Willingness to adopt and disseminate projects related to the "twin transition" on an area. The farmer's perspective

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Abstract

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The concept of enterprise 4.0 represents an extension of the initial industry 4.0, linked to the evolution of the industrial context towards a highly innovative and digital scenario. The use of technology contributes, through various levers, to the agro-ecological and digital transition: by improving farming efficiency (higher yield for the same environmental impact), by precision farming (adapting the different operations to the needs of vegetation or animals) and through the introduction of specialized machinery capable of helping the farmer to "close the cycle" (e.g., recycling of organic effluents) or to take advantage of biodiversity (i.e., with agro-equipment adapted to mixed crops). This research addresses these issues and aimed to understand the ability of farms to implement projects linked to the "twin transition" for improving competitiveness and capture high-value jobs in a local area. To this end 23 farmers were involved in a semi-structured interview to assess their ability to implement projects linked to green and digital transformation. The results highlight the difficulty both for farmers to welcome this innovative drive and for the local area (the north-eastern area of Sicily) to develop new skills and invest in the training of future generations to strengthen competitiveness.

Keywords: Twin transition; Green and Digital transition; Farmers; Public fundings; University

Introduction

Although from the literature emerges how the agricultural sector takes advantage of the opportunities linked to the technological evolution and digitalization, such as precision agriculture, in which technological tools are used in order to increase yield (Marucci et al., 2017), but also from the use of simpler technologies, such as RFID (Radio Frequency Identification), GPS (Global Positioning System) or Bluetooth, which allow the agricultural supply chain to self-optimize (Zambon et al., 2019) , it seems that Industry 4.0 is increasingly of interest to other economic sectors rather than the manufacturing one (including agriculture). Furthermore, even if a part of the literature encourages small and medium-sized enterprises (SMEs) to integrate the typical strategies of Industry 4.0 with the concepts of sustainable and green production (Bakkari & Khatory, 2017; Schlegel et al., 2017), the suggestions proposed are still quite theoretical and approximate, without tangible and definite recommendations on how to achieve these intentions. In this perspective, this paper aims to analyze the specific capabilities and challenges that farms, typically SMEs (in a local area: the north-eastern area of Sicily), facing to allow the operational implementation of projects or actions related to the so-called *"twin" transition* (digital and green transformations) (Bianchini et al., 2022).

In this perspective, this paper seeks to address the following research question:

#RQ₁: Is there a willingness of farmers to implement projects linked to the twin transition, in order to improve competitiveness and capture high-value jobs in a local area?

Furthermore, in a regional and local area, the relational system constitutes a key factor for improving the capacity of enterprises, network systems, and cooperation between enterprises as a single system (Prabowo et al., 2020; Lanfranchi et al., 2019). For this purpose, both the role of public funding and the role of the University are considered as drivers to implement this transition. As the replicability of a project represents one of the prerequisites for promoting the dissemination and development of its results on a local area, allowing to reduce the obstacles, the diffusion in the local area of the green and digital practices introduced by these enterprises, was considered to evaluate the possible replicability of these practices/projects. In this regard, some factors that determine and influence the replicability of a practice are considered. These aspects concern technical, economic, regulatory factors as well as acceptance by the stakeholders involved (Sigrist et al., 2016; Calvo et al., 2018).

Theoretical Background

SMEs are increasingly aware of the advantages that can be obtained through improved efficiency in the use of resources, in particular: achievement of competitive advantages, savings on the cost of raw materials and materials and/or access to new markets (Rizos et al., 2016). However, numerous difficulties may arise in addressing and implementing activities related to these aspects due, for example, to the difficulty of evaluating the long-term benefits compared to the current costs, the possibility of accessing information and knowledge, the availability of technologies, and uncertainty about the demand for green products (Rizos et al., 2016). These difficulties can affect both large and small businesses. However, while the former can support "twin" transition projects through their research and development activities, SMEs often depend on the availability of the technology available on the market and/or on the local area. According to Sevinç et al. (2018), the difficulties faced by SMEs in starting practices based on the green and (also) digital transition, often depend on the lack of financial resources and of adequate skills. In this perspective, the literature points out that one of the most relevant aspects for SMEs is represented by the lack of capital (Trianni & Cagno, 2012). Activities related to green production planning require time and investment (Dervojeda, et al., 2016). The initial cost, human resources, time, depreciation are important elements for SMEs, and make them more dependent than large companies on the additional cost deriving from the green transaction

(Lee et al., 2011; Rademaekers et al., 2011). Furthermore, companies in general and SMEs in particular, must take into account the risks of change in their business context and recognize the need to adopt a long-term perspective (Giannetto et al., 2016; Weaver, 1996). Consequently, a corporate culture based on resistance to change could keep its business models rooted in their traditional configuration and this can be a major obstacle for SMEs (Besch, 2005; Lanfranchi et al., 2014). Employee culture also falls into this category. If on the one hand for an employee working for an environmentally conscious company can be motivating, on the other a reluctant culture not aware of a twin transition can perceive these practices as extraordinary tasks to be performed (Chan et al., 2014). Sevinç et al. (2018), in a study on the difficulty of SMEs in attending to Industry 4.0 (as a business model), speak of distrust in the benefits of these innovations. The high costs and the lack of return on investment are factors that prevent companies from convincing themselves about the twin transition. Furthermore, from the point of view of rural finance, Nagarajan & Meyer (2005) show that meeting the demand for rural finance is more complicated than urban finance. The difficulties faced in rural finance are attributable to various agricultural risks: vulnerability risks (e.g., credit and market risks); operational risks (low investments, low rate of return on investment, geographical dispersion, and low levels of production); risks related to skills (training, technical and infrastructural capacity, and social exclusion); and political and regulatory barriers (Miller, 2004). Added to this is the increased dispersion of demand due to the lower population density compared to the urban population (Lanfranchi et al., 2015a).

The role of public funding and Government to support the "twin transition"

The literature on environmental economics agrees that enterprises require support to develop the knowledge and skills needed to transform their activities in sustainable (and digital) projects (Velenturf & Jopson, 2019). This particularly regards the SMEs that do not have the time, people, or financial resources for developing sustainable practices in terms of ecological as well as social sustainability, see Gerlitz et al. (2021). For these enterprises, an adequate support is critical to ensure a wider participation in a sustainable economy. Development policies aimed at regional economic growth and promoted using new technologies, have the function of accelerating and favoring the increase in the productivity of companies in a local area (Surya et al. 2021). This includes the role of public funding and state support in promoting significant financial and social investments (involving employment) to ensure both the effective functioning of SMEs (Gumar, 2018) and resource

efficiency and environmental benefits. The influence of agricultural subsidies on farm performance has always attracted policy makers (Kravčáková Vozárová et al., 2020). This is also due to the possible positive relationship between grant amounts and farm performance. First, subsidies reduce agricultural credit constraints and risk aversion, which positively affects farm productivity (Rizov et al., 2013). From an economic point of view, a subsidy is a payment usually by the government designed to form a wedge between the price paid by consumers and the costs of producers, so that the price is lower than the marginal cost. The agricultural sector in the European Union is currently heavily subsidized, for example, the Common Agricultural Policy (CAP). Subsidy policy also has a large impact on the economic performance of farms and acts on farmers' optimal decisions using various mechanisms (Bhowmik et al., 2019). Indeed, if the subsidies contribute to fostering and promoting the technological development of the beneficiary farms, providing stimulus for innovation and the transition to new technologies, their performance will also grow accordingly. In order to foster the development and creation of favorable conditions for agricultural enterprises to ensure a progressive twin transition, government and industrial programs have operated at various times, in Italy, and through several support areas, including the Rural Development Programmes (RDPs) (EAFRD), in particular the Measure 16 - Innovation and Cooperation; the Fund for Innovative Investments of Agricultural Enterprises, through concessions as non-repayable grants; the Fund for Sustainable Growth which provides aids to support initiatives aimed at the green and circular transition within the Italian Green New Deal's aim.

The Transition 4.0 (2019-2020) in which all enterprises located on the national area, can benefit from the tax credit for investments in research and development, green transition, technological innovation 4.0 and other innovative activities. As well as the Recovery and Resilience Plan (RRP) "Agriculture 2022" split up into three macro-areas: Circular Economy and Sustainable Agriculture; Supply Chain and Districts; Territory and Water Resource Protection. Furthermore, other initiatives (foreseen by the RRP) support farmers, such as: the development of biomethane and biogas; the digitalization, innovation, and competitiveness of the production system and the expansion of high-speed internet in rural areas; the enhancement of small villages - mainly those with agricultural vocation - through programs of cultural regeneration and tourism revitalization. In other words, the aim is to encourage the private sector to create high value-added enterprises.

Localized knowledge and the role of university

Today, knowledge is a crucial element in all markets. Every small or large economy, to be competitive, must pay attention to knowledge, to its planning, but also to its transfer and conservation. In this perspective, knowledge represents a very important factor in guaranteeing the sustainable position of a local area in a competitive context (Širá et al., 2020). In a context of regional growth, supporting the existence of local enterprises, especially SMEs, must be aimed at fostering their competitiveness and productivity in local, national, and global markets (Lanfranchi et al., 2015b). This requires a dissemination of knowledge, as well as a consolidation and management of the skills of the human resources present in that local area (Orhan et al., 2019; Lanfranchi et al., 2017). This is also supported by studies that have shown how the relationship between the skills of human resource and the SMEs performance is affected by knowledge, skills and the capacity to enhance business performing (Xirogiannis et al., 2008).
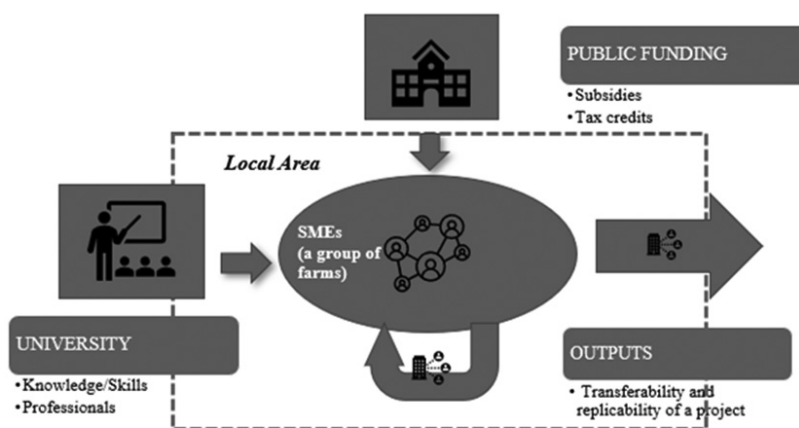

Fig. 1. Proposed basis for a conceptual framework
Source: Own elaboration based on the above literature

In this perspective, universities can be considered external sources of knowledge. They represent, for the area in which they are located, a resource and a driving force for change in the direction of sustainability (Qui et al., 2017; Abbate et al., 2021). Enterprises can take advantage of the scientific knowledge produced and made available by academic institutions and can use this knowledge for their own purposes. However, infrequently the knowledge produced within universities translates into new products/services for enterprises (Pavitt, 2001; Lanfranchi, 2010). Furthermore, higher knowledge contexts can generate more entrepreneurial opportunities than contexts with more limited knowledge (Raspe & van Oort, 2011). To tackle these issues, the present research analyzes the impact of public funding and Government support on the twin transition of SMEs operating in the agricultural sector in a specific area (the north-eastern area of Sicily). Particularly, taking into account the policy measures aimed to support SMEs through incentives as well as public funding and support measures to encourage the use of renewable energies, energy efficiency as well as the development of innovative eco-efficient processes, products, or services. Figure 1 shows the proposed basis for a conceptual framework to analyze these aspects.

Material and Methods

To answer to research question, the conceptual framework was applied to the case of local farms and combine semi-structured interviews and a survey to identify their ability to implement projects related to the twin transition, in order to improve competitiveness and support high-value jobs in a local area, taking into consideration the following points:

the role of public funding in supporting research and innovation and technological integration (e.g., incentives as well as funding and support measures to encourage the use of renewable energies, energy efficiency as well as the development of innovative eco-efficient processes, products or services) following the approach used by Muscio & Ciffolilli (2019);

the role of the university on the twin transition in supporting SMEs operating in the study area, in order to build local human capital and professionalism.

Between May and July 2022, 23 semi-structured interviews were conducted.

The survey, addressed to farmers, was divided into some main themes, and was designed on the basis of the literature on the subject, in particular: (a) firm's characteristics and employment structure; (b) organizational innovations and human resources management practices; (c) relations between firms and (d) employee evaluation, according to Pini

and Santangelo (2005) ; (e) challenges related to the replicability of projects and actions (Giannoccaro et al., 2021) and (f) factors that influence their replicability (Sigrist et al., 2016; Calvo et al., 2018).

Results

The survey involved farms located in the north-eastern area of Sicily (Italy), selected to represent a wide range of in-

Table 1. Sample characteristics

Number		23
		%
Types of enterprises	Sole Proprietorship	78.3
	Partnership	13
	Corporation	4.3
	Other	4.3
Average Annual Turnover during the past 3 years (€)		
	Up to 50,000	56.5
	50.001-150.000	34.8
	150.001- 500.000	4.3
	1.000.001-5.000.000	4.3
Total Farm area		
Surface area	ha	
	<1	13.0
	1-3	34.8
	10-15	30.4
	16-25	4.3
	26-50	4.3
	> 100	4.3
Farmers' characteristics		
Gender	Male	81
	Female	19
Age		
	20-30	1.4
	31-40	13.0
	41-50	34.8
	51-60	17.4
	>60	17.4
Education		
	Primary	4.3
	Secondary (agricultural/non-agricultural)	43.5
	Higher (agricultural/non-agricultural)	52.2
Time of running the agricultural business		
	Less than 5 years	17.4
	5–10 years	4.3
	11–20 years	39,1
	21–30 years	26.1
	More than 30 years	13.0

terests and involvement in farmers' change processes towards a green and digital transformation. The respondents came from the following sectors: olive growing; cultivation of vegetables; milk processing; agritourism and agricultural products; wine tourism; carob cultivation; viticulture; production of dried fruit; organic farms; breeding of cattle and pigs; earthworm farming; plant nurseries; citrus fruits; poultry farming.

These data were integrated with information regarding: the farms' attitude to use public funds to co-finance green and digital investments; the role of university in disseminating knowledge. The interviews were conducted partly in person and partly online. Table 1 organizes and summarizes our sample data.

Table 1 shows that 18 farms are sole proprietorships, the second type of enterprise represented is partnerships involving three respondents.

As regards the Average Annual Turnover during the past 3 years, 56.5% of farmers declare up to €50 000. While the surface area extension most represented is comprised between 1 and 15 ha. As to the farm's characteristics, it emerges that the sample is made up of 17 males and 4 females, while the average age is between 41-50 years.

An initial aspect emerges from the propensity of the respondents to invest in innovation projects. Figure 2 shows how in the last 3 years, 30.4% of the respondents declare that they have allocated less than 1% to these projects, testifying to a low propensity to invest in innovation.

We found that 78.30 % of the respondents claimed to be familiar with the so-called twin transition (Figure 3). However, it was surprising that the majority of respondents (56.5%) did not develop projects/practices/activities related to the green and digital transformation.

The respondents with a higher-level of education were most familiar with the term "twin transition" (52.2%) and
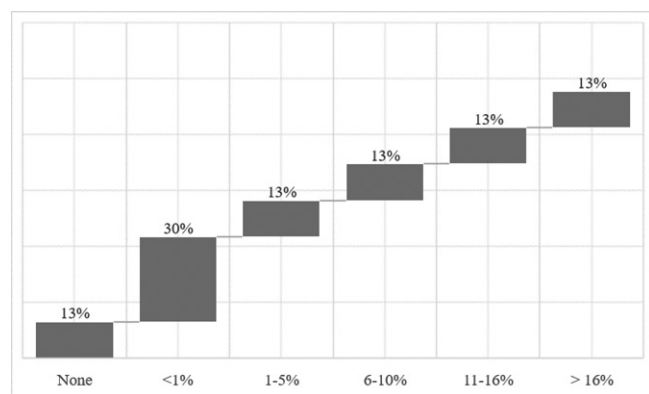

Fig. 2. Percentage of revenue invested in innovation projects, over the past three years

followed by the group of respondents with a secondary level of education (34.4%). It was unexpected that among the latter respondents, the majority (34.4%) know the term "twin transition", however the same percentage (34.4%) of respondents did not develop any related project (Figure 4).

While for those who have developed projects/practices related to this aspect, 54.5% of farmers declare that they have started a single project; 36.4% of respondents: supply chain projects; 27.3% process innovations (production/distribution); lower percentages concerned other activities (business models, product, marketing, etc.). However, only 30.4% of the respondents hire individuals with specific competences (for developing these projects) gained in the local area covered by this research, and only 13% attended the "local" University. With regard to the willingness to hire, 39.1% of the respondents stated that they "*did not find adequate professional skills in the area, to develop these tasks*"; 30.4% recur to private consultants; while 21.7% affirm to "*prefer para-subordinate workers*" (i.e. individuals who are legally self-employed but who are often "economically dependent" on a single employer), only 4.3% would be willing to offer a regular employment contract (fixed or permanent contract). However, it seems that 39.1% of the respondents indicate, among the barriers that have prevented their company from starting projects related to the twin transition: the "*difficulty in finding skills and professionals in the area*".

As regards the use of fundings, which in the model was defined as public fundings, it emerges that only 17.4% of the respondents employed public fundings to develop projects related to the twin transition. Among the most used measures are the RDPs funds.

The last variable represented in the theoretical model concerns the replicability of the project/practice. Regarding this question, 69.6% of the respondents answered that "*the general conditions for the replicability of the project/practice, in the same economic sector or in other sectors, do not exist*".

In this perspective, the barriers indicated by the respondents are: "*difficulty in obtaining public funding*" (56.5%) confirming that adequate support for these enterprises is crucial to ensure wider participation in a sustainable economy, as demonstrated by Velenturf & Jopson (2019) and Gerlitz et al. (2021); "*these projects are too complex*" (43.5%); "*difficulty in finding skills and professionalism in the area*" (39.1%) this aspect is consistent with Pavitt (2001) according to which the knowledge produced within universities rarely translates into new products/services for SMEs; "*high investments costs and lack of incentives*" (34.8%) as proved by Sevinç et al. (2018) and with Nagarajan and Meyer (2005) about the difficulties encountered in rural finance; "*lack of knowledge of any successful projects (related to the*
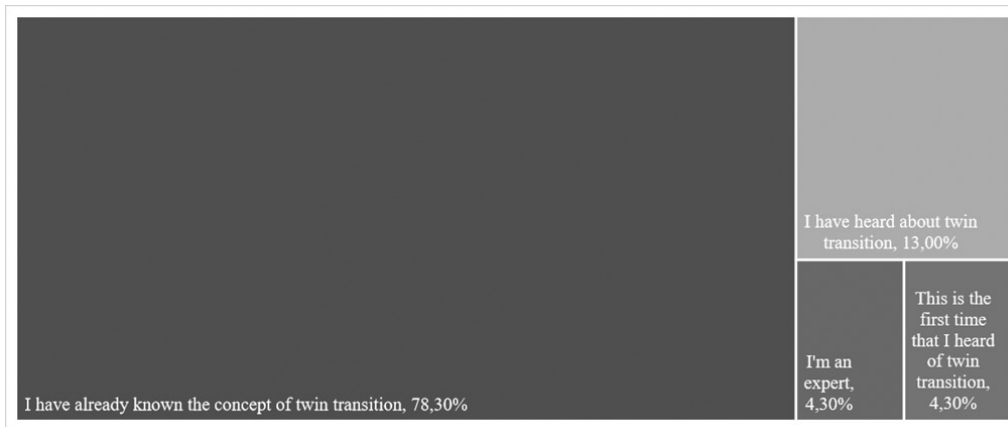
Fig. 3. Knowledge and awareness of the so-called "twin transition" (Digital and green transformations)

twin transition) (benchmark)" and "*difficulty in identifying (and choosing) technical, economic and/or supply chain partners*" (30.4%); "*complex legislation and strategies to address these issues*" (26.1%) confirming what was established by Miller (2004) regarding political and regulatory barriers. On the other hand, only 8.7% of those interviewed indicate "*lack of consumer awareness*" as a barrier.

On the contrary, among the farmers who have declared the replicability of their projects, as enabling conditions emerge: "*effortlessness in project design and development*" (42.9%); standardization (compliance with mandatory or voluntary standards), particularly they assert that "*the project is standards compliant or can easily be made standards compliant*" and "*no difficulty in identifying the positive impacts of the project*" (28.6%). Minor but useful features to ensure the replicability of the project concern the "*interoperability*", in particular "*replicability is linked to the possibility of sharing data via software and/or hardware*"; furthermore "*the replicability is influenced by the local infrastructure and by the location of the farm (i.e., climatic conditions such*

as temperature, wind, precipitation levels, soil, etc.)", "the project can be easily implemented in another context and/ or company without further investment (time/money)", and "replicability is subject to acceptance by stakeholders", answers provided by 14.3% of the farmers interviewed.

In this perspective Table 2 presents according to classification proposed by Sigrist et al. (2016) and Calvo et al. (2018) the technical, economic, regulatory and acceptance by the stakeholders aspects linked to the replicability of a project, taking into account the responses of farmers.

As shown in Table 2, the aspects most indicated by the farmers interviewed mainly concern the technical and economic aspects.

Conclusions

The aim of this research was to verify the ability of farms, in the study area (the north-eastern area of Sicily), to start green and innovative projects and check whether the public funding and the knowledge transfer, deriving from the
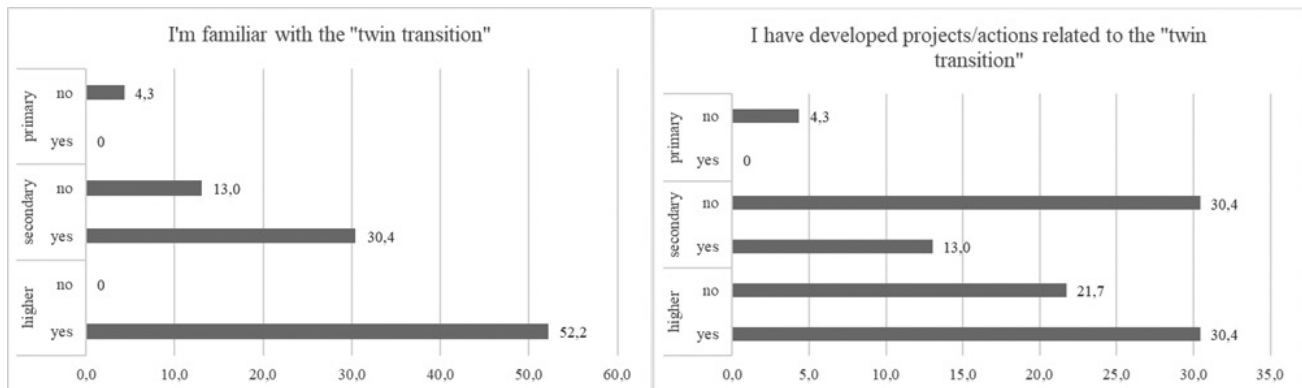

Fig. 4. Familiarity with the term "twin transition" versus willingness to develop related projects

Table 2. Technical, economic, regulatory and stakeholder acceptance aspects related to the replicability of a project

Technical	%	Economic	%	Regulatory	%	Acceptance by the stakeholders	%
Effortlessness in project design and development	42.9	No difficulty in identifying the positive impacts of the project	28.6	There are regulatory barriers affecting replicability	14.3	Replicability is subject to acceptance by stakeholders	14.3
The project is standards compliant or can easily be made standards compliant	28.6	The project can be easily implemented in another context and/or company without further investment (time/money	14.3	Replicability depends on the current national or regional regulation.	14.3		
Interoperability	14.3						
Local infrastructure and by the location of the farm	14.3	The economic indicators show that the Business Model associated with the project is quite easy to replicate	14.3				
		I foresee developments in the short to medium term which will positively influence the cost-benefit ratio of the developed project.	14.3				
		I think the developed project would be profitable in my area	14.3				

presence of a university, could represent a driver in the twin transition process.

It emerges as the evolution towards the so-called "twin transition" and consequently to the agriculture 4.0 can offer extremely significant benefits, against costs that are probably subjected to dynamic economies of scale. Certainly, this study highlights how the initial investment is particularly weighty and represents an important barrier in the implementation of these practices, but we must remember the amount of financial resources to support these investments available nowadays in our country (and not only), also because of the National Recovery and Resilience Plan generated after the Covid-19 pandemic. However emerges that only 17.4% of the respondents employed public fundings to develop projects related to the twin transition.

The farmers interviewed shown a poor knowledge of the opportunities offered by the green and digital transaction, and furthermore they do not find, in the study area, the knowledge and skills necessary for the implementation of practices and projects related to this topic. This confirms the presence of a gap or a disconnection between the new needs of farms and the professionals trained.

This aspect is worthy of particular attention since with the advent of agriculture 4.0, driven by the twin transition, there will be a decline in low value-added activity tasks, which can be replaced by robotics, drones and remote control of tech-

nologies, and an increased request of data analysts, software developers and IT experts. In the medium-long run, this will make it necessary to develop widespread reskilling projects for the agricultural workforce. These aspects will become more evident as a result of the generational turnover which, like other sectors, is presumed to affect the agricultural sector as well.

The goal should be to increasingly integrate and connect the entire end-to-end production chain from "farm to fork", to encourage the enhancement of rural areas, SMEs, productivity, different employment, and access to new markets.

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