frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 19 September 2023
DOI 10.3389/fsufs.2023.1196824

OPEN ACCESS

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RECEIVED 30 March 2023
ACCEPTED 25 August 2023
PUBLISHED 19 September 2023

CITATION
Rossi ES, Materia VC, Caracciolo F, Blasi E and Pascucci S (2023) Farmers in the transition toward sustainability: what is the role of their entrepreneurial identity?
Front. Sustain. Food Syst. 7:1196824.
doi: 10.3389/fsufs.2023.1196824

Farmers in the transition toward sustainability: what is the role of their entrepreneurial identity?

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Introduction: The European Union has recently prompted a shift toward Ecological Intensification (EI) practices, aiming to harmonize agricultural productivity and environmental conservation. Despite the benefits of EI, its implementation has been limited, as farmers face challenges in business reorganization and supply chain adaptation. This paper investigates the role of contract farming (*CF*) in promoting the adoption of sustainable practices among Italian wheat producers. Specifically, it analyzes the influence of farmers' entrepreneurial identity on their engagement in such initiatives.

Methods: Using the case study of Barilla Group's Carta del Mulino initiative, an innovative contract farming scheme incentivizing sustainable EI practices, the study explores the relationship between entrepreneurial identity and participation in *CF* schemes supporting EI. Data from a sample of 314 soft wheat farmers in four regions of Northern Italy were collected to examine the role of entrepreneurial identity in the adoption of sustainable practices and participation in *CF* schemes. To evaluate the research hypotheses, two distinct econometric models were developed.

Results and discussion: The findings reveal that farmers with a more developed entrepreneurial identity are more likely to adopt more sustainable agricultural practices and engage in contractual schemes involving EI practices. The study highlights the importance of fostering and supporting farmers' entrepreneurial identity while increasing their knowledge of alternative agricultural techniques to address the challenges of the agricultural sector. This integration of individual perspectives (entrepreneurial identity) with a systems view (contract farming schemes) offers valuable insights for future research, policy, and practice in agri-food systems sustainability.

KEYWORDS

ecological intensification, soil health, entrepreneurial orientation, Barilla, contract farming, cereal farmers

1. Introduction

As a result of a focus on specialized, industrialized, monoculture-based agricultural systems, current agriculture practices have significant negative impacts for the environment and the climate in terms of greenhouse gas emissions (GHG_emissions), loss of biodiversity and ecosystem services, pollution of water systems, increased risk of pests and crop diseases, and loss of soil health (Foley et al., 2005; Despotović et al., 2021; Weituschat et al., 2022). Particularly, soil health is now becoming increasingly more relevant on the agenda of the European

Union—EU—(European Commission, 2018, 2020, 2021). Crop diversification, together with agro-ecology, agroforestry, organic and biodynamic agriculture—among others—are examples of regenerative practices designed for the so-called Ecological Intensification (EI). EI has emerged in the literature as an alternative to conventional and sustainable intensification agricultural systems (Altieri and Nicholls, 2005; Pretty, 2008; Foley et al., 2011; Garnett et al., 2013; Tittonell, 2014; Wezel et al., 2014; Petersen and Snapp, 2015; Rockström et al., 2017). Although the EI agricultural practices prove to restore soil health, they are not as widely spread among farmers as expected (Pretty et al., 2018; Kleijn et al., 2019; Suvanto et al., 2020; Benitez-Altuna et al., 2021; Kernecker et al., 2021).

Implementing EI practices implies a change in farmers' business strategies. More specifically, the adoption of EI-focused practices implies reorganizing farm business models and likely changing the relationships with partners in the whole agri-food supply chains, with higher costs and longer adaptation periods (Blasi et al., 2015; Meynard et al., 2017; Rosa-Schleich et al., 2019). Among the forms of organization of agri-food supply chains that could support farmers in adopting new practices and overcoming such limitations, Contract Farming (*CF*) has proved to be an effective tool to consider (Banterle and Stranieri, 2013; Wang et al., 2014; Minot and Sawyer, 2016; Ricome et al., 2016; Pancino et al., 2019). However, extant literature has not thoroughly investigated the role that contract farming (and especially privately driven initiatives) can play in enhancing specifically the adoption of sustainable practices, particularly at value chains (Weituschat et al., 2023a). What is still in need of further investigation is how the adoption and diffusion of EI practices through contract farming are influenced by entrepreneurial attitudes. The adoption of new practices, combined with a reconfiguration of participation in contractual relations, do engage with entrepreneurial attitudes and dynamics, for instance in terms of recombination of farm assets and resources, skill development, organizational capabilities, and risk management, among others. Today, only a few studies in the domain of agricultural entrepreneurship have provided insights into the entrepreneurial processes mobilized by farmers when engaging in the adoption of sustainable practices and through supply chain participation and contracting (Weituschat et al., 2023a). These studies mainly point to how these entrepreneurs adopt more sustainable agricultural practices for mitigating the impact of their business on natural resources (Fitz-Koch et al., 2018; Mann, 2018; Bakker et al., 2021), thus revealing the presence of entrepreneurial attitudes where business and environmental aspects are strongly intertwined. Consistently, extant studies indicate that farmers' Entrepreneurial Identity (EntID), namely the set of values and attitudes behind farmers' decisions and objectives, likely plays a significant role in the choice to adopt sustainable practices (Azman et al., 2013; De Rosa et al., 2019; Dias et al., 2019; Suvanto et al., 2020). However, no study has so far analyzed whether the entrepreneurial identity of farmers triggers participation in contract farming schemes that aim at incentivizing a higher adoption of sustainable practices.

In this article, we argue that understanding at the systemic level of the value chain what role contracts play as governance mechanisms conducive to the transitions toward more sustainable food systems is necessarily connected to the understanding at the individual level of the farmers of how individuals use their entrepreneurial identity to ensure productivity is improved in quality and conditions within planetary boundaries. Therefore, this paper aims at analyzing the relationship between farmers' entrepreneurial identity and their choice to participate in a contractual scheme that aims to enhance the adoption of EI practices. In order to analyze whether a relationship exists between the entrepreneurial identity of the farmers so defined and the participation in contractual schemes for the adoption of sustainable practices, we draw on the case of a large–scale value chain-based initiative that the Italian multi-national food manufacturer Barilla Group has recently implemented in Italy. In recent years, value chain agreements and contracts are becoming more common in the cereals sector (Carillo et al., 2017; Frascarelli et al., 2021; Ciliberti et al., 2022). Barilla Group launched in 2019 the sustainability–focused Carta del Mulino initiative (CdM; Barilla, 2021a), namely a newly designed contract farming scheme, to reconfigure its value chain and to incentivize particularly farmers producing wheat to adopt sustainable EI practices (Barilla, 2018, 2021b; Pancino et al., 2019).

Implications for research, policy, and practice are provided that enhance the understanding of the potential for integrating an individual-level perspective (entrepreneurial identity) into a systems view (contract farming schemes at the industrial value chain level) when it comes to organizing sustainability in agri-food systems.

2. Conceptual background

2.1. Entrepreneurial and institutional changes for sustainable transitions

Evidence of the detrimental effect that food systems have in particular on the environment at all stages (from production to consumption and waste management) is well documented in the literature: agricultural intensification and specialization have persisted over the last decades with profound negative effects on biodiversity (Rockström et al., 2017; Kleijn et al., 2019), such as depletion of freshwater resources, soils degradation, deforestation, and loss of plants and animal species (Campbell et al., 2017; Davies, 2017; Rockström et al., 2020). Such effect has motivated the emergence of initiatives at the policy level in Europe—such as the Farm to Fork strategy, a cornerstone in the European Green Deal (European Commission, 2020)—and at the stakeholders' level globally—such as the UN Food Summit in 2021—that underlines how the overall goals of a food system's transformation should be achieved while ensuring food systems' resilience to shocks. Tensions clearly emerge when addressing at the same time these goals (Béné et al., 2018).

This calls for a radical transformation of how the agricultural sector produces commodities (Vermunt et al., 2020; Di Bene et al., 2022) to support and make sustainable use of biodiversity. At the individual level, farmers need to embrace new sustainable agricultural practices which necessarily also imply a change in their business model, but for these practices to flourish, at a more systemic level agricultural supply chains need major changes. Transforming food systems by breaking down barriers (such as structural inequalities) necessarily challenges established assumptions, mindsets, procedures, political and economic interests, and power relations (IFAD's Rural Development Report, 2021). Although new technologies, governance modes, economic deregulation, and changes in consumer patterns have been widely introduced to reduce barriers (Fuenfschilling and Truffer, 2014), food system transformations remain very challenging. The reason is the existence of so-called "lock-ins" which tend to reproduce the status quo and impede change (Magrini et al., 2016; Meynard et al., 2018; Geels, 2019). Several factors have been identified in the literature

as relevant to lock-ins: at a systemic level, technologies, economic and institutional mechanisms and rules, and political dynamics; at the individual level, the role of social and cognitive processes and attitudes as impediments or drivers, although recognized as relevant to sustainability transitions, has only partially been explored (Geels, 2019).

However, the literature also suggests that the orientation toward sustainability and environmental protection actively influences the entrepreneurial actions of types of individuals (Munoz and Cohen, 2017; De Bernardi and Sydow, 2022). Environmental and/or sustainable entrepreneurs act by combining the creation of economic value with the creation of environmental value (Lans et al., 2014; Antolin-Lopez et al., 2019; Gregori et al., 2021). The empirical evidence seems to be strong enough to state that the cognitive and individual aspects of entrepreneurs can determine processes of change and transition toward alternative production systems (Suvanto et al., 2020; De Bernardi and Sydow, 2022; Weituschat et al., 2023a).

In this framework, we propose that the entrepreneurial identity concept can be mobilized to understand the role that attitudes of individual agricultural producers play in their decision to accept supply chain governance mechanisms that explicitly require the adoption of sustainable agricultural practices. Among the organizational mechanisms widely studied in the literature, contract farming has received much attention and proved to be a useful tool in opposing existing lock-in toward more sustainable production systems transition (Banterle and Stranieri, 2013; Ricome et al., 2016; Pancino et al., 2019; Cholez et al., 2020; Weituschat et al., 2023a,b). In particular, contract farming schemes regulating crop cultivation processes build on creating a relationship of trust between suppliers and buyers on the premise that risk is shared (Key, 2005; Weituschat et al., 2023a,b). Participation in value chain contracts involves overcoming problems of access to markets by stabilizing the prices and costs incurred by agricultural producers, generating a higher income (Dubbert et al., 2021). The adoption of cultivation contracts that support the adoption of EI practices often requires the use of incentive tools though, to encourage the choice of this type of agreement (Banterle and Stranieri, 2013; Bonjean, 2019; Grandori and Furlotti, 2019; Pancino et al., 2019).

2.2. Entrepreneurial identity as a driver of sustainable transitions

A move toward a more sustainable food production at a systemic level necessarily builds on how—at the individual level—farmers as entrepreneurs embrace change, and at a multiple level (Fitz-Koch et al., 2018; De Rosa et al., 2019; Suvanto et al., 2020). During the last few decades, and particularly in the European Union context, farmer's roles have changed from being merely producers of raw materials to being entrepreneurs who, with their businesses, are at the center stage for the sustainability transition to happen in agricultural systems (European Commission, 2018; Fitz-Koch et al., 2018; Dias et al., 2019). Pivotal concept for understanding entrepreneurship as a social and economic phenomenon (Radu-Lefebvre et al., 2021), entrepreneurial identity emerges as a concept that informs about entrepreneurs' decisions, actions, and feelings as they run their business and commit to it in terms of acquiring resources, adopting practices and being passionate about it.

Scientific evidence suggests that entrepreneurial identity actively affects farmers' cultivation choices (Verhees et al., 2011; McElwee and Smith, 2012; Suvanto et al., 2020). When investigating the concept of entrepreneurial identity, research has reported on various dimensions through which EntID is manifest. Suvanto et al. (2020) demonstrated how entrepreneurial orientation (EO)—which is proposed as a way of envisioning what it means for organizations to "be entrepreneurial" (Wales et al., 2020)—could provide farmers with a competitive advantage, particularly for innovation processes such as new crop adoption. EO is an important determinant of corporate performance as it involves strategic entrepreneurial skills to be competitive in the sector (Shane, 2003; Wiklund and Shepherd, 2005). Entrepreneurial orientation is composed of three dimensions: innovativeness, proactivity, and risk-taking (Miller, 1983; Lumpkin and Dess, 1996; Rauch et al., 2009; Wales et al., 2013; Fuentes-Fuentes et al., 2015). Innovativeness concerns the ability to adopt new techniques for new products and services development (Hurley and Hult, 1998; Miller, 2011). Risk-taking refers to the ability to take strategic and financial risks generated by the development of new products and services (Miller, 2011; Willebrands et al., 2012). Proactivity refers to the foresight an entrepreneur has in expecting changes in consumer needs (Lumpkin and Dess, 1996; Miller, 2011). These capabilities determine the possibility for entrepreneurs to reach new markets or potential changes (Miller, 2011). Furthermore, an emerging topic that the literature is looking at with growing interest in environmental entrepreneurship is environmental attitude (Fauchart and Gruber, 2011; York, 2018; De Bernardi and Sydow, 2022). In the agricultural sector, farmers' environmental attitude seems to play a fundamental role in the transition toward sustainability (De Bernardi and Sydow, 2022; Weituschat et al., 2023b). Specifically, this environmental attitude seems to be closely influenced by the context in which farmers operate, and it is also characterized by aspects that refer to how much the farmer follows a collaborative approach in his or her decision-making. Indeed, farmers often believe that their pro-environmental actions can only be successful if carried out collectively (Poteete and Ostrom, 2004; Ostrom and Ahn, 2009; Cleveland et al., 2020; Despotović et al., 2021). Entrepreneurial identity oriented toward collaboration and environmental issues have shown to be more inclined to adopt more sustainable agricultural practices (Sadati et al., 2010; Azman et al., 2013; Kyalo and Holm-Mueller, 2013). Specifically, evidence in the literature shows how the context provided by collective actions favors changes aimed at improving agricultural systems' sustainability and natural resources management (Ravnborg et al., 2000; Pretty and Ward, 2001; Swallow et al., 2002; Prokopy et al., 2019).

In this paper, we define entrepreneurial identity (EntID) as a multidimensional construct (Table 1) composed of Entrepreneurial Orientation (EO) and Collective Environmental Attitude (CEA). Following the seminal definition, we define EO through its three dimensions of innovativeness, proactiveness, and risk-taking, according to Miller (1983). The CEA will include the assessment of the context and the propensity to participate in collective pro-climate actions.

Previous research highlights that contract farming (*CF*) could be a valuable tool for supporting farmers in adopting EI practices (Weituschat et al., 2023b). Based on this and on our theorization over the entrepreneurial identity concept, we suggest the need to understand how the entrepreneurial identity of farmers figures in the choice to adopt new sustainable practices (e.g., new crops) through participation in a contract farming regime. The hypothesized effects

TABLE 1 Operationalization of entrepreneurial identity.

Concept	Dimensions	Description
Entrepreneurial orientation	Innovativeness	Ability to adopt new techniques for new products and services development
	Pro-activity	Ability to foresight expecting changes in consumer needs.
		Ability to foresight expecting changes in consumer needs
	Risk-taking	Ability to take strategic and financial risks generated by the development of new products and services
Collective environmental attitude		Collaborative decision-making context with other farmers that drives participation in collective pro-environmental action

are shown in Figure 1. Continuous arrows represent expected short-term relationships. Based on extant literature, it is expected that the dimensions the entrepreneurial identity is composed of in our paper (EO and CEA) guide farmers in the adoption of more sustainable agricultural practices and that in turn, this has a role in the choice to adhere to a supply chain agreement involving more sustainable practices.

Our overarching research hypothesis is therefore that both EO and CEA play a role in shaping farmers' decisions over the adoption of sustainable practices and by this over the decision to participate in contract farming. Following this approach in our attitudinal construct, we opted for simple averaging of the Likert scale items based on the assumption that all the items hold equal importance. Formally, we treated all items as equally significant, thereby assuming that each item contributes uniformly to the overall attitudinal construct. This assumption aligns with the approach of taking a simple average. The reliability of our items was assessed using Cronbach's alpha, which was found to be satisfactory overall. Such hypothesis reflects on the one hand, the exploratory nature of our study. On the other hand, we propose a conceptualization of entrepreneurial identity as constituted of the EO and CEA constructs that lack sufficient theoretical or empirical grounding. Due to this, precise *a priori* hypotheses about the role of EO and CEA in affecting farmers' decisions cannot be proposed that presuppose a specific direction of the effects.

In order to verify our overarching hypothesis, standard control variables are also considered, such as personal and structural characteristics of the farm, which the literature has indicated as influencing crop choices (Fitz-Koch et al., 2018; Suvanto et al., 2020; Weituschat et al., 2023b). Specifically, we consider variables that can proxy of farmers' knowledge of some of the aspects dealt with such as cultivation EI, and contract's standard (e.g., certification presence).

In the long run, reverse causality effects could be hypothesized between EntID and the choices of cultivation and *CF* (dashed arrow, Figure 1). Based on the knowledge acquired in the EI adoptions, required by supply chain CFs, past behaviors could influence farmers' EntID. The supply chain CFs would also act as an aggregator between the farmers, creating a context that would also strengthen the CEAs dimensions. Although these aspects are interesting, in our study, we attempted to focus on farmers new to *CF*. Based on the available information, we cannot definitively exclude the possibility of previous experience with *CF*. We consider the resulting potential bias in interpreting the results.

3. Materials and methods

3.1. Case study: "Carta del Mulino" initiative

This study draws on the "Carta del Mulino" initiative launched in 2019 by the Italian multi-national food manufacturer Barilla Group, a family-owned company with its headquarters and majority of operations in Italy. Carta del Mulino is a contract farming scheme designed by "Mulino Bianco," one of the most important Italian bakery brands owned by Barilla Group. Originating in 1975, the "Mulino Bianco" brand has shaped its communication strategy over time around principles related to the respect toward the environment and the people. Nowadays the brand relies on sustainability certifications for almost all its products made with soft wheat flour from sustainable agriculture (Barilla, 2021b). To improve its environmental performance, the company stimulates the adoption of sustainable agricultural practices in farming activities and provides information useful to educate consumers and change their food habits (Barilla, 2020). Over the years, field experiments have been conducted, the results of which have been used to suggest revisions in the agreements for the supply of raw materials. The Carta del Mulino private standard comprises 10 rules designed to bring greater quality to products, to support the work of farmers, and to restore space to nature in agroecosystems, promoting crop diversification and biodiversity, reducing the use of chemicals, and safeguarding pollinating insects (Barilla, 2021a; see Figure 2).

Some rules regulate agronomic and technical aspects to mitigate environmental issue and to biodiversity and soil fertility in cereals production specialized area (see Figure 2). Two rules (rule 2 and 3) directly involve the farmer arable land planning and promote the adoption of EI practices such as crop diversification practices. Such practices entail 5 years crop rotation with at least three different crops, one of which must be a nitrogen fixer, legumes, and/or oilseed crop; furthermore, flower strips have to be planted on at least 3% of the agricultural area dedicated to wheat (Barilla, 2021a). This implies that farmers need support to plan the crops allocation of their land for long time, being the choice of how to use differently their arable land limited and focusing therefore more on a longer-term economic perspective (deriving from a 5-year window of performances for the crop system) than on the short term (annual) benefits (Benini et al., 2023). Furthermore, the use of pesticides and herbicides is regulated in two dedicated rules (rule 5 and 7) which propose a ban on their use. The ban concerns neonicotinoid-treated seeds and/or plant protection products containing neonicotinoids for sowing "Carta del Mulino" soft wheat fields; glyphosate and/or plant protection products containing glyphosate are banned in soft wheat fields from pre-sowing to harvest phases. Other rules regulate socio-economic aspects: according to rule 10, the premium price paid for flour produced in compliance with Carta del Mulino set of rules must be distributed throughout the supply chain actors. These rules are included in a system of supply chain agreements and contracts followed by over 1,400 farmers, mostly in Italy, for about 270,000 tons of flour per year (Barilla, 2021a).

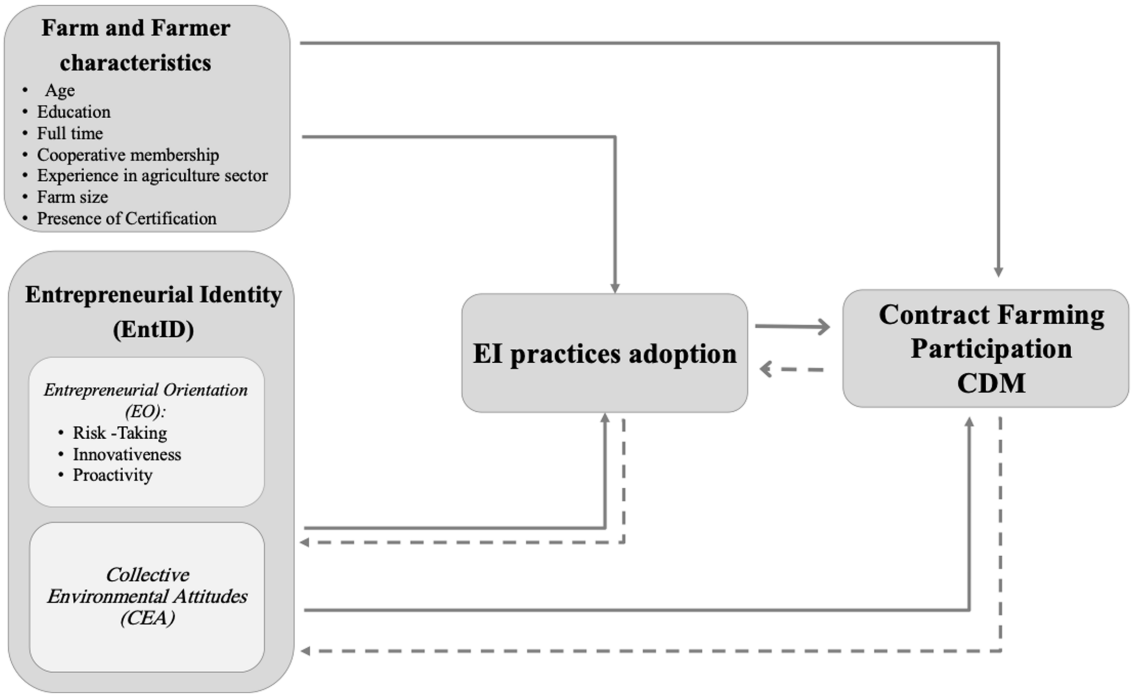

FIGURE 1
Entrepreneurial Identity (EntID) construction and effect on farm management.

FIGURE 2
The 10 rules of "Carta del Mulino" contract (source: https://www.mulinobianco.it/)—Authors elaboration.

Although the practices proposed by such a contract farming scheme and the executive certification procedures connected to their adoption are common to other certification schemes in the agri-food sector (FAO, 2014; Zezza et al., 2020), the Carta del Mulino contract scheme is original in the process that led to the definition of that set of rules and practices. The proposed agro-ecological practices resulted from a participatory process that engaged soft wheat flour value chain actors and third parties, such as environmental NGOs, universities, high-tech start-up, and agricultural extension services companies. Furthermore, the rules are periodically reviewed to embrace new practices as long as an increase in their effectiveness regarding the achievement of Carta del Mulino objectives is demonstrable. The Carta del Mulino definition process, as a contract farming regime, adapts an experimental socio-ecological approach (as described by Gaba and Bretagnolle, 2020) to the case of an agro-industrial supply chain. Indeed, the agricultural EI practices technical features (crop rotations, flower strips) and the definition of technical limits (ban on pesticides and herbicides) were shared with groups of suppliers to translate agro-ecological principles into solutions capable of

responding to the needs of farmers operating in very different areas. The specific formulation of the Carta del Mulino contract practices therefore considered the actual impacts that these generated both in the environmental sphere and in the social and economic one in the areas where the raw materials were procured.

3.2. Methodology

Understanding the factors that influence farmers' adoption of sustainable practices as well their participation in the "Carta del Mulino" contract farming requires the application of multiple methodologies. More specifically, two separate analyses are carried out to analyze whether cognitive and psychological aspects related to entrepreneurial attitudes might play a relevant role on farmer's adoption of EI practices by means of participating in a contractual scheme. Firstly, a count data model is implemented to identify factors affecting farmers' adoption of sustainable practices in the past, under the assumption that the more practices adopted, the greater the farmer's engagement in the EI process.

Traditionally, to analyze the adoption of sustainable practices, count data models are estimated that use Poisson or negative binomial regressions (Winkelmann, 2003). For instance, Park and Lohr (2005) use negative binomial models to estimate the adopted integrated pest management strategies in the United States; Jara-Rojas et al. (2012) use a Poisson model to estimate the number of water conservation practices implemented by farmers in Chile, while similarly Bellon et al. (2016) explained the counts of plant species grown by smallholders in Southern Benin with a Poisson-based specification. The EI practices considered in our analysis include: (1) Minimum or zero tillage; (2) Green manure; (3) Flower strips; (4) Crop rotation; (5) Intercropping; and (6) Avoidance of using glyphosate.

Formally, we assume that the farmer's i-th utility associated to the adoption of n, $n = 0, 1, 2, \ldots, 6$, EI practices, is the sum of an unobserved random component ε_{ij} and a deterministic component V_i. Such component depends on an x_i vector which includes observable characteristics of both farmer and farm, and on a z_i vector which includes individual aspects such as farmers environmental attitudes and their entrepreneurial orientation.

$$U_{in} = V_i + \varepsilon_{in} \quad (1)$$

Moreover, we assume that i-th farmer implements n practices rather than k when $U_{in} \geq U_{ik}$ and $\text{Prob}(N_i = n) \geq \text{Prob}(N_i = k)$ with $n \neq k$.

We assume that the conditional distribution of n_i given V_i follows a Poisson distribution:

$$n_i \,|\, (V_i) \sim \text{Poisson}\left[\lambda(V_i)\right] \quad (2)$$

After verifying the absence of overdispersion, and zero inflation, the $\text{Prob}(N_i = n)$ can be expressed as:

$$\frac{e^{-\lambda(V_i)}\lambda(V_i)^{n_i}}{n_i!} I = 1, \ldots, I; n = 0, 1, 2, \ldots N \quad (3)$$

with $\lambda(V_i)$ generally parametrized as $exp(x_i'\beta + z_i'\delta)$ with β and δ the parameter vectors measuring the effects of x and z on the number of EI practices.

Secondly, a Multinomial Probit Model (MNP) is used to estimate the probability of participation in a conventional contract farming scheme that does not require any sustainability related activities vs. the "Carta del Mulino" initiative which is centered around sustainability. Such model allows us to cover a gap over the role contract farming can play for sustainability. Recent examples of studies using multinomial probit model to analyze farming decisions include Zhang et al. (2019) and Ahmad et al. (2021). In this paper, we assume that the i-th farmer faces three mutually exclusive alternatives: $j = 1$ when the farmer is not participating to any forms of contract farming; $j = 2$ when the farmer participates to a contract farming scheme without EI obligations; and $j = 3$ when the farmer participates to "Carta del Mulino" scheme.

The utility associated by the i-th farmer to the alternative j can be expressed as:

$$U_{ij} = F_{ij} + \eta_{in}, \text{with } F_{ij} = \boldsymbol{x}_i'\boldsymbol{\gamma}_j + \boldsymbol{z}_i'\boldsymbol{\alpha}_j \text{ and } \eta_{in} \sim \text{N}[0, \Sigma] \quad (4)$$

The outcome of the decision making process of the i-th farmer will be $C_i = j$ when the farmer selects the j-th alternative rather than k, when the $U_{ij} \geq U_{ik}$ and $\text{Prob}(C_i = j) \geq \text{Prob}(C_i = k)$, j,k = 1,2,3, and $n \neq k$ with the probability that the alternative j is chosen given as:

$$\text{Prob}(C_i = j) = \frac{\exp\left(X_i'\gamma_j + Z_i'\alpha_j\right)}{\sum_{j=1}^{3}\exp\left(x_i'\gamma_j + Z_i'\alpha_j\right)}, j = 1, \cdots 3; i = 1, \cdots I. \quad (5)$$

3.3. Survey design and sample

The study design involved the development of a questionnaire structured in different sections that collected information on farmers socio-demographic data, farm characteristics, value-chain relationships, cultivation choices, and farmers attitudes. Furthermore, additional information was collected on farmers' participation in associative forms, on EI practices implemented on the farm in the past, and on current adoption of cultivation contracts (with specific request to indicate whether farmers were already participating in the Carta del Mulino contractual scheme or in another contract that did not require the adoption of EI practices). In addition, in order to collect information over the entrepreneurial orientation of the farmers and their environmental and collective attitudes (necessary to construct the entrepreneurial identity variable), four attitudinal scales were included through a five-point Likert scale (1—totally disagree, 5—totally agree). As defined in Table 1, for the entrepreneurial orientation concept, we use the three-dimensional scale (innovativeness, proactivity, and risk-taking) developed by Khandwalla (1977) and improved by Miller (1983). To construct the Collective Environmental Attitudes scale (CEA), we follow the literature on collective action (Poteete and Ostrom, 2004; Cleveland et al., 2020; Cruz and Manata, 2020; Despotović et al., 2021) which informs us about the environmental orientation as defined in the context of participation in collective actions for the environment (Table 2).

TABLE 2 Dimensions of collective environmental attitude, entrepreneurial orientation, and associated items.

Collective environmental attitude (six items)
1. If I do something for the environment just as a single person, it will have no effect.*
2. Since other farmers already contribute to sustainable crop productions, my contribution is not relevant.*
3. The best way to solve environmental problems is to act collectively.
4. Forming an association with other farmers to contribute to environmental improvement is just a waste of time.*
5. For me, participating in collective actions related to the realization of a sustainable supply chain is important to help the environment.
6. My family and friends would be proud of me if I contributed to the realization of a sustainable supply chain.
Innovativeness (three items)
1. If I see an opportunity, I am always willing to try new practices and techniques.
2. I always look for opportunities to try something new.
3. I am not willing to experiment with new crops.*
Risk taking (three items)
1. If I see an opportunity to increase profits, I am always willing to take risks.
2. I would rather maintain current crops than replace them with ones I do not know.
3. If I cannot be sure of the benefits, I am not willing to invest in my business.
Proactiveness (three items)
1. I am willing to start activities that other farmers are not yet doing.
2. I am always looking for new connections to access inputs, funding, and new markets.
3. It is hard to analyze market trends and therefore set my business strategies.*

*Reversed in code.

TABLE 3 Descriptive statistics of the sample ($n = 314$).

Qualitative variables	Categories		
Gender	*Male*	*Female*	
	95.54%	4.46%	
Contract's adoption	*None*	*Contract farming*	*Carta del Mulino*
	35.08%	*35.69%*	*29.23%*
Education	*No degree*	*High school degree*	*University degree*
	23.25%	70.06%	6.69%
	Yes	*No*	
Full time farmer	86.62%	13.38%	
Cooperative membership	71.97%	28.03%	
Presence of certification	36.94%	45.54%	
Quantitative variables	Mean	Std.dev	
Age (years)	51.24	12.97	
Experience in agriculture (years)	28.78	13.43	
Farm size, UAA (ha)	77.89	286.67	
n. Practices	1.55	1.44	
Entrepreneurial identity			
[a]Collective environmental attitudes	0.945	0.588	
EO—[a]Innovativeness	1.367	0.758	
EO—[a]Risk-taking	1.275	0.636	
EO—[a]Proactiveness	3.465	0.688	

[a]Cronbach α: CEA: 0.68; IN: 0.65; RT: 0.41; and PRA: 0.62.

In order to include in the sample farmers' who work on farming activities as a hobby rather than main occupation, the data also include information related to the time spent on the farm (i.e., full-time is equivalent to a 5-day work week); finally, in order to understand to what extent farmers are familiar with the adoption of standards that are comparable to those required by some cultivation contracts such as the analyzed CdM, information is collected over the adoption of certification schemes at the farm level (e.g., GlobalGAP, organic, or similar).

The survey was administered to soft wheat farmers in four regions of Northern Italy: Emilia Romagna, Veneto, Lombardy, and Piedmont. Specifically, they were selected within the Po Valley, the area most intensely suited to agricultural production in Italy wherein many farmers already joined the novel Carta del Mulino *CF* program. The survey was distributed through Qualtrics Survey Software in the period December 2019 and February 2021. The extension of this period is due to an adjustment in the data collection strategy because of the COVID-19 Pandemic. The final sample contains 314 complete observations.

4. Results

4.1. Descriptive statistics

Table 3 shows the percentages of the sample by gender, education level, farm management (full-time or part-time), participation in associative forms (organization of producers, cooperatives, consortium, or association of farmers), and adherence to a certification standard. It also shows the average values for the sample by age, years of experience in the agricultural sector, and company UAA. For all the scales required for our research (Innovativeness, Proactiveness, risk-taking, and Collective Environmental Attitudes), Cronbach alphas supplied satisfactory reliability coefficients (in Table 2; mean value, standard deviation, and Cronbach alphas). Cronbach's α analysis revealed that the scales of Innovativeness, Proactivity, and Collective Environmental attitude show a good internal consistency (respectively CEA $\alpha = 0.68$, IN $\alpha = 0.65$, and PRA $\alpha = 0.62$). The risk-taking scale α shows uncertain reliability (RT $\alpha = 0.41$). The final sample considers 314 farmers, most of them male (95.54%) with a high school degree (70.06%), and full time farmers (86.62%). The vast majority of farmers is member of a cooperative (71.97%) and many do not adhere to any certification scheme (45.54%). The interviewees have an average of 51 years and approximately 28 years of farming experience. Considering the UAA, the average farm size is about 80 ha.

Figure 3 shows the number of EI agricultural practices implemented at the farm in the past and before to being potentially involved in CdM schemes. In detail, of the six practices analyzed, crop

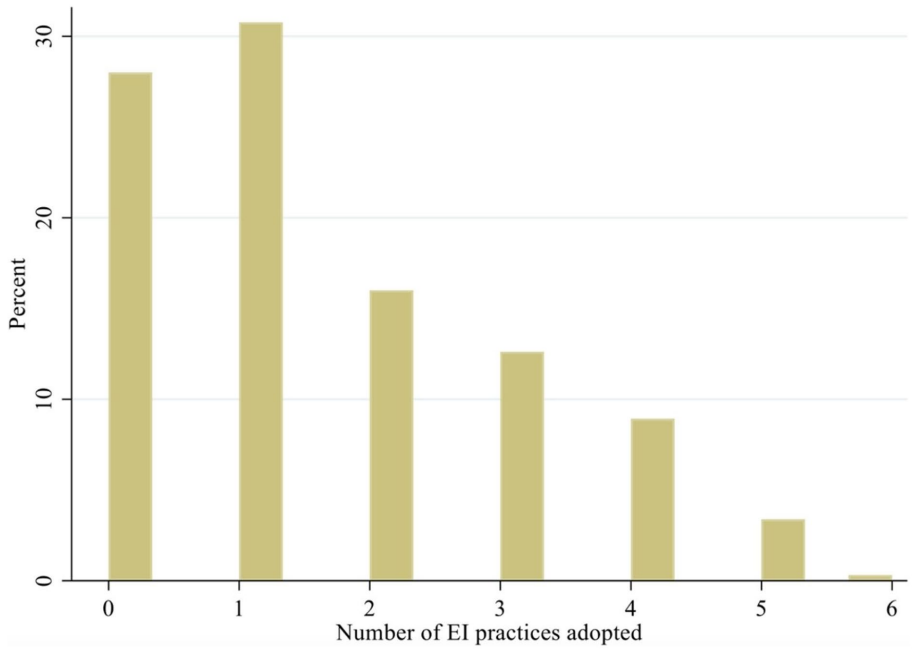

FIGURE 3
Number of EI practices adopted by farmers in the past.

rotation seems to be the most widely adopted by about 43% of farmers, followed by flower strips (32%).

Figure 4 shows as a percentage how the sample is distributed in the contract's adoption and how this variable is linked to the number of EI practices previously implemented on the farm. About 29% of the sample signed the CdM contract and it is also the part of the sample that has the highest percentage of EI practices adopted in the past. There are values above 20% from 2 to 4 practices.

4.2. Farmers' entrepreneurial identity analysis

To verify whether farmers with a stronger Entrepreneurial Identity have a greater propensity to adopt more EI practices and sign a contractual scheme as CdM, as hypothesized in our study, we have run two sets of models. The results are reported in Table 4.

First, the count data referring to the number of EI practices adopted by each farmer was estimated through a Poisson regression model. The results of this model seem to confirm that the EntID concept plays overall an important role in farmers' choice to implement EI practices (first part of our overarching hypothesis). Such role is led predominantly by the environmental and collective action attitudes (CEA) and the EO dimension of innovativeness. A collective environmental attitude seems to positively relate to the choice to implement sustainable practices, but it is especially the entrepreneur's innovativeness that plays a relatively stronger positive role in enhancing the taking up of these practices. Being proactive does not apparently play a role in the adoption though, while risk taking shows a negative significant coefficient: this EO component might actually surprisingly hinder the adoption of EI practices. The socio-demographic and farm structural characteristics do not seem to relate to the adoption of practices either, with the exception of the full-time variable which shows a negative coefficient.

The number of practices adopted identified in the first model (Poisson regression) is then used in the second model that estimates the participation of farmers in different contract farming schemes and verifies therefore the second part of our overarching hypothesis. It is assumed that the higher the number of practices farmers implement over time increases farmers' knowledge of the technical functioning of these practices, therefore the greater the awareness of what implies EI practices adoption implies.

Specifically, the reference base for the model is the choice not to enter any sort of contract farming scheme. Results are to be interpreted as the propensity of farmers to participate in a conventional contractual agricultural regime, i.e., without obligations as per the adoption of specific sustainable practices, and in the Carta del Mulino contract, which formally requires the adoption of EI practices. Table 3 indicates that some variables influence the participation on both the types of contracts. In particular, possessing a certification positively relates to the participation to a contract farming scheme in general, with a higher magnitude for the contract that provides requirements as per the adoption of sustainable practices. Conventional cultivation contracts seem to be more likely chosen by farmers that are already members of a cooperative, while such membership does not seems to relate to the participation to a contract with sustainability related formal requirements. Entrepreneurial pro-activeness and innovativeness both drive the farmers' participation to either the forms of contract farming analyzed. However, their impact is greater under a *CF* scheme with formal requirements such as CdM than with conventional *CF*. Risk-taking instead does not appear to affect participation in any cultivation contracts. The collective environmental attitudes (CEA) seem to negatively relate to the participation in any form of contract, but particularly for the CdM results indicate that such attitudes might be actually discouraging the participation in a

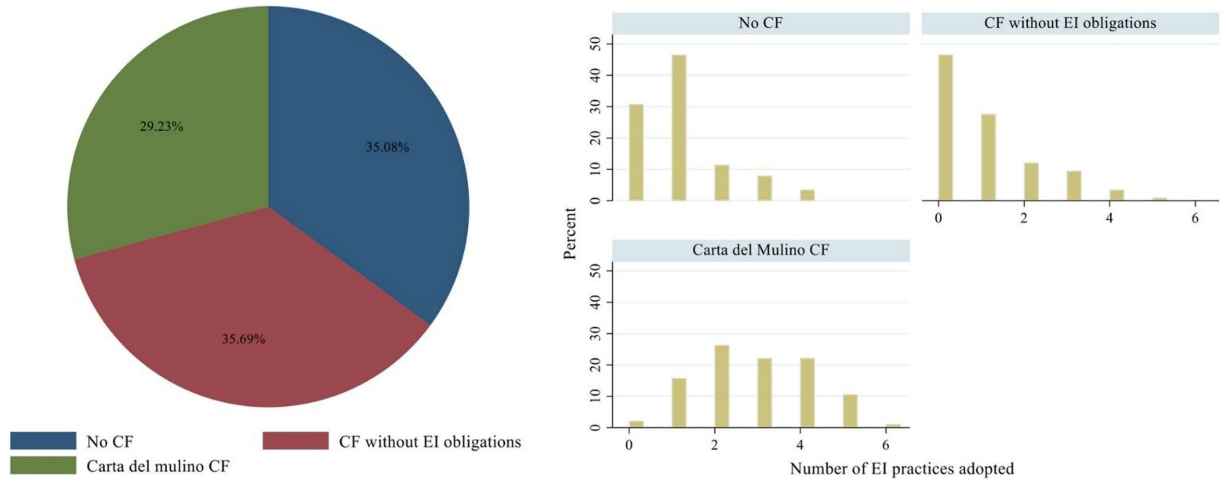

FIGURE 4
Number of EI practices adopted by farmers in the past and their present participation to *CF*.

TABLE 4 Estimates of the Poisson regression and Multinomial Probit model for adoption of EI practices and contract farming participation.

	n. Practices (Poisson Regression[c])			Contract farming (MNP)[b]			Carta del Mulino (MNP)[b]		
	Coef	std.err[a]	*p* value	Coef	std.err[a]	*p* value	Coef	std.err[a]	*p* value
n. Practices				−0.049	0.143	0.730	**0.801**	**0.128**	**0.000**
Gender (male)	−0.225	0.205	0.273	−0.735	0.942	0.435	−0.437	0.796	0.583
Age	−0.023	0.022	0.305	0.045	0.081	0.577	0.034	0.075	0.646
Age (squared)	0.000	0.000	0.348	0.000	0.001	0.670	0.000	0.001	0.932
Education	−0.062	0.104	0.549	−0.398	0.293	0.174	**−0.816**	**0.331**	**0.014**
Full time	**−0.289**	**0.139**	**0.038**	0.753	0.459	0.100	0.623	0.487	0.201
Cooperative membership	−0.155	0.104	0.135	**2.270**	**0.357**	**0.000**	0.472	0.342	0.167
Experience in agr.	0.007	0.006	0.311	−0.006	0.018	0.719	−0.015	0.019	0.437
Farm size (*ln*)	0.036	0.052	0.494	0.027	0.172	0.874	**−0.342**	**0.170**	**0.044**
Presence of Certification	0.163	0.112	0.145	**0.598**	**0.292**	**0.041**	**1.666**	**0.352**	**0.000**
Entrepreneurial identity									
EO—Innovativeness	**0.294**	**0.082**	**0.000**	**0.463**	**0.230**	**0.045**	**0.610**	**0.245**	**0.013**
EO—Risk-taking	**−0.166**	**0.075**	**0.027**	−0.012	0.197	0.951	0.115	0.232	0.619
EO—Proactiveness	0.068	0.070	0.335	**0.449**	**0.223**	**0.045**	**0.660**	**0.223**	**0.003**
Collective environmental attitudes	**0.184**	**0.093**	**0.047**	−0.319	0.282	0.258	**−0.644**	**0.310**	**0.038**
Cons.	**1.177**	**0.583**	**0.044**	−2.635	2.078	0.205	−2.083	2.085	0.318

[a]Robust standard errors are reported. [b]"No contract-farming" is the base outcome category. [c]Pseudo R^2: 0.12; # obs: 314. In bold are reported statistically significant coefficient ($p < 0.05$).
We tested for the presence of multicollinearity using the Variance Inflation Factor (VIF). The results showed an absence of significant collinearity, with all VIF values within acceptable limits.

contractual scheme that requires the adoption of EI practices. The number of practices previously implemented and therefore the awareness farmers have of how to implement such practices seems to strongly determine the choice to sign the CdM contract.

5. Discussion

The present research aimed to understand how farmers' entrepreneurial identity acts on the adoption choice of new sustainable practices (e.g., new crops) through participation in a *CF* scheme in Italy. In that context, we need to be mindful of the ongoing challenges facing the agricultural sector. In recent years, the strategies on which the CAP was built aim at redefining the role and position of farmers in the supply chain with a view to the sustainability of agricultural systems. However, the distribution of power within the value chain still represents an obstacle for farmers to innovate their business models and adopt new sustainable practices.

Our exploratory study hypothesizes therefore that the dimensions the entrepreneurial identity concepts build on, namely entrepreneurial

orientation and collective environmental actions, play a role in shaping farmers' decisions over the adoption of sustainable practices (our first focus) and by this over the decision to participate in contract farming (our second focus).

We first analyzed what role the EntID dimensions play in the choices of adopting EI practices. As we know EI practices adoption, our first research focus, implies for farmers a change in the management of their farm and the uncertainty of the process partially slows down the innovation process (Phillipson et al., 2004; Stenholm and Hytti, 2014; Thompson et al., 2019). The traditional resistance to innovation, typical of the agricultural sector and generally explained with the amount of time and financial resources needed to engage with innovation (a deterrent for this), seems in the context analyzed to be overcome by the presence of specific skills of the farmer that actually rather than being a simple food producer consider himself/herself as an entrepreneur and thus an agent of change (Fitz-Koch et al., 2018; Dias et al., 2019; Suvanto et al., 2020). Specifically, EntID dimensions such as Innovativeness and CEA act positively in more sustainable cultivation choices. CEA results are in line with other studies that indicate that a pro-environmental context and an attitude toward collaboration are valid drivers of change toward more sustainable agricultural practices (Swallow et al., 2002; Azman et al., 2013; Abeyrathne and Jayawardena, 2014; Prokopy et al., 2019; De Bernardi and Sydow, 2022). In contrast to other studies (e.g., Suvanto et al., 2020), our results do not appear to link the choice to adopt EI practices to higher risk-taking. In our sample, this result is due to the component of entrepreneurs probably being more interested in the speculative aspect. These could prefer an even more "risky" cultivation approach than EI practices adoption.

On the other hand, innovativeness seems to be the EntID dimension capable of driving the change from the EI practices adoption up to the choice of a cultivation contract, such as CdM. Scientific evidence demonstrates that innovation is a characterizing aspect of the entrepreneurial identity of farmers more predisposed to the transition to alternative production systems (Dias et al., 2019; Suvanto et al., 2020; De Bernardi and Sydow, 2022).

Our second focus included understanding the role that EntID plays in choosing to join a contract farming scheme. Literature evidence suggests the agricultural contract (*CF*) is an effective tool in supporting farmers in the transition toward more sustainable agricultural systems (e.g., Banterle and Stranieri, 2013; Pancino et al., 2019). From our analyses, it emerges that entrepreneurial identity plays an important role also in the participation in cultivation contracts, as shown by comparison between farmers with a CdM contract and a "standard" one. Being inclined to innovate—for example being open to adopt new techniques—and being proactive in the search for new techniques and ways to improve business with foresight stimulate farmers' openness toward the cultivation arrangements proposed by contract farming schemes. As indicated in the literature, contracts might provide an opportunity to access new products or markets (Lumpkin and Dess, 1996; Woldesenbet et al., 2011; Fitz-Koch et al., 2018) and to do so in a safe or regulated environment.

Considering standard contract adoption, our results confirm what emerged from several studies (e.g., Kyalo and Holm-Mueller, 2013; Solazzo et al., 2020) on the support that cooperatives exercise for farmers in improving bargaining power and access to markets. For the CdM contract, on the other hand, these factors do not seem to override the choice but might affect the speculative aspects. Among the rules, we recall that farmers receive a price premium on production and direct access to a "privileged" supply chain. Furthermore, in the contract adoption process, knowledge seems to play an important role. We can consider certifications presence and EI practices adopted in the past as a "proxy" of this factor. On the one hand, knowledge of the standards required by a certification leads farmers to sign a contract (standard/CdM). On the other hand, the knowledge of the practices, due to the previous adoption of these, influences the choice of contracts that want to drive the transition toward sustainability. In this way, we must consider that knowledge of these aspects (certification standards and practices) has the potential to reduce the time needed to implement processes required for a transition toward more sustainable practices. Being familiar with the production techniques and the required standards reduces uncertainty and increases control over the actions that the farmer needs to implement in the process of adopting new cultivation plans (D'Silva et al., 2010; Uli et al., 2010; Lawrence et al., 2011).

Furthermore, a collective environmental attitude negatively affects participation in the Carta del Mulino contract. The explanation for this result can be 2-fold. Considering that our analyses are based on data collected at the beginning of the CdM project, we propose at least two different explanations.

First, the literature suggests that environmental farmers combine their respect and passion for nature in their entrepreneurial actions (De Bernardi and Pedrini, 2020; De Bernardi and Sydow, 2022). Those with a marked aptitude for collective environmental actions may prefer a sustainable approach to agriculture in a pioneer or early adopter perspective driven by their niche beliefs, giving more weight to the knowledge co-created within their reference system of relationships and values (Schill et al., 2019). In this approach, the farmers have a more marked environmental-value component than the entrepreneurial-market component, therefore aspects of choice outside the market, such as environmental values or social matters, could be affecting more than the profit expectations of their entrepreneurial choices (Van der Werff et al., 2013; Ratliff et al., 2017; De Bernardi and Pedrini, 2020).

Secondly, farmers may have chosen the contract looking first at the premium price guaranteed by the contract or to be recognized as reliable suppliers by one of the major leader agro-industry companies in Italy, giving less importance to the pro-environmental aspects required by the rules either the socio-environmental benefit.

Furthermore, farmers with a higher level of education and a more extensive company size appear to be more resistant to adopting the CdM contract (Weituschat et al., 2023b). Given their experience in implementing EI practices some types of farmers may feel capable of achieving certain objectives without necessarily entering contractual schemes that impose strict conditions on their business, but rather making decisions over their cultivation plans individually. In our sample, this type of farmer may be more interested in the higher opportunity costs generated by the availability of more options in the spot market. Furthermore, as Ciliberti et al. (2023) show, farmers in Italy prefer to maintain their decision-making autonomy and do not seem interested in applying sustainable practices that they perceive as more expensive than ordinary ones. As the literature indicates, a cultivation contract reduces certain risks (e.g., costs, prices) to the detriment of the farmer's autonomy (Key, 2005; Solazzo et al., 2020). The question of individualism is complex and generated both by

corporate structural factors and by supply chains. To overcome this approach, in the name of environmental sustainability, policies and supply chains are acting with various tools to strengthen horizontal cooperation between farmers (Viaggi and Zanni, 2012; European Commission, 2020, 2022; Solazzo et al., 2020).

In conclusion, if we consider the transition process toward the sustainability of the supply chains, achieved through the signing of a contract that provides for EI practices adoption, aspects emerge which is important to reflect on. Entrepreneurial identity, as defined in this study, seems to be capable of some aspects of overcoming barriers to adoption but at the same time, other individual factors have a negative influence. Further future analyses could delve into these aspects and investigate the long-term aspects of reverse causality between EntID and the choices of cultivation and *CF* (dashed arrow Figure 1). CdM could be a tool capable of creating a community of farmers with strong entrepreneurial identities able to drive Italian soft wheat sector toward sustainability.

6. Conclusion

Soil health and the transition to more sustainable and regenerative production systems is the challenge that the agricultural sector has been facing in recent times. This transition of food systems entails a great deal of change, at multiple levels, that engage with farmers' decision and attitudes. Particularly to support food systems transitions recent scholarship has pointed to the necessity to better understand which aspects influence farmers toward change from an entrepreneurial attitude and identity perspective. Engaging in practices that represent a transition from agricultural traditional and consolidated production systems to innovative systems entails a gamble and a risk for the farmer: driven by purely economic considerations if not effectively supported by institutions, farmers' organizations or policies, agricultural producers may not be willing to take such a risk.

Based on this background, the research we present in this paper has highlighted the role that some dimensions of the entrepreneurial identity of farmers have in cultivation choices—specifically ecological intensification practices—and for the participation in a supply chain contract which requires and provides for their adoption. In this paper, one specific scheme that has the potential to drive the transition is under investigation, namely a contract farming initiative started in recent years by a multinational company based in Italy in order to achieve greater sustainability in soft wheat industrialized value chains.

The findings provided valuable empirical evidence on what factors influence these adoption processes. From this study it emerges that it is important that the entrepreneurial identity of farmers is strengthened and supported, enriched by a greater knowledge of alternative agricultural techniques and practices to the usual ones to respond to the challenges of the agricultural sector.

This study has several limitations that should be acknowledged. Primarily, while we targeted farmers who were, based on available information, in their first experience with Contract Farming (*CF*), we cannot definitively exclude the possibility of some participants having prior experiences with *CF* that we were not informed. This could introduce a potential bias when interpreting our findings. Secondly, while our theoretical framework acknowledges the presence of feedback mechanisms, it can potentially lead to endogeneity. Thus, our findings should be interpreted as highlighting statistical associations rather than definitive causal pathways. Although these associations provide valuable insights into the relationships among our variables of interest, we must be cautious about attributing causal interpretations to these associations. Future research could benefit from longitudinal data to further investigate these relationships and address potential endogeneity issues. Moreover, we adopted econometric models that led us to use the simple mean method for Likert scale items in our attitudinal construct, that means all items contribute equally. This approach could lead to a potential limitation in our findings, although Cronbach's alpha tested an overall satisfactory level of reliability. Lastly, the study refers to a specific contract farming initiative for a specific supply chain. Carta del Mulino was in its start-up phase, i.e., this initiative had not yet reached wide margins of adoption by farmers at the time the data were collected. Furthermore, it should be considered that some aspects may not be generalized to other supply chains and other countries. For this reason, we suggest that future research could compare the results of the CdM contract in the countries where it is now implemented. Despite these limitations, we believe our findings contribute valuable insights to the existing body of research.

Farmers with a more developed entrepreneurial identity and with prior knowledge of alternative agricultural techniques and practices are more likely to adopt EI practices and the CdM contract. Farmers who have a strong innovative spirit appear to be leading this transition. Making such a process affordable for all farmers requires two-pronged support from brands and policies.

In recent years, industry and private brands have taken the field proposing tools, such as contract farming, capable of pushing the most industrialized agricultural supply chains (e.g., cereals) toward sustainability also through horizontal agreements between brands. On the other hand, policies such as CAP have been addressing these challenges across the last 20 years.

The recent approval of the CAP in Europe has led in many European states to the approval of eco-schemes very similar to what is proposed in the contract scheme analyzed; in Italy flower strips for pollinators and crop rotation schemes are subsidized by land based payment (European Commission, 2022). The two dimensions (political/private) over time, with different tools, are converging toward a single goal: the sustainability of the agricultural sector.

Future research could verify if what we observe in the private sphere (CdM contract) occurs in the public one. In other words, it would be interesting to analyze the role of farmers EntID in the choice of practices adoption linked to a subsidy system based on public funds and rules of the new CAP reform and, at the same time, to investigate the choice between the subsidy of a policy (payment per hectare provided by CAP) and a price premium (per ton of product provided by sustainable *CF* private brand).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and

institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

ESR: writing—original draft, conceptualization, and visualization. VCM: writing—original draft and conceptualization. FC: conceptualization, data curation, methodology, formal analysis, validation, and writing—review and editing. EB: conceptualization, investigation, validation, resources, writing—original draft, visualization, funding acquisition, and project administration. SP: supervision. All authors contributed to the article and approved the submitted version.

Funding

This research was funded by European Commission Horizon 2020 project Diverfarming (grant agreement 728003).

Acknowledgments

The authors acknowledge support by the EU H2020 project Diverfarming—Grant Agreement 728003. The authors are grateful to Michele Zerbini, Group Supply Chain Central Purchasing Department, and Orlando Visciano, Group Supply Chain Sustainable Farming Soft Wheat, of Barilla Group and to all farmers involved in the survey for their collaboration for providing data and information used in the experimentation. We also like to thank Lorenzo Fosci for his valued contributions during the data collection phase.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2023.1196824/full#supplementary-material

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