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Full Research Article

Farmer's motivation to adopt sustainable agricultural practices

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Abstract. The 2014-2020 Common Agricultural Policy (CAP) reform defines new rules for farmers including maintenance of the ecological focus area (EFA). Sustainability is also a requirement to meet consumer expectations and a competitive advantage for firms. This paper aims to evaluate the farmers' intention to implement sustainable practices related to the EFA measure and to the private sustainability schemes proposed by the food industry. The Theory of Planned Behaviour (TPB) was applied on a sample of durum wheat producers to analyse intentions 1) to maintain 7% of the arable land as an EFA, and 2) to implement the private sustainability scheme. Structural equation modelling was applied to test for the relative importance of intention determinants. The farmers' attitude and past behaviour positively affect intentions to implement the EFA, while perceived behavioural control and attitudes predict intentions to adopt the private sustainability scheme. These results suggest possible interventions that public authorities and supply chain leaders might implement to stimulate farmers' sustainable behaviours.

Keywords. Common Agricultural Policy, durum wheat, theory of planned behaviour, sustainability, ecological focus area.

JEL Codes. Q18, D22, Q01

1. Introduction

The design of alternative, sustainable agricultural systems and technologies is largely debated in the literature and rapidly evolving. The environmental objectives have become increasingly integrated into the EU's Common Agricultural Policy (CAP), and the new 2014-2020 reform reinforces eco-friendly agricultural practices by introducing new commitments for beneficiaries. The CAP green direct payment (greening), accounting for 30% of the national direct payment envelope, rewards farmers for respecting three actions: crop diversification, maintenance of permanent grassland and the ecological focus area

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(EFA). As defined by the Regulation (EU) n. 1307/2013, the greening is a new mandatory component of the CAP which compensates for the possible profit losses incurred by farmers for provisioning environmental public goods and services to the wider public, such as landscapes, farmland biodiversity, etc. (European Commission, 2013)[1]. Crop diversification aims to avoid the monoculture practice and establishes that farms with more than 10 ha of arable land will need to cultivate a least two crops, while on farms with more than 30 ha farmers will need to cultivate at least three crops. The ratio between the permanent grassland and the total agricultural area (at national, regional, sub-regional or farm level) must not fall by more than 5% of a reference ratio to be established in 2015. The EFA action forces farms with more than 15 hectares of arable land to maintain at least 5% of the arable land (likely 7% after 2017) to an area with particular environmental characteristics, such as strip and buffer areas, environmental set-aside and nitrogenous fixing crops. Because of its high compliance costs, the new CAP mechanism will likely affect farmers' decisions (input allocation) and the economic results of farms (Schulz *et al.*, 2014; Solazzo *et al.*, 2014).

Besides the CAP, sustainability is becoming an important requirement to meet consumer expectations and, thus, a competitive advantage for firms that can guarantee the monitoring of the processes' environmental performances. In several cases the cooperation between farmers and food industries to meet retailer and consumer needs has produced effective private (voluntary) sustainability schemes able to achieve a more sustainable supply chain and to create value for the stakeholders (Hamprecht *et al.*, 2005; Muradian and Pelupessy, 2005). Examples are the processed tomato district in Northern Italy and the Sustainable Agricultural Initiative (SAI, 2013). In this context, farmers' acceptance to participate in these schemes needs to be considered. Although private sustainability schemes may contribute to improve the farm profitability, some barriers can prevent the participation of farmers. There are significant transaction costs in implementing sustainability schemes (Falconer, 2000), such as those necessary to get additional information on procedures and profitability of similar experiences; in this context, internal or external barriers may exist, like farmers' risk aversion, market and policy uncertainty, cultural resistance, high farm fixed investments, and lack of long-run entrepreneurial vision. All these factors drive farmers' behaviour and potentially reduce their willingness to adopt eco-friendly agricultural practices.

While the effect of CAP payments on farmers' behaviours has been widely studied in the economic literature, the agri-environmental measures have been less investigated. In particular, the second pillar agri-environmental actions have been evaluated to understand the responsiveness of farmers and their effectiveness at the territorial level (Primdahl *et al.*, 2010; Godard *et al.*, 2008; Buysse *et al.*, 2007). Attempts to predict the impact of agri-environmental measures and related payments on farmers behaviour and decisions have been developed mainly applying mathematical programming techniques (Arfini and Donati, 2013; Louhichi *et al.*, 2010; Janssen *et al.*, 2010; Galko and Jayet, 2011; Buysse *et al.*, 2007; Röhm and Dabbert, 2003) and other econometric models, such as stochastic production frontier (Reinhard *et al.*, 1999), random parameter logit (Espinosa-Godet *et*

[1] According to the Regulation (EU) n. 1306/2013, failure to respect the greening component should lead to penalties up to the 125% of the greening payment.

al., 2010), nonparametric regression (Kleinhanß *et al.*, 2007), and dual approach in production theory (Bonnieux *et al.*, 1998).

Despite the extensive use of quantitative methodologies to study the adoption of agri-environmental measures, behavioural approaches such as attitude-based methods, have also been used to predict the farm response to new environmental policy design. In particular, the Theory of Planned Behaviour (TPB) (Ajzen, 1991), which focuses on the assessment of behavioural intentions determinants, has been widely applied to understand and predict the likely behaviour of farmers regarding environmental protection actions. The TPB suggests that the likelihood of a particular behaviour can be predicted by the individual's intention to perform that behaviour, capturing the motivational factors that influence behaviour. According to the TPB, behaviour is guided by the favourable or unfavourable evaluation of the behaviour (attitude towards the behaviour), perceived social pressure (subjective norms, SN) and perceived ability to perform the behaviour (perceived behavioural control, PBC). In general, the more favourable the attitude and subjective norm, and the greater the perceived control, the stronger the intention to perform a given behaviour should be (Ajzen, 1991). Although widely applied in the analysis of consumer's behaviour (see, e.g., Menozzi and Mora, 2012; Menozzi *et al.*, 2015), the TPB has been successfully used to predict entrepreneurial behaviour, such as starting a business (Kautonen *et al.*, 2013), or to test the determinants of farmers' strategic behaviour (Bergevoet *et al.*, 2004), providing more predictive power than personality traits or demographic characteristics. There have been a large number of TPB studies addressing environmental and sustainability-related behaviours in agriculture, such as farmers' conservation-related behaviour (Beedell and Rehman, 2000; Yazdanpanah *et al.*, 2014), improved grassland management (Martínez-García *et al.*, 2013), climate information use (Sharifzadeh *et al.*, 2012), adoption of soil erosion control practices (Wauters *et al.*, 2010), adoption of environmentally-oriented behaviour (Power *et al.*, 2013), participation in sustainability programs (Corbett, 2002), and in other sustainable agricultural practices (e.g., Fielding *et al.*, 2008). All of these TPB applications attempted to identify the driving factors that lead producers to adopt a given decision. The results are important for policy makers and food chain actors who consider the cause-effect linkage between policies and producer behaviour to develop the most appropriate strategy and intervention to stimulate farmers' sustainable behaviour (Beedell and Rehman, 2000).

This paper adds to this stream of literature by evaluating the farmers' intention to adopt sustainable agricultural practices. In particular, we have studied the intention 1) to maintain at least 7% of the arable land as EFAs and 2) to implement at farm level a private sustainability scheme as proposed by the food industry. In relation to the 2014-2020 CAP reform, we decided to concentrate the study only on the EFA actions because of its high estimated compliance cost (Solazzo *et al.*, 2014). The analysis focused on durum wheat producers in Italy. This Mediterranean production represents the raw material for one of the most important Italian food chain: the pasta's food chain. In 2013, the pasta industry showed an annual turnover of 4.5 billion € equal to 3.5% of the Italian food industry turnover. Almost the entire quantity of semolina used in Italy, obtained from 1.2 billion hectares cultivated with durum wheat, is addressed to the pasta industry (ISMEA, 2014). Moreover, this sector has shown to be particularly sensitive to CAP changes (Cisilino *et al.*, 2012), and its intensive production in some parts of Italy constitutes an environmental

issue to consider. Understanding the farmers' perception towards greening CAP practices and private approaches to sustainability can contribute to improve the cooperation among the food chain operators and a better integration of the public and private sustainable measures.

The following section describes the theoretical framework and its application to durum wheat farmers defining the hypotheses to be tested. Based on this theory a working model was developed to evaluate the farmers' intention to adopt sustainable agricultural practices. The data collection and analytical procedures to test the hypothesis are outlined in the next section and the empirical results are presented. Discussion and conclusions make up the final section of the paper.

2. The theoretical framework

The econometric models generally applied to study farmers' adoption of eco-friendly agricultural practices employ a range of determinants such as farm and farmer characteristics, institutional setting, individual perceptions related to the economic environment, etc. Hansson *et al.* (2012) noticed that psycho-social models have recently been used in the field of behavioural economics and have been shown to explain economic behaviour and to increase the relevance of economic models. This paper extends this research by introducing psychosocial constructs to explain farmers' intention to adopt environmental sound practices (i.e. maintenance of at least 7% of the arable land as EFAs and implementation of a private sustainability scheme) by applying Ajzen's (1991) Theory of Planned Behaviour (TPB). Originating from social psychology, the TPB considers the individual's intention to perform a given behaviour a central factor in performing the behaviour. Intentions are assumed to capture the motivational factors that influence a behaviour, and depend on beliefs that link the given behaviour to certain outcomes (attitudes) and on the perceived social pressure to perform the behaviour (subjective norms). Intentions are expected to influence behavioural performance to the extent that the person has actual control over the behaviour (PBC). In the agri-environmental context, the TPB thus contributes to our understanding of the emergence of farmers' behaviour and determinants prior to any observable action, which has notable implications for agricultural policy and food industry strategy (Kautonen *et al.*, 2013), for example if the objective is to promote sustainable management of natural resources by fostering a culture of sustainability among farmers (Matthews, 2013). Indeed, from a methodological perspective, TPB is an appropriate theoretical framework providing a parsimonious model for understanding farmers' beliefs and motivations, and how information can influence behaviour (Fielding *et al.*, 2008). Attempts to promote sustainable agricultural systems, e.g., by private sustainability schemes, will require an understanding of how behavioural change can be influenced. In this context, questions regarding farmers' environmental sustainability behaviours are increasingly tackled by using the TPB for its ability in addressing complex behaviours depicting the mechanisms that lead people to be supportive of such ecological practices (Yazdanpanah *et al.*, 2014). The role of individual attitudes, social pressure and control over the behaviour can be evaluated and assessed to understand what encourages farmers to accept or reject agri-environmental practices as part of their farm management activities.

Prior applications of the TPB to the agri-environmental context suggest that attitude, subjective norms and PBC explain from 23% to 72% of the variance in intention (Corbett, 2002; Sharifzadeh *et al.*, 2012; Fielding *et al.*, 2008; Wauters *et al.*, 2010; Yazdanpanah *et al.*, 2014). The farmers' intention to adopt environmental sound practices was found to be positively affected by their personal attitudes towards the behaviour (e.g., Fielding *et al.*, 2008; Wauters *et al.*, 2010). Secondly, it has been argued that farmers' behaviour is not fully under volitional control (Sharifzadeh *et al.*, 2012), whilst is strongly influenced by external stakeholders such as producers' organizations, food industries, public authorities, etc. Thus, PBC and subjective norms become valuable theoretical constructs. Therefore, in this study we suggest that:

H1a: A favourable attitude would significantly predict farmers' intention to adopt sustainable agricultural practices.

H1b: Subjective norms would significantly predict farmers' intention to adopt sustainable agricultural practices.

H1c: PBC would significantly predict farmers' intention to adopt sustainable agricultural practices.

Although the success of the TPB in predicting behaviour has been proved (Armitage and Conner, 2001), it has been argued that for some behaviour and contexts the inclusion of other variables may increase the model's predictive power (Menozzi *et al.*, 2015). It is reasonable to assume that the farmers with greater environmental awareness and who feel moral responsibilities toward environmental behaviours could be expected to have more positive attitudes towards the adoption of sustainable agricultural practices (Beedell and Rehman, 2000; Corbett, 2002; Fielding *et al.*, 2008). Therefore, a measure of moral obligation, defined as an individual's perception of the moral correctness or incorrectness of performing a behaviour (Ajzen, 1991), has been added to the model suggesting the following hypothesis:

H2: Moral obligations have a positive and significant effect on farmers' attitudes towards sustainable agricultural practices.

Several studies have also suggested that past behaviour may be an important predictor of future behaviour (Armitage and Conner, 2001). Fielding *et al.* (2008) argued that past efforts in ecological management practices, comprising a set of behaviours that require substantial outlay of time and capital, are likely to have a substantial impact on future intentions. Consistent with their argument and findings, a variable measuring past behaviour was also included in the model relative to EFAs and expected to be a positive predictor of intentions. Thus, we propose the following:

H3: Farmers that have already an ecological area on their agricultural holdings would intend to maintain the EFAs also in the future.

Consistent with similar studies (see, e.g., Kautonen *et al.*, 2013), the model specification includes also other variables related to the structure of agricultural holdings (e.g., farmer age, % of rented agricultural land, % of durum wheat acreage, etc.), in order to monitor their effect on behavioural intentions.

Therefore the contributions of this paper are twofold. First, it provides an understanding of the determinants of durum wheat farmers' adoption of sustainable agricultural practices (EFAs and private sustainability schemes), in the context of the forthcoming 2014-2020 CAP reform and the possible initiatives proposed by the food industry. Sec-

ondly, the relationships between TPB predictors and intention to adopt environmental sound practices will be addressed, justified, and empirically tested using structural equation modelling (SEM) technique.

3. Data and methodology

A survey on a sample of durum wheat producers in Italy, involved in the pasta's supply chain, allowed to analyse two behaviours related to sustainable agricultural practices: 1) the maintenance of at least 7% of the arable land as EFAs, and 2) the implementation at farm level of a private sustainability scheme including the adoption of eco-friendly farming practices. For this latter behaviour, the questionnaire suggested as an example few possible actions that farmers could have implemented within the private sustainability scheme, such as pesticides and chemical fertilizers reduction, renewable energy provision, integrated agriculture, etc. The questionnaire specified that the farmers would have to agree with other stakeholders (i.e. the food industry) their commitments to the eco-friendly farming practices included in the scheme. The specific mechanisms of the private sustainability scheme and related economic incentives were not investigated. The aim was to assess the intention to adopt at farm level the new environmental strategies developed within the pasta supply chain, once they become available. Since at the time of the survey neither the 2014-2020 CAP reform nor the private sustainability schemes were implemented by the Italian durum wheat producers, the study focused on intention to behave as a proxy for actual behaviour (Lobb *et al.*, 2007). However, explorative research including extensive literature searches and a focus group was conducted prior to questionnaire design in an attempt to minimise the differences in observed and real responses. A SEM technique was used to test for the relative importance of determinants in the two considered behavioural intentions.

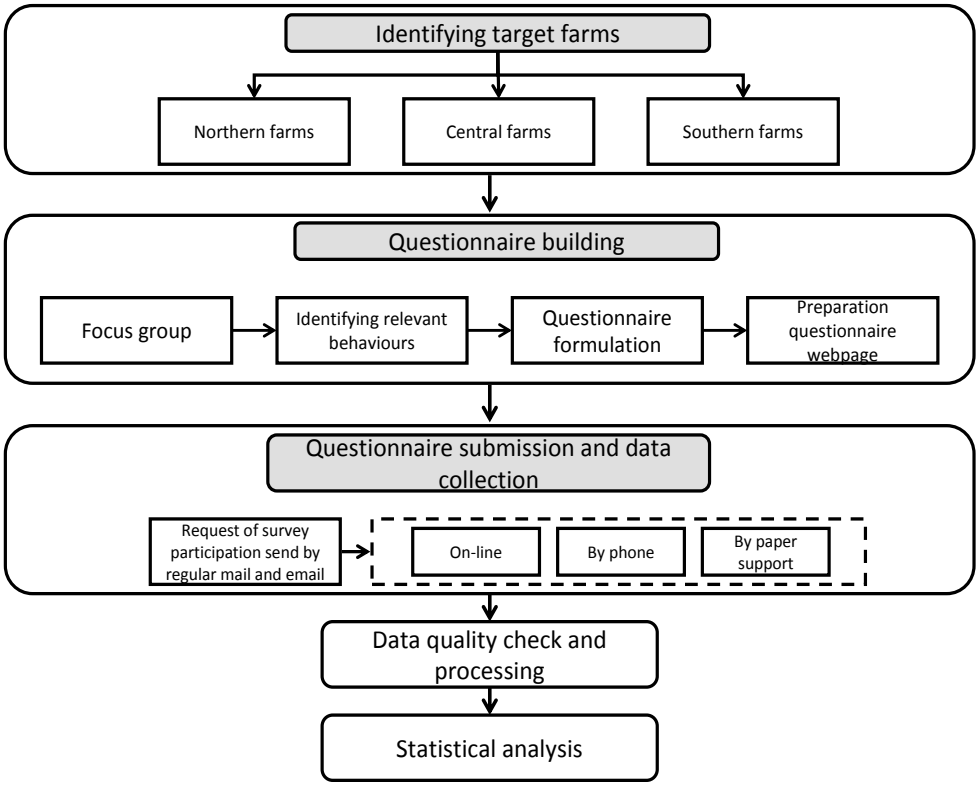
3.1 Data collection

A survey was conducted from June to July 2013 on a sample set of farmers involved in the pasta supply chain producing durum wheat in Italy. In particular, all of the contacted farmers signed contracts with the world's largest pasta producer. Contract farming establishes the technical and agronomic criteria for growing and delivering durum wheat with a specified quality as well as price. Most of these farms belong to producers' organisations (POs), which represent the main interface between farmers and the industry. Through the pasta industry and POs, we have identified 211 durum wheat producers that were formally involved in the supply chain of the world's largest pasta industry, distributed uniformly in the three Italian geographical areas, i.e., North, Centre and South.

As shown in Figure 1, this survey was conducted in different steps, starting with the organisation of a preliminary focus group of 6 participants (4 farmers, 1 food industry representative and 1 agronomist) to identify the main issues perceived by durum wheat producers regarding the new CAP reform (Fioravanzi, 2013). The focus group identified the relevant behaviours related to CAP reform and agro-environmental practices to be tested with statistical analysis. Then, a questionnaire based on the TPB constructs

was defined and sent to the farmers by regular and electronic mail. In the beginning of the questionnaire, a request of participation was emphasised with the explanation of the study's aim and the instructions to fulfil the questionnaire to prepare and commit the farmers to the survey. Farmers could fill in the questionnaire in three ways: on-line by a specific webpage, by phone through direct interview, and by paper questionnaire to return via regular mail.

Figure 1. Analysis design.



A total of 73 questionnaires were completed, 16 by paper and 57 on-line questionnaire; no farmers decided to reply by phone interview. After two incomplete questionnaires were removed, the final sample consisted of 71 respondents. As shown in Table 1, the sample set was almost equally distributed between the three geographical areas.

Most of the farms of the sample are specialised in field crops, particularly cereal production, while 63% of the farms belonged to POs. The farms that were surveyed in Central Italy were larger, in terms of Utilised Agricultural Area (UAA), than were those in the Northern and Southern regions. As shown in Table 1, their size is much larger than the average size of farms specialised in field crops in Italy (i.e. 13 ha). The percentage of durum wheat surface on total UAA is on average 43% for the sample, with higher values

Table 1. Description of the main characteristics of the sample set and Italian farms producing durum wheat.

Description	Sample				Italy			
	North	Centre	South	Total	North	Centre	South	Total
No. of farms	21	29	21	71	14,718	31,818	156,254	202,790
- Specialised in cereals	17	22	20	59	n.a.	n.a.	n.a.	n.a.
- Belonging to the Producers' Organisation	16	16	13	45	n.a.	n.a.	n.a.	n.a.
Utilised Agricultural Area per farm (UAA, average ha)	114.6	212.6	71.3	141.8	13.4 [a]	14.5 [a]	11.5 [a]	12.8 [a]
Durum wheat surface per farm (average ha)	23.1	94.8	45.3	80.4	8.0	9.9	6.3	7.0
% Durum wheat surface on total UAA	20.2	44.6	63.6	43.0	5.5 [a]	34.9 [a]	52.5 [a]	28.9 [a]
% Rented agricultural land on total UAA	36.1	58.3	19.7	40.4	44.3	24.7	21.7	31.4
% Single farm payment of total revenue	29.1	31.1	46.8	35.1	n.a.	n.a.	n.a.	n.a.
% Durum wheat revenue of the total revenue	18.8	45.0	59.2	41.5	n.a.	n.a.	n.a.	n.a.
Farmer age (average)	50.6	47.1	53.3	50.1	62.9 [a]	62.4 [a]	58.5 [a]	61.5 [a]
Distance from milling plant (Km)	129.1	87.6	172.2	124.9	n.a.	n.a.	n.a.	n.a.

[a] Data referred to farms specialised in field crops.
Source: own elaboration on data of the 2010 Agricultural Census.

in Southern and Central regions (respectively 64% and 45%), and a lower value in Northern Italy (20%). This data is higher than the Italian average (29%), and the average for the three macro-areas (North 6%, Centre 35% and South 53%). On average, 40% of the UAA of the surveyed holdings was rented, with a greater incidence in Central and Northern Italy (respectively 58% and 36%) as compared to Southern regions (20%). This figure is slightly higher than the Italian average data for farms with durum wheat production. Approximately 35% of the total revenue is represented by the single farm (decoupled) payment, demonstrating the high level of dependence of these farms on public subsidies. The introduction of more balanced CAP payments could strongly affect farms' revenues and, consequently, investments. The high percentage of durum wheat revenue and cultivated surfaces of the total reflects the high degree of specialisation, particularly in the surveyed farms of Central and Southern Italy. In this sample, the farmer's average age is approximately 50 years; this figure is lower than the average age of Italian farmers producing durum wheat (62 years). The average distance of farms from the mill is 125 km, with higher values in the Southern regions (172 km), and a lower distance in the Central Italy (88 km). It can be concluded that the surveyed farms are larger, more specialized in the production of durum wheat, managed by younger farmers then the national population. These differences are likely to be influenced by the sampling criteria, i.e. farms with contractual agreements with the food industry; indeed, vertically integrated farms are more likely to be larger and managed by younger and trained managers than non-integrated ones (Deininger and Byerlee, 2012).

3.2 Model measures

The questionnaire was defined considering a) Ajzen's conceptual and methodological guidelines for constructing a TPB questionnaire (Ajzen, 1991; 2006), b) previous findings on similar topics (Beedell and Rehman, 2000; Corbett, 2002; Fielding *et al.*, 2008; Wauters *et al.*, 2010; Hansson *et al.*, 2012), and c) the preliminary focus group (Fioravanzi, 2013). After having explained in detail the 2014-2020 CAP reform in terms of greening commitments and the possibility to adopt private environmental sustainability schemes, two behaviours were surveyed: 1) the maintenance of at least 7% of the arable land with particular environmental characteristics (ecological focused area, EFA), and 2) the implementation at farm level of the private sustainability scheme including the adoption of eco-friendly farming practices like fertilizers and pesticides reduction, green energy, integrated agriculture, etc. The questionnaire explained that the farmers, that voluntarily had decided to participate in the scheme, would have agreed with other stakeholders (i.e. the food industry) their commitments to the included environmental sustainability practices. The participants received a questionnaire containing items measuring the model variables across these two behaviours: attitudes, subjective norms, PBC, moral obligation and behavioural intentions. All of the items were scored on a 7-point Likert scale (1 = "strongly disagree", 7 = "strongly agree"); the questionnaire items related to model variables are listed in Table 3 and Table 4 with the resulted means and standard deviations.

Regarding the first behaviour analysed, i.e. maintenance of EFAs, attitudes were measured using four questionnaire items (e.g., "Maintaining at least 7% of the arable land as an EFA is negative – positive for the environment"), the subjective norms were measured by means of eight items (e.g., "The mills and the food industry expect me to maintain at least 7% of the arable land as an EFA"), three items measured the PBC (e.g., "Whether I maintain at least 7% of the arable land as an EFA is a decision that depends entirely on me") and two items measured behavioural intentions (e.g., "I intend to maintain at least 7% of the arable land as an EFA"). A measure of perceived moral obligation (Beedell and Rehman, 2000; Corbett, 2002; Fielding *et al.*, 2008) was added to the TPB model, including two items in the questionnaire (e.g., "I believe that maintaining at least 7% of the arable land as an EFA is fair for future generations"). A variable measuring past behaviour was also modelled to consider farmers that have already EFA features on their arable land. The respective single-item measure in the survey questionnaire was: "My farm is already maintaining part of its arable land as an EFA".

Concerning the second behaviour, i.e. the adoption of the private sustainability scheme, a total of four questionnaire items measure attitude in this survey (e.g., "Implementing sustainability schemes will improve the environmental quality"). Subjective norms were measured by six questionnaire items (e.g., "The public authorities expect me to implement sustainability schemes"), while four questionnaire items assessed the PBC (e.g., "My skills and knowledge allow me to implement sustainability schemes"). Two questionnaire items measured behavioural intentions (e.g., "I intend to implement sustainability schemes"). Finally, moral obligation was measured by two questionnaire items (e.g., "I believe that implementing sustainability schemes is a commitment to society").

The questionnaire also included items forming variables related to the structure of agricultural holdings (e.g., farm size, farm location, crop cultivation, etc.), and other

socio-economic aspects (e.g., % durum wheat revenues of the total farm revenues), in order to monitor their effect on behavioural intentions.

3.3 Data analysis

We tested the hypothesis specified in Section 2 by applying an extended version of the TPB model, as defined by Ajzen (1991), where intention is determined by attitudes, subjective norms and PBC, farm characteristics and other socio-economic aspects, and where attitudes are influenced by farmers' moral obligations. A structural equation model (SEM) technique was employed on the data that were collected to test for the relative importance of intention determinants in the two considered behaviours. In contrast to other techniques, like multiple regression, SEM determines the specifications of the model structure with both latent and observed variables. The latent variables are abstract phenomena that cannot be directly measured by the researcher; latent variables are formed by observed variables (in this case the questionnaire items) that are hypothesised to measure them. The extent to which each questionnaire item is measuring the same psychological construct (e.g., attitudes) is assessed by confirmatory factor analysis, CFA (Byrne, 2010). CFA, often referred to as the measurement model, is used when the researcher has some knowledge of the underlying latent variable structure or wishes to evaluate a priori hypotheses driven by theory. In other words, the measurement model (CFA) depicts the links between the latent variables and their observed measures. The internal consistency of the latent variables has been assessed by Cronbach's alpha coefficient. The relationships between the latent variables, identified as the structural model, are usually formulated by linear regression equations, graphically expressed by so-called path diagrams using arrows (see Figure 2 and Figure 3). SEM deals not only with a single simple or multiple linear regression, but with a system of regression equations allowing more complex modelling (Nachtigall *et al.*, 2003; Mulaik, 2009). Using SEM it is possible to examine the influence of several variables on several other variables, according to a specified model. In SEM exogenous latent variables (i.e. independent variables) "cause" fluctuations in the values of other latent variables in the model (Byrne, 2010). In the case studied, subjective norms, PBC, moral obligation and other background variables, such as farmers' age, are examples of such external factors. Endogenous latent variables (i.e. dependent variables) are influenced by the exogenous variables in the model either directly or indirectly, i.e. mediated by other (endogenous) variables. Fluctuation in the values of endogenous variables is explained by the model (Byrne, 2010). Thus, the whole TPB can be tested in relation to the dataset in one analysis (Hankins *et al.*, 2000)[2].

The use of different goodness-of-fit indices is generally recommended to test how well the observed data fit the model. The model fit was assessed with chi-square normalised by the degrees of freedom (χ^2/df), comparative fix index (CFI) and root mean square error of approximation (RMSEA). The coefficient of determination R-square was used to measure the explained variance of the endogenous variable (i.e., intention). The models were estimated using maximum likelihood procedures. To make sure that the overall fit was not inflated because of the small sample size relative to the degrees of freedom of the model,

[2] Information on the mathematical foundations of structural equation models can be found in Mulaik (2009).

we performed a model-based bootstrapping simulation (Yuan and Hayashi, 2003; Byrne, 2010). Bootstrapping methods are re-sampling simulations with repetition from the initial collected sample (Byrne, 2010). Bootstrapping is widely used with path modelling and SEMs, as these models usually are associated with many degrees of freedom and therefore require a larger sample size than the collected sample (Dentoni *et al.*, 2012). In this study, a model-based bootstrapping simulation increasing the sample up to one thousand repetitions leaves the overall fit of the model still acceptable on the basis of the chi-square, RMSEA and CFI.

4. Results

4.1 Farmers' intention to maintain part of the arable land as an EFA

Farmers reported a moderately low level of knowledge regarding the overall new CAP reform. Table 2 shows that farmers believe that the new reform will moderately reduce the land value and farm labour. The beliefs of the modifications of the input use (labour included) indicate that the durum wheat producers expect to reduce rather than increase the level of input used in response to the CAP reform. Moreover, given a supposed reduction in the level of subsidies and farm margins, the respondents have indicated a significant land value reduction in response to the new CAP. On the other hand, farmers don't believe that the CAP reform will significantly affect the durum wheat acreage and the fallow areas.

Table 2. The perceived effects of the new CAP.

Description	Mean (SD)	p value [3]
Self-reported level of knowledge regarding the new CAP [1]	3.62 (1.60)	0.049
How do you believe that the CAP reform will affect the durum wheat acreage? [2]	3.85 (1.13)	0.252
How do you believe that the CAP reform will affect the input use? [2]	3.70 (1.26)	0.050
How do you believe that the CAP reform will affect farm labour? [2]	3.52 (1.21)	0.001
How do you believe that the CAP reform will affect the fallow areas? [2]	4.23 (1.46)	0.196
How do you believe that the CAP reform will affect the land value? [2]	3.49 (1.31)	0.002

Source: own elaboration.
[1] Scale: 1 ("worst") – 4 ("moderate") – 7 ("excellent").
[2] Scale: 1 ("strong reduction") – 4 ("no variation") – 7 ("strong increase").
[3] One-sample t-test on value 4 ("moderate" or "no variation").

Then, we have investigated the intention to maintain at least 7% of the arable land as an EFA (Behaviour 1), which is considered the most costly greening measure included in the CAP reform (Matthews, 2013). Farmers have expressed a low intention to adopt the new agro-environmental measure (items scores lower than 2.60), even though they believe that the EFA is "positive" for the environment (Table 3). In this case, farmers are called to adopt practices foreseen by a regulatory public body that might be perceived as an intrusion in the farmer's decision process. The attitude towards the behaviour is generally nega-

Table 3. Variables and questionnaire items of behaviour 1 "Ecological focus area", Cronbach's alpha, means and standard deviations (SD).

Variables	Questionnaire Items	Mean	SD	p value [2]
Intention (alpha = 0.95)	I intend to maintain at least 7% of the arable land as an EFA [1]	2.59	2.00	0.000
	I'm sure that I will maintain at least 7% of the arable land as an EFA [1]	2.39	1.96	0.000
Attitude (alpha = 0.81)	Maintaining at least 7% of the arable land as an EFA is bad (1) – good (7)	3.79	2.06	0.391
	Maintaining at least 7% of the arable land as an EFA is unrealistic (1) – realistic (7)	3.45	1.67	0.007
	Maintaining at least 7% of the arable land as an EFA is unprofitable (1) – profitable (7)	2.41	1.29	0.000
	Maintaining at least 7% of the arable land as an EFA is negative (1) – positive (7) for the environment	4.97	2.04	0.000
Subjective norms (alpha = 0.89)	Other farmers expect me to maintain at least 7% of the arable land as an EFA [1]	2.89	1.74	0.000
	My family expects me to maintain at least 7% of the arable land as an EFA [1]	3.63	2.02	0.130
	The mills and the food industries expect me to maintain at least 7% of the arable land as an EFA [1]	3.68	1.86	0.146
	The public authorities expect me to maintain at least 7% of the arable land as an EFA[1]	4.87	1.83	0.000
	The cooperatives and POs expect me to maintain at least 7% of the arable land as an EFA[1]	3.69	1.78	0.146
	The agronomists expect me to maintain at least 7% of the arable land as an EFA [1]	3.54	1.76	0.029
	Other durum wheat producers will maintain at least 7% of the arable land as an EFA[1]	3.25	1.65	0.000
	Consumers (society) expect me to maintain at least 7% of the arable land as an EFA[1]	4.39	1.98	0.098
PBC (alpha = 0.75)	I think that maintaining at least 7% of the arable land as an EFA is possible [1]	3.77	2.11	0.372
	My skills and knowledge allow me to maintain at least 7% of the arable land as an EFA [1]	3.37	2.09	0.013
	Whether I maintain at least 7% of the arable land as an EFA is a decision that depends entirely on me [1]	4.45	2.20	0.088
Moral obligation (alpha = 0.94)	I believe that maintaining at least 7% of the arable land as an EFA is fair for future generations [1]	4.24	2.01	0.319
	I believe that maintaining at least 7% of the arable land as an EFA is a commitment to society [1]	4.10	1.99	0.678
Past Behaviour	My farm is already maintaining part of its arable land as an EFA [1]	3.68	2.69	0.313

Source: own elaboration.
[1] Scale: 1 ("strongly disagree") – 7 ("strongly agree").
[2] One-sample t-test on intermediate value 4.

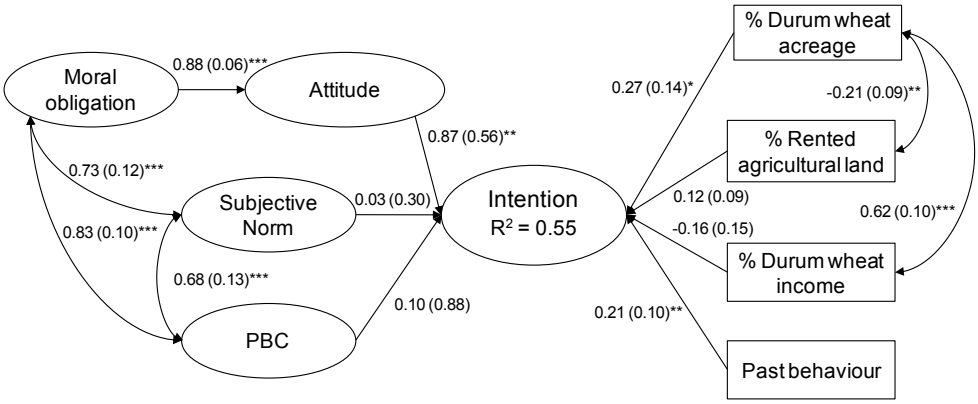
tive; although durum wheat producers believe that they would provide public goods by maintaining at least 7% of the arable land as an EFA (i.e., is "positive" for the environment, score 4.97), they also note that this measure could have negative consequences on farm profitability (score 2.41) and be unrealistic (score 3.45). This result is not contradictory, while suggesting that the farmers' greatest concern is the supposed economic losses from the reduction of productive arable land and not the uncertainty of the positive externality generated. In fact, the general statement "bad – good" yielded 3.79, not significantly different than the median value 4, indicating that farmers perceive both positive and negative consequences.

According to the subjective norm items, farmers perceive that especially public authorities and, to a lesser extent, consumers/society expect and would approve their decision to adopt the greening EFA measure. From the farmers' point of view, the public authorities (e.g., the EU and regions) maintain the role of agricultural policy makers and controllers, while consumers represent the end-users of their environmental services provision. The items measuring the moral obligation, however, show different opinions since the mean values, not significantly different than 4 (intermediate level), and the relatively high standard deviations indicate that while some respondents believe in the relevance of the EFA for future generations and society, others are not convinced. The scores of the other subjective norm items indicate that farmers perceive that agronomists and other producers would not expect them to perform the behaviour. The other mean scores of the subjective norms, not significantly different than 4, may suggest that farmers might require more participation by external subjects in making their EFA decision, such as industries or POs, who may give suggestions on how implement (interpret) the EFA measure and provide technical advice. The PBC items confirm that farmers believe to a lesser extent that their skills and knowledge allow them to maintain at least 7% of the arable land as an EFA. Nevertheless, farmers claim that this decision would be made autonomously. The Cronbach's alpha coefficient values showed a good internal reliability of the constructs.

Figure 2 shows the results of the structural equation model predicting the intention to maintain at least 7% of the arable land as an EFA. The overall goodness-of-fit of the illustrated model, as measured by the fit indices, indicated a good fit to the data.

The results show that attitude, subjective norms, PBC, moral obligation and other farms characteristics (i.e., the relative importance of the single farm payment, the relative importance of the durum wheat surface and revenue) accounted for 55% of the variance in the intention to maintain at least 7% of the arable land as an EFA (Figure 2). This confirms that the hypothesised antecedents account for a significant amount of the variance in intentions. Hypothesis H1a suggests that a favourable attitude would predict farmers' intention to adopt sustainable agricultural practices. The farmers' attitude towards the behaviour, i.e., the positive or negative personal evaluation of maintaining the arable land as an EFA, is indeed the main determinant of the intention ($\beta=0.87$, $p<0.05$), supporting H1a. The other TPB variables are not significant predictor of behavioural intentions; these findings are in contrast to H1b and H1c which suggest, respectively, that subjective norms and PBC would significantly predict farmers' intention to adopt environmental sound practices. The past behaviour is a significant positive predictor of intentions ($\gamma=0.21$, $p<0.05$). This finding confirms H3 predicting that farmers that have already an ecological area on their agricultural holdings would intend to maintain the EFAs also in the future.

Figure 2. Structural equation model results, behaviour 1 "Ecological focus area": R-squared, standardised coefficients, correlations and standard errors (in parenthesis).



Signif. codes: *** = p < 0.01; ** = p < 0.05; * = p < 0.10.
Model fit: $\chi^2/df = 1.387$; CFI = 0.922; RMSEA = 0.074.

The percentage of the durum wheat acreage positively affects the intentions to implement the EFA (γ=0.27, p<0.10). The perceived moral obligation, i.e., the personal normative considerations felt by farmers with respect to future generations and society, strongly affects attitude (γ=0.88, p<0.01). Hypothesis H2, which predicts that moral obligations have a positive effect on farmers' attitudes towards sustainable farming, is thus supported. This result suggests that, rather than directly influencing intentions, the farmers who felt a self-generated personal moral obligation had more positive personal attitudes towards the behaviour, which significantly affects the intention to maintain at least 7% of the arable land as an EFA. The percentage of the durum wheat surface and the percentage of the durum wheat income are positively correlated (φ=0.62, p<0.01). Hence, the moral obligation construct and the other TPB variables are all positively correlated.

4.2 Farmers' intention to implement a private sustainability scheme

The analysis of the participation in private sustainability schemes suggests a moderately positive willingness to manage farm activities to achieve environmental goals (Table 4). This result is probably due to the voluntary nature of the proposed eco-friendly scheme which is viewed as a flexible entrepreneurial tool for fostering the environmental effort of farmers in a market key. It is likely that the energy production from agricultural biomass indicated as part of a sustainability scheme to be agreed with the food industry, has more contributed to define a clearer connection of the farmer's environmental efforts with the market, than the CAP greening did. However, the attitude of durum wheat producers, based on behavioural belief, personal perception, knowledge and experience, points out that the sustainability scheme is good for environment and human wellbeing, although it will not affect farm's profitability. Indeed, farmers moderately disagree that it would improve farm income (score 3.49), and neither agree or disagree that it would

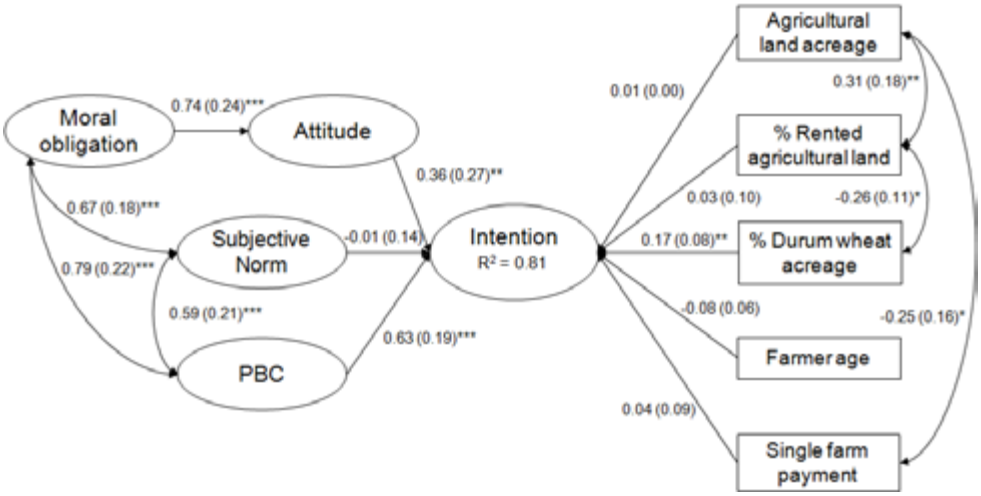
Table 4. Variables and questionnaire items of behaviour 2 "Sustainability scheme", Cronbach's alpha, means and standard deviations (SD).

Variables	Questionnaire Items	Mean	SD	p value [3]
Intention (alpha = 0.94)	I intend to implement sustainability schemes [1]	4.58	1.91	0.013
	I'm sure that I will implement sustainability schemes [1]	4.17	1.90	0.457
Attitude (alpha = 0.83)	Implementing sustainability schemes will improve the environmental quality [2]	5.08	1.85	0.000
	Implementing sustainability schemes will improve the life quality [2]	4.77	1.81	0.001
	Implementing sustainability schemes will increase farm income, if associated with a certification [2]	3.49	1.79	0.020
	Implementing sustainability schemes will increase the durum wheat price, if associated with a certification [2]	3.97	1.91	0.902
Subjective norms (alpha = 0.92)	My family expects me to implement sustainability schemes [1]	4.52	1.84	0.020
	The mills and the food industries expect me to implement sustainability schemes [1]	4.59	1.80	0.007
	The public authorities expect me to implement sustainability schemes [1]	5.04	1.73	0.000
	The environmental associations expect me to implement sustainability schemes [1]	5.39	1.78	0.000
	The cooperatives and POs expect me to implement sustainability schemes [1]	4.46	1.68	0.023
	Consumers (society) expect me to implement sustainability schemes [1]	5.01	1.66	0.000
PBC (alpha = 0.80)	My skills and knowledge allow me to implement sustainability schemes [1]	4.61	1.81	0.006
	Whether I implement sustainability schemes is a decision that depends entirely on me[1]	5.10	1.88	0.000
	I think that implementing sustainability schemes is possible [1]	4.97	1.51	0.000
	The new technologies could encourage me to implement sustainability schemes [1]	5.04	1.44	0.000
Moral obligation (alpha = 0.90)	I believe that implementing sustainability schemes is fair for future generations [1]	5.30	1.65	0.000
	I believe that implementing sustainability schemes is a commitment to society [1]	4.83	1.79	0.000

Source: own elaboration.
[1] Scale: 1 ("strongly disagree") – 7 ("strongly agree").
[2] Scale: 1 ("extremely unlikely") – 7 ("extremely likely").
[3] One-sample t-test on intermediate value 4.

increase durum wheat price (score 3.97). This uncertainty may have affected the individual evaluation. Farmers are normally risk averse agents (Hennessy, 1998) and a change in farm production can engender concerns for future farm profitability. The high score for

Figure 3. Structural equation model results, behaviour 2 "Sustainability scheme": R-squared, standardised coefficients, correlations and standard errors (in parenthesis).



Signif. codes: *** = p < 0.01; ** = p < 0.05; * = p < 0.10.
Model fit: χ^2/df = 1.276; CFI = 0.948; RMSEA = 0.063.

items related to subjective norms indicates that farmers agreed that environmental associations, public authorities, consumers and society in general expect them to implement private sustainability schemes. Hence, farmers' beliefs concerning family, industries, cooperatives and POs expectations about the implementation of eco-friendly practices are also not negligible. The personal skills and the technology can positively contribute to adopt the sustainability schemes; similarly, the autonomy in decision making is a key factor of the PBC. However, the information collected cannot clarify the farmer's willingness to cooperate with other actors, other farmers and industries, which might reduce the level of autonomy but improve the results. The cooperation along the supply chain represents an important straightness for making sustainability actions effective and for achieving economic and environmental objectives (Ilbery and Maye, 2005).

Figure 3 shows the results of the structural equation estimation concerning the intention to implement at farm level the private sustainability scheme as proposed by the food industry. The estimated model shows good fit with the data. The TPB model accounted for 81% of the variance in the intention to implement the private sustainability scheme. The PBC positively affects intentions (γ=0.63; p<0.01). This result confirms H1c, which suggests that PBC would predict farmers' intention to adopt sustainable agricultural practices. In other words, the individual perceived capacity to face difficulties in performing the behaviour is the main determinant of intentions. The PBC construct is mainly defined by the role of knowledge and the real possibility to implement at farm level the private sustainability scheme. Behavioural attitude also play a major role, although to a lesser extent than the PBC, as antecedent of intention (β=0.36; p<0.05). This result supports H1a suggesting that a favourable attitude would predict farmers' intention to adopt sustainable

farming practices. Consistent with H2, predicting that moral obligations have a positive effect on farmers' attitudes towards sustainable agricultural practices, farmers' attitude is positively influenced by their moral considerations for future generations and society (γ=0.74; $p<0.01$). The subjective norm is even not a significant predictor of intention, contrasting with H1b. The incidence of durum wheat acreage on total UAA is another influent driver of behavioural intentions (γ=0.17; $p<0.05$). This means that the wider the share of durum wheat area, the greater is the intention to join private sustainability schemes, that could result in a lower demand for fertilizers, in the production of renewable energies and/or in the conversion to ecological practices (e.g., integrated and organic farming).

5. Discussion and conclusions

The results show that attitude, subjective norms, PBC and other farms characteristics accounted for 55% and 81% of the variance in the intention, respectively, to maintain at least 7% of the arable land as an EFA and to implement at farm level the private sustainability scheme. These results are satisfactory because a meta-analysis of 185 independent studies in a wide number of domains found that attitude, subjective norms and PBC, on average, accounted for 39% of the variance in intention (Armitage and Conner, 2001). Hence, past applications to the agri-environmental context suggest that TPB variables explain from 23% to 72% of the variance in intention (Corbett, 2002; Sharifzadeh *et al.*, 2012; Fielding *et al.*, 2008; Wauters *et al.*, 2010; Yazdanpanah *et al.*, 2014).

The particular novelty of this paper is in evaluating the Italian durum wheat farmers' intention to adopt sustainable agricultural practices related to the 2014-2020 CAP reform design (the EFA) and to the private schemes as proposed by the food industry. The EFA, although being evaluated as a positive initiative for enhancing the public good provision, is perceived by farmers as a costly measure that can depress the farm economic performance. Farmers evaluate the efforts that are required by the greening not properly compensated by the economic transfer (approximately 100 €/ha). This study shows that the farmers' attitude is the main determinant that positively affects the intention to implement the EFA. Thus, the awareness that farm investment in EFA can protect and improve rural environmental quality is the key element that may support the farmers' decision to dedicate at least 7% of the arable land to areas with particular environmental features. In past TPB research related to agri-environmental practices, farmers' attitude has consistently emerged as an important predictor of intentions in different domains, including the adoption of soil erosion control practices (Wauters *et al.*, 2010), riparian zone management (Fielding *et al.*, 2008), water conservation activities (Yazdanpanah *et al.*, 2014) and climate information use (Sharifzadeh *et al.*, 2012). As suggested by other authors, a measure of moral obligation may contribute to an independent effect in the prediction of behavioural intentions for certain forms of social behaviour (Sparks *et al.*, 1995; Beedell and Rehman, 2000). In this study, however, the measure of moral obligation did not prove to be a significant direct predictor of intention. Perceived moral obligation may be less important in situations in which behaviour is compulsory (de Lauwere *et al.*, 2012), as for the commitment to an EFA. Nevertheless, in this study, the farmers who felt a self-generated personal moral obligation had more positive personal attitudes, which significantly affected the intention to dedicate at least 7% of the arable land to an EFA. The farm's level of spe-

cialisation can explain the relationship between the percentage of durum wheat acreage and the intention to maintain arable land as an EFA, with the supposed better knowledge of the CAP reform and the related criteria of exclusion (Matthews, 2013). Hence, several studies have argued that repetition of past behaviours can influence current behaviour (see, e.g., Corbett, 2002). In this study, past actions taken to maintain natural elements that are required by the EFA (e.g., strip and buffer areas, environmental set-aside, etc.) have been strong indicators of farmers' intention to behave in the future. Meaningful past behaviour could include past participation in public-sponsored programs, as well as past actions taken independently to care for the agricultural area, such as planting vegetation not intended for livestock feed (Corbett, 2002).

The results show a moderate intention to adopt private sustainability schemes for providing positive externalities to society, but preferably if under farmers' control. Attitudes and PBC, including the capacity to manage with own knowledge the sustainability scheme, are the intention's main drivers. The significant effect of PBC, confirmed by other studies (see, e.g., Fielding *et al.*, 2008), may indicate the presence of inhibiting factors or the absence of necessary skills or resources to perform the behaviour. The relevance of collective actions for adopting environmental practices in durum wheat production resulted negligible: the subjective norm, that evaluates the perceived pressure of industries, cooperatives and POs for introducing private schemes, is not significant and cannot be considered as a driving factor. This can mask a lack of coordination between durum wheat producers and other actors along the supply chain in managing the environmental strategies. This situation is highlighted in other studies aiming to identify the level of synergy for integrating environmental sustainability practices into the food chain (Ilbery and Maye, 2005; Renting *et al.*, 2003; Falconer and Saunders, 2002; Falconer, 2000). In particular, farmers seem to perceive that POs are uniquely finalized to sell the product on the market at best possible economic conditions, rather than contributing to redesign the food chain in a more innovative and sustainable way.

The cross-comparison of the two analysed behaviours shows both differences and similarities. The intention to maintain the EFA land is negative, with average scores of the related questionnaire items significantly below the intermediate value, while the intention to implement the private sustainability scheme is moderately positive. This confirms that the EFA requirement is likely considered as an unavoidable costly restriction, whose economic effects are unequally distributed along the chain. On the other hand, the private sustainable scheme seems to be perceived as a possible strategy for improving farmers' profitability and to catch opportunities within a common effort throughout the pasta supply chain. Attitude is a significant predictor of intention in both cases, indicating that as long as durum wheat producers favourably evaluate the sustainable farming practices, they will have higher intention to implement them, and vice versa. The PBC items for the private sustainability scheme yielded significantly higher values than the EFAs[3], indicating that farmers perceive a greater level of knowledge and skills in implementing the private sustainable scheme then in maintaining the EFAs. In both cases, the subjective norms is not statistically significant in predicting intentions, suggesting that the farmers' perception of social pressure (e.g., what the food industry, POs, agronomists, public authorities,

[3] The mean score of the PBC items for the private scheme is 4.93, while for the EFA is 3.86 ($p<0.001$).

etc., expect them to do about the behaviour) and descriptive norm (i.e., how other farmers would behave) doesn't affect their intention to implement the sustainable practices. This may also suggest that the pasta supply chain and other key stakeholders (e.g., public authorities) should improve the involvement of farmers in exchanging information and sharing the benefits of implementing the eco-friendly practices.

The TPB may provide suggestions for possible interventions aiming to stimulate the behaviour (Ajzen, 1991). In particular, the analysis clearly indicates the need for a better understanding of farmers regarding the new CAP tools. Although the questionnaire provided farmers with some specific information regarding the CAP reform, we believe that most of the farmers' concerns towards the greening are due to an incomplete understanding of the new policy instrument. Thus, efforts to improve not only the farmers' knowledge of the greening agricultural payments *per se*, but also their awareness of the rationale for greening payments, including the new role that the society requires of agriculture, is a central issue that must be addressed by both the policy makers and the food chain operators. Although this would require many efforts in terms of time and money, public training programs enabling farmers to acquire the necessary complete understanding of the new policy design are highly recommended. Given the low intention of durum wheat farmers to implement the EFA measure, a peripheral route of communication using implicit persuasion techniques, which is recommended when farmers are less motivated to perform the desired behaviour, may be more appropriate (Jansen *et al.*, 2010; de Lauwere *et al.*, 2012). For the adoption of private sustainability schemes, it is evident the need of a greater involvement of farmers in the environmental strategy of the food chain through an enhancement of the strategic role of the POs. As suggested by the analysis, the relationships between POs and food industry should be strengthened to give response to environmental issues creating economic conditions to compensate for transaction costs, and to provide technical support for farmers to improve their skills and knowledge to implement sustainability schemes. Farms are not isolated entities but rather participate through their cooperatives and POs in enhancing the competitiveness path of each food chain. This research also shows that the success of a private sustainability scheme will be limited unless the supply chain leaders succeed in shaping more positive farmer attitudes towards ecological practices. Indeed, efforts to solve technical difficulties when adopting eco-friendly farming practices are likely to have little effect when farmers' attitudes remain negative. Given a moderately positive intention to implement private sustainability schemes, supply chain leaders could effectively involve durum wheat producers with a more traditional argument-based communication campaign (e.g., instruction cards, checklists and software, etc.). However, tailored communication, taking different farmers' attitudes into account, is also recommended (Jansen *et al.*, 2010).

We acknowledge that the limited number of respondents and the length of the questionnaire are the primary limitations in the current study. Moreover, our analysis has only modelled self-reported behavioural intention. The triangulation of these results with on-field observations may provide further consistent results. It is also possible that the questionnaire formulation, providing examples of private schemes mainly based on integrated farming, reduction of fertilizers and pesticides and agro-energies, might have limited the spectrum of alternatives to individual farm environmental strategies. Nevertheless, this study, originally designed in the context of the forthcoming 2014-2020 CAP reform, pro-

vides a comprehensive picture of the main determinants that public authorities and food chain operators must address to improve the Italian durum wheat producers' adoption of the new CAP's greening practices and private sustainable schemes.

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