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Editorial

Special Issue on Worker Safety in Agricultural Systems

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1. Introduction

Farming is one of the most hazardous industries, with a high level of accidents affecting the sustainability and viability of the sector. Accidents at work are a complex phenomenon linked to a multiplicity of causes, whose analysis is certainly difficult. They are structural, organizational, and environmental in nature and the organization of work itself plays a key role. Indeed, agriculture is a sector where the difficulty of structuring environments and procedures is particularly high, unlike in industry and indoor activities. It is often believed that the risks materialize due to the subject's lack of ability, rather than being due to a set of factors now well studied by ergonomics, which should finally be understood as an interdisciplinary technique aimed at the analysis, evaluation, and design of the interactions of the human operator in complex systems. In addition, the reduction in the number of agricultural workers and the increase in their productivity, obtained with growing mechanization, often lead to work in solitude, thus enlarging the conditions of risk.

Beside structural and social factors, staff information and training also play a decisive role, bearing in mind that a significant proportion of the staff employed are seasonal, temporary, and self-employed workers, with the latter too often willing to accept situations of risk due to underestimation or other reasons. Health and safety are a fundamental requirement of a sustainable farming business and should be regarded as an essential part of farm business management.

In this framework, the Special Issue on "Worker Safety in Agricultural Systems" has contributed to the collection of information, case studies, and proposals of improvement, useful for enhancing the safety conditions of agricultural and agro-industrial workers.

2. Main Aspects Involved in Worker Safety in Agriculture

As any survey carried out on this topic shows, workers of agricultural and agro-industrial sectors remain among the most exposed to the risk of accidents and the causes are varied and difficult to investigate and to interconnect. Farm workers operate with potentially dangerous machinery, vehicles, chemicals, and livestock and work at height or near pits and silos. They are exposed to the effects of bad weather, noise, and dust. Agricultural work can also be physically demanding and the repetitive nature of the work causes a range of health problems [1].

Some of these aspects have been treated by the authors that contributed to this Special Issue (SI) on Worker Safety in Agricultural Systems, presenting six articles covering ergonomics and musculoskeletal risks, operator dermal exposure during pesticide application, vibrations transmitted to the hand–arm system by portable harvesters, and the efficacy of hearing-protection devices for workers.

The first article, authored by Olowogbon et al., presents a study on the prevalence and exposure to ergonomic risk factors among Nigerian cassava farmers [2]. Cross-sectional data were collected by administering a questionnaire to the farmers and they were analyzed by using descriptive statistics and binary regression. The paper provides

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an exhaustive description of the study area and setting, the questionnaire, and the statistical method adopted, as well as the results of the survey. Optimal Design free software [3] was used for estimating the study sample size, while the standardized semi-structured questionnaire was developed by the authors themselves and validated before being administered. The authors found that shoulder pain, back pain, and neck pain were prominent ergonomic injuries among crop farmers due to the nature of work in farm workplaces, which involves repetitive bending, placement of heavy sprayers on the back, and engaging the back in pulling cassava tubers at harvest. Furthermore, they found that previous agricultural health training on the safe use of farm chemicals can be a protective factor against ergonomic risks.

Ergonomic risk factors were also investigated in the article authored by Kee [4]. The author analyzed, by means of a questionnaire survey, disorders through lifting, carrying heavy loads, and sustained or repeated full body bending in a whole peach farming cycle of a South Korean organization. The study was based on a participatory approach, with an ergonomist, farmers, and the Rural Development Agency having parts in it. The data for the ergonomic analysis were collected through discussions with volunteer participants and helped to identify ergonomic interventions to mitigate risk factors in a farming organization. Musculoskeletal loadings before and after ergonomic interventions were assessed through the RULA, Rapid Upper-Limb Assessment [5]. The RULA scores were significantly reduced after the introduction of the proposed ergonomic intervention and the author retains that the procedures and results adopted in the study can be applied to other types of crop farming activities and in industries.

The paper authored by Estrada-Muñoz et al. evaluated the musculoskeletal risks for coffee farm workers in Honduras [6]. It first identified risk factors and musculoskeletal lesions in farm workers, then it described the study in terms of its participants, instruments, procedure, and results. The Quick Exposure Checklist (QEC) method [7] was applied for assessing biomechanical risk factors. It is concluded that, in all the coffee fruit harvesting processes, the people who work in these jobs are exposed to ergonomic risks. Furthermore, they demonstrate that, in future research, it could be interesting to include the evaluation of other risk factors, such as environmental, organizational, and psychosocial, and to address aspects associated with safety in the workplace and social protection for families. On the other hand, it would be interesting to study the incorporation of exoskeleton systems as a viable alternative to help operators and harvesters in agricultural tasks, such as in the coffee industry, since these portable devices help reduce physical demands, avoiding related musculoskeletal injuries with work.

The fourth article in the SI, authored by Ammar et al., deals with the proper usage of hearing-protection devices (HPD) among noise-exposed mill workers in Malaysia [8]. It evaluated the efficacy of a targeted intervention method to improve the use of HPD between agro-industrial workers. The paper provides a full description of the study design that was implemented on two worker groups, one of which was the control one. The research was carried out by administering questionnaires before and after a training module was allocated to the intervention group. With the study, the authors found the efficacy of a targeted intervention method in improving the use of HPD among noise-exposed workers. In addition, they demonstrated that implementing a well-designed training method is practicable without the need for extensive resources and that better training on hearing protection can lead to improved compliance with HPD usage among workers, thereby reducing the health impact of workplace noise hazards.

The article authored by Cerruto and Manetto deals with the risks to the hand–arm system of worker exposure to vibration during olive harvesting when using portable and self-propelled vibrating machines [9], which are widely used where full mechanization is not possible due to structural conditions such as low tree density, old trees, irregular spacing, and terraced fields. In this study, several models of electrical portable harvesters were tested under both idling and load conditions; the machines differed between each other in harvester kinematics, rod diameters, and materials. The hand-held harvester

configurations, test conditions, acceleration acquisition system, signal analysis, and data processing were well described and the vibration values transmitted to the hand–arm system in correspondence with the hand positions along the rod of the machines were reported and discussed. The authors found that, using the machinery for 4 h a day, the result is a level of daily vibration exposure much higher than the daily exposure limit stated by the European Directive 2002/44/EC. With the same harvester head, the reduction in vibration may be achieved by using carbon-fiber rods rather than aluminum ones or by increasing the rod diameter. The most significant reduction is achievable by designing harvester heads whose kinematics inherently incorporate oscillation compensation. However, the results require the assessment of risk under real working conditions: in fact, different kinematics may imply different behavior between idling and load conditions.

The last paper in the SI, authored by Tsakirakis et al., investigates dermal exposure and data transfer for operators involved in pesticide applications in Greek tomato greenhouses [10], considering also the contribution due the re-entry in greenhouses for conducting a sequential hand-held application. An exhaustive description of study design, field trials, laboratory phase, and quantitative risk assessment were provided and the results were widely discussed. The exposure measurements were based on the principles of the whole-body dosimetry (WBD) method, which evaluates an individual's outer and inner clothing to measure dermal exposure. The low values of the pesticide amount penetrating the coverall (actual dermal exposure) in all cases highlight and confirm the need for the use of appropriate personal protective equipment (PPE) for operator safety.

3. Future Perspectives on Worker Safety in Agriculture

Pesticide-related risks, musculoskeletal disorders, zoonoses, skin cancer, stress, and psychosocial issues are all major emerging and continuing risks in the agricultural sector, which either have not been adequately managed or have been underestimated owing to the lack of accurate data over the years. Future trends will include other potential risks, namely those linked to technology development in the sector and resulting from climate change.

Every further study on worker health safety in agriculture will support farmers and policy makers in developing strategies, regulations, and support measures.

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