Sustainable Production and Consumption 47 (2024) 178–189

Contents lists available at ScienceDirect

Sustainable Production and Consumption

journal homepage: www.elsevier.com/locate/spc

Behavioural factors for farmers' adoption of agroforestry practices in Sweden

Gaëlle Leduc [a,b,*], Helena Hansson [a]

[a] Department of Economics, Swedish University of Agricultural Sciences, Box 7013, 750 07 Uppsala, Sweden
[b] Bordeaux School of Economics, 16 avenue Léon Duguit, 33600 Pessac, France

ARTICLE INFO

Editor: Dr Luca Panzone

Keywords:
Agroforestry
Ecosystem services
Farmers' decision-making
Farmer identity
Factor analysis

ABSTRACT

Agroforestry has recently been recognized as a sustainable land-use system that can both address farmers' productive needs and provide ecosystem services to society such as biodiversity and carbon sequestration. Further investigation into the role played by social and psychological factors for adoption of agroforestry within a European context, is needed. This paper provides an analysis of farmers' behavioural drivers with respect to their adoption of agroforestry practices, using a survey of 387 farmers from Sweden. We extended the Theory of Planned Behaviour (TPB) model to incorporate the following behavioural factors: businessperson identity, network memberships, conservation objectives, as well as perceived economic benefits and labour constraints on actual adoption. Latent constructs in the model were first extracted with factor analysis before estimating their impact on adoption using logit models. The results indicate that network memberships improve the explanation of adoption and positively impact farmers' adoption of agroforestry, while the remaining behavioural variables were found to be statistically insignificant. We therefore recommend to encourage farmers' connection to formal networks in order to disseminate ideas, technical experience and guidance on agroforestry, thereby facilitating adoption. The lack of a significant influence of the TPB-factors in our study suggests that we are not able to confirm that TPB variables have an effect on actual adoption and may support the common criticism given to the model in relation to the well-known intention-behaviour "gap".

1. Introduction

The European Union's Common Agricultural Policy (CAP) has increasingly incorporated, in its policy agenda, the idea of agriculture as provider of public goods (Viaggi et al., 2021). The recent EU Green Deal emphasizes a list of agricultural practices that can deliver environmental public goods, including biodiversity protection and carbon sequestration (European Commission, 2021). A number of policy documents highlight the indirect connection of these environmental public goods with economic, social and cultural services (Cooper et al., 2009; ENRD, 2010). For instance, farming practices that preserve biodiversity, traditional production methods and landscape diversity increase opportunities for activities such as green tourism which can positively affect the local rural economy (ENRD, 2010). Farmers using such practices can also be in a better position to market value-added products and develop higher levels of interaction with consumers, for instance via participation in short value chains (Levidow and Psarikidou, 2011).

Agroforestry is a prominent example of an ecological practice that has potential for combining environmental, economic and social benefits and can therefore pave the way towards more sustainable production (Waldron et al., 2017). This type of farming can be defined as "the practice of deliberately integrating woody vegetation (trees or shrubs) with crop and/or animal systems to benefit from the resulting ecological and economic interactions." (Burgess and Rosati, 2018). Consequently, agroforestry can refer to a range of practices that encompass both farming and forestry activities and makes use of, for instance, intercropping, grazing in wooden or forested land and landscape features (Torquebiau, 2000; Nerlich et al., 2013). Several ecosystem services have been promoted from using agroforestry. These include environmental benefits such as nutrient retention, erosion control, carbon sequestration, pollination, pest control, fire risk reduction and social benefits such as increase in recreational, aesthetic, and cultural heritage values (Mcadam et al., 2018; Smith et al., 2021; Terasaki Hart et al., 2023). In addition, agroforestry has potential, with careful management, to be more productive than monoculture systems (Smith et al., 2021) which can provide an economically viable alternative to farmers and

* Corresponding author at: Bordeaux School of Economics, Université de Bordeaux, 16 avenue Léon Duguit Bât. H2, CS 50057, 33608 Pessac CEDEX, France.
E-mail address: gaelle.leduc@slu.se (G. Leduc).

https://doi.org/10.1016/j.spc.2024.03.023
Received 27 June 2023; Received in revised form 29 February 2024; Accepted 20 March 2024
Available online 21 March 2024

ensure food security. The Common Agricultural Policy (CAP) has shown increasing interest to reward and incentivize adoption of agroforestry practices. In fact, support to farmers using these practices has gone from simple compensation for incurred costs, regulated in the Pillar II, to direct payments, regulated in the Pillar I, supporting ecosystem services through eco-schemes (Lampkin et al., 2020; Laporta et al., 2021).

Whilst economic drivers are acknowledged to influence farmers' adoption behaviours (Khaledi et al., 2010; Williamson, 2011; Pilarova et al., 2018), recent contributions have emphasized the importance of social and psychological influences that go beyond simple financial factors. As Howley (2015) explained, wider social and lifestyle motivations have a significant role to play in explaining farmers' decision-making and their engagement for a wide range of on and off-farm activities. Consequently, it is reasonable to suggest that nonpecuniary factors motivate farmers to adopt less intensive farming methods. A prominent model used in the farming adoption literature is the Theory of Planned Behaviour (TPB) (Ajzen, 1991). It argues that attitudes, perceived behavioural control and subjective norms predict individuals' intentions to perform a behaviour, which in turn predicts their actual behaviour. Whilst social and psychological factors are increasingly gaining interest in the literature, several remain insufficiently investigated including the social concept of identity (Thompson et al., 2024). The seminal work of Akerlof and Kranton (2000) nevertheless underlined the importance of identity for modelling behaviour. In their study, identity is based on a person's self-image and their assigned social categories. They found that including identity in behavioural models substantially changed conclusions of previous economic analyses. Since then, studies have contributed to the understanding of how farmers' perceived societal role and identity relate to their pro-environmental behaviour (Lokhorst et al., 2011; McGuire et al., 2013; van Dijk et al., 2015; Inman et al., 2018; Valizadeh et al., 2020; Cullen et al., 2020; Zemo and Termansen, 2021). Whilst Cullen et al. (2020) focused on participation to agri-environment schemes, Lokhorst et al. (2011), van Dijk et al. (2015) and Valizadeh et al. (2020) on behavioural intentions, the studies of McGuire et al. (2013), Inman et al. (2018), Zemo and Termansen (2021) and Walpole and Wilson (2022) focused on the actual adoption of ecological practices. However, from these last studies, only the studies of Zemo and Termansen (2021) and Walpole and Wilson (2022) make use of quantitative methods.

Most research on agroforestry adoption has been conducted in tropical countries, where the practice is the most widespread (Mwase et al., 2015; Awazi et al., 2019; Shennan-Farpón et al., 2022). Studies in the European context are relatively scarcer. Within this developing strand of literature, the study of Graves et al. (2017), focused on Bedfordshire in England and Rois-Díaz et al. (2018), who compared eight European countries, analysed the perceived costs and benefits of farmers for adopting agroforestry practices. They found that financial aspects explained the lack of willingness to adopt, compared to social and environmental rationales which are clear motivations. Sereke et al. (2016) explain the low level of observed adoption of agroforestry among Swiss farmers because of social standing, low profitability and lack of perceived behavioural control. In Germany, farmers believed that public perceptions of including wood on farmland are not positive enough (Beer and Theuvsen, 2019), which parallels the results of Otter and Beer (2021) who found that expected image from different stakeholders influenced farmers' adoption of alley cropping systems, highlighting the importance of social norms as a factor for adoption.

Compared to other EU study areas, Sweden has a larger agroforestry component. In 2012, this represented 15.2 % of utilized agricultural area (UAA), compared to 8.8 % for EU-27. However, this is still far below what can be observed in Southern EU study areas such as Greece, Portugal and Cyprus displaying between 30 and 40 % of UAA (den Herder et al., 2017). Sweden has a long history of agroforestry, traditionally as silvo-pastoral systems. In fact, 99 % of the agroforestry component is accounted by livestock type of agroforestry, arable agroforestry and agroforestry with high value trees being trivial (Den Herder et al., 2017). Silvo-pastoral systems are nevertheless nowadays used to a lower extent in Sweden (Asplund and Björklund, 2016). Given the current lower prevalence of agroforestry in Sweden and the European ambition to develop it further (European Commission, 2021), a better understanding of how behavioural factors could restrict or motivate farmers' adoption of agroforestry would help to inform on incentives for further adoption in the country.

Accordingly, this paper aims to understand how behavioural factors contribute to farmers' adoption of agroforestry practices in Sweden. Our study contributes to this emerging literature by augmenting the TPB with the construct of farmers' businessperson identity. Four additional behavioural factors for adoption are also integrated, namely, farmers' network memberships, farmers' conservation objectives, farmers' perceived economic benefits and farmers' perceived labour constraints. Farmers' network memberships were added to consider the role of exogenous factors that are lacking to the TPB, which is a model focused on cognitive types of variables (Castillo et al., 2021). This variable was also added to better understand its interplay with farmers' identity (Burke and Stets, 2009; Inman et al., 2018). Conservation objectives were added to understand the role of a non-practice specific type of variable, referred as "dispositional" in Dessart et al.'s (2019) terminology. Contrastingly, the two last factors were added to better understand the role of specific types of farmers' perceived benefits and challenges towards ecological practices, for their adoption. This would contribute to the emerging literature exploring such perceptions for adoption of agroforestry (Sereke et al., 2016; Rois-Díaz et al., 2017; Graves et al., 2017; Rois-Díaz et al., 2018; Opdenbosch and Hansson, 2022). For this purpose, survey data was collected from Swedish agriculture and factors were analysed to measure our constructs. Factor scores were then extracted from the retained factors and used as predictors in logistic regressions.

This study makes three main new contributions to the existing literature. It contributes to the emerging strand of literature investigating behavioural factors on the actual adoption of agroforestry, in a European context, and not intentions or attitudes towards adoption. Second, it is one of the few studies to consider identity as an influential social psychological construct on farmers' adoption of ecological practices and it is the first to specifically investigate its connection with the actual adoption behaviour of agroforestry, in a European context. Finally, it is the second attempt to focus on factors for agroforestry adoption in the Swedish context, with quantitative methods.

2. Conceptual framework

Farmers' choices of any production method, including the adoption of ecological farming practices, is a choice that impacts the economy of the farm; this decision relates to how to manage internal and external inputs and how to market outputs to consumers, ultimately affecting the farm's profits, survival and resilience. Notwithstanding the importance of economic and financial aspects to consider in this choice, studies in agricultural economics have a long tradition of augmenting economic models with psychology theory to study farmers' behaviours and economic decision-making (Willock et al., 1999; Akerlof and Kranton, 2000; Edwards-Jones, 2006).

The Theory of Planned Behaviour (TPB) (Ajzen, 1991) is a theoretical model from psychology that has been widely applied to explain farmers' intentions and behaviours (e.g. Sutherland, 2010; Hansson et al., 2012; Läpple and Kelley, 2013). The TPB originates from the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) which posits that individuals' intentions to perform a behaviour best predicts that behaviour. The intention is itself determined by two psychological constructs. First, attitudes which are formed based on individual's behavioural beliefs about the possible consequences of an action. Second, subjective norms which correspond to the perceived social pressure in relation to the approval or disapproval of performing a given behaviour (Ajzen, 1991). The TPB adds a further psychological construct to the TRA model: perceived behavioural control (PBC), which refers to the individual's belief that they can influence and control that behaviour. This study omits however intentions and predicts these constructs directly on behaviour, which is discussed later in the article.

In our case, we refer to attitudes (Att) as positive attitudes towards ecological farming, PBC as PBC towards adoption of ecological practices. Subjective norms (SN) are more precisely measured as group norms which relate to scepticism from other farmers towards implementing ecological practices. We augment the TPB further with five additional explanatory variables. First, the construct of businessperson identity, measured as a combination of identifying self as entrepreneur, producer or professional (Vesala and Vesala, 2010). Second, farmers' network memberships (Lee et al., 2018; Usman and Ahmad, 2018; Castillo et al., 2021) are included to consider its interplay with farmers' identity (McGuire et al., 2013; Inman et al., 2018). Third, farmers' conservation objectives (Willock et al., 1999; Greiner et al., 2008; Kallas et al., 2010), which are related to environmental goals such as preserving the land and environment for future generations, are included. Farmers' perceived economic benefits of ecological practices (Sereke et al., 2016; Graves et al., 2017; Rois-Díaz et al., 2018) were added as a fourth behavioural construct and farmers' perceived labour constraints related to labour intensity requirements and time (Rois-Díaz et al., 2017; Rois-Díaz et al., 2018), as a fifth one. Our overall conceptual framework is represented in Fig. 1.

2.1. *Explanatory variables of the Theory of Planned Behaviour (TPB)*

Our hypotheses in regard to the effect of the variables of the TPB on adoption are formulated as follows:

H1. Positive attitudes towards ecological farming positively influence farmers' adoption of agroforestry practices.

H2. Negative subjective norms will reduce farmers' adoption of agroforestry practices.

H3. Positive perceived behavioural control will increase farmers' adoption of agroforestry practices.

2.2. *Augmenting the Theory of Planned Behaviour*

2.2.1. *Businessperson identity*

Identity can be defined as an answer to the question "Who am I?" and provides meaning to the self (Augoustinos et al., 2014). There are, according to Sets and Burke (2010), three types of identities: the person, the role and social identity. The person identity relates to self-meaning, the role identity relates to the role a person wants to fulfil in society while the social identity is related to being at one with a group (Sets and Burke, 2010). In our study, farmers' identity can be understood from either a role or social perspective as farmers do serve a role for society through their job but can also have a certain sense of belonging to a specific group of farmers.

Recent literature focused on farmers' identity in Europe, reports that members of the farming community tend to perceive themselves as producers (Inman et al., 2018; Vesala and Vesala, 2010; Burton and Wilson, 2006). The perceived traditional productivist role that farmers should fulfil for society seems to pertain among farmers. It is however challenged by public views of the farmer's role, which should have a "multifunctional" dimension, that is, farmers should concomitantly be "conservationist", "agricultural producer", "diversifier" and "agribusiness person" (Burton and Wilson, 2006). Furthermore, several studies reveal that farmers identify themselves with the status of "entrepreneur" (Vesala et al., 2007; Couzy and Dockes, 2008; Suvanto et al., 2020). Whilst Burton and Wilson (2006) indicated that this role can have derogatory connotations for farmers, entrepreneurship can be associated with risk-taking, growth orientation and innovativeness (Vesala et al., 2007). These would seem to be critical skills for farmers to comply with their increased responsibility for generating economic and environmental sustainability. Finally, one other type of farmer identity is the professional type which is linked to the use of collective skills and expertise from the farming community for society (Couzy and Dockes, 2008).

In our study, we combine the entrepreneurial, producer and professional types of identity together to refer to what we define as a businessperson type of identity, since the business dimension of farming is a common characteristic among these three identities. Furthermore, these types of identities can coexist among farmers. Vesala and Vesala (2010) showed that these three are not mutually exclusive for Finish farmers and found that 70 % of interviewed farmers identified themselves both as producer and entrepreneur.

Several studies have attempted to link identity and behaviour including pro-environmental behaviour (Stets and Biga, 2003; Whitmarsh and O'Neill, 2010), farm diversification behaviour (Vesala et al., 2007), or consumption behaviours (Cook et al., 2002). Whilst Rise et al. (2010) showed that including the self-identity construct to the TPB model improves its explanatory power, farmers' self-identity has only recently been studied as a direct determinant for farmers' behaviour to

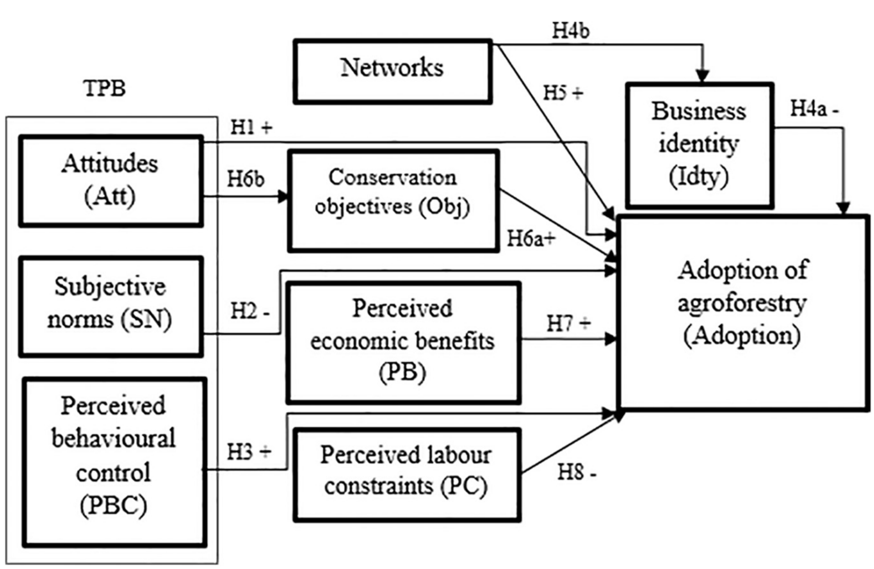

Fig. 1. Conceptual framework.

adopt ecological farming methods (Cullen et al., 2020; Zemo and Termansen, 2021; Walpole and Wilson, 2022). The productivist type of identity has shown to be detrimental for adoption (Cullen et al., 2020; Inman et al., 2018), while environmental identity plays a positive role in the adoption of unsubsidized practices (Lokhorst et al., 2011; Zemo and Termansen, 2021). However, none of these studies have looked at the broader type of businessperson identity. We theorize that it would have a negative influence on adoption.

H4a. A strong farmers' businessperson identity negatively influences their adoption of agroforestry practices.

2.2.2. Network memberships

Network memberships, often associated to social capital (Bourdieu, 1986), has been identified as an important predictor of farmers' adoption of ecological practices (Wossen et al., 2013; Lee et al., 2018; Castillo et al., 2021). Castillo et al. (2021) point out the limitations of the TPB in the agricultural literature, which mainly considers cognitive constructs and omits exogenous factors, including farmers' interactions with their community. We therefore include farmers belonging to farmers' unions, organizations and landowners associations (see Table 2). As Small et al. (2015) explained, the more networks a decision-maker belongs to, the greater exposure farmers will have to new ideas, techniques and ways of thinking, which we hypothesize as being beneficial for farmers' adoption of new practices that are agroforestry.

Furthermore, the role or position, which builds identity, is socially constructed, as it results from interactions with others belonging to the same social category or social network (Burke and Stets, 2009). It is therefore reasonable to posit that farmers' network memberships will shape farmers' businessperson identity. We thus test for businessperson identity as a mediator variable, where network memberships first predict businessperson identity which then predict adoption.

H5. Farmers' network memberships positively influence their adoption of agroforestry practices.

H4a * H4b. Farmers' businessperson identity acts as a mediator variable for the effect of network memberships on adoption.

2.2.3. Conservation objectives

Farmers' objectives have widely been recognized as important factors influencing their decision-making and behaviours (Kallas et al., 2010). We include conservation objectives, namely enhancing the environment, improving the land condition and protecting the environment for future generations (see Table 2). Furthermore, based on Willock et al. (1999) conservation objectives are included here as a mediating variable, predicted by attitudes. We therefore hypothesize that holding positive attitudes towards ecological farming would precede individual's objectives to conserve the environment. In fact, it appears reasonable that farmers' beliefs would direct the pursuit of their personal end results.

H6a. Farmers' conservation objectives positively influence their adoption of agroforestry practices.

H6a * H6b. Farmers' conservation objectives act as a mediator variable of the effect of attitudes on adoption.

2.2.4. Perceived economic benefits

Farmers' perceived economic benefits of ecological practices include their perceived effect on profitability, production and on their ability to meet farming objectives. In the agroforestry literature, farmers tend to perceive adoption of agroforestry systems as having low financial returns (Workman et al., 2003; Sereke et al., 2016; Graves et al., 2017; Rois-Díaz et al., 2017), through the lack of sufficient financial support (Sereke et al., 2016; Rois-Díaz et al., 2018) or induced income (Graves et al., 2017). Moreover, Rois-Díaz et al. (2018) argued that the opportunity cost that trees represent on land may be a barrier.

H7. High farmers' perceived economic benefits of ecological practices positively influence their adoption of agroforestry practices.

2.2.5. Perceived labour constraints

Finally, we include farmers' perceived limitations of adopting ecological practices which are related to labour requirements, mental and physical workload. In the case of agroforestry, farmers in Europe have reported that this practice entails higher labour costs and requires more time (Rois-Díaz et al., 2017). In fact, intercropping and tree management make it difficult for mechanization and render this practice more labour intensive (European Parilament, 2020).

H8. High farmers' perceived labour constraints of ecological practices negatively influence their adoption of agroforestry practices.

3. Methods

3.1. Sample

Our data is based on a randomly drawn sample of 2000 farms, specialized in dairy, sheep, cattle, livestock or mixed livestock. Farms with a minimum of 1600 working hours per year were selected in order to focus on commercial farms with sufficient amount of activity and exclude potential hobby farmers. The sample was stratified with 1538 farmers randomly drawn from the South (Blekinge län, Skåne län, Hallands län, Västra Götalands län, Örebro län, Västmanlands län, Södermanlands län, Uppsala län, Stockholms län och Gävleborgs län) and 462 farmers from the North (Jämtlands län, Västernorrlands län, Västerbottens län och Norrbottens län), to represent the case study areas of Sweden in the LIFT project (see Fig. 2). The random draw was carried by Statistics Sweden from their statistical register by using random numbers. Stratification ensures a better representation of the regional dispersion of farming activity in the considered areas.

Table 1.1 in provides regional descriptive statistics of the sample. Farms localized in the North, which represent 30 % of the sample, are in majority, milk producers while meat production is more characteristic of Southern farms with 45 % cattle and 9.7 % mixed livestock. Northern farms are on average smaller with 118 ha compared with 132 ha in the South. Farm size refers to the total utilized agricultural area (UAA) including arable and pasture land, both owned and rented. Very large farms are found in the South. This reflects the more extensive nature of farming, characteristic of Northern Sweden where mountains and forests dominate. Almost all farmers from both regions reported to have arable land and 13 % did not have any pasture land in the North.

Table 1.2 compares descriptive statistics between the sample of farmers who answered the survey and the target population it was sent to. The difference between the statistics is not statistically significant, except for Region meaning that the sample is biased towards the North, with a higher proportion of farmers coming from Northern Sweden.

To collect the data, we conducted an online survey, implemented with the help of a marketing research company, during May 2020. Implementing an internet-based survey appeared feasible in our context since 98 % of the Swedish population has access to internet.[1] The questionnaire was structured into two main sections: i) questions related to farmers' current and future adoption of various categories of ecological practices and ii) questions related to drivers of adoption and attitudinal characteristics. This questionnaire was a shortened version of the questionnaire elaborated by the Low-Input Farming and Territories (LIFT[2]) project (Tzouramani et al., 2019). Farmers were first contacted by sending an invitation letter by post explaining the purpose of the study, how to complete the questionnaire online and the possibility to

[1] https://svenskarnaochinternet.se/rapporter/svenskarna-och-internet-2021/internetanvandning-och-det-uppkopplade-hemmet/.

[2] https://www.lift-h2020.eu/.

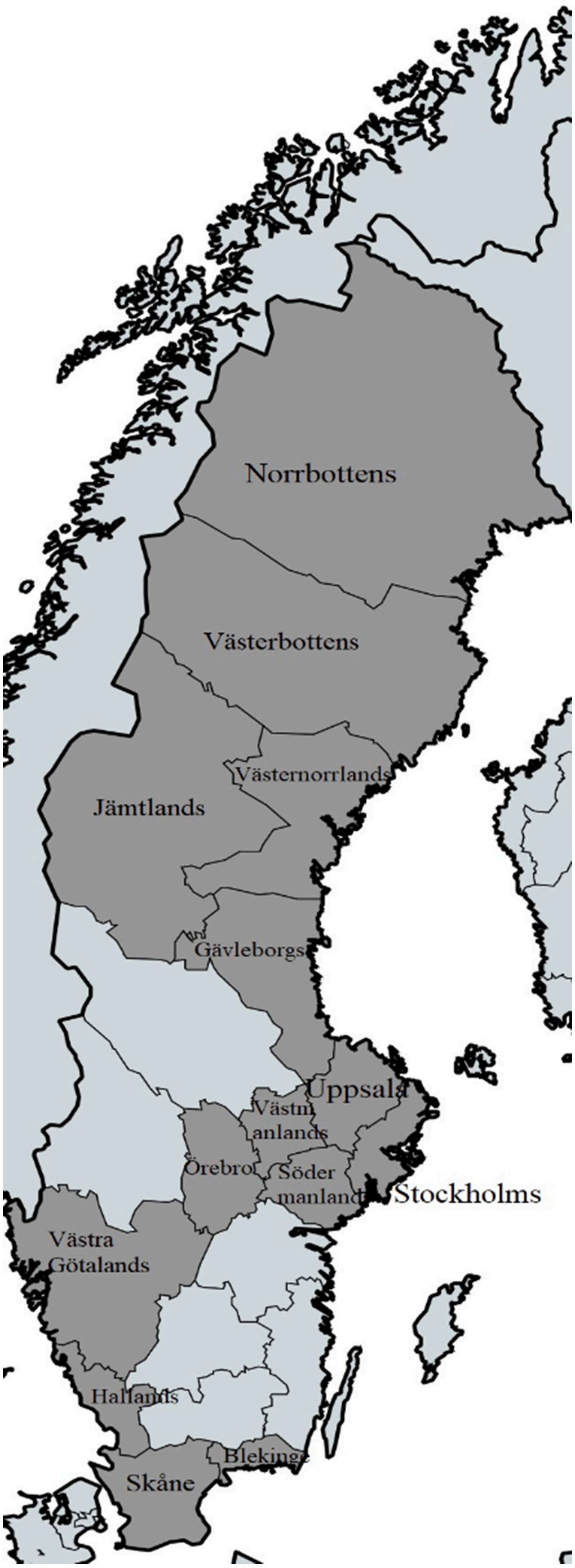

Fig. 2. Map of Sweden and county case study areas.
Note: case study areas for this analysis are based on different län or counties from Sweden, which are here represented in dark grey.

Table 1.1
Regional descriptive statistics, mean and standard deviation.

Region	Production specialization (%)	Farm size (Ha)	Arable land (dummy, %)	Pasture land (dummy, %)
North N = 116	Dairy: 50.9 % Cattle: 39.7 % Sheep: 0.9 % Mixed livestock: 6 % Mostly livestock/ mixed farming: 2.6 %	Mean: 118 SD: 65 Min: 4 Max: 460	97.4 %	87 %
South N = 271	Dairy: 24.7 % Cattle: 45 % Sheep: 3.7 % Mixed livestock: 9.7 % Mostly livestock/ mixed farming: 16.97 %	Mean: 132 SD:126 Min: 16 Max: 1100	100 %	97 %

Table 1.2
Descriptive statistics for sample and target population.

Characteristics	Sample mean N = 387	Target population mean (including non-responses) N = 2000	Wilcoxon rank sum test (z-stat)[a]
Production specialization			
Dairy	32.5 %	31 %	−0.605
Cattle	43.4 %	43.5 %	0.032
Sheep	2.8 %	2.7 %	−0.214
Mixed livestock	8.5 %	7.9 %	−0.416
Mostly livestock/ mixed farming	12.7 %	14.9 %	1.168
Region (North)	30 %	23 %	−2.889***

[a] $Pr(|Z| > |z|)$: * = 0.05; ** = 0.01; *** = 0.001.

obtain a summary of the analysis after fully completing the questionnaire. Addresses and other contact details were retrieved from Statistics Sweden. Farmers then received three electronic reminders through emails and text messages. On average, farmers took 35 min to complete the online questionnaire. The final sample consists of 387 respondents with anonymised data, corresponding to a 19 % response rate, similar to previous online surveys carried out in Sweden (Owusu-Sekyere et al., 2022).

3.2. *Data analysis*

Our final sample was analysed with STATA 14 (StataCorp, 2015) for statistical analysis and estimation. We first carried the measurement of our latent constructs through factor analysis, before extracting the factor scores of each latent and estimating their effect on adoption with logit models.

3.2.1. *Factor analysis to measure the latent constructs*

We implemented the factor analysis (principal axis) method instead of the principal component analysis (PCA) to analyse all our factors, except for the *Networks* factor. *Networks* was analysed with PCA as it does not represent a latent since it considers not only the shared variance but also the total variance (Tabachnick et al., 2007). Furthermore, there are no underlying theory about which variables should be associated with factor of network memberships as they are simply associated empirically (Hair et al., 2014). While principal axis is based on a reflective measurement model where the causality is from the construct to the indicators, PCA is based on a formative measurement model, where causality is from the indicators to the construct (Hair et al., 2017a, 2017b; Ferguson and Hansson, 2013). In our case, reflective measurement models are preferred for our extracted factors, except for *Networks* for which a formative measurement model is more reasonable.

Factor loadings were considered significant if above the

Table 2
Constructs and their indicators with summary statistics.

Construct	Indicator	Question and statement	Mean[a] (SD)	Skewness/ kurtosis
Positive attitudes towards ecological farming (*Att*)		To what extent do you agree with the following statements?		
	Att1	Protecting the environment is an important part of my job	4 (0.7)	−0.463/3.9
	Att2	It is important to adopt farming practices that provide environmental or social benefits	3.9 (0.6)	−0.456/3.9
	Att3	It is important to continuously assess the environmental and social impact of my farm	3.7 (0.7)	−0.277/3.4
Subjective norms (*SN*)		How do other farmers you know view the adoption of ecological practices[b]?		
	SN1	Most farmers I know question using more ecological farming practices	3.2 (0.9)	−0.072/3.0
	SN2	Few farmers I know are using ecological practices	3.3 (0.9)	−0.419/2.6
	SN3	Most farmers I know have not considered applying ecological farming practices beyond what is required by regulations	3.2 (0.9)	−0.081/2.7
Perceived behavioural control (*PBC*)		How prepared do you feel to use more ecological farming practices in the next five years?		
	PBC1	I feel well prepared to use more ecological farming practices	3.1 (0.9)	−0.301/2.9
	PBC2	Ecological farming practices are easy to use	2.9 (0.8)	−0.340/3.5
	PBC3	Ecological farming practices are easy to implement	3.1 (0.8)	−0.252/3.2
Businessperson identity (*Idty*)		Since you adopted more ecological production methods/if you were to adopt more ecological production methods, do you feel, in relation to your company, that you are now/would become more or less:		
	Idty1	Entrepreneur	4.28 (0.6)	−0.77/3.7
	Idty2	Professional	4.02 (0.7)	−0.68/4.3
	Idty3	Producer	3.99 (0.7)	−0.47/3.4
Network memberships (*Networks*)		How often do you consult the following organizations of which you are a member?		
	Net1	Farmer/grower organizations	4.06 (1.4)	−0.28/2.08
	Net2	Farmers union	3.80 (1.4)	−0.12/2.03
	Net3	Landowners association	4.70 (1.2)	−0.77/2.9
Conservation objectives (*Obj*)		How important are the following objectives to you?		
	Obj1	Farming in a way that enhances the environment	4.2 (0.6)	−0.421/3.3
	Obj2	Improving the condition of the land	4.2 (0.6)	−0.127/3.4
	Obj3	Protecting the environment for future generations	4.4 (0.6)	−0.672/3.4
Perceived economic benefits (*PB*)		What effect has adoption of ecological farming practices had on the following outcomes? If you do not currently use ecological farming practices, please consider the effect you believe their adoption WOULD have.		
	PB1	Profitability of your farm	2.7 (1.1)	−0.046/2.1
	PB2	Production of your farm	2.2 (0.9)	0.429/2.6
	PB3	Your ability to meet your farming objectives	2.8 (0.9)	−0.328/3.0
Perceived labour constraints (*PC*)		What effect has adoption of ecological farming practices had on the following outcomes? If you do not currently use ecological farming practices, please consider the effect you believe their adoption WOULD have.		
	PC1	Labour requirements for your farm	3.2 (0.7)	0.611/3.0
	PC2	Your time spent working on the farm	3.7 (0.8)	−0.154/2.4
	PC3	Intensity of seasonal peaks of work during the year (for you and the other farm workers)	3.4 (0.5)	0.37/3.02
	PC4	Physical nature of work (for you and the other farm workers)	3.7 (0.8)	−0.302/2.9
	PC5	Mental workload (for you and the other farm workers)	3.5 (0.8)	0.458/2.3
Adoption		In 2018 did you use any of the following agroforestry practices?	24.3 % (yes)	
		Agroforestry on arable land		
		Agroforestry on permanent grassland		
		Agroforestry with permanent crops (grazing and intercropping of permanent crops)		

[a] Or % for the adoption variable.
[b] Ecological practices were introduced in the survey as farming practices understood to have environmental and/or social benefits. They were said to be common in organic or agro-ecological farming systems, but also in more conventional farming systems, and include the use of precision technologies or integrated pest management.

recommended threshold of 0.3 for a sample size larger than 350 observations (Hair et al., 2014), and based on the latent root criterion, we retained single factors with an eigenvalue >1. Indicators with a factor loading below 0.3 were removed one at a time until only significant factor loadings remain. We used factor rotation for interpretability and more precisely, the oblique rotation was selected and undertaken with the Quartimin method, which allowed resulting factors to be correlated. We also checked for potential cross-loadings to assess discriminant validity. Finally, Cronbach's alpha, item-to-total and item-to-item correlations were assessed once the final factor structure was established in order to assess reliability of the factors, that is, the degree of consistency between multiple indicators of a factor (Hair et al., 2014).

Table 2 presents in details the indicators used to measure each latent. Except for the dependent variable which was measured with binary indicators, the other explanatory variables of the questionnaire were measured using 5 or 6-points Likert scales. Especially, Att, SN, PBC were measured on a 5-points Likert scale from "strongly disagree" to "strongly agree", Idty on a 5-points Likert scale from "much less" to "much more", Networks on a 6-points Likert scale from "I am not a member" to "At least monthly", Obj on a 5-points Likert scale from "Not at all important" to "Very important", PB and PC on a 5-points Likert scale from "Large decrease" to "Large increase" and Adoption was measured on a binary scale Yes or No. In regard to the question on agroforestry adoption, the concept of agroforestry was defined as a combination of agriculture and forestry practices to farmers in the questionnaire. This definition was provided in addition to asking to specify whether they were performing agroforestry on arable land, on permanent grassland or with permanent crops.

3.2.2. *Logit models*

In the second step, we extracted the factor scores of the retained factors from the factor analysis before including them as predictors in our logistic regressions. Factor scores are composite measures of each factor computed for each individual (Hair et al., 2017a, 2017b). Binary logistic estimation was used as our dependent variable is binary (adoption vs non-adoption). Our factor scores were calculated with the regression scoring method which provides standardized scores (DiStefano et al., 2019). The factor scores were also tested for normality and since normality was rejected, statistical inference was carried with bootstrapped standard errors.

We estimated several logit models to check the extent to which each of our additional explanatory variables, outside of the TPB, would contribute to improve the model.

First, we estimated adoption based on the original TPB variables:

$$Adoption_i = \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \epsilon_i \quad (1)$$

where i represents each individual, β the associated parameters and ε represents the error term.

Agroforestry adoption is defined as:

$$y = \begin{cases} 1 \text{ if } Adoption > 0 \\ 0 \text{ if } Adoption = 0 \end{cases}$$

More precisely, Adoption was coded as 1 when farmers were implementing agroforestry on either arable land (silvoarable), permanent grassland (silvopastoral) or with permanent crops, or when two or three of the aforementioned were implemented (see Table 2).

Model 2, 3, 4, 5 and 6 extended Model 1 by adding stepwise, variables to account for identity (*Idty*), networks (*Networks*), objectives (*Obj*), perceived economic benefits (*PB*) and perceived labour constraints (*PC*) respectively.

$$Adoption_i = \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \beta_4 Idty_i + \epsilon_i \quad (2)$$

$$Adoption_i = \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \beta_4 Networks_i + \epsilon_i \quad (3)$$

$$Adoption_i = \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \beta_4 Obj_i + \epsilon_i \quad (4)$$

$$Adoption_i = \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \beta_4 PB_i + \epsilon_i \quad (5)$$

$$Adoption_i = \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \beta_4 PC_i + \epsilon_i \quad (6)$$

As an extension, we also estimated Model 7 by including all explanatory variables and a set of farm control variables:

$$\begin{aligned} Adoption_i = {} & \beta_0 + \beta_1 Att_i + \beta_2 SN_i + \beta_3 PBC_i + \beta_4 Idty_i + \beta_5 Networks_i \\ & + \beta_6 Obj_i + \beta_7 PB + \beta_8 PC + \beta_9 Landscape + \beta_{10} Crop \\ & + \beta_{11} Livmgt + B_{12} Logfarmsize + B_{13} Region + \epsilon_i \end{aligned} \quad (7)$$

where *Landscape* corresponds to the amount of bushes, hedgerows, tree lines, woodland or isolated trees. *Crop* is the amount of crop diversification or crop rotation practices used, *Livmgt* is the amount of livestock management practices used, *Logfarmsize* the amount of total utilized agricultural area and *Region* a dummy variable if the farm is located in a Northern Län of Sweden.

Using the mediation effect model created by Baron and Kenny (1986), we also tested the meditation effect of *Idty* between *Networks* and *Adoption* and the mediation effect of *Obj* between *Att* and *Adoption* such that:

$$M_i = i_1 + a_1 X_i + a_2 Z_i + \sigma_1 \quad (8)$$

$$Adoption_i = i_2 + \beta_j' X_i + b_1 M_i + b_2 Z_i + \sigma_2 \quad (9)$$

where M_i represents the mediators, *Idty* and *Obj* respectively and X_i the independent variables which correspond to *Networks* and *Att* respectively. Z_i refers to all other control variables from model (7), σ_1 and σ_2 are errors and i_1 and i_2 regression constants when estimating M_i and $Adoption_i$ respectively. As for the estimated effects, β_j' estimates the direct effect of X_i on $Adoption_i$ while the indirect effect of X_i on $Adoption_i$ through M_i is the product of $a_1$and b_1. The effects and relationships of the model can be represented in Fig. 3:

4. Results

The following section first presents in Section 4.1 the results from the factor analysis before showing the estimated results obtained from the logit models presented in Section 4.2.

4.1. Factor analysis of behavioural variables

The results of the factor analysis are displayed in Table 3.1. Our behavioural variables were factor analysed category by category, that is, not altogether at the same time, but by type of variable. We were able to extract 8 different factors as predictors of our adoption variable. All factor loadings are significant as above the threshold of 0.3. Furthermore, as shown in Appendix, Table A, indicators' loading on their associated factor are greater than their cross-loadings on other factors, confirming discriminant validity, which means that our constructs are distinct from each other (Hair et al., 2017a, 2017b). The Cronbach's alpha, which measures scale reliability or how closely related the set of indicators are as a group, is above 0.7 for all constructs. Item-total correlations of indicators for each factor were above the recommended threshold of 0.5, except for SN1 and PBC1 which was just below the threshold but was retained because of acceptable Cronbach alpha's value. Finally, all the inter-item correlations were above the cut-off value of 0.3 (Hair et al., 2014).

4.2. Estimation results

This section first presents the results of Wilcoxon rank sum test for each explanatory variable included in our model before presenting the results of logistic regressions.

Table 3.2 shows that Network memberships (*Networks*) and conservation objectives (*Obj*) between adopters and non-adopters of agroforestry practices are statistically different while the rest of the explanatory variables show no statistical difference.

In Table 3.3, can be found the results of estimating six different logit models for behavioural drivers of adoption of agroforestry. The first model tests the TPB whilst the rest of the models successively test for potential improvement of the TPB model fit, after including one additional behavioural driver at a time, namely *Idty*, *Networks*, *Obj*, *PB* and then *PC*. Model 7 (the full model) in Table 3.4 includes all behavioural drivers together including farm control variables.

4.2.1. The Theory of Planned Behaviour (TPB) for adoption of agroforestry

The results of the model 1 of the TPB show that *Att*, *PBC* and *SN* are not statistically significant behavioural drivers for adoption of agroforestry practices. Furthermore, the Likelihood-ratio test of the hypothesis that the coefficients of the explanatory variables are zero, is not statistically significant with a *p*-value of 0.20. The TPB model, in our study, is therefore not significant. However the direction of the effects of *Att* and *PBC* is positive as hypothesized in the literature and *SN*, measured as negative views from other farmers for using ecological farming

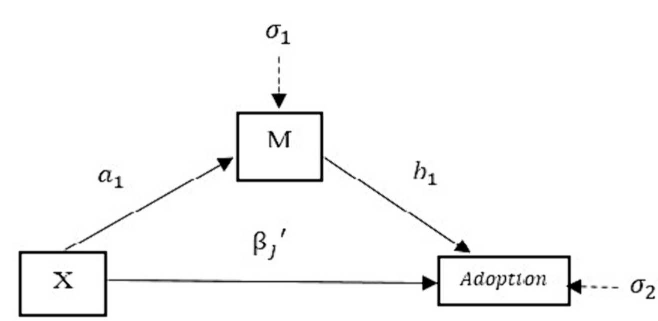

Fig. 3. Diagram of mediation model.
Inspired from Hayes (2017).

Table 3.1
Factor solution for suggested endogenous constructs.

Construct & indicators	Factor loading	Eigenvalue	Cronbach alpha	Range item-total correlation	Range inter-item correlation
Att		1.90971	0.86	0.679–0.784	0.609–0.746
Att1	0.812				
Att2	0.847				
Att3	0.730				
SN		1.45486	0.73	0.471–0.600	0.419–0.89
SN1	0.550				
SN2	0.707				
SN3	0.706				
PBC		1.32841	0.74	0.478–0.629	0.399–0.597
PBC1	0.558				
PBC2	0.732				
PBC3	0.694				
Obj		1.78269	0.84	0.650–0.744	0.581–0.704
Obj1	0.814				
Obj2	0.708				
Obj3	0.787				
Idty		1.35687	0.75	0.538–0.643	0.417–0.552
Idty1	0.628				
Idty2	0.649				
Idty3	0.735				
Networks					
Net1	0.757	2.06503	0.77	0.514–0.665	0.456–0.655
Net2	0.868				
Net3	0.858				
PB		1.56975	0.79	0.539–0.712	0.455–0.681
PB1	0.800				
PB2	0.750				
PB3	0.605				
PC		2.921	0.88	0.706–0.747	0.508–0.744
PC1	0.798				
PC2	0.809				
PC3	0.685				
PC4	0.769				
PC5	0.757				

practices, has, as we hypothesized in H3, a negative effect.

4.2.2. The augmented Theory of Planned Behaviour (TPB) for adoption of agroforestry

Model 2 tests for the improvement of the TPB by adding the *Idty* construct. In this case, the Likelihood-ratio tests the hypothesis that the nested model provides as good fit for the data as the more complex model. We fail to reject this hypothesis implying that Model 2 does not provide a significant improvement over Model 1 and the estimate of *Idty* is not significant. Model 3 adds on *Networks* to the TPB and in this case, the hypothesis is rejected at 5 % level implying that Model 3 provides a significant improvement of the TPB. The estimate of *Networks* is positively significant, which confirms H5. A standard deviation increase in *Networks* means a farmer is 35 % more likely to adopt agroforestry practices. The AIC also shows a lower value for Model 3 meaning that this model relatively better fits the data compared to Model 1. Models 4, 5 and 6 which include conservation objectives (*Obj*), *PB* and *PC* respectively, do not improve the TPB and their respective estimate is not significant. The direction of the effect for *Obj* is nevertheless in line with H6a.

Table 3.4 shows the results of the test of model 7. As the hypothesis of the LR test is rejected at 5 % level, our full model provides an improvement of Model 1. H5 is also confirmed when controlling for the rest of behavioural drivers and farm level variables. In terms of marginal effect, an increase in one unit of *Networks* score is associated on average with an increase of adoption by 4.75 percentage points. Furthermore, the significant and negative estimate of *Landscape* suggests that farmers are 21.5 % less likely to adopt agroforestry practices if they already have some landscape features on their farm (woody areas, trees or bushes etc.). Model 3 that corresponds to the augmented TPB with *Networks* appears to be the best model of those tested if we retain the one with the

Table 3.2
Wilcoxon rank sum test for explanatory constructs, comparison between adopters and non-adopters of agroforestry.

Explanatory variables	Mean for adopters (n = 94)	Mean for non-adopters (n = 293)	Wilcoxon rank sum test (z-stat)[a]
Att	0.136	−0.044	−1.349
SN	−0.048	0.015	0.532
PBC	0.117	−0.374	−1.067
Idty	0.103	−0.032	−1.438
Networks	0.245	−0.079	−2.379*
Obj	0.191	−0.061	−2.341*
PB	0.087	−0.028	−1.162
PC	−0.007	0.003	0.090

Note: Explanatory variables are here measured based on their factor score.
[a] Pr(|Z| > |z|): * = 0.05; ** = 0.01; *** = 0.001.

lowest AIC value. Robustness for these results are shown in Supplementary material including a disaggregation of these results by type of agroforestry.

Finally, we also test for potential mediation effect of *Networks* on adoption, where *Idty* acts as a mediator, and of *Att* on adoption, which is assumed to be mediated by conservation objectives (*Obj*). Regarding results of the first mediation analysis (Table 3.5), while the direct effect of *Networks* on adoption is significant, the indirect effect is not significant. There is therefore no evidence of mediation effect through *Idty*. However, results of the second mediation analysis (Table 3.6) show that although the direct effect is not significant, the indirect is significant at 10 % level, which confirms H6a * H6b and indicates that attitudes predicts conservation objectives which then predicts adoption. However, once we control for the rest of the covariates, the indirect effect is not significant anymore (see Appendix, Table F).

5. Discussion

In this section, we discuss the results obtained from Section 4.2, suggest potential areas for further investigation and discuss potential limitations of this study.

5.1. The Theory of Planned Behaviour (TPB) model for adoption of agroforestry

In regard to the variables of the TPB, our results indicate that they do not significantly influence adoption behaviour and that the model itself is not significant. This result however needs to be nuanced given the absence of the intention variable in our TPB model. As our model was based on cross-sectional data, it focused directly on adoption behaviour and omitted the intention to adopt, which predicts adoption in the TPB model. In so doing, we were able to test the direct impact of the TPB psychological constructs on adoption behaviour. While our results indicate that the TPB variables do not have a significant association with adoption, this result may be explained by the intention-behaviour "gap". As the intention-behaviour "gap" criticism emphasizes, individuals tend to fail to act in line with their intentions, suggesting that the TPB model would tend to better predict intentions than actual behaviour (Sheeran, 2002). For instance, in the study of Borremans et al. (2016) in Belgium, the TPB model is significant when the dependant variable is focused on intentions to adopt agroforestry rather than adoption. Future research could therefore collect data covering intentions first and at a later stage in time, follow up with a data collection on actual behaviour. This would be useful in order to test the TPB model in a more holistic way, in order to verify if the tested behavioural factors do have an impact on intentions to adopt agroforestry, and if these intentions can also predict the behaviour to do so. Furthermore, it would also help to verify whether there is in fact an intention-behaviour "gap" as it is suspected here.

Table 3.3
Logistic regressions results, N = 387.

Adoption agroforestry	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Odds ratio (SE[a,b])	Odds ratio (SE[a,b])	Odds ratio (SE[a,b])	Odds ratio (SE[a,b])	Odds ratio (SE[a,b])	Odds ratio (SE[a,b])
Att (H1)	1.2140 (0.183)	1.1502 (0.186)	1.1524 (0.183)	1.0585 (0.184)	1.2086 (0.186)	1.2074 (0.185)
SN (H2)	0.9194 (0.135)	0.8967 (0.132)	0.9370 (0.136)	0.9033 (0.133)	0.9241 (0.137)	0.9123 (0.135)
PBC (H3)	1.1771 (0.173)	1.1990 (0.177)	1.2006 (0.180)	1.1155 (0.171)	1.1596 (0.187)	1.2083 (0.182)
Idty (H4a)		1.2079 (0.194)				
Networks (H5)			1.3504* (0.176)			
Obj (H6a)				1.3195 (0.240)		
PB (H7)					1.0364 (0.171)	
PC (H8)						1.0787 (0.150)
Log likelihood	−212.2	−211.5	−209.1	−210.9	−212.2	−212.0
LR chi^2	Chi^2(3) = 4.59 (p = 0.20)	Chi^2(1) = 1.45 (p = 0.22)[c]	Chi^2(1) = 6.28 (p = 0.012)[c]	Chi^2(1) = 2.65 (p = 0.104)[c]	Chi^2(1) = 0.05 (p = 0.81)[c]	Chi^2(1) = 0.31 (p = 0.58)[c]
AIC	432.4	433.0	428.2	431.8	434.4	434.1
Pseudo R^2	0.0107	0.0141	0.0254	0.0169	0.0109	0.0114
Max variance inflator	1.12	1.17	1.12	1.49	1.44	1.23

[a] Bootstrapped standard errors.
[b] Pr(|T| > |t|): * = 0.05; ** = 0.01; *** = 0.001.
[c] Model 1 is nested.

Table 3.4
Logistic regression results for the full model, N = 387.

Adoption agroforestry	Model 7					
	Odds ratio	Standard errors[a]	P-value	Marginal effects[c]	Standard errors[a]	P-value
Att (H1)	0.9973	0.1938	0.989	−0.0004	0.0336	0.989
SN (H2)	0.9022	0.1374	0.500	−0.0177	0.0262	0.498
PBC (H3)	1.1113	0.1995	0.557	0.0182	0.0310	0.557
Idty (H4a)	1.1189	0.2084	0.546	0.0194	0.0321	0.546
Networks (H5)	1.3166	0.2034	0.075	0.0475	0.0261	0.068
Obj (H6a)	1.2174	0.2450	0.328	0.0340	0.0347	0.327
PB (H7)	1.1453	0.2137	0.467	0.0234	0.0321	0.466
PC (H8)	1.0450	0.1636	0.778	0.0076	0.0271	0.779
Landscape	0.7852	0.0787	0.016	−0.0418	0.0170	0.014
Crop	1.1061	0.1266	0.378	0.0174	0.0197	0.377
Livmgt	0.9165	0.1803	0.658	−0.0150	0.0339	0.657
Logfarmsize	0.8823	0.1832	0.547	−0.0216	0.0358	0.546
Region	1.2255	0.3637	0.493	0.0351	0.0511	0.492
Log likelihood	−203.04					
LR chi^2	Chi^2(10) = 18.41 (p = 0.04)[b]					
AIC	434.08					
Pseudo R^2	0.0536					
Max variance inflator	1.55					

[a] Bootstrapped standard errors.
[b] Model 1 is nested.
[c] The marginal effect is calculated at the mean of the dependent variable (average marginal effect).

Table 3.5
Results of mediation analysis, businessperson identity tested as mediator between networks membership and adoption, N = 387.

Adoption agroforestry	Odds ratio (SE[a])	P-value
Networks		
Total effect	1.38314 (0.1251)	0.010
Direct effect	1.35248 (0.1285)	0.019
Indirect effect H4a * H4b (Idty = M)	1.02267 (0.0224)	0.368

[a] Robust standard errors.

Table 3.6
Results of mediation analysis, conservation objectives tested as mediator between attitudes and adoption, N = 387.

Adoption agroforestry	Odds ratio (SE[a])	P-value
Att		
Total effect	1.25259 (0.131)	0.088
Direct effect	1.06777 (0.155)	0.674
Indirect effect H6a * H6b (Obj = M)	1.17309 (0.091)	0.079

[a] Robust standard errors.

5.2. The augmented Theory of Planned Behaviour (TPB) for adoption of agroforestry

The rest of our results deal with other behavioural variables that aimed to augment the TPB. First, our results indicate that the higher farmers' involvement in formal types of networks (*Networks*), including farmers' organizations, union and/or landowners' association, the more likely they are to adopt agroforestry practices. Furthermore, the factor *Networks* significantly improves the adoption model. This shows that exogenous type of factors to the TPB can play a role for adoption in the case of agroforestry. This result can help to shed light on the lack of clear understanding in relation to the type of network that is linked to higher or lower adoption of ecological practices, as Inman et al. (2018) raised. While Lee et al. (2018) found that farmers engagement in conservation type of network had a positive impact on their cover crop adoption, we find that non-conservation types of network also seem to have a positive role, in the case of agroforestry. Although we could expect that farmers engaged in strong farming communities would support the status quo and reinforce their feeling to comply with the social norm of being a "good farmer", a concept defined by Burton (2004), our result indicates that it is not that straightforward. We discuss what this can imply for policy further below in the conclusion section.

Second, we do not find a statistical significant effect of holding a businessperson type of identity (*Idty*) on agroforestry adoption. We were then not able to confirm our hypothesis that seeing oneself as the archetypal "economic" farmer should be detrimental for adoption, as agroforestry practices are deemed beneficial for the environment and others. Previous studies have instead shown that environmental identity positively impacts farmers' adoption of ecological practices (Lokhorst et al., 2011; Zemo and Termansen, 2021). As we also integrated the "producer" identity to our construct, our result can, to some extent, be contrasted to studies focused on the role of productivist identity on ecological practices adoption, which found a negative significant effect (Cullen et al., 2020; Walpole and Wilson, 2022). Given the point estimate and the relatively low standard errors, these results suggest that if there was an association of *Idty* with adoption, it would be small and most likely negligible. As *Idty* is a socially constructed concept, we also tested for potential mechanism effect, where *Idty* was predicted by *Networks* to then predict adoption and we could not find a significant mediation effect either.

Regarding the rest of our behavioural drivers, we do not find statistically significant results for the influence of conservation objectives (*Obj*), perceived economic benefits (*PB*) and perceived labour constraints (*PC*) on adoption of agroforestry practices. Our results for *Obj* and *PC* contrast results of previous literature, which finds that farmers have clear environmental and social motivations to adopt agroforestry (Sereke et al., 2016) and are demotivated by labour costs and additional time (Rois-Díaz et al., 2017). However, the non-significant estimate of *PB* can to some extent be explained if paralleled to the results of Opdenbosch and Hansson (2022) who show that perception of maintenance costs by farmers have a negative association with intentions and Graves et al. (2017) who explain that perception of low financial returns act as a barrier for adoption. Farmers' perception of economic benefits in terms of production and profitability in our study may therefore not be relevant for adoption of agroforestry given that it could rather incur an economic cost for them than an economic benefit. In Supplementary material, the disaggregation of results by type of agroforestry show very similar results except for the estimate of *PC,* which is positive and significant for the adoption of agroforestry with permanent crops. This different result is probably due to the very few number of adopters for this type of agroforestry (10.8 %), which makes the results sensitive.

As for the farm variable of landscape features, the negative significant relationship may first appear contradictory as it is a farming practice that is compatible with agroforestry systems. This result points instead that farmers who already have landscape features on their farm, prefer to utilize the rest of their arable land in a different way, by using farming practices different than agroforestry which would imply implementing these landscape features once more.

This study also investigated two mediation effects on adoption, one where conservation objectives (*Obj*) was being tested as a mediator between attitudes and adoption, and another one where *Idty* was being tested as a mediator between *Networks* and adoption. We find that attitudes have a positive influence on adoption only through its positive impact on *Obj*, although the significant indirect effect disappears once we control for the rest of the predictors of our full model (see Appendix, Table F). As for the other mediation analysis, the indirect effect is not significant. Since we do not use experimental data, our mediation analysis should not be interpreted as a causal relationship, although as supported by Hayes (2017), our results are still relevant as they are theoretically motivated. We suggest for future research that additional relationships between psychological constructs are explored. Especially, the feedback loop mechanism suggested by McGuire et al. (2013) and adapted from Burke and Stets (2009), offers an interesting theoretical approach for research that aims at investigating the complexity between farmers' identity and their social environment. This feedback loop mechanism could, for instance, be implemented with non-recursive models in structural equation modelling (SEM) (Martens and Haase, 2006). Furthermore, Caffaro et al. (2019) suggest to study farmers' adoption of sustainable practices by looking at TPB factors as mediators that are predicted by sources of information, in a model that integrates the TPB together with Rogers's (2010) diffusion of innovation theory.

Some potential limitations and areas for future research should also be discussed. Questions from the questionnaire were targeted on ecological practices generally and not on agroforestry practices precisely. Nevertheless, it is reasonable to assume that farmers' general positive attitudes towards ecological practices would, generally, translate into positive attitudes towards specific ecological practices, with agroforestry being a type of ecological practice. Thus, it is reasonable to assume that farmers who hold positive psychological constructs, such as positive attitudes towards ecological practices in general, also hold positive psychological constructs towards agroforestry. Second, the significant positive relationship of *Networks* with adoption should be nuanced with potential issue of omitted variable bias (OVB). Our analysis mainly focused on psychological and latent types of drivers hence socio-economic or more tangible types of variables could be candidates for omitted variables. We nonetheless capture some economic and structural aspects of farming by including farmers' perceived economic benefits and farm size. However, land occupational status (rented or owned), could be correlated with farmers' membership and frequency of consultation of landowner associations, which would lead to a biased estimate of *Networks* on adoption of agroforestry. We therefore let for future research the task to investigate how networks influence agroforestry adoption, given land occupational status. Finally, when comparing the means of the analysed sample and the targeted population, our sample appears to be biased towards the North. This bias should nevertheless not be of a major issue for the results of the analysis as the analysed sample and targeted population from the North and the South do not statistically differ in terms of farm specialization (see Tables B in Appendix). Furthermore, when controlling for Region, this variable is not statistically significant which indicates that results should not substantially be impacted by this bias.

6. Conclusions

Agroforestry has the potential to provide environmental and social services to society. Yet, these acknowledged benefits are often accompanied by perceived challenges from farmers, which relate to costs and social standing. European scientific literature investigating behavioural factors to better understand adoption of agroforestry is growing and further needed. This paper therefore analysed several behavioural factors that influence farmers' adoption of agroforestry practices, in a Swedish context. For this purpose, we augmented and tested, in a stepwise manner, the TPB with logit models. The model integrated, to the TPB, the influence of businessperson identity, network memberships, conservation objectives, perceived economic benefits and perceived labour constraints. Besides contributing to the developing literature on agroforestry adoption in Europe, the main novelty of this paper is to consider the businessperson identity as a factor for farmers' actual adoption of this practice.

The TPB model itself and the different constructs that compose it, are not significant for adoption in our study. From all the rest of the explanatory variables tested to augment the TPB, only farmers' membership to organizations, union and/or landowners' association improves the TPB and has a positive influence on agroforestry adoption. This highlights the importance to encourage farmers' connection to these types of networks and especially, the need to bring together and encourage interactions between farmers to spread new ideas and experience. This result also suggests the potential role for agricultural advisors that are part of these networks and farmers' associations, to promote and assist farmers in implementing agroforestry practices, which have been reported by some farmers in Europe as being tedious to implement in terms of, for instance, labour requirements. The proposed Common Agricultural Policy (2023–2027) encourages member states to build stronger agricultural knowledge and innovation systems to foster advice, knowledge flow and innovation in agriculture and rural areas. Government's expert authorities in the food sector, farmers' federations, and advisors have key role into spreading knowledge among farmers in Sweden. In regard to agroforestry, farmers could benefit from participating to activities arranged by these networks, where experience, scientific and practical knowledge on agroforestry practices are transmitted and discussed. Further research on the types of source of information that encourage farmers adopting agroforestry practices and how this information interplays with network memberships, could be a way forward to better understand the role played by networks for farmers' adoption of these practices.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

We would like to express our sincere appreciation to the anonymous reviewers for their valuable comments and suggestions.

Funding

This study is part of the LIFT ('Low-Input Farming and Territories – Integrating knowledge for improving ecosystem-based farming') project that has received funding from the European Union's Horizon 2020 - Research and Innovation Framework Programme under grant agreement no. 770747. The paper contributes to Mistra Food Futures (DIA 2018/24 #8), a research program funded by Mistra (The Swedish foundation for strategic environmental research). All funding is gratefully acknowledged.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.spc.2024.03.023.

References

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Akerlof, G.A., Kranton, R.E., 2000. Economics and identity. Q. J. Econ. 115 (3), 715–753. https://academic.oup.com/qje/article/115/3/715/1828151.

Asplund, L., Björklund, J., 2016. Agroforestry systems in sweden. In: 3rd European Agroforestry Conference, (May), 23–25. Montpelier. www.agroforestry.se.

Augoustinos, M., Walker, I., Donaghue, N., 2014. Social Cognition: An Integrated Introduction. Sage. https://books.google.se/books?hl=fr&lr=&id=oKyHAwAAQBAJ&oi=fnd&pg=PP1&ots=JCprkaFXAU&sig=Dt7kTZ0AsWCvCLSjX3CP3DxvNZs&redir_esc=y#v=onepage&q&f=false.

Awazi, N.P., Tchamba, M.N., Avana, T.M.L., 2019. Climate change resiliency choices of small-scale farmers in Cameroon: determinants and policy implications. J. Environ. Manag. 250, 109560.

Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J. Pers. Soc. Psychol. 51 (6), 1173.

Beer, L., Theuvsen, L., 2019. Conventional German farmers' attitudes towards agricultural wood and their willingness to plant an alley cropping system as an ecological focus area: a cluster analysis. Biomass Bioenergy 125, 63–69.

Borremans, L., Reubens, B., Van Gils, B., Baeyens, D., Vandevelde, C., Wauters, E., 2016. A sociopsychological analysis of agroforestry adoption in Flanders: understanding the discrepancy between conceptual opportunities and actual implementation. Agroecol. Sustain. Food Syst. 40 (9), 1008–1036. https://doi.org/10.1080/21683565.2016.1204643.

Bourdieu, P., 1986. The forms of capital. In: Richardson, J.G. (Ed.), Handbook of Theory and Research for the Sociology of Education, vol. 241(258). Greenwood, New York, p. 19.

Burgess, P.J., Rosati, A., 2018. Advances in European agroforestry: results from the AGFORWARD project. Agrofor. Syst. 92 (4), 801–810. https://doi.org/10.1007/S10457-018-0261-3/FIGURES/3.

Burke, P.J., Stets, J.E., 2009. Identity Theory. Oxford Press, New York.

Burton, R.J.F., 2004. Reconceptualising the "behavioural approach" in agricultural studies: a socio-psychological perspective. J. Rural. Stud. 20, 359–371. https://doi.org/10.1016/j.jrurstud.2003.12.001.

Burton, R.J.F., Wilson, G.A., 2006. Injecting social psychology theory into conceptualisations of agricultural agency: towards a post-productivist farmer self-identity? J. Rural. Stud. 22 (1), 95–115. https://doi.org/10.1016/j.jrurstud.2005.07.004.

Caffaro, F., Roccato, M., Micheletti Cremasco, M., Cavallo, E., 2019. An ergonomic approach to sustainable development: the role of information environment and social-psychological variables in the adoption of agri-environmental innovations. Sustain. Dev. 27 (6), 1049–1062. https://doi.org/10.1002/SD.1956.

Castillo, G.M.L., Engler, A., Wollni, M., 2021. Planned behavior and social capital: understanding farmers' behavior toward pressurized irrigation technologies. Agric. Water Manag. 243 (September 2020), 106524 https://doi.org/10.1016/j.agwat.2020.106524.

Cook, A.J., Kerr, G.N., Moore, K., 2002. Attitudes and intentions towards purchasing GM food. J. Econ. Psychol. 23 (5), 557–572. https://doi.org/10.1016/S0167-4870(02)00117-4.

Cooper, T., Hart, K., Baldock, D., 2009. Provision of Public Goods Through Agriculture in the European Union. Institute for European Environmental Policy, London. https://www.researchgate.net/publication/265407011.

Couzy, C., Dockes, A.-C., 2008. Are farmers businesspeople? Highlighting transformations in the profession of farmers in France. J. Entrep. Small Bus. 6 (3), 407–420.

Cullen, P., Ryan, M., O'Donoghue, C., Hynes, S., HUallacháin, D., Sheridan, H., 2020. Impact of farmer self-identity and attitudes on participation in agri-environment schemes. Land Use Policy 95, 104660. https://doi.org/10.1016/J.LANDUSEPOL.2020.104660.

den Herder, M., Moreno, G., Mosquera-Losada, R.M., Palma, J.H.N., Sidiropoulou, A., Santiago Freijanes, J.J., Crous-Duran, J., Paulo, J.A., Tomé, M., Pantera, A., Papanastasis, V.P., Mantzanas, K., Pachana, P., Papadopoulos, A., Plieninger, T., Burgess, P.J., 2017. Current extent and stratification of agroforestry in the European Union. Agric. Ecosyst. Environ. 241, 121–132. https://doi.org/10.1016/J.AGEE.2017.03.005.

Dessart, F.J., Barreiro-Hurlé, J., Van Bavel, R., 2019. Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review. Eur. Rev. Agric. Econ. 46 (3), 417–471. https://doi.org/10.1093/erae/jbz019.

DiStefano, C., Zhu, M., Mindrila, D., 2019. Understanding and using factor scores: considerations for the applied researcher. Pract. Assess. Res. Eval. 14 (1), 20.

Edwards-Jones, G., 2006. Modelling farmer decision-making: concepts, progress and challenges. Anim. Sci. 82 (6), 783–790. https://doi.org/10.1017/ASC2006112.

ENRD, 2010. Public goods and public intervention in agriculture. http://enrd.ec.europa.eu.

European Commission, 2021. List of Potential Agricultural Practices that Eco-schemes Could Support. https://agriculture.ec.europa.eu/system/files/2021-01/factsheet-agri-practices-under-ecoscheme_en_0.pdf.

European Parliament, 2020. Agroforestry in the European Union.

Ferguson, R., Hansson, H., 2013. Expand or exit? Strategic decisions in milk production. Livest. Sci. 155 (2–3), 415–423. https://doi.org/10.1016/j.livsci.2013.05.019.

Fishbein, M., Ajzen, I., 1975. Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Addision-Wesley, Reading, MA.

Graves, A.R., Burgess, P.J., Liagre, F., Dupraz, C., 2017. Farmer perception of benefits, constraints and opportunities for silvoarable systems: preliminary insights from Bedfordshire. England. Outlook on Agriculture 46 (1), 74–83. https://doi.org/10.1177/0030727017691173.

Greiner, R., Patterson, L., Miller, O., 2008. Motivations, Risk Perceptions and Adoption of Conservation Practices by Farmers. https://doi.org/10.1016/j.agsy.2008.10.003.

Hair, J., Black, W., Babin, B., Anderson, R., 2014. Multivariate Data Analysis (Seventh). Pearson, New Jersey, USA.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2017a. A primer on partial least squares structural equation modeling (PLS-SEM). In: International Journal of Research & Method in Education, Second, vol. 38(2). SAGE Publications. https://doi.org/10.1080/1743727x.2015.1005806.

Hair, Joe F., Matthews, L.M., Matthews, R.L., Sarstedt, M., 2017b. PLS-SEM or CB-SEM: updated guidelines on which method to use. International Journal of Multivariate Data Analysis 1 (2), 107. https://doi.org/10.1504/ijmda.2017.10008574.

Hansson, H., Ferguson, R., Olofsson, C., 2012. Psychological constructs underlying farmers' decisions to diversify or specialise their businesses – an application of theory of planned behaviour. J. Agric. Econ. 63 (2), 465–482. https://doi.org/10.1111/J.1477-9552.2012.00344.X.

Hayes, A.F., 2017. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-based Approach. Guilford Publications.

Howley, P., 2015. The happy farmer: the effect of nonpecuniary benefits on behavior. Am. J. Agric. Econ. 97 (4), 1072–1086.

Inman, A., Winter, M., Wheeler, R., Vain, E., Lovett, A., Collins, A., Jones, I., Johnes, P., Cleasby, W., 2018. An exploration of individual, social and material factors influencing water pollution mitigation behaviours within the farming community. Land Use Policy 70, 16–26. https://doi.org/10.1016/J.LANDUSEPOL.2017.09.042.

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. https://doi.org/10.1111/j.1574-0862.2010.00454.x.

Khaledi, M., Weseen, S., Sawyer, E., Ferguson, S., Gray, R., 2010. Factors influencing partial and complete adoption of organic farming practices in Saskatchewan, Canada. Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie 58 (1), 37–56. https://doi.org/10.1111/J.1744-7976.2009.01172.X.

Lampkin, N., Stolze, M., M, S., de P, M., Haller, L., Mészáros, D., 2020. Using eco-schemes in the new CAP: a guide for managing, IFOAM EU. www.ifoam-eu.org.

Laporta, L., Domingos, T., Marta-Pedroso, C., 2021. It's a keeper: valuing the carbon storage service of agroforestry ecosystems in the context of CAP Eco-Schemes. Land Use Policy 109, 105712. https://doi.org/10.1016/J.LANDUSEPOL.2021.105712.

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.

Lee, D., Arbuckle, J.G., Zhu, Z., Nowatzke, L., 2018. Conditional causal mediation analysis of factors associated with cover crop adoption in Iowa, USA. Water Resour. Res. 54 (11), 9566–9584. https://doi.org/10.1029/2017WR022385.

Levidow, L., Psarikidou, K., 2011. Food Relocalization for environmental sustainability in Cumbria. Sustainability 3 (4), 692–719. https://doi.org/10.3390/SU3040692.

Lokhorst, A.M., Staats, H., Van Dijk, J., Van Dijk, E., De Snoo, G., 2011. What's in it for me? Motivational differences between farmers' subsidised and non-subsidised conservation practices. Appl. Psychol. 60 (3), 337–353. https://doi.org/10.1111/J.1464-0597.2011.00438.X.

Martens, M.P., Haase, R.F., 2006. Advanced applications of structural equation modeling in counseling psychology research. Couns. Psychol. 34 (6), 878–911. https://doi.org/10.1177/0011000005283395.

Mcadam, J.H., Burgess, P., Graves, A., Rosa Mosquera-Losada, M., 2018. Classifications and Functions of Agroforestry Systems in Europe Long-term Soil Organic Matter Dynamics in Cocoa Plantations: A Meta-analysis View Project. https://doi.org/10.1007/978-1-4020-8272-6_2.

McGuire, J., Morton, L.W., Cast, A.D., 2013. Reconstructing the good farmer identity: shifts in farmer identities and farm management practices to improve water quality. Agric. Hum. Values 30 (1), 57–69. https://doi.org/10.1007/S10460-012-9381-Y/FIGURES/2.

Mwase, W.F., Njoloma, J., Isaac Nyoka, B., Manduwa, D., Mwase, W., Sefasi, A., Nyoka, B.I., Nyaika, J., 2015. Factors affecting adoption of agroforestry and evergreen agriculture in Southern Africa. Environment and Natural Resources Research 5 (2). https://doi.org/10.5539/enrr.v5n2p148.

Nerlich, K., Graeff-Hönninger, S., Claupein, W., 2013. Agroforestry in Europe: a review of the disappearance of traditional systems and development of modern agroforestry practices, with emphasis on experiences in Germany. Agrofor. Syst. 87 (2), 475–492. https://doi.org/10.1007/s10457-012-9560-2.

Opdenbosch, H., Hansson, H., 2022. Farmers' willingness to adopt silvopastoral systems: investigating cattle producers' compensation claims and attitudes using a contingent valuation approach. Agrofor. Syst. 1–17.

Otter, V., Beer, L., 2021. Alley cropping systems as Ecological Focus Areas: a PLS-analysis of German farmers' acceptance behaviour. J. Clean. Prod. 280, 123702.

Owusu-Sekyere, E., Hansson, H., Telezhenko, E., 2022. Use and non-use values to explain farmers' motivation for the provision of animal welfare. Eur. Rev. Agric. Econ. 49 (2), 499–525. https://doi.org/10.1093/ERAE/JBAB012.

Pilarova, T., Bavorova, M., Kandakov, A., 2018. Do farmer, household and farm characteristics influence the adoption of sustainable practices? The evidence from the Republic of Moldova. Int. J. Agric. Sustain. 16, 367–384. https://doi.org/10.1080/14735903.2018.1499244.

Rise, J., Sheeran, P., Hukkelberg, S., 2010. The role of self-identity in the theory of planned behavior: a meta-analysis. J. Appl. Soc. Psychol. 40 (5), 1085–1105.

Rogers, E.M., 2010. Diffusion of Innovations, 4th edition. Simon and Schuster Inc.. https://www.scirp.org/(S(czeh2tfqyw2orz553k1w0r45))/reference/ReferencesPapers.aspx?ReferenceID=1770117

Rois-Díaz, M., Lovric, N., Lovric, M., Den Herder, M., Graves, A., Pisanelli, A., Losada, R. M., Ferreiro Rodríguez, N., De Jalon, G., Vityi, A., Varga, A., Burgess, P.J., Lamersdorf, N., Amaral, J., Marosvölgyi, B., Mirck, J., Tsonkova, P., Pantera, A., Mantzanas, K., Camilli, F., 2017. Environmental and socio-economic framework conditions of agroforestry in different regions in Europe. www.agforward.eu.

Rois-Díaz, M., Lovric, N., Lovric, M., Ferreiro-Domínguez, N., Mosquera-Losada, M.R., den Herder, M., Graves, A., Palma, J.H.N., Paulo, J.A., Pisanelli, A., Smith, J., Moreno, G., García, S., Varga, A., Pantera, A., Mirck, J., Burgess, P., 2018. Farmers' reasoning behind the uptake of agroforestry practices: evidence from multiple case-studies across Europe. Agrofor. Syst. 92 (4), 811–828. https://doi.org/10.1007/S10457-017-0139-9/TABLES/5.

Sereke, F., Dobricki, M., W, J., K, A., G, A.R., Szerencsits, E., Herzog, F., 2016. Swiss farmers don't adopt agroforestry because they fear for their reputation. Agrofor. Syst. 90 (3) https://doi.org/10.1007/s10457-015-9861-3.

Sets, Jan E., Burke, P.J., 2010. Identity theory and social identity theory. Soc. Psychol. 63 (3), 224–237.

Sheeran, P., 2002. Intention-behavior relations: a conceptual and empirical review. Eur. Rev. Soc. Psychol. 12 (1), 1–36. https://doi.org/10.1080/14792772143000003.

Shennan-Farpón, Y., Mills, M., Souza, A., Homewood, K., 2022. The role of agroforestry in restoring Brazil's Atlantic Forest: opportunities and challenges for smallholder farmers. People and Nature 4 (2), 462–480.

Small, B., Brown, P., Montes de Oca Munguia, O., 2015. Values, trust, and management in New Zealand agriculture. Int. J. Agric. Sustain. 14 (3), 282–306. https://doi.org/10.1080/14735903.2015.1111571.

Smith, J., Pearce, B.D., Wolfe, M.S., 2021. Reconciling Productivity With Protection of the Environment: Is Temperate Agroforestry the Answer? https://doi.org/10.1017/S1742170511000585.

Stets, J.E., Biga, C.F., 2003. Bringing identity theory into environmental sociology. Sociol Theory 21 (4), 398–423.

Sutherland, L.A., 2010. Environmental grants and regulations in strategic farm business decision-making: a case study of attitudinal behaviour in Scotland. Land Use Policy 27 (2), 415–423. https://doi.org/10.1016/J.LANDUSEPOL.2009.06.003.

Suvanto, H., Niemi, J.K., Lähdesmäki, M., 2020. Entrepreneurial identity and farmers' protein crop cultivation choices. J. Rural. Stud. 75, 174–184. https://doi.org/10.1016/J.JRURSTUD.2020.01.022.

Tabachnick, B.G., Fidell, L.S., Ullman, J.B., 2007. Using Multivariate Statistics, vol. 5. Pearson, Boston, MA. https://lccn.loc.gov/2017040173%0Ahttps://www.vlebooks.com/Vleweb/Product/Index/437320?page=0.

Terasaki Hart, D.E., Yeo, S., Almaraz, M., Beillouin, D., Cardinael, R., Garcia, E., Cook-Patton, S.C., 2023. Priority science can accelerate agroforestry as a natural climate solution. Nat. Clim. Chang. 1–12.

Thompson, B., Leduc, G., Manevska-Tasevska, G., Toma, L., Hansson, H., 2024. Farmers' adoption of ecological practices: a systematic literature map. J. Agric. Econ. 75 (1), 84–107.

Torquebiau, E.F., 2000. A renewed perspective on agroforestry concepts and classification. Comptes Rendus de l'Académie Des Sciences - Series III - Sciences de La Vie 323 (11), 1009–1017. https://doi.org/10.1016/S0764-4469(00)01239-7.

Tzouramani, I., Latruffe, L., Konstantidelli, V., Desjeux, Y., Bailey, A., Bardounioti, M., Barnes, A., Dakpo, H., Davidova, S., 2019. LIFT- Deliverable 2.2: LIFT large-scale farmer survey questionnaire. https://hal.inrae.fr/hal-02790328.

Usman, M., Ahmad, M.I., 2018. Parallel mediation model of social capital, learning and the adoption of best crop management practices: evidence from Pakistani small farmers. China Agricultural Economic Review 10 (4), 589–607. https://doi.org/10.1108/CAER-01-2017-0002.

Valizadeh, N., Bijani, M., Karimi, H., Naeimi, A., Hayati, D., Azadi, H., 2020. The effects of farmers' place attachment and identity on water conservation moral norms and intention. Water Res. 185, 116131 https://doi.org/10.1016/J.WATRES.2020.116131.

van Dijk, W.F.A., Lokhorst, A.M., Berendse, F., de Snoo, G.R., 2015. Collective agri-environment schemes: how can regional environmental cooperatives enhance farmers' intentions for agri-environment schemes? Land Use Policy 42, 759–766. https://doi.org/10.1016/J.LANDUSEPOL.2014.10.005.

Vesala, H.T., Vesala, K.M., 2010. Entrepreneurs and producers: identities of Finnish farmers in 2001 and 2006. J. Rural. Stud. 26 (1), 21–30. https://doi.org/10.1016/J.JRURSTUD.2009.06.001.

Vesala, K.M., Peura, J., McElwee, G., 2007. The split entrepreneurial identity of the farmer. J. Small Bus. Enterp. Dev. https://doi.org/10.1108/14626000710727881.

Viaggi, D., Raggi, M., Villanueva, A.J., Kantelhardt, J., 2021. Provision of public goods by agriculture and forestry: economics, policy and the way ahead. Land Use Policy 107, 105273.

Waldron, A., Garrity, D., Malhi, Y., Girardin, C., Miller, D.C., Seddon, N., 2017. Agroforestry Can Enhance Food Security While Meeting Other Sustainable Development Goals. https://doi.org/10.1177/1940082917720667.

Walpole, H.D., Wilson, R.S., 2022. Why do we conserve?: identifying mechanisms in agricultural conservation practice adoption decisions. Soc. Nat. Resour. 35 (3), 340–352. https://doi.org/10.1080/08941920.2021.2019862.

Whitmarsh, L., O'Neill, S., 2010. Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. J. Environ. Psychol. 30 (3), 305–314. https://reader.elsevier.com/reader/sd/pii/S0272494410000046?token=A259898C7AB633FF9BDD3638819134CFC1847511A795A536C1BADC27BF37A45843804DAE03E929BCBFE45DAB7674BB60&originRegion=eu-west-1&originCreation=20210621093749.

Williamson, J.M., 2011. The role of information and prices in the nitrogen fertilizer management decision: new evidence from the agricultural resource management survey. J. Agric. Resour. Econ. 552–572. https://www.proquest.com/docview/935901907?pq-origsite=gscholar&fromopenview=true.

Willock, J., Deary, I.J., Edwards-Jones, G., Gibson, G.J., McGregor, M.J., Sutherland, A., Dent, J.B., Morgan, O., Grieve, R., 1999. The role of attitudes and objectives in farmer decision making: business and environmentally-oriented behaviour in Scotland. J. Agric. Econ. 50 (2), 286–303. https://doi.org/10.1111/j.1477-9552.1999.tb00814.x.

Workman, S.W., Bannister, M.E., Nair, P.K.R., 2003. Agroforestry potential in the southeastern United States: perceptions of landowners and extension professionals. Agrofor. Syst. 59, 73–83.

Wossen, T., Berger, T., Mequaninte, T., Alamirew, B., 2013. Social network effects on the adoption of sustainable natural resource management practices in Ethiopia, 20 (6), 477–483. https://doi.org/10.1080/13504509.2013.856048.

Zemo, K.H., Termansen, M., 2021. Environmental identity economics: an application to farmers' pro-environmental investment behaviour. Eur. Rev. Agric. Econ. 00 (00), 1–28. https://doi.org/10.1093/erae/jbab049.