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Analysis of Reports on the Occupational Health and Safety in The Agricultural Industry: A bibliometrix-Aided Approach

Okan ÖZBAKIR[1*]

Highlights:

- Occupational health and safety in agriculture has increased after 1990.
- Ergonomic hazards are increasing in agricultural industry
- The rate of cooperation between countries quite low

Keywords:

- Bibliometrics
- Occupational Risk
- Thematic map
- Co-occurrence networks

ABSTRACT:

Agricultural activities are fundamental to societies, including the planting, growing, harvesting and processing of agricultural crops. However, there are a large number of occupational risks that can arise during the course of agricultural activities. These risks could result in serious injury or even death. This requires introducing and providing the relevant bodies and workers with knowledge, perception and awareness of the risk. The present study assessed the available reports on occupational health and safety using a bibliometric analysis and dimension reduction approach. Briefly, the reports were extracted from SCOPUS database. We identified 943 relevant and available peer-reviewed publications from the Scopus database. These were published between 1956 and 2022. The retrieved documents were analysed with the R-studio based software Bibliometrix. For the analysis, co-occurrences of networks, thematic maps and trending topics were analyzed. The results of the present study show that the time span of the documents ranges from 1956 to 2022 and these documents, including journals, books, book chapters and conference papers, were disseminated in 313 different sources. The estimated annual growth rate of these documents is 6.35%. Even the first paper dates back to the 1950s, the average age of the documents are 10.7. Considering the spatial distribution of the documents, USA topped at the list and was followed by Australia, Brazil, Italy, Canada, UK, and China. It is interesting to note that 'confined spaces' were found to be the trending topic according to the trend topic analysis of the keywords. Also, after the basic keywords (occupational health and safety and agriculture) of the study, ergonomics was the core keyword of the relevant analysis. Critically, the level of co-operation between countries was very low, with a rate of 0.025-0.207 for co-operation between countries (MCPs). For Turkey, the MCP was found to be 0.000. According to the thematic map, the motor theme is composed of two major clusters. One relates to food safety, risk analysis, knowledge and awareness and hygiene. To the best of our knowledge, this is the first study of its kind to identify the key issues in occupational health and safety in the agricultural industry. Therefore, the study has potential to contribute to the field.

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INTRODUCTION

In the context of occupational safety and health, the term "agriculture" is generally used in a broad sense to include all directly related activities such as planting, growing, harvesting and processing of agricultural products, animal husbandry, aquaculture and forestry, regardless of the size of the operation. However, some sources do not consider subsistence farming to be part of agriculture. For example, subsistence farming is not included in agriculture by the International Labour Organisation (ILO). However, the International Social Security Association (ISSA) includes almost all agricultural activities within the scope of agriculture (Asher, 2009). Agriculture is one of the most dangerous industries in the world, with some 1.3 billion workers employed in agricultural production, or half the world's workforce, according to the ILO.The majority of agricultural workers are employed as wage labourers in developing countries.

According to the World Health Organization (WHO), around 170,000 people die or are seriously injured each year as a result of accidents in the agricultural sector (Vetrivel and Manigandan, 2013). This figure indicates that the agricultural sector is more exposed to risks compared to other industries (Ovchinnikova et al., 2016). Therefore, taking measures to keep agricultural workers healthy and protected is extremely important (McLaughlin et al., 2014). In addition to agriculture, work-related fatalities are higher than in other sectors in forestry, fishing and hunting. In 2008, 661 occupational fatalities were reported on US farms. Due to the variability of working conditions, occupational risks in these sectors are very different (Pyykkönen and Aherin, 2012). A major factor that increases the risk of occupational accidents is the variable working conditions in agriculture. For example, work is carried out in the open air and workers are exposed to climatic conditions. The work is seasonal in nature, and certain tasks become urgent during certain periods. There are significant differences in work positions and job durations. Workers are exposed to bites, infections, allergies and other health problems from contact with animals and plants. Workers come into contact with chemical and biological products. Different types of machinery are used. Work is usually carried out alone, away from other businesses, and emergency services may be delayed due to the distance between work areas. The risk of farming-related accidents for children is also increased by the fact that the worker's home is part of the farm population. A high proportion of young and older people in the workforce also increases the risk factor (Yalcın, et al., 2016).

The widespread use of pesticides worldwide to increase crop yields and control pests has increased the negative impact of these substances on human health and the environment. Therefore, from an occupational health and safety perspective, the use of pesticides is an issue that requires special attention.

Despite the banning of some products due to their acute and chronic effects, pesticide applicators often fail to recognize the significant toxicological profile of modern pesticides, resulting in a global health burden. Most of the existing research on the knowledge, attitudes, and practices of pesticide applicators focuses on workers in high or relatively poor socio-economic environments. Studies on modern pesticide practices are therefore more common among low-income workers. It should be noted that two-thirds of the 350,000 pesticide-related deaths that occur each year occur in developing countries, although they are also significant in high-income countries. In Italy, between 2005 and 2011, approximately 2,500 cases of acute pesticide poisoning were identified as occupational incidents, representing 5% of all poisonings (Ricco et al., 2018). In addition to facing a range of hazards such as tractor accidents, exposure to chemicals, and injuries from animal bites and farm equipment, agricultural workers are also exposed to various occupational disease risks. Many chemicals used in agriculture can cause respiratory and skin diseases in addition to those caused by pesticides. Musculoskeletal problems

can result from heavy physical work related to the characteristics of the work (Durczak and Jurek, 2017). Therefore, measures such as the use of appropriate equipment, providing suitable training to workers, ensuring the proper use of harmful substances, appropriate working hours and rest periods must be taken to protect the health and safety of agricultural workers. With the help of these measures, employees can be more efficient in their work and at the same time be in good health.

Due to its multidisciplinary structure, it is expected that the number of reports published on agriculture and occupational health and safety will be high. In general, these reports are published as review articles that are recognized in each field of work. These review articles serve as a source of inspiration for researchers, suggesting new avenues for future research or highlighting gaps in the literature. They offer the most up-to-date knowledge on the subject and provide information on the latest technologies. Bibliometric analyses have recently become popular in order to reduce the dimension of the reports disseminated (Rejeb et al., 2022; Malanski et al., 2019; Luo et al., 2020). There are a number of tools available for bibliometric analysis. However, the use of several tools is recommended, as each tool has its advantages and disadvantages (Choudhri et al., 2015; Karanatsiou et al., 2017, Lin, 2020; Markscheffel and Schröter, 2021). CiteSpace, VOSviewer and R-bibliometrix are the most commonly used software packages for bibliometric and visualized analysis. The basic information contained in the included publications could be extracted and retrieved using these tools. Information includes countries/regions, institutions, authors, journals, keywords and citations. These programs can identify the authors, institutions, and countries/regions that contribute the most from collaboration networks and select relevant publications.

Bibliometric analysis is a method based on the use of statistics and vizualisation tools. It aims to show how information works and how it evolves in a particular field (Devos and Menard, 2019; Ma et al., 2021). This method makes it possible to objectively identify research trends and emerging topics, evaluate the performance of authors and organisations, and map international collaborations and geographical distribution networks (Ou et al., 2022).

The basis of the study is to find answers to questions such as changes in studies related to agriculture and occupational health and safety over time and spatial distribution, popular terms and topics, the relationship between the country's agricultural development and effectiveness and the number of studies and whether studies conducted in different countries differ in terms of the subject.

• How does the temporal and spatial distribution of studies related to agriculture and occupational health and safety change? Using bibliometric analyses, the present study adressed the issues such as when studies were carried out in agriculture and occupational health and safety, and in which geographical areas they were concentrated.

• What are the most popular terms and topics in agriculture and occupational safety and health? Within this framework, the most frequently used terms and topics were identified as a result of the analyses carried out using the Bibliometrix programme.

• Is there a relationship between the number of studies related to agriculture and occupational health and safety and the country's agricultural development and effectiveness? Analyses conducted on this issue revealed the relationship between the level of agricultural development of different countries and the number of studies carried out.

MATERIALS AND METHODS

Data source and search strategy

The SCOPUS database contains approximately 14.359 documents with a broad scope in the field of occupational health and safety. However, the search was limited to "occupational accident and occupational disease" category, particularly for studies on topics such as work accidents and occupational diseases. Accordingly, 943 documents were recorded after the following criteria (TITLE-ABS-KEY (occupational AND health AND safety) AND (LIMIT-TO (SUBJAREA,"AGRI")) (on May 26, 2023). Subsequently, the relevant documents were downloaded in BibTex format and were then analysed using R studio-based Bibliometrix program (Fig 1).

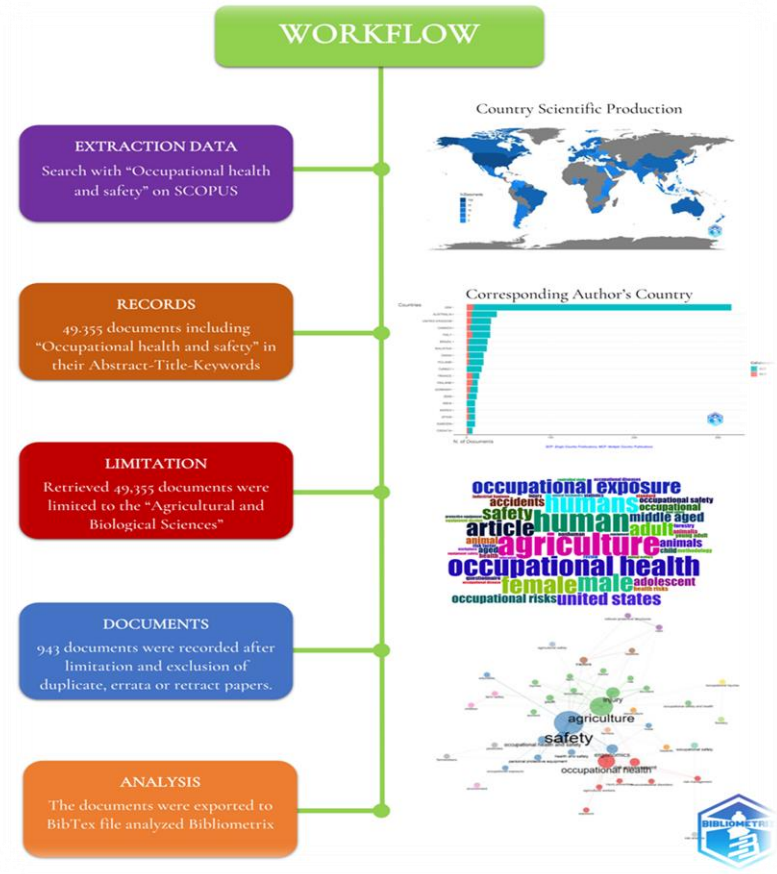

Figure 1. Work flow of the study.

RESULTS AND DISCUSSION

Descriptive findings of the 943 documents were collectively presented in Table 1, indicating that the time-span of the documents range from 1956 to 2022. These papers have been disseminated in 313 different sources. These include journals, books, book chapters and conference papers. These are estimated to be growing at an annual rate of 6.35%. The average age of the documents is 10.7 years, with the first document dating back to the 1950s. Such a low age suggests that occupational safety and health reports related to the agricultural sector are very recent. Time trending of the documents (Fig 1) clearly indicates that the majority of the documents has been reported after 1990s and peaked in the late decade. The number of citations per document was found to be 12.83. Of the 943 documents, 680 were published as original research papers and the rest were chapters, books and conference proceedings. Overall, those documents were 2827 co-authored documents (Table 1). For the following sections of the

current study, those documents were subjected to a series of analysis for the sources and their impacts, productivity of countries, co-occurrence of keywords, thematic maps, word clouds, conceptual structure maps, and topic dendrogram. The study was designed as a comprehensive approach to reveal the core theme of the documents considered for analysis in agriculture and occupational safety.

Table 1. Descriptive findings and details of the retrieved documents

Description	Results
Time-span	1956-2022
Sources (journals, books, etc)	326
Documents	943
Annual growth rate	% 6,55
Document average age	11,6
Average citation per doc	13,42
Keyword plus	5870
Author keywords	2511
Authors	2865
Authors of single-authored documents	175
Articles	686
Book	5
Book chapter	28
Conference paper	75
Review	98
Editorial	24
Erratum	2
Letter	5
Note	11
Short survey	9

Annual scientific production of documents

Concerning the annual production of the documents (Fig 2), it has been observed that the first examples of publications in the relevant field date back to the 1950s, but a significant trend started in the 1990s and continued with increasing momentum. The increased interest and number of documents might be attributed to the factors, viz. serious diseases in the health sector (Kanvermez and Sumer, 2021), increased work accidents (Bakırcı, 2011), and laws and regulations introduced in the field of occupational health and safety (Özkan et al., 2019). Additionally, technological developments and easier access to info rmation can also be considered among the factors supporting the increase in the number of publications in this field (Gugercin and Baytorun, 2018).

Most Relevant Sources

As mentioned in the previous section (Table 1), the relevant publications are included in 313 different sources. These journals have been categorized in accordance with Bradford's law on the basis of their importance (Figure 3). This categorization is related to relevance. As seen in Figure 4, the top three journals are Journal of Agricultural Safety and Health (N=187), Journal of Loss Prevention in the Process Industries (N=55), and Annals of Agricultural and Environmental Medicine (N=28).

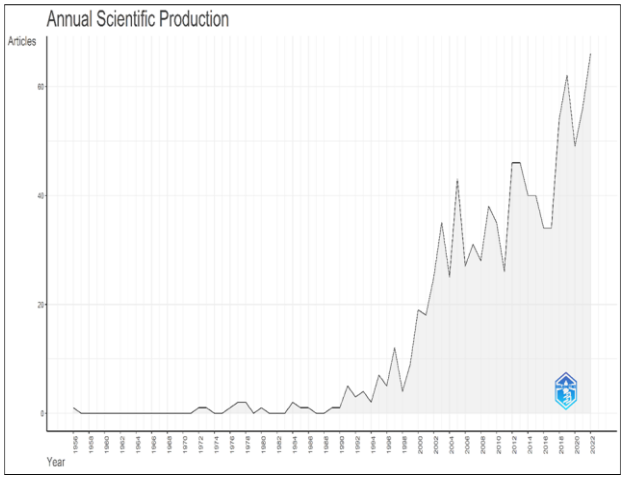

Figure 2. Annual scientific production of documents

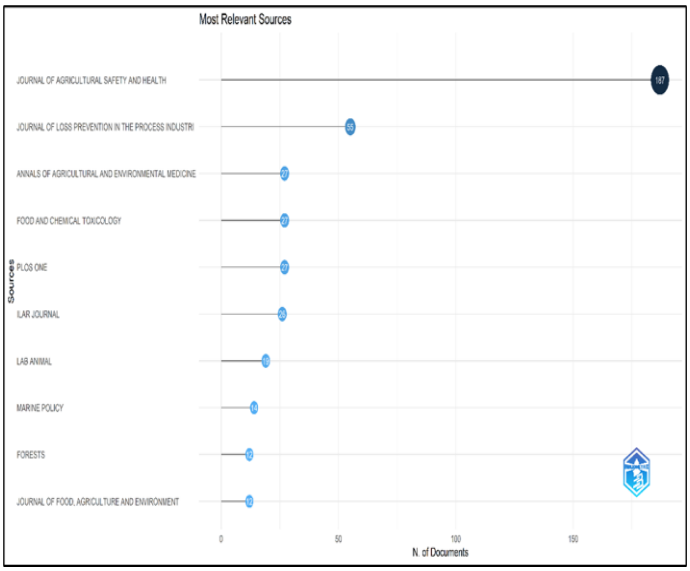

Figure 3. Most relevant sources for publications

Country Scientific Production and affiliations

Considering the number of documents, United States topped at the list (N=759) and was followed by Australia (N=90), Brazil (N=73), Italy (N=69), Canada (N=65), UK (N=65), China (N=64), Malaysia (N=62), France (N=61), and Poland (N=57) (Fig 4). Of the most productive institutions of those countries, National Institute for Occupational Safety and Health (N=43), the University of Kentucky (N=25), and Purdue University (N=24) ranked in the top three institutions (Fig 5). Being consistent with the time-trends of the disseminated documents (Fig 2), the number of publications from these institutions has shown a significant increase after the 1990s (Fig 6). Of the countries we have analysed here, the United States is one of the leading countries, as it has a significant share of employment in the agricultural sector compared to the other countries. As of 2021, approximately 2,188,200 million people work in this sector. While the agricultural industry is inherently fraught with potential hazards and risks, workplace accidents are common in the US because the majority of workers are immigrants who often lack sufficient education about workers' rights and safety, or access to legal resources to protect their rights. This situation can make them more vulnerable to accidents at work (Pawlak et al., 2021). The USA is followed by Australia in terms of the number of documents. According to report of foreign economic relations board of Turkey (2014), approximately 3% of all work-related accidents occurred in the agricultural sector in Australia between 2019 and 2020. However, as the likelihood of fatal accidents in agriculture is higher than in other sectors, this rate is still concerning. In the countries topped at the list of documents, approximately 11% of all work-related accidents in Brazil occur in the agricultural sector. This rate is considerably high and indicates that those who work in the agricultural industry are at greater risk. Such a high rate of accidents in Brazil has been attributed to the exposure to toxic chemicals, tractor accidents, animal attacks, falls, and the use of cutting tools (Cavalli et al., 2020).

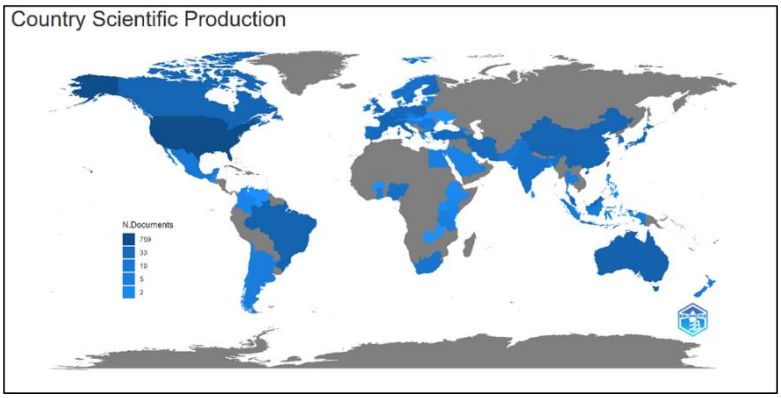

Figure 4. Country scientific production

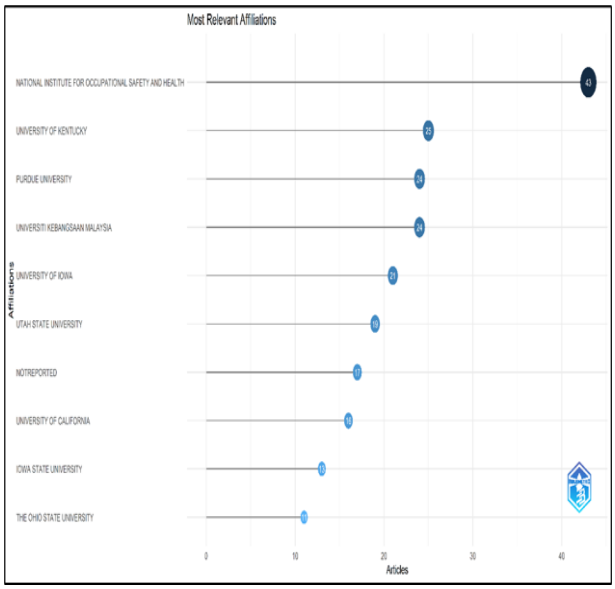

Figure 5. Most relevant affiliations

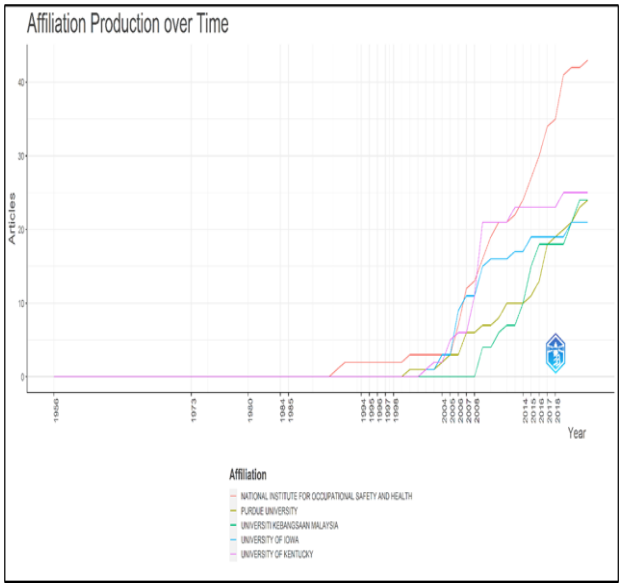

Figure 6. Affiliations' production over time

Corresponding author (Intra-country (SCP) and inter-country (MCP) collaboration)

Figure 7 shows the authors' countries, and the potential for each country to collaborate, either individually or collectively. For this purpose, we assessed the Intracountry (SCP) and inter-country (MCP) collaboration of each country for the period of 1956-2022. The figure 7 depicts the first twenty countries. Accordingly, USA ranks at the first by its high number of documents but the number of collaborations was relatively very low (MCP ratio: 0.025). However, the same low ratio was also recorded for Australia (MCP ratio: 0.114), United Kingdom (MCP ratio: 0.167) and Canada (MCP ratio: 0.207). Concerning our country (Türkiye-Turkey), MCP ratio was found to be 0.000 (SCP: 18; MCP:0.00). MCP ratio might not reflect the collaboration in fields and topics since certain topics might be interest of the locals but might not be interest of our regions or countries. For each topic, collaboration may not be possible. For that reason, the low MCP ratio may be explained with the locality and specificity. Considering the reports from Turkey, Australia and the United States are among the most active countries in occupational health and safety. According to the ILO, the rate of fatal accidents at work per 100,000 workers in agriculture, forestry and fishing is 33.52 in Australia and 57.70 in the United States, while it is around 2.00 in our country. However, the number of accidents in Turkey is quite high. The number of studies that were carried out in Turkey and are included in the Scopus data is 11, as also can be seen from Figure 7. Agricultural workers make up a large part of Turkey's economically active population. However, they do not have healthy and safe working conditions (Oktay et all., 2018). In the agricultural sector, it is quite difficult to maintain standardisation in occupational health and safety. Compared to other sectors, it has different working areas, duration and conditions (Bahşi and Kendi, 2019). In occupational accidents in this sector, injuries and cuts are mostly observed in the hands and feet of workers (Gümüş et al., 2020). There is a need to raise awareness of occupational health and safety culture among employees (İnanç and Ağyürek, 2019), increase awareness through education and keep risk perception fresh (Şen and Güngör, 2019).

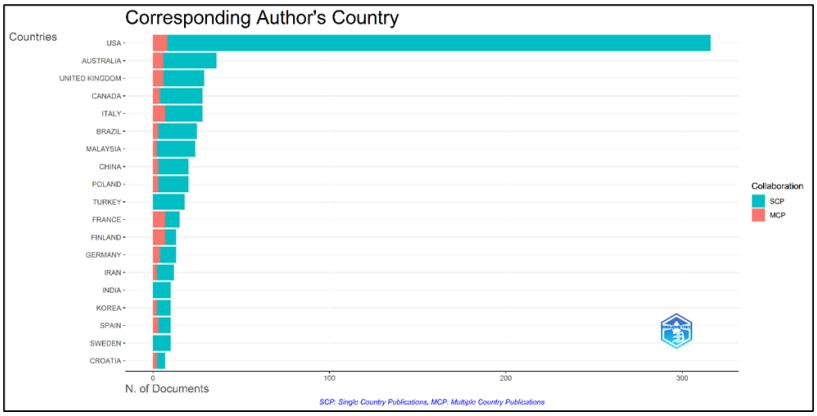

Figure 7. Countries conducting studies in agriculture and occupational health and safety (Intra-country (SCP) and inter-country (MCP) collaborations)

Word cloud analysis of the retrieved documents

We have further extended our insights towards to the content of the documents considered for analysis. In this context, we constructed three Word Clouds using Author Keywords, Keyword Plus and Titles (Fig 8-10). As well-reported by Zhang et al (2016); author keywords, the traditional ones, are provided by the authors of the relevant reports, whereas Keywords Plus are retrieved/extracted from the

titles of cited references by Thomson Reuters. In addition, Title is of the critical indicators in reaching to the relevant audiences. For each analysis, the most frequently used 50 words were used for the construction of Word Cloud (Kulak et al., 2019; Kulak and Kilic, 2020). Considering the words, safety (N=81), agriculture (N=60), occupational health (N=45), occupational health and safety (N=30), ergonomics (N=29), injury (N=26), risk assessment (N=26) etc, refer to Fig 8. As deduced from the Fig 8, "ergonomics" has been core-keyword of the relevant analysis after basic keywords (occupational health and safety and agriculture) of the study. Ergonomics is of the critical issues to be considered for workers in agricultural industry since workers in this field are particularly exposed to ergonomic risks such as musculoskeletal disorders. In this regard, a plethora of documents clearly revealed that farmers and farm laborers experience high rates of musculoskeletal disorders such as back pain, shoulder pain, and upper extremity discomfort. These types of conditions are especially prevalent among young farmers and migrant workers depending on the type of farm task (Davis and Kotowski, 2007). As expected, For the reasons mentioned above, ergonomics has been one of the priority topics in the relevant reports and in the following areas.

Figure 8. WordCloud of author's keyword (number of words: 50)

Keyword Plus words were as agriculture (N = 400), human (N = 387), occupational health (N=348), humans (N=324), male (N=311), female (N=302), occupational exposure (N=252) etc, refer to Fig 9. Regarding title, safety (N=256), health (N=190), occupational (N=155), risk (N=71), workers (N=68), exposure (N=67), agricultural (N=66), farm (N=49) etc. are of the most pronounced words in the title section, refer to Fig 10.

As also seen in the country analysis (Fig 4-7), the United States is the country with the highest number of publications. Due to its frequent use as a keyword, in the word cloud analysis, it appears as the USA (United States). In terms of agricultural occupational health and safety, both female and male are reported with similar frequencies. Additionally, distinctions were made between child, adolescent, and adult. These results demonstrate that the concept of occupational health and safety can affect all members of society. The potential negative effects of chemical pesticides (herbicides, insecticides, and conventional fertilizers) used in agricultural fields on human health are determined experimentally in vitro or in vivo (animals). Therefore, it is an expected outcome to see terms such as animals and experimental design (Forget,1993).

Figure 9. WordCloud of Keyword Plus (number of words: 50)

Figure 10. WordCloud of Title (number of words: 50)

Trending topics

Depending on the time and place, the subjects of scientific studies can vary considerably. As seen in Figure 8, there have been significant changes over time in the most popular occupational safety and health topics in agriculture. According to Keyword Plus analysis, mercury use, noise pollution, and fishing activities were of the most pronounced topics (Fig 11). On the other hand, ‘confined space’, ‘occupational safety and health, ‘workers‘, ‘aquaculture‘, ‘risk management‘, ‘personal protective equipment’ are of the trending topic for the authors’ keywords. Being very different from trend topics of Keyword Plus, we noted “confined space” words in Keyword analysis (Fig 12). ‘Agricultural confined space’ refers to grain bins, silos, and fertilizer storage facilities which Injuries and deaths frequently occur in. In this regard, Riedel and Field (2011) reported 1,255 incidents in confined spaces in the agricultural sector in the United States between 1964 and 2010. Of these incidents, 71% occurred in grain storage facilities, 10.5% in fertilizer storage structures, 9.2% in agricultural transportation vehicles, and 5.7% in feed storage structures (Riedel and Field, 2011). In this case, appropriate engineering standards and practices should be developed to increase the safety of agricultural facilities and equipment. There is a need for standardization of working practices in common ‘agricultural confined spaces’ such as grain stores, fertilizer stores and others. This includes providing instructions and warnings, taking measures to prevent falls, maintaining access points, designing components to minimize the need for service or repair access, providing locking/tagging facilities and finding suitable anchorage points for ‘confined spaces’.

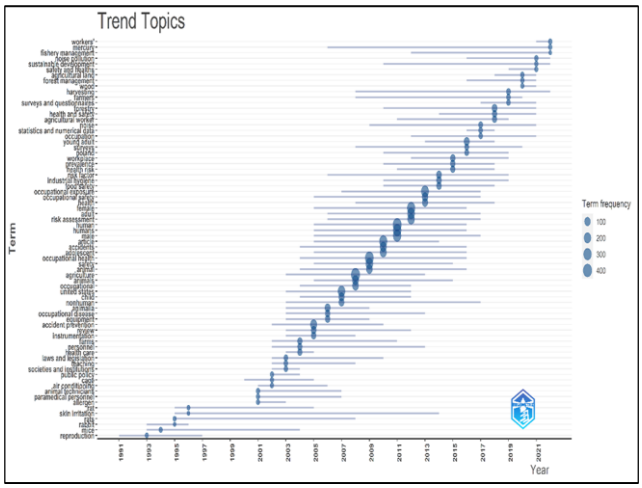

Figure 11. Trend topics according to the Keyword Plus

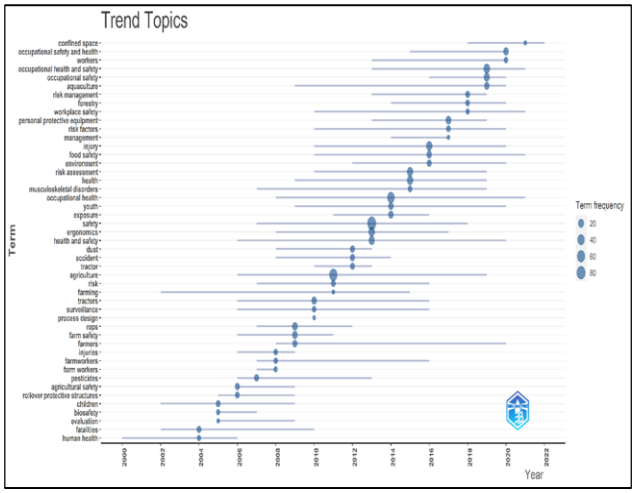

Figure 12. Trend topics according to the Authors' Keywords

Co-occurrence Network

In order to understand the relationship between the terms used in the reports, the co-occurrence of words is the most important analysis. For example, a high level of co-occurrence between words reflects a high level of relationships between them. We hereby constructed co-occurrence networks of authors' keywords and Keyword Plus (Fig 13-14). Accordingly, Fig 13 depicts very narrow clusters. Of the major clusters, the green one includes the risk-linked words, viz. injury, tractor, risk, accident etc. other major cluster (blue) contains the protection-related words such as equipment, safety. However, the co-occurrence network of Keyword Plus was more organized, in comparison to Fig 13, Figure 14 includes two major networks. Accordingly, three different clusters emerged from the relevant publications included in the analysis. The first cluster (green) includes topics related to human and occupational health and safety under the groups of males, female, and adult workers in the agricultural sector. The second cluster (red) consists of terms related to risk assessment, prevention, and safety in livestock farming. The third cluster (blue) focuses on risks related to the work environment in general (Fig 14).

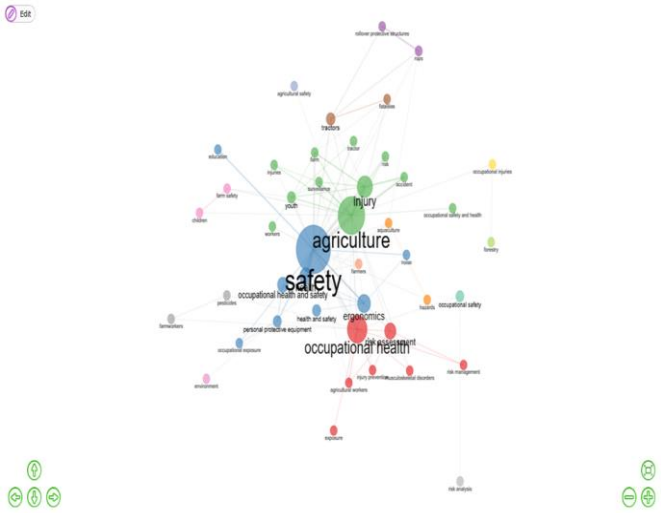

Figure 13. Co-occurrence Network of authors' keywords

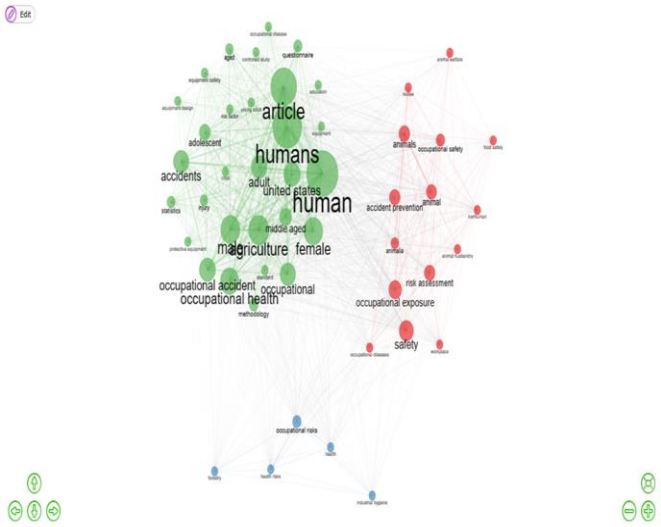

Figure 14. Co-occurrence Network of Keyword Plus

Thematic map of hotspots

Thematic mapping, which has become popular in recent years, is important for identifying main and general topics in a field. Thematic maps consist of four quadrants. The motor theme (1st quadrant) consists of the most relevant and evolving terms related to the analysed topic. The niche theme (2nd quadrant) consists of terms that are not directly related to the topic. The emerging or decline theme (3rd quadrant) comprises terms with low development or marginal relevance to the topic. The last quadrant (base theme) consists of general terms rather than specific terms unique to the analysed topic. Therefore, the same terms can be encountered in other fields as well. As the case of co-occurrence of networks, we also constructed thematic maps for authors' keywords (Fig 15). The Figure 15 displays the thematic map of author keywords. The first quadrant (motor themes) is composed of two major clusters. One is related to the food safety, risk analysis, knowledge and perception and occupational hygiene. The second major cluster is associated with the occupational injuries, farmworkers, pesticides and questionnaire. Considering all clusters considered here, we should note that all clusters are either directly or indirectly intertwined to each other. For instance, questionnaires, in general, estimate the knowledge, perception,

attitude and awareness of the human beings with respect to a certain topic. The high level of knowledge and perception is generally manifested as reduced frequency/incidence of hazard, risk or injury, in the case of occupational health and safety. As observed in motor theme, COVID-19 and knowledge/perception are linked each other for occupational hygiene. Being very similar to this approach, we have recently carried out a study with 320 female employees in Igdir during the Covid-19 pandemic, reporting that female employees with higher education levels and who participated in continuous education programs (associate degree, undergraduate, graduate, and on-the-job training) had a higher perception level regarding Covid-19 and occupational health and safety issues, especially in workplaces where they were employed. A participation rate of 67% was achieved in the implementation of measures, and it was determined that there is an important correlation between this situation and the education level (Özbakır and Bakkıran, 2023). The second quadrant (niche theme) was linked to the irrelevant topics such as mining, explosion and particle size. Interestingly, confined space has been included into the category of niche themes. However, the Figure 12 referring to the trending topics clearly depicts and tops the "confined space" at the list of trending topics. We should utter that explosion or particle size terms are directly/indirectly associated with "confined space". The reports concerned with "confined space" are relatively low, in comparison to the other aforementioned topics but it has gained a significant attention in the recent decade. Corresponding to the intensive works or time-span, the categorization of the topics of the quadrants might change (well and critically reviewed by Di Cosmo et al., 2021). In the third quadrant, the words including "occupational exposure, human health, workplace safety, fire and human factors" exhibit a trend towards high centrality and density. Those might suggest that the relevant topics might move to the motor theme and basic themes. Interestingly, we have noted "animal welfare" in the 3rd quadrant. As well-depicted from the analysis of word cloud topic (Fig 8-10), trend topics (Fig 11-12) and co-occurrences of networks topic (Fig 13-14) of keywords or keyword plus, "human/human beings" has been the hotspots or core-content of occupational health and safety. In this approach, the effects of chemicals on "human" are the main interest of this subject. However, animals are under investigation but not very common as research interest. The present observation does not reflect that animal and their welfare are not the out of scopes of this subject. In the future, this topic might emerge and then become the motor theme of this subject. The last quadrant (Basic Theme) identifies the general topics which are transversal/ common to the different research areas, including the words, viz. risk assessment, safety, health hazards.

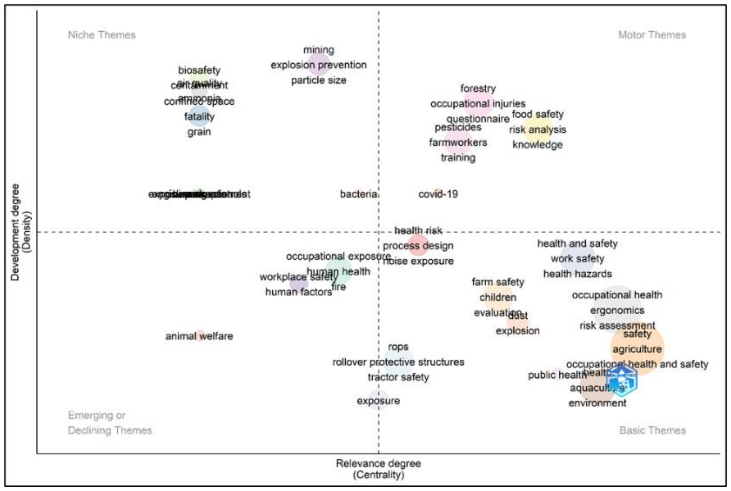

Figure 15. Thematic map of keywords

CONCLUSION

This study represents the first bibliometric analysis of worldwide research patterns in occupational health and safety within the agricultural industry, spanning from 1956 to 2022. Among the most significant results of this study are:

Between 1956 and 2022, 943 scientific documents were found in the area of occupational health and safety in the agricultural sector. Time-trend analysis has shown a consistent change in annual growth of documents; however, the annual publication of articles began to show a significant increase after 1990.

(1) The United States was the leading country in the publication of these documents, followed by Australia, the UK, Canada, and Italy

(2) The Journal of Agricultural Safety and Health has the highest number of publications with 187 articles. Almost a third of all publications were published in four journals: the Journal of Agricultural Safety and Health, the Journal of Loss Prevention in the Process Industry, the Annals of Agricultural and Environmental Medicine and Food and Chemical Toxicology. These journals are considered to be the main journals in the field of occupational health and safety in agriculture.

(3) In addition to the 'ergonomic risks' that need to be considered in the agricultural sector, it has also been observed that 'confined space' activities have increased in importance.

(4) The level of collaboration between countries is quite low in the analysis of studies on health and safety in the agricultural sector. The United States, Australia and the United Kingdom also have very low rates, while in Turkey the rate is zero.

Up to our best knowledge and survey, this is the first study regarding comprehensive and specific view of available research on occupational health and safety in agriculture industry. For this reason, the study has the potential to contribute to the relevant field. However, the present study has some limitations. For instance, (I) The reports were only extracted data from SCOPUS and so documents in non-indexed plant journals were not included for the analysis, (II) The search was then restricted for publications that contain the words "occupational health and safety" in the title-abstract-keywords, (III) Along with the study, some publications might not contain occupational health and safety in in the title-abstract-keywords, it is therefore possible that not all occupational safety and health publications in the agricultural sector have been reported and analysed.

Conflict of Interest

The author declares that she has no conflict of interest.

REFERENCES

Asher, M. (2009). Extending social security coverage in Asia-Pacific: A review of good practices and lessons learnt. International social security association working paper No, 6.

Bahşi, N., & Kendi, O. (2019). Farmers' approaches on occupational health and safety: the case of city of Osmaniye and Konya, Turkey. Ciência Rural, 49.

Bakırcı, N. (2011). Tarımda Çalışanların Sağlığı ve Güvenliği. TTB Mesleki Sağlık ve Güvenlik Dergisi, 11(39), 7-13.

Cavalli, L. S., Marques, F. B., & Watterson, A. (2020). A critical overview of work-related injury and illness in aquaculture workers from Brazil. Reviews in Aquaculture, 12(2), 1157-1164.

Choudhri, A. F., Siddiqui, A., Khan, N. R., & Cohen, H. L. (2015). Understanding bibliometric parameters and analysis. Radiographics, 35(3), 736-746.

Davis, K. G., & Kotowski, S. E. (2007). Understanding the ergonomic risk for musculoskeletal disorders in the United States agricultural sector. American journal of industrial medicine, 50(7), 501-511.

Devos, P., & Menard, J. (2019). Bibliometric analysis of research relating to hypertension reported over the period 1997–2016. Journal of hypertension, 37(11), 2116.

Di Cosmo, A., Pinelli, C., Scandurra, A., Aria, M., & D'Aniello, B. (2021). Research trends in octopus biological studies. Animals, 11(6), 1808.

Durczak, K., & Jurek, P. (2017). Safety and ergonomics as important criteria of quality of agricultural machinery. Journal of Research and Applications in Agricultural Engineering, 62(2), 27-31.

Forget, G. (1993). Balancing the need for pesticides with the risk to human health. In Impact of pesticide use on health in developing countries: proceedings of a symposium held in Ottawa, Canada, 17-20 Sept. 1990. IDRC, Ottawa, ON, CA.

Güğercin, Ö., & Baytorun, A. N. (2018). Tarımda İş Kazaları ve Gerekli Önlemler. Çukurova Tarım ve Gıda Bilimleri Dergisi, 33(2), 157-168.

Gümüş, S., Okan, S. Ü., & Hatay, T. Y. (2020). Analysis of work accidents in wood harvesting: a case study of the East Black Sea region. Forestist, 70(1), 1-7.

ILO (International Labour Organization) (2021): [https://www.ilo.org/shinyapps/bulkexplorer31/; Access date: July 14, 2023)

İnanç, S., & Ağyürek, C. (2019). Effects of occupational health and safety law on forestry employees.

Kanvermez, Ç., & Sümer, S. K. (2021). Türkiye'de Tarım Sektöründe Çalışanların İş Sağlığı ve Güvenliğinin Kanun ve İş Hukuku Kapsamında Değerlendirilmesi. Ankara Üniversitesi SBF Dergisi, 76(2), 575-596.

Karanatsiou, D., Li, Y., Arvanitou, E. M., Misirlis, N., & Wong, W. E. (2019). A bibliometric assessment of software engineering scholars and institutions (2010–2017). Journal of Systems and Software, 147, 246-261.

Kulak, M., & Kılıç, N. (2020, May). A bibliometric analysis: How important is salicylic in response to the salinity from NaCl?. In EGU General Assembly Conference Abstracts (p. 1302).

Kulak, M., Ozkan, A., & Bindak, R. (2019). A bibliometric analysis of the essential oil-bearing plants exposed to the water stress: How long way we have come and how much further?. Scientia horticulturae, 246, 418-436.

Lin, M., Chen, Y., & Chen, R. (2021). Bibliometric analysis on Pythagorean fuzzy sets during 2013–2020. International Journal of Intelligent Computing and Cybernetics, 14(2), 104-121.

Luo, J., Han, H., Jia, F., & Dong, H. (2020). Agricultural Co-operatives in the western world: A bibliometric analysis. Journal of Cleaner Production, 273, 122945.

Ma, D., Yang, B., Guan, B., Song, L., Liu, Q., Fan, Y., ... & Xu, H. (2021). A bibliometric analysis of pyroptosis from 2001 to 2021. Frontiers in immunology, 12, 731933.

Malanski, P. D., Schiavi, S., & Dedieu, B. (2019). Characteristics of "work in agriculture" scientific communities. A bibliometric review. Agronomy for Sustainable Development, 39, 1-16.

Markscheffel, B., & Schröter, F. (2021). Comparison of two science mapping tools based on software technical evaluation and bibliometric case studies. COLLNET Journal of Scientometrics and Information Management, 15(2), 365-396.

McLaughlin, J., Hennebry, J., & Haines, T. (2014). Paper versus practice: occupational health and safety protections and realities for temporary foreign agricultural workers in Ontario. Perspectives interdisciplinaires sur le travail et la santé, (16-2).

Okyay, R. A., Tanır, F., & Ağaoğlu, P. M. (2018). Occupational health and safety characteristics of agricultural workers in Adana, Turkey: a cross-sectional study. PeerJ, 6, e4952.

Ou, Z., Qiu, L., Rong, H., Li, B., Ren, S., Kuang, S., ... & Li, J. (2022). Bibliometric analysis of chimeric antigen receptor-based immunotherapy in cancers from 2001 to 2021. Frontiers in Immunology, 1333.

Ovchinnikova, E., Shkrabak, R., & Shkrabak, V. (2016). Current status and prospective aspects of labor safety in agriculture. Verun Deutsheringenieure Universitet Hohenheim lnstitute fur Agrartechnik.-Heft4. 01-02 Marz, 171.

Özbakır, O. & Bakkıran, H. (2023). Iğdır ilinde pandemi döneminde çalışan kadınların çalışma hayatında karşılaştıkları sorunlar. Doğal ve Beşeri Bilimler Açısından IĞDIR-II,173-196.

Özkan, A., Dilay, Y., & Mehmetbey, K. (2019). Tarım Kesiminde Meydana Gelen Bazı Kazaların İş Güvenliği Açısından Değerlendirilmesi. CİLT 3, 40.

Pawlak, K., Smutka, L., & Kotyza, P. (2021). Agricultural potential of the EU countries: how far are they from the USA?. Agriculture, 11(4), 282.

Pyykkönen, M., & Aherin, B. (2012). 53 Occupational Health and Safety in Agriculture.

Rejeb, A., Abdollahi, A., Rejeb, K., & Treiblmaier, H. (2022). Drones in agriculture: A review and bibliometric analysis. Computers and Electronics in Agriculture, 198, 107017.

Report of foreign economic relations board of Turkey, Deik, (2014).

Riccò, M., Vezzosi, L., & Gualerzi, G. (2018). Health and safety of pesticide applicators in a high income agricultural setting: a knowledge, attitude, practice, and toxicity study from North-Eastern Italy. Journal of preventive medicine and hygiene, 59(3), E200.

Riedel, S. M., & Field, W. E. (2013). Summation of the frequency, severity, and primary causative factors associated with injuries and fatalities involving confined spaces in agriculture. Journal of agricultural safety and health, 19(2), 83-100.

Şen, G., & Güngör, E. (2019). Local Perceptions of Forest Certification in State-Based Forest Enterprises. Small-scale Forestry, 18(1), 1-19.

Vetrivel, V., & Manigandan, R. (2013). An empirical study of agricultural labour in India. Journal of exclusive management science, 2(12), 1-6.

Yalçın, G. E., Yazıcı, E., Kara, F. Ö., İpekçioğlu, Ş., & Yalçın, M. (2016) Tarımda iş kazaları ve hastalıkları.

Zhang, J., Yu, Q., Zheng, F., Long, C., Lu, Z., Duan, Z. Comparing keywords plus of WOS and author keywords: A case study of patient adherence research. Journal of the Association for Information Science and Technology 2016, 67(4), 967–972.