenure changes in the study period (*Ch_Owner*)	Yes = 1		%	9.1
Mean% of farms in each Municipality under AES contract (*LAG_Farms%),* selected years	2000		Mean[a]	0.08 (0.26)
	2006		Mean[a]	0.51 (0.81)
	2014		Mean[a]	2.67 (3.33)

[a] Standard deviation in parentheses.

4.6. Results and discussion

Table 4.3 presents the coefficient estimates and associated standard errors of the discrete-time duration models of remaining in the AES.

Table 4.3. Duration models estimates for AES decision to remain.

	Model 1		**Model 2**	
Variable	β (S.E.)	Odds-ratio	β (S.E.)	Odds-ratio
N_Years	1.923 (0.068) ***	6.839	1.833 (0.070) ***	6.251
N_Years_squared	- 0.132 (0.006) ***	0.877	- 0.126 (0.006) ***	0.882
Design07_10	2.829 (0.143) ***	16.930	3.208 (0.152) ***	24.739
Design11_14	2.500 (0.238) ***	12.178	2.925 (0.247) ***	18.643
Area	0.262 (0.080) ***	1.300	0.433 (0.092) ***	1.542
F_UAA			0.003 (0.001) **	1.003
AES_Increase			1.432 (0.125) ***	4.186
Thickets			0.683 (0.139) ***	1.979
Age_Class: >65 years				
Age_Class: Other business type			0.399 (0.180) **	1.490
Age_Class ≤ 40 years			0.715 (0.135) ***	2.045
Age_Class 41-65 years			0.549 (0.104) ***	1.732
Ch_Owner			3.905 (0.456) ***	49.665
LAG_Farms%			0.033 (0.011) ***	1.033
Constant	- 0.236 (0.064) ***	0.790	- 1.501 (0.126) ***	0.223
Log L	-2183.0		-1877.4	
Cox e Snell pseudo R^2	0.266		0.307	
Nagelkerke pseudo R^2	0.521		0.600	
% of correctly classified cases	90.3		93.7	
Farm-year observations	10745		10745	
Number of farms	2922		2922	

*** p<0.01; ** p<0.05; * p<0.1.

Model 1 includes only the predictors expressing changes of the policy design and the area-targeting focus in the study period, and the effect of time, i.e. the number of years each farmer remains in the AES: all the estimated coefficients differ significantly from zero.

Results confirm that the policy design is an important determinant of farmers' choices, as already highlighted by Nyblom et al. (2003) and Kallas et al. (2010) for organic farming adoption and by Raggi et al. (2015) for some agri-environmental measures with specific reference to the policy targeting. Our model estimates show that the growing effort of the regional administration to tailor the policy design to the situation on the ground, the adjusting of payments, as well as the financial incentive to remain in the scheme (Table 4.1), positively affect the remaining odds-ratio. *Ceteris paribus*, when a farmer enters the AES under the RDP *Design07_10*, his/her remaining odds-ratio is nearly seventeen-fold higher than under the *Design00_06* baseline. The effect of the adjustment of AES payments in the 2011–2014 period (*Design11_14*) is still positive but lower than the impact of the most comprehensive RDP 2007–2010 policy review, which took into account the CAP Fishler reform decoupling the area payments. Similarly, the policy targeting, assigning priorities to farms in target areas (*Area*), has resulted in a positive impact on the remaining odds-ratio, all else being equal. There is consistency between our results and the findings of Murphy et al. (2014) for Irish

REPS, where higher payment rates and institutional changes leading to a decrease in farmers' participation opportunity costs over time, increased their participation in more recent REPS. In the estimated model, the time dependency of the log-odds is captured by a quadratic function. The signs of the linear and quadratic terms of *N_Years* show that the impact on the remaining log-odds ratio increases as the number of years under contract until time *t* increases for the average farmer, but the differential in logit hazard per year declines over time, the log-odds function being concave to the time axis. In line with the results obtained by Hynes and Garvey (2009) for the Irish REPS, by Läpple (2010) for organic farming and by Moser and Barrett (2006) for rice production practices in Madagascar, our findings confirm the relevant role played by time dynamics in the farmers' decision-making process. In our case, and consistently with the literature, the positive impact of time-dependence of the decision to remain in a given year is explained by the farmer slowly building up experience in actively managing hedgerows and buffer strips according to the scheme requirements. Moreover, it should be emphasized that the effect of the farmer's skills accumulation process can be captured solely by duration models, and not by conventional cross-section analysis (Burton et al., 2003; Moser and Barrett, 2006).

In the second specification of the model we included also the time-varying and time-invariant covariates expressing the influence on the remaining log-odds ratio of the farm and farmer's specific variables, as well as the time-varying lagged variable we considered as a proxy for the spatial neighbourhood effect.

The positive farm size (*F_UAA*) impact on log-odds is due to the fact that the larger the farm is at a given time *t*, the lower the impact of planting hedgerows along field edges on the overall farm income. Läpple (2010) and Hynes and Garvey (2009) had similar results when analysing other agri-environmental measures.

As expected, an increase in the area under AES (*AES_Increase*) during the spell positively influences the choice not to leave the scheme, being the result of a farmer's good evaluation of the impact of the measure after having experimented it on his/her farm.

In the case of sole proprietorship farms, a negative effect of farmer age (*Age_Class*) on the remaining odds-ratio is observed, e.g. the remaining odds-ratio of farmers younger than 41 years is about twice that of farmers aged over 65. This is in line with the duration analysis literature, where age is negatively related to the probability of staying in the scheme (Hynes and Garvey, 2009 for REPS; Kallas et al., 2010 for conversion to organic farming). However, both Moser and Barrett (2006) and Läpple (2010) found that the age effect is generally not significant.

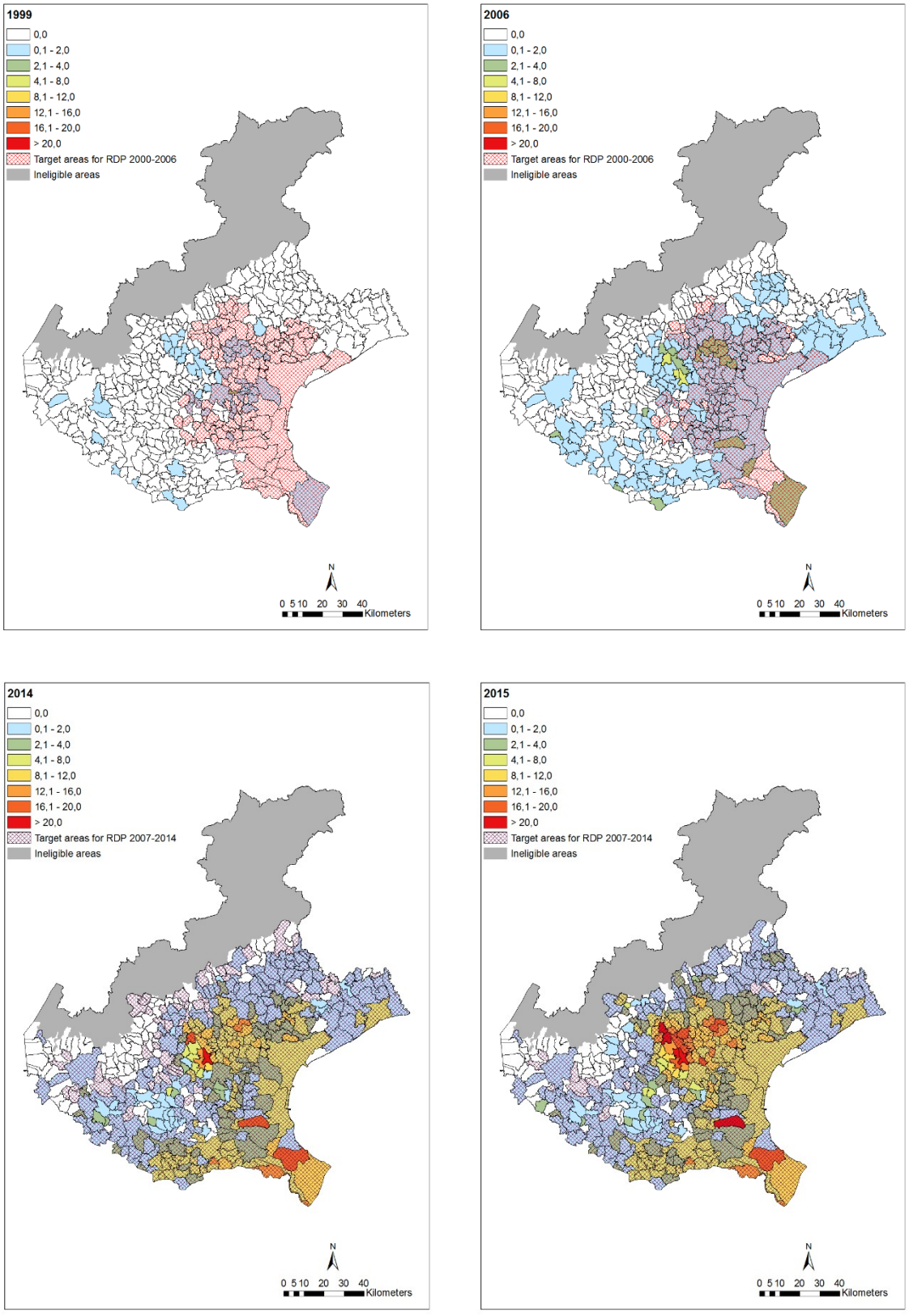
According to the interpretation we gave to the *Ch_Owner* variable, *ceteris paribus,* when one younger family member takes over the farm management, the remaining odds-ratio at time *t*

increases. In our view, this result is connected to an age-reduction effect during the spell, which positively impacts on the risk of remaining. This may be seen as a result of already-shared farm development pathways within the family, including the contractual obligations that are bound to the land. To the best of our knowledge, this effect has not yet been explored under a duration analysis framework. In the AES uptake literature – based on cross-sectional data – where this aspect is however mostly considered in terms of farmer's succession planning and not on actual taking over, negative or no significant effects are reported (Lastra-Bravo et al., 2015).

The personal motivations and attitudes towards environmental protection, expressed by the proxy *Thickets,* positively affect the decision to remain at time *t*, nearly doubling the odds-ratio, all else being equal. A similar effect, based on primary motivational and attitudinal data, was also found by Burton et al. (2003) and by Läpple (2010) for organic farming adoption.

Besides the above-mentioned 'learning by doing', 'learning from other farmers'– the neighbourhood effect – may also influence both the participation decision and, once a farmer is in the AES, the conditional probability of remaining at year *t* (Hynes and Garvey, 2009). In the literature, this effect is reported as explaining several factors affecting the spatial innovation diffusion patterns: learning from other farmers, receiving communications, interactions, sharing experiences and imitation amongst neighbours (Raggi et al., 2015; Burton et al., 2003; Läpple and Kelley, 2014) help to lower the uncertainty of the impact of AES implementation on the farm management (Lewis et al., 2011) and the pressure to comply with social norms (Moser and Barrett, 2006; Chen et al., 2012). In our model, the neighbourhood effect at time *t* on the remaining log odds-ratio, expressed by the percentage of AES participants in the same municipality as the farm in the previous year (*LAG_Farms%)*, is statistically significant and remarkable: a 1% increase in *LAG_Farms%* increases the remaining odds-ratio by 3.3%. With our longitudinal perspective, this positive spillover effect is observed not only for farmers in the target areas, where it was expected and already shown by Raggi et al. (2015), but also outside them (Figure 4.3). This highlights that the neighbourhood effect plays a significant role in AES persistence over time independently of the geographical targeting of the policy design. More generally, our results are consistent with those of Moser and Barrett (2006) for disadoption of some rice production practices and Lewis et al. (2011) for organic dairy farming.

Figure 4.3. Percentage of farms under AES in the same municipality, study area, selected years*



*The 2015 call new-entries are also reported in Figure 4.3, although not considered in our analysis.

4.7. Conclusions

Our work primarily aimed at estimating the impact of determinants on the conditional probability that a farmer remains one more year under the contract, after the five-year mandatory period, given that he/she was previously participating in the AES. In particular, we scrutinized the role played by farmer's and farm specific characteristics, farmer's learning process over time, neighbourhood effect and changes in policy design made by the regional authorities. To this end, we have fully taken into account the time dimension and the impact of time-varying factors, under a discrete-time duration analysis approach. By focusing our attention on the remaining rather than on the adoption perspective, we have enriched a still limited body of literature and offered an original contribution to a theme deserving more attention, given the stage of maturity AES are now reaching after more than two decades.

Our results have shown that a larger farm size amongst structural factors, a younger farmer as well as farm succession, with a new generation taking the lead, are all factors that positively affect the decision to remain. Similarly, the farmer's positive attitude towards the environment triggers longer durations in AES.

The effect of time emerged clearly in both models we estimated. The accumulation of experience, growing with the number of years under the AES contract, positively affects the remaining decision of the average farmer[5]: this result, not enough stressed by the literature, has been made available thanks to the duration approach. Specifically, for our case study area we found that the impact of the build-up of the farmer's experience on the decision to remain, although with decreasing rates, has a long persistence over time. The neighbourhood effect is also crucial for increasing the probability of remaining in the scheme one year more. This effect occurs in a dynamic perspective, regardless of policy targeting in specific areas. Lastly, the changes in policy tailoring and targeting made over time have a positive impact on the remaining in AES, contributing to reintroduce landscape and habitat features which had disappeared in the regional lowlands.

Our results are based on the entire population of AES participants and rely only on secondary data already available from public authorities. This is a strength of our work, as it allows to directly estimate the impact of AES design changes on farmers' decisions to remain or leave in a time-dynamic perspective without time-consuming and costly direct surveys. However, because of the fewer information available on each participant, our work is affected by a main limitation, i.e. the effect of individual (farmer's and farm) motivations and social factors is not so widely explored in comparison to analyses based on primary data. Caution should be

[5] The effect of time is explained as a self-learning effect by the scarce duration literature. However, we agree with a reviewer that this interpretation has to be empirically supported through farmers' surveys: we plan to better explore this issue through a questionnaire-based sample-survey.

exercised when extending our results to other regions sharing with Veneto a similar farming structure. In our case-study context, the interplay amongst the considered AES and the others could be neglected, because adoption of multiple measures was not strongly addressed in the policy design. In other regional contexts, this issue may be important and therefore should not be ignored. More generally, our results need to be corroborated by further analyses on other regions and other AESs impacting on the overall farming system. Overall, considering the above-mentioned caveats, our results show that duration analysis could provide guidance to policy-makers to entice farmers to remain, in accordance with the conclusion of Hynes and Garvey (2009) that 'high degree of persistence may have some policy uses'. In our case, the following policy recommendations could be offered:

- the issue of taking enough time before considering the AES as fully established needs careful consideration; efforts in information and extension service provision cannot be restricted to the period prior to, or immediately following, the signing of the first contract, but need to be continued in the following years, also after contract renewal
- farmer-to-farmer information sharing networks, representing the social capital asset of the farm (Burton et al., 2003), should be identified and used to reinforce not only AES participation (Läpple and Kelley, 2014) but also AES persistence, as there seem to be neighbourhood effects in keeping farms in the scheme once they are in, as well as learning by doing effects that work in the same direction
- policy-makers should leverage young farmers to act as examples, spread information and technical knowledge on the scheme to the whole farming community, given that they are more inclined to remain in the AES. Rather than taking advantage of young participants to increase AES diffusion, public authorities just stimulated, through the priority scores system, young farmers to sign contracts in the 2000–2006 RDP
- changes in the policy design over time, when attempting to better suit the situation on the ground, to fine-tune and simplify the payment tiers, facilitate the decision to remain
- the gradual widening of target priority areas could be worth considering as a possible win–win strategy, taking advantage of the neighbourhood spillover effect on the decision to remain and saving financial resources previously assigned to higher payments for farmers remaining in the policy – i.e. maintaining hedgerows or buffer strips deriving from previous programming periods – rather than for new entries (as in the RDP 2007–2014)
- as there is a positive effect of farm size on the decision to remain, care should be paid as to how the payments are estimated, especially with regard to the higher impacts of participation costs on small farms. This issue was already considered by the regional

policy-makers during the study period. However, it now needs further attention, given that large farms can today include hedgerows and buffer strips in the mandatory Ecological Focus Areas (EFA) required under the greening of the CAP first pillar, while small farms are exempt from EFA.

Thanks to our dynamic approach, which fully incorporates the time dimension into the analysis of the farmers' decision process to remain in the AES for a long period, such policy recommendations may provide policy-makers with more effective information than static approaches, enabling them to design more mature agri-environmental policies based on persistent voluntary participation, and therefore to achieve a more sustainable environmental change.

Author contributions: Edi Defrancesco and Paola Gatto conceived and designed the idea of the article; Daniele Mozzato analysed data; Edi Defrancesco, Paola Gatto and Daniele Mozzato wrote the paper.

4.8. References

Agriconsulting, (2008). Valutazione del Piano di Sviluppo Rurale 2000–2006 della Regione Veneto. Rapporto di Valutazione ex post (Rev. 1), 456 pp.

Agriconsulting, (2012). Valutazione in itinere del Programma di Sviluppo Rurale 2007–2013 della Regione del Veneto. Aggiornamento della relazione di valutazione intermedia (Rev. 1), 245 pp.

Ajzen, I., Fishbein, M., 2005. The influence of attitudes on behavior. In: Albarracin, D., Johnson, B.T., Zanna, M.P. (Eds.), The Influence of Attitudes on Behavior. Erlbaum, Mahwah, NJ, pp. 173–221.

Allison, P.D., 2014. Event History and Survival Analysis. SAGE Publications Inc., Thousand Oaks 93 pp.

Berger, T., 2001. Agent-based spatial models applied to agriculture: a simulation tool for technology diffusion, resource use changes and policy analysis. Agric. Econ. 25 (2–3), 245–260.

Brown, P., Hart, G., Small, B., Montes de Oca Munguia, O., 2016. Agents for diffusion of agricultural innovations for environmental outcomes. Land Use Policy 55, 318–326.

Burton, R.J., Paragahawewa, U.H., 2011. Creating culturally sustainable agri-environmental schemes. J. Rural Stud. 27 (1), 95–104.

Burton, M., Rigby, D., Young, T., 2003. Modelling the adoption of organic horticultural technology in the UK using duration analysis. Aust. J. Agric. Resour. Econ. 47 (1), 29–54.

Chen, X., Lupi, F., An, L., Sheely, R., Vina, A., Liu, J., 2012. Agent-based modeling of the effects of social norms on enrolment in payments for ecosystem services. Ecol. Model. 229, 16–24.

Collavini, F., Bettiol, C., Zaggia, L., Zonta, R., 2005. Pollutant loads from the drainage basin to the Venice Lagoon (Italy). Environ. Int. 31 (7), 939–947.

Cox, D.R., Oakes, D., 1984. Analysis of Survival Data. Chapman and Hall, London 212 pp. D'Emden, F.H., Llewellyn, R.S., Burton, M.P., 2006. Adoption of conservation tillage in Australian cropping regions: an application of duration analysis. Technol. Forecast. Soc. Change 73 (6), 630–647.

Dadi, L., Burton, M., Ozanne, A., 2004. Duration analysis of technological adoption in Ethiopian agriculture. J. Agric. Econ. 55 (3), 613–631.

De Souza Filho, H.M., Young, T., Burton, M.P., 1999. Factors influencing the adoption of sustainable: evidence from the State of Espıŕito Santo, Brazil. Technol. Forecast. Soc. Change 60 (2), 97–112.

DeMaris, A., 2004. Regression with Social Data: Modeling Continuous and Limited Response Variables. John Wiley & Sons, Inc, Hoboken 560 pp.

Defrancesco, E., Gatto, P., Runge, F., Trestini, S., 2008. Factors affecting farmers' participation in agri-environmental measures: a Northern Italian perspective. J. Agric. Econ. 59 (1), 114–131.

Ducos, G., Dupraz, P., Bonnieux, F., 2009. Agri-environment contract adoption under fixed and variable compliance costs. J. Environ. Plan. Manage. 52 (5), 669–687.

Gamon, J.A., Scofield, G.G., 1998. Perceptions of sustainable agriculture: a longitudinal study of young and potential producers. J. Agric. Educ. 39 (1), 63–72.

Hynes, S., Garvey, E., 2009. Modelling farmers' participation in an agri-environmental scheme using panel data: an application to the Rural Environment Protection Scheme in Ireland. J. Agric. Econ. 60 (3), 546–562.

INEA, 1999. Le misure agroambientali in Italia. Analisi e valutazione del reg. CEE 2078/ 92 nel quadriennio 1994-97. Rapporti Regionali, 305 pp.

Ingram, J., Gaskell, P., Mills, J., Short, C., 2013. Incorporating agri-environment schemes into farm development pathways: a temporal analysis of farmer motivations. Land Use Policy 31, 267–279.

Jackson-Smith, D.B., Halling, M., de la Hoz, E., McEvoy, J.P., Horsburgh, J.S., 2010. Measuring conservation program best management practice implementation and maintenance at the watershed scale. J. Soil Water Conserv. 65 (6), 413–423.

Kallas, Z., Serra, T., Gil, J.M., 2010. Farmers' objectives as determinants of organic farming adoption: the case of Catalonian vineyard production. Agric. Econ. 41 (5), 409–423.

Karali, E., Brunner, B., Doherty, R., Hersperger, A., Rounsevell, M., 2014. Identifying the factors that influence farmer participation in environmental management practices in Switzerland. Hum. Ecol. 42 (6), 951–963.

Klerkx, L., Leeuwis, C., 2009. Establishment and embedding of innovation brokers at different innovation system levels: insights from the Dutch agricultural sector. Technol. Forecast. Soc. Change 76 (6), 849–860.

Kolawole, O.D., Farinde, A.J., Alao, J.A., 2003. Other side of farmers adoption behaviour forms of discontinuance. J. Ext. Syst. 19 (1), 70–80.

Läpple, D., Kelley, H., 2014. Spatial dependence in the adoption of organic drystock farming in Ireland. Eur. Rev. Agric. Econ. 42 (2), 315–337.

Läpple, D., Van Rensburg, T., 2011. Adoption of organic farming: are there differences between early and late adoption? Ecol. Econ. 70 (7), 1406–1414.

Läpple, D., 2010. Adoption and abandonment of organic farming: an empirical investigation of the Irish drystock sector. J. Agric. Econ. 61 (3), 697–714.

Lancaster, T., 1979. Econometric methods for the duration of unemployment. Econometrica 47 (4), 939–956.

Lastra-Bravo, X.B., Hubbard, C., Garrod, G., Tolón-Becerra, A., 2015. What drives farmers' participation in EU agri-environmental schemes?: Results from a qualitative meta-analysis. Environ. Sci. Policy 54, 1–9.

Lewis, D.J., Barham, B.L., Robinson, B., 2011. Are there spatial spillovers in the adoption of clean technology? The case of organic dairy farming. Land Econ. 87 (2), 250–267.

Marcomini, A., 2005. Special issue preface. Environ. Int. 31, 921–922.

Marenya, P.P., Barrett, C.B., 2007. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. Food Policy 32 (4), 515–536.

Marra, M., Pannell, D.J., Ghadim, A.A., 2003. The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: where are we on the learning curve? Agric. Syst. 75 (2), 215–234.

Mettepenningen, E., Vandermeulen, V., Delaet, K., Van Huylenbroeck, G., Wailes, E.J., 2013. Investigating the influence of the institutional organisation of agri-environmental schemes on scheme adoption. Land Use Policy 33, 20–30.

Morris, C., 2004. Networks of agri-environmental policy implementation: a case study of England's Countryside Stewardship Scheme. Land Use Policy 21 (2), 177–191.

Moschitz, H., Roep, D., Brunori, G., Tisenkopfs, T., 2015. Learning and innovation networks for sustainable agriculture: processes of co-evolution, joint reflection and facilitation. J. Agric. Educ. Extension 21 (1), 1–11.

Moser, C.M., Barrett, C.B., 2003. The disappointing adoption dynamics of a yield-increasing, low external-input technology: the case of SRI in Madagascar. Agric. Syst. 76 (3), 1085–1100.

Moser, C.M., Barrett, C.B., 2006. The complex dynamics of smallholder technology adoption: the case of SRI in Madagascar. Agric. Econ. 35 (3), 373–388.

Murphy, G., Hynes, S., Murphy, E., O'Donoghue, C., 2014. An investigation into the type of farmer who chose to participate in Rural Environment Protection Scheme (REPS) and the role of institutional change in influencing scheme effectiveness. Land Use Policy 39, 199–210.

Neill, S.P., Lee, D.R., 2001. Explaining the adoption and disadoption of sustainable agriculture: the case of cover crops in northern Honduras. Econ. Dev. Cult. Change 49 (4), 793–820.

Nyblom, J., Borgatti, S., Roslakka, J., Salo, M.A., 2003. Statistical analysis of network data –an application to diffusion of innovation. Soc. Netw. 25 (2), 175–195.

Padel, S., 2001. Conversion to organic farming: a typical example of the diffusion of an innovation? Sociol. Ruralis 41 (1), 40–61.

Pedzisa, T., Rugube, L., Winter-Nelson, A., Baylis, K., Mazvimavi, K., 2015. Abandonment of conservation agriculture by smallholder farmers in Zimbabwe. J. Sustain. Dev. 8 (1), 69–82.

Raggi, M., Viaggi, D., Bartolini, F., Furlan, A., 2015. The role of policy priorities and targeting in the spatial location of participation in Agri-Environmental Schemes in Emilia-Romagna (Italy). Land Use Policy 47, 78–89.

Regione Veneto, 1997. Legge regionale 16 dicembre 1997, n. 42. Disposizioni per la valorizzazione delle produzioni agro-faunistiche. BUR (Regional Official Journal) n. 107/1997.

Regione Veneto, 2000. Piano Direttore 2000. Piano per la Prevenzione dell'inquinamento e il risanamento delle acque del bacino idrografico immediatamente sversante nella Laguna di Venezia. Delibera del Consiglio Regionale n. 24 1/3/2000.

Reimer, A., Thompson, A., Prokopy, L.S., Arbuckle, J.G., Genskow, K., Jackson-Smith, D., Lynne, G., McCann, L., Morton, L.W., Nowak, P., 2014. People, place, behavior, and context: a research agenda for expanding our understanding of what motivates farmers' conservation behaviors. J. Soil Water Conserv. 69 (2), 57A–61A.

Riley, M., 2016. How does longer term participation in agri-environment schemes [re] shape farmers' environmental dispositions and identities? Land Use Policy 52, 62–75.

Shields, M.L., Rauniyar, G.P., Goode, F.M., 1993. A longitudinal analysis of factors influencing increased technology adoption in Swaziland, 1985–1991. J. Dev. Areas 27 (4), 469–484.

Singer, J.D., Willett, J.D., 2003. Applied Longitudinal Data Analysis. Modeling Change and Event Occurrence. Oxford University Press, New York 644 pp.

Sitzia, T., Trentanovi, G., Marini, L., Cattaneo, D., Semenzato, P., 2013. Assessment of hedge stand types as determinants of woody species richness in rural field margins. iForest 6, 201–208.

Swetnam, R.D., Mountford, J.O., Manchester, S.J., Broughton, R.K., 2004. Agri-environmental schemes: their role in reversing floral decline in the Brue floodplain, Somerset, UK. J. Environ. Manage. 71 (1), 79–93.

Taylor, B.M., Van Grieken, M., 2015. Local institutions and farmers participation in agri-environmental schemes. J. Rural Stud. 37, 10–19.

Tempesta, T., 2010. The perception of agrarian historical landscapes: a study of the Veneto plain in Italy. Landsc. Urban Plan. 97 (4), 258–272.

Vance, C., Geoghegan, J., 2002. Temporal and spatial modelling of tropical deforestation: a survival analysis linking satellite and household survey data. Agric. Econ. 27 (3), 317–332.

Varble, S., Secchi, S., Druschke, C.G., 2016. An examination of growing trends in land tenure and conservation practice adoption: results from a farmer survey in Iowa. Environ. Manage. 57, 318–330.

Vaz, E., Nijkamp, P., 2015. Gravitational forces in the spatial impacts of urban sprawl: an investigation of the region of Veneto, Italy. Habitat Int. 45, 99–105.

Wilson, G.A., Hart, K., 2000. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Environ. Plan A 32 (12), 2161–2185.

Wilson, G.A., Hart, K., 2001. Farmer participation in agri-Environmental schemes: towards conservation-oriented thinking? Sociol. Ruralis 41 (2), 254–274.

Woolcock, M., Narayan, D., 2000. Social capital: implications for development theory, research and policy. World Bank Res. Observ. 15 (2), 225–249.

Yamaguchi, K., 1991. Event History Analysis. SAGE Publications Inc., Newbury Park 182 pp.

5. Reshaping the role of factors affecting farmers' decisions to continue with agri-environmental schemes from a temporal perspective

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5.1. Abstract

The need to assess the impact of agri-environmental schemes in a long-term perspective has cast light on the issue of temporal dynamics of farmers' participation over single contract durations. This would help to better target and tailor the schemes and to achieve more persistent environmental benefits. This issue is addressed by considering the interplay of time and background factors on farmers' decisions. Farm, farmer's socio-demographic characteristics, attitudes and motivations, social and informational factors have been considered amongst the background factors according to the theory of reasoned action and planned behaviour. A discreet-time duration model was estimated – the only approach that allows to fully consider the effect of time and the temporal changes in the role played by the background factors in the continuation of agri-environmental schemes. The analysis is based on a longitudinal sample of 344 farmers located in the Veneto region of Italy, who have adopted a specific scheme – i.e. plantation and/or maintenance of hedgerows and buffer strips – for at least one contract period within a time span of eighteen years (2000-2017). Results highlight that farmer's continuation for a long time in agri-environmental schemes is the outcome of a mix of concurring factors, amongst which attitudes and motivations as well as social factors, play an important role and complement the financial policy support. The impact of those factors also evolves in time, being social pressure and neighbouring farms effect the most important factors in recent years. These outcomes provide useful insights when rethinking the policy design at any new round. Care should be paid also to nudge farmers to share information amongst peers, where not only experiences are conveyed, but also local communities' social values.

Keywords: AESs, duration analysis, social factors, temporal patterns, AEMs, farmers' motivations and attitudes

5.2. Introduction

Agri-Environmental Schemes (AESs) are voluntary incentive schemes offered by the European Union to steer adoption of environmentally friendly practices. Despite having been proposed uninterruptedly since the early nineties, starting with EU Regulation 2078/92 and continuing with Rural Development Programmes (RDPs), AESs have not always achieved the desired adoption rates (Pavlis et al., 2016). Many reasons can be given for this; it has been shown that in most cases the sole financial support is not enough to motivate farmers' participation (Moon, 2013), while a much wider range of factors has to be taken into account (Blazy et al., 2011; Reimer et al., 2014). Several agricultural economics studies have analysed the role of factors affecting farmers' choices in AESs adoption; recent reviews like e.g. those by Reimer et al. (2014), Lastra-Bravo et al. (2015), Mozzato et al. (2018), Emery and Franks (2012); Ma et al. (2012) provide evidence of the large array of extrinsic and intrinsic factors of farmers' AESs uptake.

The theory of reasoned action and planned behaviour advanced by Ajzen and Fishbein (2005) helps to frame the background factors affecting AESs uptake into farm factors, farmer's socio-demographic characteristics, attitudes and motivations, social factors and informational factors (Beedell and Rehman, 2000; Defrancesco et al., 2008; Mettepenningen et al., 2013). This theory offers a valuable analytical tool to fine-tune the design of AESs and increase their role as catalysers of environmental improvement.

Given that environmental benefits often need a long period to be produced (Swetnam et al., 2004), the need to assess AESs' impacts in a long-term perspective has recently cast light on the issue of temporal dynamics of farmers' participation over single AES contract durations (Ingram et al., 2013). Considering farmers' decision patterns in AES continuation for a long time period helps to better target and tailor AESs and to achieve more persistent environmental benefits (Morris, 2004).

Duration analysis is an effective approach to model the effect of the time dimension on the farmers' decision process concerning whether continuing with the agri-environmental practice by subscribing a new AES contract or leaving the scheme. Research along this line has been proposed by Burton et al. (2003), D'Emden et al. (2006), Dadi et al. (2004), De Souza Filho et al. (1999), Hynes and Garvey (2009), Kallas et al. (2010), Läpple (2010), Marenya and Barrett (2007), Moser and Barrett (2006) Murphy et al. (2014) – see Defrancesco et al., 2018 for a recent review of the literature. However, research on farmers' behaviour in relation to AESs continuation or disadoption in a long-time perspective is still scanty (Ingram et al., 2013; Riley, 2016), also for the lack of longitudinal datasets at farm level (Kallas et al., 2010; Marra et al., 2003; Moser and Barrett, 2006).

Grounding on an earlier work (Defrancesco et al., 2018), this paper contributes to the scarce AESs duration literature by considering the joint effect on farmers' decisions of time and background factors – including a wider set of social factors in respect to those proposed by the literature (Mettepenningen et al., 2013). Only under a duration approach like the one we propose it is possible to study the impact of time, i.e. the accumulation of experience by farmers, and the temporal changes in the role played by the background factors on AESs continuation. This provides useful insights when rethinking the policy design at any new RDP round (Darragh and Emery, 2018; Läpple, 2010).

Our research is based on a longitudinal sample of 344 farmers who have adopted a specific AES – plantation and/or maintenance of hedgerows and buffer strips – for at least one contract period within a time span of eighteen years (2000-2017). With some variations in the design, this AES has been ongoing without interruption since late nineties in the Veneto region of Italy, where our case-study is located.

5.3. Model and data

At the end of the duration of the AES contract, the farmer can choose to continue with the AES by signing a new contract, or to disadopt it. Our research focus is on modelling – under a discrete-time duration approach[1] (Allison, 2014; DeMaris, 2004; Singer and Willett, 2003) – this continuation or disadoption behaviour for a farmer who was already in the scheme, while we are not interested in modelling the behaviour of new adopters. Hence, our risk set is a sample of farmers implementing the AES in the analysed period – 2000-2017 – at least for one five-years contract duration and located in the lowland of the Veneto Region. The case-study area is fertile and intensively farmed, where the traditional green hedgerows almost completely disappeared during the seventies and the eighties of the last century. Public authorities make efforts to restore the historical landscape and the ecological connectivity in the area by financially supporting for a long time both the maintenance and new plantation of hedgerows and buffer strips under Reg. 2078/92, regional initiatives and the following RDP rounds. The policy design was aligned over time to the situation on the ground, changing e.g. the requirements to comply with the AES, the payments scheduling during the contract period, enlarging the environmental-sensitive target areas where the highest priority scores

[1] We have used a discrete-time duration model for two reasons. Firstly, the time at which a farmer signs the first AES contract is intrinsically discrete (as RDP calls are not available each year, depending policy-makers decisions). Secondly, the abandonment decision has relevant 'ties' in the duration, as the leaving option generally occurs at the end of the five years contract duration (or multiples of it). In our dataset, longer duration ties are also reported due to the fact that regional authorities give the possibility to farmers to prolong their contract until the end of a given RDP. For these reasons, as highlighted by Cox and Oakes (1984) and Yamaguchi (1991), continuous-time models are unreliable.

were assigned to farmers accessing the scheme. The different policy rounds can be identified as follows: policy round before 2000, policy round (RDP) 2000-2006 and, under RDP 2007-2014, policy round 2007-2010 and policy round 2011-2014 (see Defrancesco et al., 2018 for a detailed description of the case-study context and AES policy schemes).

To select our sample, we firstly created the overall dataset by linking together the yearly panel official dataset of the AES participants' population of the Veneto region (see Defrancesco et al., 2018 for a detailed description). Secondly, a random sample of 344 participating farmers was selected from this dataset. The sample was stratified according to both the RDP under which the first AES contract was subscribed and the farm localisation inside or outside policy target areas.

A questionnaire was administrated through a face-to-face interview to the farmers in the sample, taking place between January and September 2017. The questionnaire collected information on farm structure and localisation, farmer's socio-demographic characteristics, attitudes and motivations, number of years under AES contract, informational and social factors.

We created a yearly farm-level panel dataset of the collected data, where different records were generated for each year *t* in which the individual farmer i^{th} implemented the AES (Singer and Willett, 2003). However, in our case, the first five years of adoption are mandatory for farmers and, therefore, mainly related to the adoption and not to the continuation decision. For this reason, they are uninformative for our research. Hence, following Moser and Barrett (2006) we removed them from the farm-year dataset by dropping the first five records associated to each i^{th} farmer in the analysed period, while the continuation or disadoption information related to the sixth year was maintained. This reduced the sample in the initial farm-level dataset from 344 to 256 farms and led to 1676 records in the farm-year dataset. 115 farmers disadopt the AES during the analysed period (44.9% of farmers in the farm-level dataset and 6.9% in the farm-year dataset); the median period of staying under the AES contract is 6 years, while the observed maximum is 31 years. Only right-censoring (Allison, 2014) occurred, when a farmer never left the contract in the analysed period. Thus, the only censored data occurred at the end of the period of analysis, for those farmers who renewed the contract under the RDP 2015-2020 calls. Left-truncation – which occurs when a farmer signed his/her first AES contract before 2000 (i.e. under Reg. 2078/92 or regional initiatives) – was easily addressed by adding, to the individual farmer's AES duration at each time *t*, the number of years under previous AES contracts (Singer and Willett, 2003).

Under the discrete-time approach, the discrete time hazard P_{it} is the conditional probability that the i^{th} farmer experiences the event under examination at a particular time t, given that no event happened to her/him before time t:

$$P_{it} = P(T_i = t \mid T_i \geq t)$$

Where T_i is a discrete time variable identifying the event occurrence for individual i^{th}. Logit model is the most used for truly discrete-time hazard (Allison, 2014). It explains the log-odds of the event occurrence at time t:

$$\ln \frac{P_{it}}{1 - P_{it}} = \alpha(t) + \mathbf{x}^{i'} \boldsymbol{\beta}$$

where $\alpha(t)$ describes how the log-odds of the event depends on time, while $\boldsymbol{x}^i$ considers the effects of both time-varying and time-invariant predictors.

In line with the aim of the paper and in order to more easily evaluate the effect of predictors on the continuation choice, we chose to model the event non-occurrence – i.e. the continuation of the AES rather than its disadoption. Therefore, the observed dichotomous variable T_i identifying the target event occurrence for the farmer i^{th} at each time t was set equal to 1 for AES continuation and to 0 for its disadoption.

In our model, $\alpha(t)$ is a linear and quadratic function of *Years*, a time-variant variable defining for how many years (including ante-2000 programmes) the farmer i^{th} continued to adopt the AES until time t. Following Singer and Willett (2003), the variable *Years* was rescaled by subtracting the median value of duration as centering constant.

Table 5.1 reports the list of time-varying and time-invariant covariates we included in the models, while Table 5.2 shows their descriptive statistics. Moreover, Table 5.2 provides information on the percentage of farmers subscribing the first contract in each given AES policy round. We used the policy rounds of the farmers' first uptake as interaction terms with some attitude and motivation and social factors in model 3.

When discussing our results against the existing literature in the next section, we consider only the papers referring to the limited duration analyses literature. When these are unavailable, we consider mostly the AESs adoption literature referred to the same temporal period and geographical context (Southern Europe). Indeed, a review of factors affecting AESs adoption has shown that some opposite results in the signs of the factor can be explained under a temporal and geographical perspective (Mozzato et al., 2018).

Table 5.1. Factors included in the models as covariates

Name	Meaning	Specification	Time-varying
Farm factors			
F_Size	farm UAA	continuous - hectares	yes
Dairy_Cattle	dairy cows	continuous - number	no
Change_Own	changes of tenure or ownership	1=ownership change occurred in the analysed period, 0=otherwise	no
Target_Area	farm location in policy target areas	1= farm located in target area at the moment the farmer signed the first AES contract, 0=otherwise	no
Farmer's factors			
Socio-demographic characteristics			
Gender		1=male, 2 = female	yes
Full_Time		1= full-time farmer, 0=otherwise	no
Attitudes and motivations			
AES_Impact	farmer's perception of AES impact on farming	1=negative, 0=otherwise	no
Envir_Att	environmental-friendly attitude of the farmer	continuous [a]	no
Health_Mot	farmer's positive motivation towards adopting environmental-friendly practices when they positively impact on own and local community health	continuous [a]	no
Income_Int	farmer's perception of positive impact of public support on farm income	continuous [a]	no
Informational factors			
AES_Aware	years farmer has been aware of AES existence	1=less than 5 years, 2=5-10 years, 3=more than 10 years	no
AES%_TAA	percentage of farm Total Agricultural Area under the AES which proxies the accumulation of experience	continuous - percentage	yes
Training	participation in training courses in the last 5 years	1=yes, 0=no	no
Tech_reading	farmer reads technical journal or publications	1=yes, 0=no	no
Institut_Advice	farmer received technical advice from public institutions	1=yes, 0=no	no
FO_Member	membership of Farmers' Organisations	1=yes, 0=no	no
Social factors			
Institutional_Trust	farmer's trust in regional authorities	continuous [a]	no
Soc_Pressure	farmer's perception of environmental-friendly practices impact on local community and other farmers' appreciation	continuous [a]	no
Neighb_farm	neighbouring farmers' influence on AES continuation	continuous [a]	no

[a] Average of farmer's rating of a set of statements. Each statement was measured on a 5-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

Table 5.2. Descriptive statistics of the variables included in the models (n = 256 farms)

Variables		**Statistic**	**Value**
Years		Median	6
F_Size		Mean*	20.87 (44.90)
Dairy_Cattle		Mean*	4.35 (19.20)
Change_Own	Yes	%	8.20
Target_Area	2000	%	54.9
	2006	%	75.0
	2014	%	96.6
Gender	Male	%	83.20
	Female	%	16.80
Full_Time	Yes	%	52.73
AES_Impact	Yes	%	24.22
Envir_Att		Mean*	4.25 (0.57)
Health_Mot		Mean*	4.41 (0.60)
Income_Int		Mean*	4.09 (0.80)
AES_Aware	less than 5 years	%	2.73
	5-10 years	%	17.97
	more than 10 years	%	79.30
AES%_TAA		Mean*	7.12 (4.62)
Training	Yes	%	32.03
Tech_reading	Yes	%	78.91
Institut_Advice	Yes	%	9.77
FO_Member	Yes	%	17.97
Institutional_Trust		Mean*	2.82 (1.11)
Soc_Pressure		Mean*	3.14 (0.92)
Neighb_farm		Mean*	1.92 (0.89)
Farmers subscribing the first contract in each given AES policy round	Initiatives prior to 2000 (Policy_Ante00)	%	21.09
	RDP 2000-2006 (Policy00_06)	%	42.97
	RDP 2007-2014 until 2010 (Policy07_10)	%	14.45
	RDP 2007-2014 from 2011 (Policy11_14)	%	21.48

* Standard deviations are reported in parentheses

5.4. Results and discussion

Table 5.3 reports the estimated coefficients and the related standard errors of the discrete-time duration models for farmers' decision to continue to implement the AES by signing a new contract.

Table 5.3. Duration models estimates for farmers' decision to continue to implement the AES [a]

Variables	Model 1	Model 2	Model 3
Years	0.584 (0.070) ***	0.566 (0.071) ***	0.498 (0.073) ***
Years_2	-0.027 (0.004) ***	-0.026 (0.004) ***	-0.025 (0.004) ***
F_Size	0.024 (0.008) ***	0.019 (0.007) ***	0.017 (0.007) **
Dairy_Cattle	-0.016 (0.007) **	-0.018 (0.007) ***	-0.026 (0.008) ***
Change_Own	2.678 (1.045) ***	3.017 (1.063) ***	3.533 (1.212) ***
Target_Area	0.537 (0.238) **	0.633 (0.247) **	0.812 (0.298) ***
Gender	0.588 (0.321) *	0.514 (0.328)	0.662 (0.384) *
Full_Time	0.563 (0.263) **	0.635 (0.271) **	0.854 (0.317) ***
AES_Impact	-0.318 (0.268)	-0.173 (0.279)	-0.540 (0.332)
Envir_Att		-0.059 (0.341)	
Health_Mot		-0.312 (0.316)	-0.963 (0.408) **
Income_Int		0.320 (0.158) **	
AES_Aware	0.547 (0.269) **	0.481 (0.281) *	1.694 (0.511) ***
AES%_TAA	0.190 (0.035) ***	0.173 (0.035) ***	0.196 (0.041) ***
Training	0.396 (0.293)	0.578 (0.308) *	0.833 (0.370) **
Tech_reading	0.490 (0.282) *	0.570 (0.305) *	0.885 (0.348) **
Institut_Advice	-0.593 (0.431)	-0.637 (0.448)	-1.378 (0.511) ***
FO_Member	0.884 (0.400) **	0.963 (0.402) **	1.264 (0.444) ***
Institutional_Trust	0.188 (0.105) *	0.181 (0.110)	0.333 (0.131) **
Soc_Pressure		-0.166 (0.171)	
Neighb_farm		-0.213 (0.143)	
Envir_Att*Policy_Ante00			0.778 (0.608)
Envir_Att*Policy00_06			1.013 (0.466) **
Envir_Att*Policy07_10			-2.501 (0.856) ***
Envir_Att*Policy11_14			-0.277 (0.634)
Income_Int*Policy_Ante00			0.485 (0.252) *
Income_Int*Policy00_06			0.071 (0.232)
Income_Int*Policy07_10			3.568 (1.006) ***
Income_Int*Policy11_14			1.658 (0.574) ***
Soc_Pressure*Policy_Ante00			-0.342 (0.372)
Soc_Pressure*Policy00_06			-0.300 (0.259)
Soc_Pressure*Policy07_10			1.620 (0.625) ***
Soc_Pressure*Policy_11_14			-1.050 (0.493) **
Neighb_farm*Policy_Ante00			0.049 (0.299)
Neighb_farm*Policy00_06			-0.713 (0.245) ***
Neighb_farm*Policy07_10			-1.767 (0.718) **
Neighb_farm*Policy11_14			0.989 (0.431) **
Constant	-4.135 (1.029) ***	-2.639 (1.598) *	-7.390 (2.125) ***
Log L	*-282.297*	*-276.238*	*-236.366*
McFadden pseudo R^2	*0.137*	*0.143*	*0.183*
Nagelkerke pseudo R^2	*0.357*	*0.373*	*0.477*
Farm-year observations	*1676*	*1676*	*1676*
Number of farms	*256*	*256*	*256*

[a] *** p<0.01; ** p<0.05; * p<0.1. Standard errors are reported in in parentheses.

Model 1 includes the variables explaining the effect of time – that can be evaluated only under a duration approach and not through conventional cross-section analysis (Burton et al., 2003) – the farm factors, the farmer's socio-economic factors, the informational factors and, among the social factors, the one most frequently used by literature, i.e. the trust in institutions and, among the motivational factors, the farmer's perceived AES negative impact on his/her farming activity. These factors are shared in common with the other two models we have estimated and show consistency in the sign of their effects.

In line with the duration literature (Defrancesco et al., 2018; Hynes and Garvey, 2009; Moser and Barrett, 2006; Murphy et al., 2014), the effect of time (*Years* and *Years_2*) on the option to continue the contract increases with the number of years under AES contract until time *t*. However, the negative sign of the quadratic term shows that this positive effect declines over time. The positive role played by time in relation to the farmers' decision to continue with the AES is linked to the farmer gradually accumulating experience (Burton et al., 2003) in actively managing hedgerows and buffer strips following the AES prescriptions.

Among the farm factors, the farm size (*F_Size*) plays a positive effect on the continuation with the AES at time *t*, because both AES implementation and transaction costs have a lower impact on the overall farm income in larger farms (Bartolini et al., 2013). This result is confirmed also by the positive sign of *AES_Impact* factor, even if it is not statistically significant. This outcome is consistent with results from adoption and continuation literature (Defrancesco et al., 2018; Hynes and Garvey, 2009; Kallas et al., 2010; Läpple, 2010; Marini et al., 2011; Murphy et al., 2014). In our study context, livestock farms are intensively managed (Giupponi et al., 2006), so a high number of dairy cows (*Dairy_Cattle)* negatively impacts on the AES continuation. Similar results have been found also by Läpple (2010) and Murphy et al. (2014). In our case-study area, family farms prevail and, when ownership or tenure changes occur, in most cases (94.4% in our sample), younger family members take over the farm management. Consequently, the positive influence on the log-odds ratio of *Change_Own* can be explained with a manager's age-reduction effect during the study period; this confirms the results of previous duration analysis literature exploring the effect of age (Hynes and Garvey, 2009; Kallas et al., 2010). In addition, *Change_Own* can also be an indicator of farm continuity implying family-shared farm development pathways (Defrancesco et al., 2018). *Ceteris paribus*, the policy targeting – which prioritises farms location in target areas – (*Target_Area*), displays a positive impact on the continuation in the AES (Kallas et al., 2010; Murphy et al., 2014; Pascucci et al., 2013). This highlights the crucial role of efforts to fine-tune policy targeting (Boncinelli et al., 2016) and, more generally, the overall policy design (Mettepenningen et al., 2013; Moon, 2013; Murphy et al., 2014; Raggi et al., 2015; Whitten et al., 2013; Wynn et al., 2001).

Amongst the farmer's socio-demographic characteristics, both being female (*Gender*) and a full-time farmer (*Full_Time*) triggers continuation. The former is in line with duration literature (Burton et al., 2003), the latter (Bartolini et al., 2013) can be explained also with the labour and management needs of constant and active maintenance of the ecological functionality of hedgerows and buffer strips, as required by the AES prescriptions.

All the informational factors we considered are statistically significant, at least in the third model, and positively affect the log-odds of staying in the AES at time *t*, with the exception of the effect of technical advice received from public institutions (*Institut_Advice*). In our survey we learned that, often, farmers identify the institutional advice mostly with the prescriptions they receive during public control visits on AES compliance. The frequency and intensity of official controls, often perceived as frustrating by farmers, may explain the negative sign. As expected, the skills farmers acquire when participating in training courses (*Training*), reading technical journals (*Tech_reading*) and being member of farmers' organisations which provide information (*FO_Member)*, positively affect the AES continuation at time *t* (Bertoni et al., 2012; Genius et al., 2014; Nyblom et al., 2003; Pascucci et al., 2013). A long farmer's awareness of AES existence (*AES_Aware*) and a rooted experience on AES management (*AES%_TAA*), i.e. the self-learning effect, play a crucial positive role on the log-odds (Hynes and Garvey, 2009; Moser and Barrett, 2006).

The trust in institutions (*Institutional_Trust*) generally plays a positive role on the adoption (Polman and Slangen, 2008); our results, which refer to the regional authorities having in charge the agri-environmental policies design and management, confirm this outcome in terms of duration.

The second model specification includes factors expressing farmers' attitudes and motivations as well as social factors expressing the influence of neighbours and the pressure by the local community on the AES continuation decision. Amongst the attitudinal and motivational factors, both farmers' environmental-friendly attitude (*Envir_Att*) and his/her positive willingness to adopt environmental-friendly practices when they positively impact on own and local community's health (*Health_Mot*) are not significant, while the only positive effect on continuation is linked to economic motivations, i.e. when farmers perceive public support as a positive integration for the farm income (*Income_Int*) (Läpple and Kelley, 2013; Micha et al., 2015). Social factors, representing an emerging strand of literature and therefore are addressed in a limited number of papers, are not significant in our model 2.

Overall, model 2 seems to indicate that most of farmers' motivations and attitudes and social factors do not influence farmers' decision to continue in participating in the AES at time *t*. However, model 2 does not take into account that decision pathways are not static but

dynamic and change over time in response to changes in personal motivations and social values (Darragh and Emery, 2018; Ingram et al., 2013).

When connecting those factors to the cohorts of farmers according to the policy round in which they firstly sign the first AES contract, the significant and dynamic role played on duration by some of these factors turns out. The interactions of these factors with the policy rounds in model 3 clearly show that a specific factor prevails on the others following a time-dynamic. The prevailing motivation linked to each policy round underlying the first uptake explains the decision to continue the contract for a long period and complements the mostly positive role of the economic factor:

- *policy round before 2000 (Policy_Ante00): public support motivations*. The only significant and positive motivation affecting farmers' decision to continue the AES at time *t* is the opportunity to integrate their income with the AES payment (*Income_Int).* This result is explained considering that, in our context, most farmers (83.3% in our sample) signed their first AES contract for pre-existing hedgerows or buffer strips (INEA, 1999), therefore receiving payments simply for adapting their ongoing management practices to the AES prescriptions (Darragh and Emery, 2018; Lioutas and Charatsari, 2018)
- *policy round 2000-2006 (Policy00_06): environmental-friendly attitudes*. In line with Burton et al. (2003), Läpple (2010) and Läpple and Rensburg (2011) for early adopters, farmers' environmental motivations (*Envir_Att*) replace income integration as the most important triggering factor affecting the AES continuation decision in this round. The environmental-friendly attitude of this cohort of farmers explains why most of them started the AES commitment by planting new hedgerows or buffer strips rather than maintaining existing ones (Agriconsulting, 2008). The strong environmental motivation of farmers in this round is stressed also by the income integration effect (*Income_Int)* being not significant only for this round
- *policy round 2007-2010 (Policy07_10): social pressure*. This cohort of farmers is moved, in their AES continuation decision, by an emerging social factor: the social pressure (*Soc_Pressure*) i.e. the need to comply with the local community's and peers' expectations and to be appreciated for that. This result is in line with Kallas et al. (2010), Läpple (2010) and Burton et al. (2003) and with the scarce adoption literature addressing this factor in a southern Europe context (Mzoughi, 2011; Welch and Marc-Aurele, 2001), the latter reporting that it is relevant for late rather than early adopters. For this wave of adopters, the positive role of income effect emerges again
- *policy round 2011-2014 (Policy11_14): neighbouring farms' effect*. Being these farmers mostly late-adopters/followers, the *Neighb_farm* factor replaces the social pressure one as leading factor positively influencing farmers' persistence in the AES over time. A

nascent group of papers agrees on the horizontal networking with peers effect, incorporating learning from other farmers, receiving information, sharing experiences and imitation among neighbouring farmers (Azizi Khalkheili and Zamani, 2009; Boncinelli et al., 2016; Burton et al., 2003; Defrancesco et al., 2018; Läpple and Kelley, 2013; Läpple and Kelley, 2015; Moser and Barrett, 2006; Mzoughi, 2011; Nyblom et al., 2003). Also in this case, the public support economic motivation is important.

In model 3, health-related motivations effect (*Health_Mot*) is not related to the policy rounds, being embedded in the individuals and, therefore, varying only in the very long period. Its effect is negative, meaning that farmers who are strongly moved by this motivation are mostly less willing to continue with the AES for a long time. This result contrasts with what found by Wollni and Andersson (2014) for organic farming, probably because the health benefits of hedgerows and buffer strips are less evident than those of other environmentally friendly practices like organic or integrated pest management farming systems.

5.5. Conclusions

The duration analysis we used is the only approach which fully takes into account the effect of time on farmers' decisions. The original outcome of our work is the reshaping, under a temporal perspective, of the role the factors affecting farmers' decisions to continue with AESs. Our results place emphasis on the point that farmer's continuation in AES for a long time is the result of the interplay of a mix of factors, amongst which attitudes and motivations, as well as social factors, play an important role and complement the economic ones linked to the policy support. Moreover, the impact of those factors evolves in time, adapting to the changing social context where farmers' values are "constantly modified and negotiated by social interactions" (Darragh and Emery, 2018, p. 383).

This time-dynamics has important implications for policy design stimulating a persistent farmers' AES voluntary participation for a long period. While the effects of farm factors, the farmer's socio-economic characteristics and the support-linked economic factors remain unchanged, the impacts of attitudes and motivations as well as social factors varies over time, discouraging adoption of one-size-fits-all policies for AES continuation.

Firstly, our results show that the policy should remain grounded on the financial support, given that environmental attitudes exclusively motivates only a farmers' minority in their decision to remain in the AES.

Secondly, the crucial effect played by time in ensuring farmers persistence in the AES suggests that policy authorities have to base their information provision strategies on a time span that goes beyond a single contract duration.

Thirdly, the emerging role played by social endorsement and recognition and of peers' effect on AES duration for farmers who recently signed their first AES contract shows that the traditional information channels should be reshaped from a top-down approach to a horizontal-based pattern. Policy actions should trigger the development of information-sharing networks amongst farmers, like the creation of discussion groups, where not only experiences are conveyed, but also local communities' social values. This would nudge farmers to be active in stimulating their peers in AES continuation (Kuhfuss et al., 2016).
Our results, however, are based only on one AES and a specific geographical context, so extending them to other schemes or areas has to be taken cautiously and requires further studies.

Author contributions: Edi Defrancesco and Paola Gatto conceived and designed the survey; Daniele Mozzato collected the data; Edi Defrancesco, Paola Gatto and Daniele Mozzato analysed the data and wrote the paper.

5.6. References

Agriconsulting, 2008. Valutazione del Piano di Sviluppo Rurale 2000–2006 della Regione Veneto. Rapporto di Valutazione ex post (Rev. 1).

Ajzen, I., Fishbein, M., 2005. The Influence of Attitudes on Behavior, in: Albarracin, D., Johnson, B.T., Zanna, M.P. (Eds.), The Handbook of Attitudes. Lawrence Erlbaum Associates, Mahwah, pp. 173–221.

Allison, P.D., 2014. Event History And Survival Analysis, Second edi. ed. Sage Publications. https://doi.org/10.4135/9781452270029

Azizi Khalkheili, T., Zamani, G.H., 2009. Farmer participation in irrigation management: The case of Doroodzan Dam Irrigation Network, Iran. Agric. Water Manag. 96, 859–865. https://doi.org/10.1016/j.agwat.2008.11.008

Bartolini, F., Andreoli, M., Brunori, G., 2013a. Explaining the determinants of on-farm diversification : The case Study of Tuscany Region, in: 2nd AIEAA Conference "Between Crisis and Development: Which Role for the Bio-Economy." Parma, p. 14.

Bartolini, F., Brunori, G., Fastelli, L., Rovai, M., 2013b. Understanding the participation in agri-environmental schemes : evidences from Tuscany Region, in: 53rd ERSA Conference."Regional Integration: Europe, the Mediterranean and the World Economy." Palermo, pp. 1–19.

Beedell, J., Rehman, T., 2000. Using social-psychology models to understand farmers' conservation behaviour. J. Rural Stud. 16, 117–127. https://doi.org/10.1016/S0743-0167(99)00043-1

Bertoni, D., Cavicchioli, D., Pretolani, R., Olper, A., 2012. Determinants of agri-environmental measures adoption : do institutional constraints matter ? Environ. Econ. 3, 8–19.

Blazy, J.-M., Carpentier, A., Thomas, A., 2011. The willingness to adopt agro-ecological innovations: Application of choice modelling to Caribbean banana planters. Ecol. Econ. 72, 140–150. https://doi.org/10.1016/j.ecolecon.2011.09.021

Boncinelli, F., Bartolini, F., Brunori, G., Casini, L., 2016. Spatial analysis of the participation in agri-environment measures for organic farming. Renew. Agric. Food Syst. 31, 375–386. https://doi.org/10.1017/S1742170515000307

Burton, M., Rigby, D., Young, T., 2003. Modelling the adoption of organic horticultural technology in the UK using duration analysis. Aust. J. Agric. Resour. Econ. 47, 29–54. https://doi.org/10.1111/1467-8489.00202

Cox, D.R., Oakes, D., 1984. Analysis of survival data. Chapman and Hall.

D'Emden, F.H., Llewellyn, R.S., Burton, M.P., 2006. Adoption of conservation tillage in Australian cropping regions: An application of duration analysis. Technol. Forecast. Soc. Change 73, 630–647. https://doi.org/10.1016/j.techfore.2005.07.003

Dadi, L., Burton, M., Ozanne, A., 2004. Duration Analysis of Technological Adoption in Ethiopian Agriculture. J. Agric. Econ. 55, 613–631. https://doi.org/10.1111/j.1477-9552.2004.tb00117.x

Darragh, H.S., Emery, S.B., 2018. What Can and Can't Crowding Theories Tell Us about Farmers' 'Environmental' Intentions in Post-Agri-Environment Scheme Contexts? Sociol. Ruralis 58, 370–391. https://doi.org/10.1111/soru.12159

De Souza Filho, H.M., Young, T., Burton, M.P., 1999. Factors Influencing the Adoption of Sustainable Agricultural Technologies - Evidence frome the State of Espírito Santo, razil. Technol. Forecast. Soc. Change 60, 97–112. https://doi.org/10.1016/S0040-1625(98)00040-7

Defrancesco, E., Gatto, P., Mozzato, D., 2018. To leave or not to leave? Understanding determinants of farmers' choices to remain in or abandon agri-environmental schemes. Land use policy 76, 460–470. https://doi.org/10.1016/j.landusepol.2018.02.026

Defrancesco, E., Gatto, P., Runge, F., Trestini, S., 2008. Factors affecting farmers'participation in agri-environmental measures: A northern Italian perspective. J. Agric. Econ. 59, 114–131. https://doi.org/10.1111/j.1477-9552.2007.00134.x

DeMaris, A., 2004. Regression with Social Data, Wiley Series in Probability and Statistics, Wiley Series in Probability and Statistics. John Wiley & Sons, Inc., Hoboken, NJ, USA. https://doi.org/10.1002/0471677566

Genius, M., Koundouri, P., Nauges, C., Tzouvelekas, V., 2014. Information Transmission in Irrigation Technology Adoption and Diffusion: Social Learning, Extension Services, and Spatial Effects. Am. J. Agric. Econ. 96, 328–344. https://doi.org/10.1093/ajae/aat054

Giupponi, C., Ramanzin, M., Sturaro, E., Fuser, S., 2006. Climate and land use changes, biodiversity and agri-environmental measures in the Belluno province, Italy. Environ. Sci. Policy 9, 163–173. https://doi.org/10.1016/j.envsci.2005.11.007

Hynes, S., Garvey, E., 2009. Modelling Farmers' Participation in an Agri-environmental Scheme using Panel Data: An Application to the Rural Environment Protection Scheme in Ireland. J. Agric. Econ. 60, 546–562. https://doi.org/10.1111/j.1477-9552.2009.00210.x

INEA, 1999. Le misure agro ambientali in Italia. Analisi e valutazione del reg. CEE 2078/92 nel quadriennio 1994-97. Rapporti regionali.

Ingram, J., Gaskell, P., Mills, J., Short, C., 2013. Incorporating agri-environment schemes into farm development pathways: A temporal analysis of farmer motivations. Land use policy 31, 267–279. https://doi.org/10.1016/j.landusepol.2012.07.007

Kallas, Z., Serra, T., Gil, J.M., 2010. Farmers' objectives as determinants of organic farming adoption: the case of Catalonian vineyard production. Agric. Econ. 41, 409–423. https://doi.org/10.1111/j.1574-0862.2010.00454.x

Kuhfuss, L., Préget, R., Thoyer, S., Hanley, N., Coent, P. Le, Désolé, M., 2016. Nudges, Social Norms, and Permanence in Agri-environmental Schemes. Land Econ. 92, 641–655. https://doi.org/10.3368/le.92.4.641

Läpple, D., 2010. Adoption and Abandonment of Organic Farming: An Empirical Investigation of the Irish Drystock Sector. J. Agric. Econ. 61, 697–714. https://doi.org/10.1111/j.1477-9552.2010.00260.x

Läpple, D., Kelley, H., 2015. Spatial dependence in the adoption of organic drystock farming in Ireland. Eur. Rev. Agric. Econ. 42, 315–337. https://doi.org/10.1093/erae/jbu024

Läpple, D., Kelley, H., 2013. Understanding the uptake of organic farming: Accounting for heterogeneities among Irish farmers. Ecol. Econ. 88, 11–19. https://doi.org/10.1016/j.ecolecon.2012.12.025

Läpple, D., Rensburg, T. Van, 2011. Adoption of organic farming: Are there differences between early and late adoption? Ecol. Econ. 70, 1406–1414. https://doi.org/10.1016/j.ecolecon.2011.03.002

Lastra-Bravo, X.B., Hubbard, C., Garrod, G., Tolón-Becerra, A., 2015. What drives farmers' participation in EU agri-environmental schemes?: Results from a qualitative meta-analysis. Environ. Sci. Policy 54, 1–9. https://doi.org/10.1016/j.envsci.2015.06.002

Lioutas, E.D., Charatsari, C., 2018. Green Innovativeness in Farm Enterprises: What Makes Farmers Think Green? Sustain. Dev. https://doi.org/10.1002/sd.1709

Marenya, P.P., Barrett, C.B., 2007. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. Food Policy 32, 515–536. https://doi.org/10.1016/j.foodpol.2006.10.002

Marini, L., Klimek, S., Battisti, A., 2011. Mitigating the impacts of the decline of traditional farming on mountain landscapes and biodiversity: a case study in the European Alps. Environ. Sci. Policy 14, 258–267. https://doi.org/10.1016/j.envsci.2010.12.003

Marra, M., Pannell, D.J., Abadi Ghadim, A., 2003. The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: where are we on the learning curve? Agric. Syst. 75, 215–234. https://doi.org/10.1016/S0308-521X(02)00066-5

Mettepenningen, E., Vandermeulen, V., Delaet, K., Van Huylenbroeck, G., Wailes, E.J., 2013. Investigating the influence of the institutional organisation of agri-environmental schemes on scheme adoption. Land use policy 33, 20–30. https://doi.org/10.1016/j.landusepol.2012.12.004

Micha, E., Areal, F.J., Tranter, R.B., Bailey, A.P., 2015. Uptake of agri-environmental schemes in the Less-Favoured Areas of Greece: The role of corruption and farmers' responses to the financial crisis. Land use policy 48, 144–157. https://doi.org/10.1016/j.landusepol.2015.05.016

Mills, J., Gaskell, P., Ingram, J., Chaplin, S., 2018. Understanding farmers' motivations for providing unsubsidised environmental benefits. Land use policy 76, 697–707. https://doi.org/10.1016/j.landusepol.2018.02.053

Moon, K., 2013. Conditional and resistant non-participation in market-based land management programs in Queensland, Australia. Land use policy 31, 17–25. https://doi.org/10.1016/j.landusepol.2011.08.011

Morris, C., 2004. Networks of agri-environmental policy implementation: a case study of England's Countryside Stewardship Scheme. Land use policy 21, 177–191. https://doi.org/10.1016/j.landusepol.2003.01.002

Moser, C.M., Barrett, C.B., 2006. The complex dynamics of smallholder technology adoption: the case of SRI in Madagascar. Agric. Econ. 35, 373–388. https://doi.org/10.1111/j.1574-0862.2006.00169.x

Mozzato, D., Gatto, P., Defrancesco, E., Bortolini, L., Pirotti, F., Pisani, E., Sartori, L., 2018. The Role of Factors Affecting the Adoption of Environmentally Friendly Farming Practices : Can Geographical Context and Time Explain the Differences Emerging from Literature? Sustainability 10, 1–23. https://doi.org/10.3390/su10093101

Murphy, G., Hynes, S., Murphy, E., O'Donoghue, C., 2014. An investigation into the type of farmer who chose to participate in Rural Environment Protection Scheme (REPS) and the role of institutional change in influencing scheme effectiveness. Land use policy 39, 199–210. https://doi.org/10.1016/j.landusepol.2014.02.015

Mzoughi, N., 2011. Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? Ecol. Econ. 70, 1536–1545. https://doi.org/10.1016/j.ecolecon.2011.03.016

Nyblom, J., Borgatti, S., Roslakka, J., Salo, M.A., 2003. Statistical analysis of network data—an application to diffusion of innovation. Soc. Networks 25, 175–195. https://doi.org/10.1016/S0378-8733(02)00050-3

Pascucci, S., De-Magistris, T., Dries, L., Adinolfi, F., Capitanio, F., 2013. Participation of Italian farmers in rural development policy. Eur. Rev. Agric. Econ. 40, 605–631. https://doi.org/10.1093/erae/jbt005

Pavlis, E.S., Terkenli, T.S., Kristensen, S.B.P., Busck, A.G., Cosor, G.L., 2016. Patterns of agri-environmental scheme participation in Europe: Indicative trends from selected case studies. Land use policy. https://doi.org/10.1016/j.landusepol.2015.09.024

Polman, N.B.P., Slangen, L.H.G., 2008. Institutional design of agri-environmental contracts in the European Union: the role of trust and social capital. NJAS - Wageningen J. Life Sci. 55, 413–430. https://doi.org/10.1016/S1573-5214(08)80029-2

Raggi, M., Viaggi, D., Bartolini, F., Furlan, A., 2015. The role of policy priorities and targeting in the spatial location of participation in Agri-Environmental Schemes in Emilia-Romagna (Italy). Land use policy 47, 78–89. https://doi.org/10.1016/j.landusepol.2015.03.005

Reimer, A., Thompson, A., Prokopy, L.S., Arbuckle, J.G., Genskow, K., Jackson-Smith, D., Lynne, G., McCann, L., Morton, L.W., Nowak, P., 2014. People, place, behavior, and context: A research agenda for expanding our understanding of what motivates farmers' conservation behaviors. J. Soil Water Conserv. 69, 57A–61A. https://doi.org/10.2489/jswc.69.2.57A

Riley, M., 2016. How does longer term participation in agri-environment schemes [re]shape farmers' environmental dispositions and identities? Land use policy 52, 62–75. https://doi.org/10.1016/j.landusepol.2015.12.010

Singer, J.D., Willett, J.B., 2003. Applied longitudinal data analysis : modeling change and event occurrence. Oxford University Press.

Swetnam, R.D., Owen Mountford, J., Manchester, S.J., Broughton, R.K., 2004. Agri-environmental schemes: their role in reversing floral decline in the Brue floodplain, Somerset, UK. J. Environ. Manage. 71, 79–93. https://doi.org/10.1016/j.jenvman.2004.01.006

Welch, E.W., Marc-Aurele, F.J., 2001. Determinants of Farmer Behavior: Adoption of and Compliance with Best Management Practices for Nonpoint Source Pollution in the Skaneateles Lake Watershed. Lake Reserv. Manag. 17, 233–245. https://doi.org/10.1080/07438140109354133

Whitten, S.M., Reeson, A., Windle, J., Rolfe, J., 2013. Designing conservation tenders to support landholder participation: A framework and case study assessment. Ecosyst. Serv. 6, 82–92. https://doi.org/10.1016/j.ecoser.2012.11.001

Wollni, M., Andersson, C., 2014. Spatial patterns of organic agriculture adoption: Evidence from Honduras. Ecol. Econ. 97, 120–128. https://doi.org/10.1016/j.ecolecon.2013.11.010

Wynn, G., Crabtree, B., Potts, J., 2001. Modelling Farmer Entry into the Environmentally Sensitive Area Schemes in Scotland. J. Agric. Econ. 52, 65–82. https://doi.org/10.1111/j.1477-9552.2001.tb00910.x

Yamaguchi, K., 1991. Event history analysis. Sage Publications.

6. Policy implications and conclusions

The thesis aimed to understand factors affecting adoption and continuation of EFFPs in forestry and agriculture. The results are useful to provide policy-makers with suggestions enabling them to design more effective policy instruments, which was the final research question of the thesis. Given the different development stages achieved by policies in agriculture and forestry as pointed out in the introduction, it is obvious that no common policy recommendations can be drawn for the two sectors. More mature AESs policies are required for farmers aiming to stimulate their participation to AESs for a long time. More structured and well-defined policy instruments to support EFFPs adoption and the design of appropriate FEPs are needed instead for private forest owners.

Referring to the RDP policies supporting the farmers' voluntary AESs implementation, one relevant point emerged from the research is that policy-makers cannot neglect that the adaptation of farmers behaviour requires time, needed in order to allow them to accumulate experience on AESs. This implies that the advice and the information provision to farmers need to be carried out for a long-enough period in order to let their behaviour permanently change, so assuring the persistence of AESs positive environmental impacts over time.

As regards the financial incentives for AESs implementation and continuation, the second policy recommendation is to ensure that they continue to be part of the policy structure. Indeed, the results of this work show that time is not ripe to ask farmers to maintain AESs unsubsidised, as it is debated, for example, in the UK context. At present, in the Italian context, environmental attitudes are not yet enough established in the overall farmers' community. In addition, fine-tuning of payments has to continue and payments should better meet the higher costs incurred by small-scale farms while to date they are yet too anchored to average costs estimates that play in favour of large-scale farms.

Furthermore, policy-makers should endure in the effort to adapt AESs to the situation on the ground by improving the policy design and targeting in order to stimulate farmers' persistence in the scheme.

Finally, policy-makers have to tailor their policies on the farmers' motivations and attitudes – which have an important role in driving farmers' decision to continue in AESs – considering also that they evolve over time. Indeed, while farmers' environmental motivations played a fundamental role on AESs continuation in the past, social factors emerge as crucial determinants in more recent years. Among them, the role played by social pressure and by the neighbouring farmers' effect has to be considered. This requires a change in the advice and information provision to farmers. The traditional top-down approach so far put in place

should be complemented with a horizontal approach supporting information-sharing networks among peers. These should not only convey technical information and knowledge but also facilitate the sharing of common social values like appreciation by other farmers and by the local communities. The shared common social values contribute to build-up a new farmer's self-image based not only on his/her productive function but also on his/her role as steward of the environment. In the medium run, this may also contribute to soften the diffuse farmers' perception that complying with ESs provision is only a societal obligation.

Considering that the future CAP will be characterised by a deeper exercise of the subsidiarity principle, all these aspects should be carefully considered in defining the implementing rules of the new CAP 2021-2027 at the country/regional level. Overall, the legislative proposal presented by the European Commission on 1 June 2018 addresses nine objectives, among which climate change mitigation, environmental care, and landscapes and biodiversity preservation remain essential tasks of the future CAP. In this regard, CAP 2021-2027 will continue to give farmers the possibility to support the provision of these ESs through the voluntary adoption of more sustainable farming practices. At the same time, CAP tools will became more flexible in order to adapt the policy design to the changing context.

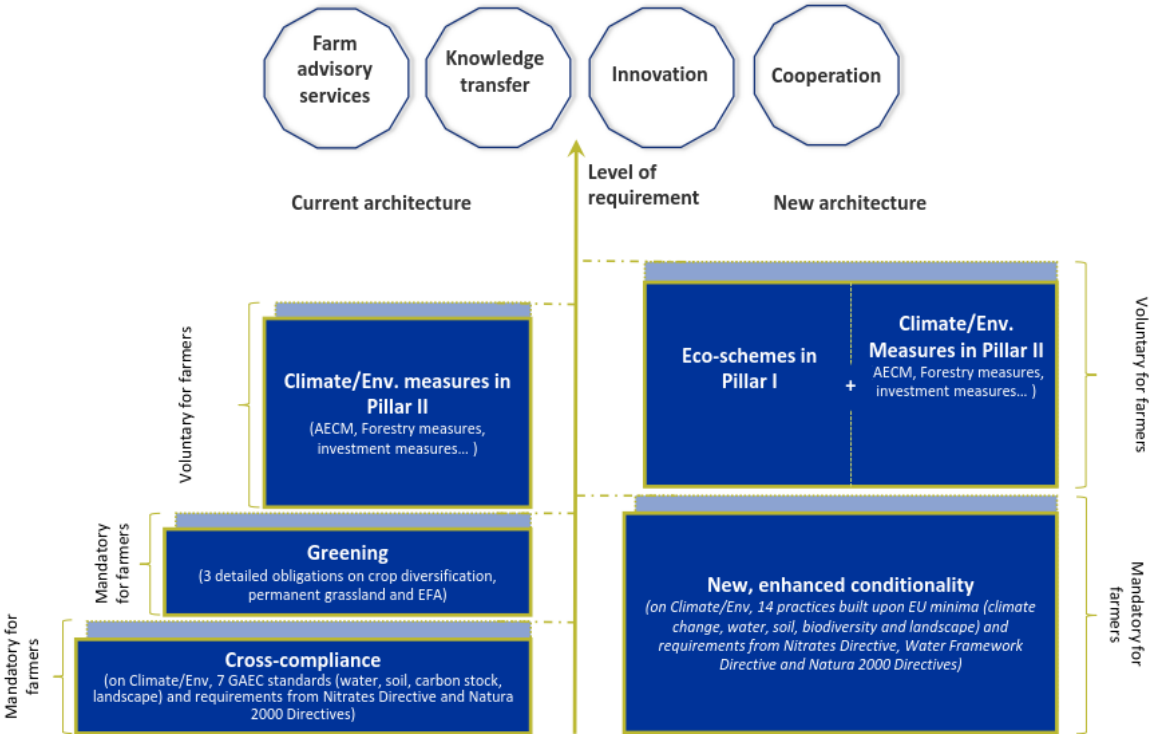
The new architecture of the CAP (Figure 6.1) proposes some new elements: i) a set of mandatory requirements for farmers (that extends the current cross-compliance and the greening obligation to all farmers); ii) a new component of the direct payments (eco-scheme) adopted by member States on a voluntary basis; and iii) a voluntary set of agri-climatic actions for farmers funded by the CAP second Pillar (the current AESs). Overall, this new architecture enhances the interplay between the mandatory and voluntary instruments of the first Pillar and the voluntary AESs of the second Pillar. Moreover, the new architecture of the CAP gives a considerable leeway to member States in designing the policy instruments connected to environmental issues.

Referring to the landscape-related AESs, the research results suggest that:

a. the inclusion of these schemes within the new mandatory environmental conditionality of the CAP first Pillar – e.g. imposing the maintenance of pre-existing hedgerows or buffer strips to all farmers – should be carefully evaluated. Indeed, if this policy change seems to be easily implemented by large-scale farms (that have already included hedgerows and buffer strips in their EFA commitments of the current CAP having more than 10 ha of arable land) more caution is needed for small-scale farms for which the AES payment is a crucial element of income integration;
b. if Italian policy-makers choose to maintain the selected AES within the environmental measures of the CAP second Pillar, the efforts to better tailoring the AES design to the situation on the ground will have to continue;

c. farmers' motivations and attitudes, as well as social factors, have to be carefully considered since they emerge as crucial determinants in their choice of adopting the selected AES, especially in the more recent policy rounds. In this regard, further efforts are needed to adapt information provision and technical advice in order to strengthen the farmers' self-image connected to the social values and to actively engage neighbouring farmers in the process of diffusion of such kind of agricultural practices.

Figure 6.1. The new green architecture of the CAP 2021-2027 (Source: EC, 2018).



In the case of forestry, results highlight that private forest owners can be split in two groups according to their motivations. On one hand, production-oriented private forest owners are effectively asking for ESs provision policies based on public financial support similar to those designed for the agricultural sector. This is connected to the fact that these private forest owners perceive the cost connected to the EFFPs adoption for ESs provision as a foregone income. For this group of private forest owners, the definition of the mandatory baseline is essential. Progresses in this direction has been made thanks to the new forest law (D.lgs n. 34/2018). However, work still needs to be done, as the law is still unclear about how to concretely implement FEPs and to identify their baseline. In addition, it is also essential to properly estimate the amount of payment also in reference to the cost of provision incurred when implementing EFFPs.

On the other hand, private forest owners motivated by sentimental and bequest values are willing to provide ESs even without payment. For these forest owners, the policy tools should not necessarily be based on financial support but focus more on strengthening their motivations and providing information. The issue is how to distinguish these two groups. In the thesis, a broad distinction between the two groups is based on the forest composition: mainly coniferous in the first case and mainly mixed or broadleaved in the second case. This distinction is difficult be used in the policy design. An institutional distinction has to be identified. One proposal is to refer to the market or non-market orientation of private forest owners even if this distinction is not effective for all the analysed ESs.
The thesis results also show that private forest owners are willing to provide ESs which they are more familiar with, like biodiversity improvement and soil conservation, while they are more reluctant for new and not well-known ESs, like carbon sequestration. In this case, a more comprehensive policy approach is needed. The low rate of willingness to provide this service asks for a financial support-based and an accurate and sharply focused information provision policy.

One limitation of this work is to be based on a single geographical and institutional context (i.e. the Veneto region) and only on a partial set of EFFPs. In addition, a second limitation is that the theory of planned behaviour and reasoned actions disregards a set of value-chain-related factors which may affect farmers' and private forest owners' choices on adoption and continuation of some EFFPs. Value-chain factors are important for farmers when the adoption of some EFFPs generates an increase of the consumers' willingness to pay for environmentally friendly products, as in the case of organic or integrated pest management food products. In these cases, the impact of prices received by farmers adopting some EFFPs should be carefully considered when defining the public financial support. In the long supply chains, the issue of how the consumer price premiums is transferred to farmers is controversial, given the strong market power of the processors and, above all, of the retail sector. Differently, in short supply chains this effect may be higher, especially for direct sales, and should be carefully explored. All these aspects have not been considered in this work and, therefore, they would deserve further analysis also for their policy implications (e.g. avoiding a double payment for EFFPs by public support and food market).
Similar considerations can be extended also to private forest owners under the existing sustainable forest management certification schemes. First, if we exclude the collective proprieties, private forest owners generally do not join these certification schemes. Second, the processor market power does not allow an adequate remuneration of the additional cost incurred for the certification and the adaptation of forest management, even if certification is

required in the international market. Finally, in the local market, although certification is potentially a mean for increase the income of private forest owners, demand is yet limited to niche markets.

Despite the above-mentioned limitations, the results are consistent with the literature, consequently the policy recommendations that have been drawn could be extended to other contexts and EFFPs. Moreover, the research brings interesting insights to both academics and policy-makers, providing a valuable contribution to the existing literature and showing the direction for future research both from a policy and a methodological perspective. From a methodological point of view, the thesis contributes to the limited duration literature concerning AESs continuation and clarifies the time dynamics that are connected to farmers' attitude and motivation. In addition, the work offers insights on private forest owners' willingness to provide ESs, an issue that has not yet been fully explored in a Southern European context.

References

European Commission (2018). Common Agricultural Policy post-2020: Legislative proposals. Oral presentation by Ramon i Sumoy, R. at the EESC Study group on Future CAP. Brussels, 25 June 2018.