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Assessment of Safety Levels in the Agricultural Sector for Supporting Social Sustainability: A Quantitative Analysis from a National Point of View

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Abstract: The scientific debate about sustainability in the agricultural sector is growing worldwide, especially thanks to the increasing awareness of customers towards the impact of their consumption behaviors. While a great deal of attention is given to the economic and environmental dimensions of sustainability, social sustainability assessment often focuses on the quality of life of farmers and the local community; the dimension regarding occupational health and safety (OHS) is not so analyzed even if the agricultural sector could be evaluated as one of the most hazardous ones all over the world. From this point of view, workers are considered high-risk groups mainly due to the presence of hazardous equipment and chemicals. The aim of this work is to propose a cross-analysis developed on public databases reporting data about injuries in the Italian agricultural sector—provided by the Italian National Institute for the Insurance of Work-Related Injuries (INAIL)—in order to point out the main sources and causes that led to these injuries. The injury analysis will allow companies as well as institutions to define more effective prevention strategies to increase the social sustainability levels of this sector. Even if results are limited to the Italian sector, they could outline some directions for improving social sustainability levels as well as research gaps and possible future research directions in order to prevent injuries in the agricultural sector.

Keywords: social sustainability; safety data; cross analysis; injury prevention

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1. Introduction

Evaluating sustainability issues in the agricultural sector is a very complex issue as it equally emphasizes environmental, economic, and quality-of-life goals [1]. Over the years, most research on sustainable agriculture has focused primarily on environmental stewardship and profitability. Analyzing the current scientific literature about sustainability assessment in the agricultural sector has shown that most results focus on environmental issues (e.g., climate change), almost neglecting the social impacts, such as those related to the health and safety of the workers involved [2].

The social dimension has been mostly disregarded, as with many other sectors, since, in general, there is a lack of consensus on what social sustainability is and how it should be measured [3]. Social sustainability assessment in agriculture is often assessed only by evaluating the quality of life of workers and local communities in this sector; less attention has been assigned to occupational safety and health (OSH) issues, even if agriculture ranks among the most hazardous industries all over the world. Providing good safety and health management at the workplace is also included among the objectives of the

UN's Sustainable Development Goals (SDG), in SDG 8 ("Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"). From analyzing the scientific literature, it can be noted that several international studies report that the agricultural sector could be considered one of the most hazardous sectors from the OSH point of view [4–6]. The specific types of injuries and illnesses that could occur for workers in this specific sector include a high incidence of muscular–skeletal injuries, hearing loss, respiratory or cardiovascular diseases, different types of cancers, and other illnesses related to chemical exposure, which could occur due to the main activities carried out [7]. The high injury rate is also related to the presence of near-miss events, which are precursor events that can be somehow connected to injuries since a positive correlation can be outlined between the number of near-miss events experienced by workers and their involvement in an accident for specific types of events (like a fall from a piece of machinery) [8]. Several different elements contribute to this result, like the presence of different hazard sources (from machinery to specific products used in farm management) and the high presence of small and medium enterprises, which are usually less organized than large companies in managing safety at the workplace [9]. Moreover, a recent study based on a survey conducted among Italian companies in agriculture suggests that the level of safety regarding climate perception is particularly low among farmers, causing a risk-taking attitude in this sector [10]. All these contributing factors highlight that agricultural injuries and illnesses are higher than in many other industries. Thus, a quantitative analysis that could point out the intrinsic (root) causes of injuries and illnesses could heavily contribute to increasing the social sustainability level of this sector: this is the main target of the present study. As an example, structured data about these events can help in the development, implementation, and translation of prevention programs and policies carried out by both national institutions as well as single companies. For several years, structured data have been available in an open data format in Italy; a national surveillance system is working to provide a wide quantity of data about injuries and illnesses occurring at Italian workplaces. It has to be noted that a national surveillance system is a critical component of effective prevention and intervention programs, thus contributing to increasing the overall social sustainability level of the agricultural sector [11].

Based on structured national datasets, the present study proposes a quantitative analysis of the occupational safety level of the agricultural sector in Italy, aiming to contribute to the assessment of its social sustainability dimension and to point out possible improvements to prevent injuries in this sector. Thus, the two main research questions evaluated in this study are the following:

RQ1: What is the current risk level characterizing the Italian agricultural sector?
RQ2: What are the main root causes, risk factors, and sources contributing to injury occurrence in the Italian agricultural sector?

In order to answer these research questions, a cross-analysis of different datasets has been carried out based on a structured method. The aim is to point out what the most critical processes and risk sources in this sector are in order to enable the design of preventive plans and actions and improve the overall social sustainability level.

The paper is organized as follows: Section 2 reports a quick state-of-the-art analysis of models adopted for injury analysis in the agricultural sector, while Section 3 describes the methods adopted for the proposed quantitative analysis. Section 4 presents the results of the analysis, and finally, the discussion and conclusions are summarized in Sections 5 and 6, respectively.

2. A Literature Review of Injury Analyses in the Agricultural Sector

Several recent and past studies have analyzed safety data about injuries in the agricultural sector from different perspectives and methods, aiming to point out injury rates, as well as critical risk factors, and the most frequent causes of injury.

The first type of study refers to quantitative methods applied to analyze aggregate data about injuries, which was developed on structured datasets that are usually available at the national level. These analyses can be developed more effectively and reliably when a national surveillance system is working. This is confirmed by Earle-Richardson et al. [12], who performed a quantitative analysis of injuries that occurred in the US agricultural sector by crossing information from three different main data sources: ambulance reports, hospital discharge, and county safety officials. Even if the cross-analysis has provided interesting feedback about the most frequent causes of injuries, the authors also outlined how a more integrated safety data system is essential to design an effective national surveillance system for preventing injuries. On the other hand, based on national data availability, Lovelock et al. [13] proposed a detailed comparison of injury data in the agricultural sector collected in different areas in the world: North America, Europe, and Australasia. Patel et al. [14] discussed injury data collected in a specific Indian region for farmer workers, outlining, for that area, that the safety of agricultural equipment could be one of the most critical issues to be solved. Baraza and Cugueró-Escofet [15] performed an analysis of occupational accidents that occurred in the Spanish agricultural sector from 2013 to 2018 based on data collected by the Spanish Institute of Occupational Safety and Health, underlining the high accident rate and the criticality of some risk factors, such as the poor work conditions and the use of heavy machinery and dangerous materials. Similarly, Angioloni and Jack [16] analyzed data about injuries in agriculture in Northern Ireland over 50 years (1968–2017) collected by the HSENI (Health and Safety Executive Northern Ireland). Authors observed that, even if fatalities due to interactions with animals have been increasing in the analyzed timespan, incidents related to vehicles and equipment are still the main cause of death for workers in the sectors. Differently for these quantitative cross-analysis studies, Murphy et al. [17] proposed and validated a more strategic approach based on a classification methodology for data about injury, illness, and disease associated with agricultural hazards aiming to support a more effective design of a structured data set of information.

Another cluster includes studies not based on national structured data: one widespread tool is the survey analysis developed on specific samples. Westaby and Lee [18] proposed a survey analysis to point out antecedents of injuries among a specific cluster in the US agricultural sector: young people working in agricultural settings. The results obtained outlined both strong relationships (e.g., between safety activities and safety consciousness) and less evident ones. Chae et al. [19] discussed a survey analysis regarding the Korean farming sector aiming to estimate the national agricultural injury rate and identify the most relevant factors associated with these injuries. Mishra and Satapathy [20] described the results obtained from a survey analysis carried out to evaluate the impact of hand tool injuries on agricultural farmers in a specific area in India. Differently from these studies, Pfortmüller et al. [21] proposed a quantitative analysis for assessing the severity of injuries in the Swiss agricultural sector based on a specific local data set, i.e., data derived by admissions to a specific emergency department.

In addition, some literature analyses have also been proposed. Jadhav et al. [22] proposed a meta-analysis of the current literature in order to point out the emerging risk factors for agricultural injuries. Several factors were outlined, ranging from organizational and technical to social ones. Kumar et al. [23] analyzed the literature about injuries related to agricultural equipment, outlining the most relevant suggestions regarding preventive measures to be adopted during their use.

The studies described so far are characterized by a top–down approach evaluating risk factors and risk sources from historical data, while another type of study adopts a bottom–up approach, evaluating the impact of specific hazards and/or hazard sources. A few studies analyzed the impact of external heat on occupational injury rates in different ways. Spector et al. [24] discussed, through a cross-analysis between injury data and historical meteorological ones, the potential relationship between heat exposure and traumatic injuries in outdoor agricultural workers. Di Blasi et al. [25] analyzed the impact of this hazard by using data extracted from national databases. Another study about a specific disease (kidney damage) was proposed by Moyce et al. [26] in a sample of California agricultural workers. The study was carried out through a dynamic analysis (based on wearable systems) and, next, a cross-analysis aimed at pointing out the most critical parameters of both working activities and workers' health. Wibowo and Soni [27] proposed a field analysis of potential hazards related to the use of specific agricultural equipment (i.e., hand tools) adopted by farmers in Indonesia: the feedback obtained by the study has been used to redesign tools in a safer way.

Next, a bibliometric map of the literature analyzed has been realized through the open-source tool VOSviewer, even though the number of articles is not high. Figure 1 shows the network based on the co-occurrence analysis of keywords (setting a minimum occurrence of 4). The map contains 22 items and shows the relevance and connections of keywords: bigger nodes indicate a higher occurrence, while arcs refer to the co-occurrence of keywords. The most frequent words are related to the specific sector analyzed (i.e., agriculture, agricultural worker), and a few concepts of the safety domain are present (occupational accident, occupational injuries, risk factor, etc.). One interesting finding is the presence of keywords specifying the demographics (age and sex) of the workers involved (e.g., young adults, adolescent, male, female, etc.), confirming that part of the criticalities of this sector is related to this dimension: farms are often family-run companies, increasing the presence of under-age or old workers.

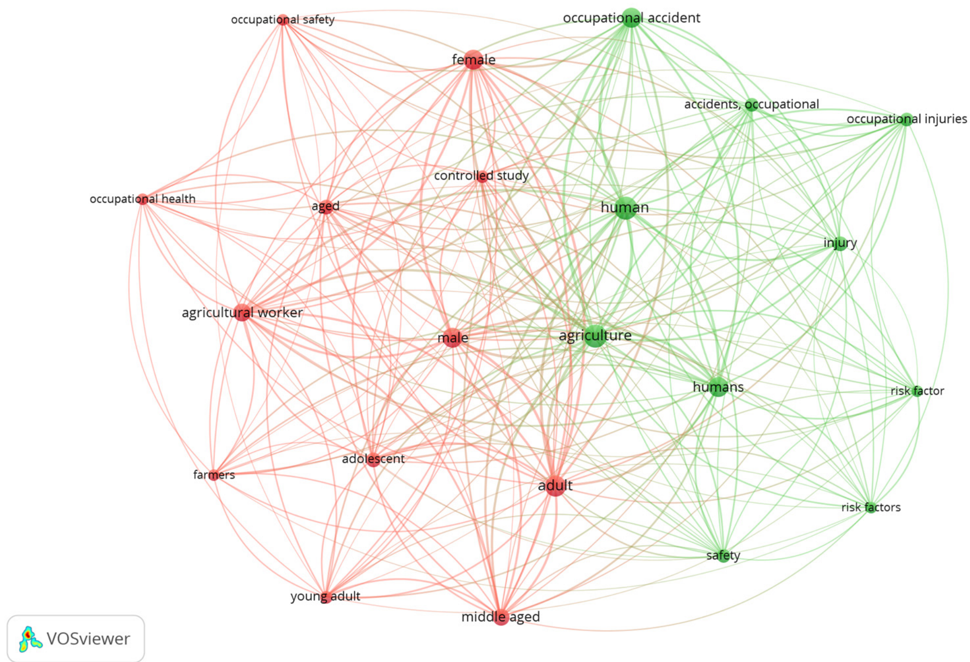

Figure 1. Co-occurrence analysis of keywords.

The present study has been developed based on a structured dataset, but differently from the ones currently proposed in the literature. The aim is twofold: analyzing national datasets to point out quantitative trends and crossing specific datasets to highlight both the basic causes and the main risk sources that have contributed to the occurrence of injuries in the agriculture sector.

3. Materials and Methods

To answer the two research questions, a structured method has been proposed based on the analysis of Italian datasets: the description is proposed in Figure 2. First of all, data have been acquired from public, structured datasets. In Italy, official data on injuries at work are collected by INAIL, the National Insurance Institute against Accidents at Work, the Italian non-profit public body that provides compulsory insurance against accidents at work and occupational diseases [28]. INAIL provides structured data through several public-specific databases, which are updated based on mandatory analyses developed by INAIL on occurred injuries and/or occupational diseases at the workplace.

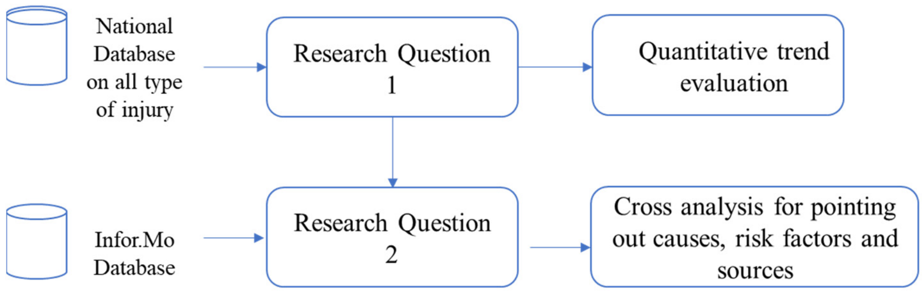

Figure 2. Steps of the adopted methodology.

The first step of the proposed method aims to answer the first research question: it has been carried out on the national generic database [29,30], collecting data on injuries over a five-year period (2017–2021). Information extracted from this database regards macro-data (e.g., total numbers, type, etc.) about injury events that occurred in the Italian agricultural sector in the period considered. It includes all types of injuries, from fatal to non-fatal. In detail, datasets about the Italian agriculture sector include information about farms, forests, and fishery sectors. Data included in this database are not structured based on a specific assessment methodology.

In the second step, in order to answer the second research question, a specific dataset called Infor.Mo has been used (from "Infortuni mortali", i.e., work-related fatalities in Italian), which is the open-access database of INAIL [31] and includes detailed information only about fatal injuries; the same period (2017–2021) has been considered.

The Infor.Mo system has been developed by INAIL in cooperation with Regions and Autonomous Provinces, and Local Health & Safety Departments (LHSDs), which are the centers of administrative operations related to public healthcare in Italy, under the National Healthcare Service. The database is based on information derived from fatal injury investigations conducted by LHSDs after each event. In detail, this second dataset has been structured by adopting a specific injury assessment method: the injury dynamic is analyzed based on a backward path, usually applied in the judicial investigative process; next, a multi-factorial model is developed in order to identify the root causes of the occurred fatal injury [31]. Starting from the last event in chronological order (i.e., the biological damage), the multi-factorial model identifies the accident that occurred (e.g., a fall from a height of the worker or the overturning of a work vehicle) and the related causes (i.e., risk factors) of the injury. These latter are grouped into six major categories: (i) activity of an injured person; (ii) activity of another person present in the injury dynamics; (iii) equipment, machines, plants, and tools; (iv) materials; (v) working environment conditions; and (vi) personal protective equipment (PPE). Extracted data collected have been analyzed to derive information on the main risk factors and sources affecting the safety level of the agricultural sector in Italy, but also to outline root causes of occurred injuries.

The results are described in the next section.

4. Result Analysis

The Italian agricultural sector accounts for more than 1.1 million companies, most of them individual or family-run companies (about 93%), and includes almost 900,000 workers: it has to be noted that the total worker population in Italy is equal to about 23 million. The Utilized Agricultural Area (UAA) is about 12.5 million hectares [30]. The following two subsections describe the results of the analysis of accident data and fatal injuries data, respectively.

4.1. Injury Trends in the Italian Agricultural Sector

The first target is to evaluate the accident trend of the agricultural sector compared to other industrial sectors in order to evaluate its overall level of hazard. Data about the trend of accidents that occurred in the agricultural sector versus accidents recorded in all other industrial sectors are reported in Table 1. Results outline that the agricultural sector is contributing to the overall value with an average of about 7%. This is an interesting result, as the weight of the agricultural sector over the total Italian worker population is about 3%; thus, this sector could be considered among the most critical ones, based on its average injury rate.

Table 1. Accident trends during the period 2017 to 2021.

	Year					
Sector	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Agricultural	27,465	26,699	25,936	20,649	20,607	121,356
Other industrial sectors	338,967	333,582	330,722	354,679	306,053	1,664,003
Total	366,432	360,281	356,658	375,328	326,660	1,785,359

Another interesting result is that from 2017 to 2021, the accidents recorded in the agricultural sector decreased by about 25%, which is a much greater reduction compared to accidents recorded in all other sectors, corresponding to about 10%; this is also outlined in Figure 3.

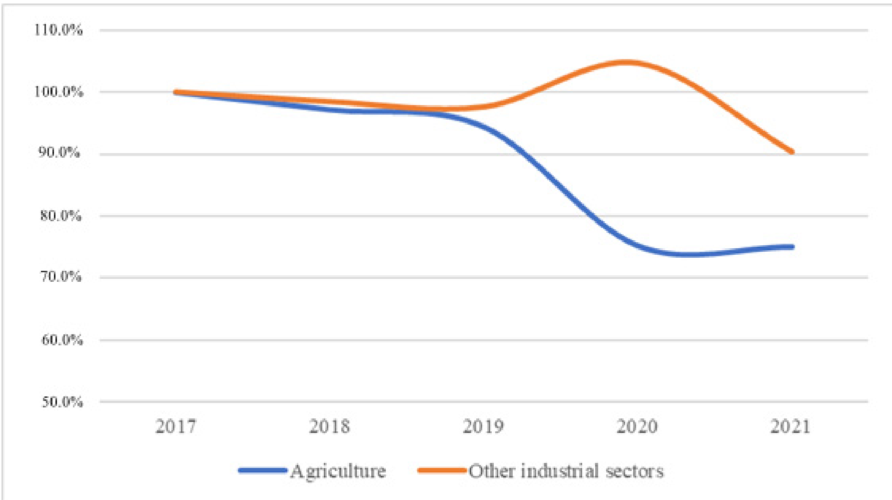

Figure 3. Trends (expressed in %) in accidents that occurred at work in agricultural and other industrial sectors in the analyzed period.

It should be emphasized that the peak observed in 2020 for all industrial sectors appears to be connected to COVID-19 diffusion, which had less impact on agriculture, probably due to its intrinsic dynamic of diffusion. However, this correlation should be further analyzed through a specific study and cannot be proved in the context of this research, as this is not the aim of the study.

Based on the structured data extracted from the INAIL database [29], a more detailed analysis of specific hazardous systems has been carried out, i.e., means of transport, involving only fatal injuries. The rationale is to point out the more critical trends about hazard sources. In detail, the total number of accidents involving or not involving means of transport in the agricultural sector is reported in Table 2.

Table 2. Patterns of accident occurrence involving or not involving means of transport for the analyzed period.

	Year					
Accident in Agriculture	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
With means of transport	1341	1418	1480	1163	1324	6726
Without any means of transport	26,124	25,281	24,456	19,486	19,283	114,630
Total	27,465	26,699	25,936	20,649	20,607	121,356

Data show that at least 5.5% of accidents in the agricultural sector involve a means of transport. It has to be noted that although accidents involving means of transport in the analyzed period essentially remain stable over time, they still represent approximately 40% of the fatal accidents collected by INAIL. Thus, as vehicles—such as tractors, earth-moving machines, tillers, etc.—are adopted in several working phases (tilling the land, mowing the grass, treatment with plant protection products, fertilizing, sowing), these data confirm that they usually represent one of the main accident hazards in the Italian agricultural sector.

4.2. Analysis of the Most Critical Root Causes, Risk Factors, and Sources

Next, the second step was carried out by analyzing only fatal injuries through the Infor.Mo database in the same period, from 2017 to 2021. This database provides more detailed information, allowing a deeper analysis. A total of 234 fatal injuries in the agricultural sector were included in this analysis. But it has to be noted that this number does not match the collected data reported in the previous section from the generic database by INAIL since only a sample of events is collected through Infor.Mo (fatal ones). Detailed information regarding the specific type of accident characterizing each specific event is reported in Table 3.

Table 3. Types of accidents that occurred in the agricultural sector that led to fatal injuries in the analyzed period (2017 to 2021), extracted from Infor.Mo.

Type of Accident Occurred	**Number of Extracted Events**	**Occurrence [%]**
Vehicles exiting their route (overturning)	109	46.6
Fall of workers from height	24	10.3
Contact with moving vehicles or objects in their usual location	22	9.4
Unexpected starting of vehicle, machine, equipment	21	9.0
Fall of heavy bodies onto workers	14	6.0
Contact with moving parts of equipment	11	4.7
Other types of accidents not classified (N < 10)	33	14.1
Total	234	100.0

The analysis of the specific accident dynamic outlines that one main cause of accidents is the loss of control while driving the work vehicle, which often leads to vehicle overturning. In this case, the accident can happen either during the work operations (such as manuring, seeding, land treatment, etc.) or on route to/from the workplace. The data show that the most involved equipment is tractors, with or without a trailer. The second most frequent type of accident is a fall from a height, which occurs when work is taking place at height (e.g., portable ladders) or from working environments at height (such as barns, warehouses, silos, etc.). Analyzing the accident type allows us to point out what are the most hazardous activities in the analyzed sample based on historical data.

Next, the analysis has focused on pointing out the main risk factors that have caused these events: data about risk factors, total fatal injuries, and events involving or not involving overturning are in Table 4. Information has been clustered in order to outline the contributions of accidents that occurred from vehicles exiting their route (overturning) towards other accidents. Overturning has been evaluated based on observations previously analyzed.

Table 4. Categories of observed risk factors for fatal injuries extracted from Infor.Mo in the analyzed period (2017 to 2021).

Risk Factor Categories	Total Fatal Injuries	Accidents Involving only Overturning [%]	Other Accidents [%]
	Occurrence *		
Activity of injured person	267 (57.4%)	61.3	53.3
Equipment, machines, plants, tools	99 (21.3%)	26.1	16.3
Working environment conditions	39 (8.4%)	5.9	11.0
Activity of another person	31 (6.7%)	2.9	10.6
Personal protective equipment (PPE)	15 (3.2%)	2.5	4.0
Materials	14 (3.0%)	1.3	4.8
Total	465 (100.0%)	100.0	100.0

* Percentage values are reported in parentheses.

The data shown what are the most critical risk factors affecting occurred fatal injuries. The highest value is related to the specific activity developed by the worker, but a high contribution is also given by the interaction with machinery and equipment, as reported by several studies in the literature (see Section 2). It has to be noted that machinery—with a different level of automation—is used in several agricultural operations: in detail, a dynamic interaction could occur when a vehicle with a cab (e.g., tractor, harvester, forklift) is involved, or a static interaction could occur due to the power take-off (PTO) of a tractor, or one powered by electricity, by water, or by hand. In both cases, the hazard level could increase due to interference risk between different workers involved in the use of machinery.

In detail, when overlapping data about the loss of control of vehicles, these two categories increase their criticality. Furthermore, for other types of accidents, two different categories—Working environment conditions and Activity of another person (e.g., other workers present in the accident scene)—are also characterized by a substantial impact.

For fatal accidents due to vehicle overturning, the loss of control is almost connected to maneuvering errors while driving (88%). In addition, overturning occurs due to two simultaneous factors in about 75% of the analyzed sample: maneuvering errors are often associated with structural deficiencies in the work equipment, like the absence of driver's seat protection systems and driver retention. This is relevant information, as the hazard could be reduced by substituting equipment with safer equipment.

In addition, driving errors are mostly due to underestimating the characteristics of the environment where workers are undertaking their activities (like the slope of the land, the presence of unevenness close to the work area, and the stability of the land); another issue to consider is the procedure adopted for driving the vehicles on external roads during the transfer phases from/to the workplace, which is usually a high source of hazard.

For fatal injuries due to the fall of workers from a height, the analysis of the causal factors highlights a lack of a risk assessment analysis or a non-effective one. One of the most critical activities is maintenance: some examples refer to procedural errors of access/parking in areas at height, which are often accompanied by deficient structural characteristics of the same areas (for example, in terms of roof capacity, absence of provisional works to protect against the risk of falling from a height such as walking surfaces and parapets, etc.). Another outlined critical issue is related to the incorrect use of PPE (personal protective equipment) assigned to specific work procedures carried out at a height; this issue is similar to the one that is usually outlined for construction sites, which have some common features with the agriculture sector in the occupational safety domain.

5. Discussion

The first consideration derived by this study is the importance of a national surveillance system, which becomes critical for sectors (like agriculture) where injury rates and illness levels are high all over the world. On the other hand, evaluating trends and critical factors contributing to reducing the safety level in this sector is not so simple due to several issues. This has been pointed out starting from the proposed literature analysis, which has outlined that the unavailability of structured data could limit an effective analysis of the social sustainability level of agriculture. In this case, researchers and technicians are forced to find alternative performance indicators (like data derived by admissions to a specific emergency department) which must be correlated to other information. In the present study, structured data have been used, as they are provided by INAIL in an open data format; this has allowed us to carry out quantitative analyses with less effort compared to the ones proposed in the literature.

Analyzing the results obtained through the two quantitative analyses aiming to answer the research questions defined, some possible general guidelines for improving the social sustainability levels in the Italian agricultural sector are proposed, with the aim of preventing accidents and injuries at this workplace.

As the most-outlined hazardous sources are machinery and equipment (which is also confirmed by other studies in the scientific literature), and considering the main risk factors that emerged from the analysis, a few possible measures can be directed to the following:

- Increasing the workers' training about the proper use of the machinery. Innovative technologies, like augmented and virtual reality, could be used to increase the efficiency of training activities, like the one proposed in [32]. This need has already been highlighted in the recent literature: Facchinetti et al. [33] underline that a non-professional and part-time workforce is often employed in the sector, increasing the risk of low-skills-related accidents. The literature shows that proper training can influence not only workers' attitudes and beliefs but also their behavior [34] and that it can be effective in reducing a firm's accident rate, especially when engaging training methods are adopted [35];
- Introducing real-time monitoring systems for the correct use of machinery. Some accidents are caused by incorrect use and procedures, as machinery should be used in accordance with their maximum capacity, avoiding overload and respecting speed limits and safety recommendations. Also, in this case, smart-sensor- or Internet of Things (IOT)-based technologies could help to monitor these parameters in real time, providing safety alerts or stopping the activity in a safe way. One recent example is proposed in [36], where, through the adoption of Global Navigation Satellite System technologies and Android apps, machinery positions and parameters are monitored in real time in order to reduce interference risks;
- Realizing more effective organizational models. Some data have outlined that workers' activities should be planned to evaluate the conditions of the environment and choose safe paths (e.g., considering the presence of steep slopes, the solidity of the soil, etc.). Smart technologies could help support these activities in a more effective way [37]. In addition, vehicle and equipment maintenance should be planned through more efficient models—like preventive and proactive maintenance methods—and obsolescent machinery should be replaced with modern ones in order to ensure full reliability during the operative phase [38,39].

Finally, considering more general guidelines, the proper use of PPE should be strongly encouraged. This is a very critical issue as different points of view must be considered. Kim et al. [40] have recently confirmed the importance of monitoring their correct use.

Regarding the second most common accident type, i.e., falling from a height, a mix of technical and organizational interventions could be suggested. It is essential to provide the work area with safe access systems oriented at preventing falls, while training and information for the workers should always be guaranteed. The presence of protective systems, such as safety nets and parapets—often neglected in the agriculture sector—should be included, and proper safety signage should clearly indicate forbidden paths. Finally, workers should be equipped with specific PPE and fall-arresting equipment, for which specific training is recommended.

These general guidelines represent a starting point to improve the social sustainability of the agricultural sector, increasing the safety level for workers. This issue is also related to the resilience of the sector since serious accidents and fatalities also represent a source of interruption of the activities of the companies involved.

However, in order to improve social sustainability levels, e by this reserach some challenges need to be evaluated. The first is related to the safety culture of the enterprises involved since the adoption of measures for preventing accidents can only be possible when there is awareness of the risks entailed and willingness to invest resources for increasing the work safety level. This leads to a second challenge since micro and small enterprises are likely to invest few resources to work safety, including skills and capital. These challenges should be further analyzed and eventually discussed with local institutions that play a role in safety management (e.g., local health services, national surveillance services, etc.), with the aim of finding regional strategies to support companies in the transition to more effective safety management.

6. Conclusions

The study proposes a critical analysis of injuries that occurred in the Italian agricultural sector in order to outline the most hazardous activities and risk factors in this sector. The purpose is to analyze the social dimension of this sector, also aiming to support the design of the most effective prevention activities. This study aims at overcoming a gap still present in the literature about the assessment of social sustainability in the agricultural sector, which so far has been mainly focused on labor organizations. Based on the analysis of data about accidents and fatal injuries in the Italian agricultural sector, some guidelines for the design of preventive measures have been proposed. One limitation of this study can be identified in the possible incompleteness of data, even if INAIL collects official data about accidents reported by companies. The main factor contributing to this issue is irregular work (events involving irregular workers are out of the analysis); therefore, it could occur that the data analyzed underestimate the number of accidents and injuries in this sector, where the level of irregular work is usually high. Moreover, the analysis is based on aggregated data, which does not allow for deriving detailed considerations for specific areas of this sector. In particular, data shown are collected on a national basis, which does not allow for capturing local variations and highlighting regional criticalities. Further developments could include the analysis of data from other sources, with the aim of including unreported events, but also focus on regional differences in order to understand and potentially address local criticalities. Also, the analysis of occupational diseases could integrate the evaluation of occupational health and safety in this sector. Finally, the research could be oriented to evaluate how accident prevention could quantitatively contribute to increasing the resilience level of the agricultural sector towards interruptions due to accidents at the workplace. In addition, future developments could also be oriented to evaluate the potentialities of smart technologies—which are becoming more and more applied in recent years—for preventing accidents in the agricultural sector by evaluating possible benefits as well as new hazards due to their full-scale introduction.

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