Selcuk Journal of Agriculture and Food Sciences

https://dergipark.org.tr/tr/pub/selcukjafsci

Research Article

(2025) 39(2), 374-390 DOI: 10.15316/selcukjafsci.1627598 e-ISSN: 2458-8377 Selcuk J Agr Food Sci

Investigation of Medium-Scale Enterprises Manufacturing Agricultural Machinery in Konya Province in Terms of Occupational Health and Safety

Mine Çetinkaya[1], **Tamer Marakoğlu**[2,*]

[1]Selcuk University, Institute of Science, Department of Agricultural Machinery and Technologies Engineering, Konya, Türkiye

[2]Selçuk University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies Engineering, Konya, Türkiye

HIGHLIGHTS

- Five medium-sized factories were visited, and the Fine-Kinney Risk Analysis Method was applied to assess occupational hazards based on probability, severity, and exposure.
- Identified risks per factory were A (117), B (96), C (102), D (91), and E (104). All were assessed across 15 hazard categories and classified as "Hazardous," indicating significant occupational safety concerns.
- Enterprises' ability to foresee and manage risks enhances emergency preparedness, protects employee health and safety, and supports long-term sustainability and efficiency.

Abstract

The agricultural machinery manufacturing sector is an area where agriculture and integration develop together and combine with technology. Rapidly increasing industrialization and technological developments also increase the risks to the health and safety of employees. Occupational health and safety provide employees with the opportunity to work in a healthy and safe environment, while also enabling employees to work in a workplace free from dangers. In the study, the characteristics of the agricultural machinery manufacturing industry in Konya province were discussed. For this purpose, when the companies were evaluated according to their sizes, it was determined that approximately 32% of the 49 companies in the province were micro-scale companies, 42% were small-scale companies, and 22% were medium-scale companies. The main purpose of this study is to examine the agricultural machinery manufacturing enterprises in terms of occupational health and safety in Konya. Five medium-sized factories producing agricultural machinery were visited, and observations were made in the working environment. In this study, it is investigated that these enterprises, which are classified as "Dangerous Fines are analyzed by using the Fine-Kinney Risk Analysis Method, and measures are taken against risks. Factory A was classified according to 15 weld of danger and the total number of risks was 117, Factory B was classified according to 15 weld of danger and the total number of risks was 96, Factory C was classified according to 15 weld of danger and the total number of risks was 102, Factory D was classified according to 15 weld of danger and the total number of risks was 91, and Factory E was classified according to 15 weld of danger and the total number of risks was 104. Recognizing the risks in the agricultural machinery manufacturing industry can help companies improve their management and prepare for emergencies.

Citation: Çetinkaya M, Marakoğlu T (2025). Investigation of medium-scale enterprises manufacturing agricultural machinery in Konya province in terms of occupational health and safety. *Selcuk Journal of Agriculture and Food Sciences*, 39(2), 374-390. https://doi.org/10.15316/selcukjafsci.1627598

***Correspondence:** marakoglu@selcuk.edu.tr

Received date: 27/01/2025

Accepted date: 27/05/2025

Author(s) publishing with the journal retain(s) the copyright to their work licensed under the CC BY-NC 4.0.
https://creativecommons.org/licenses/by-nc/4.0/

Keywords: Finney-Kinney risk assessment method; Occupational health and safety; Konya medium-sized enterprises; Agricultural machinery manufacturing industry

1. Introduction

Providing a safe working environment for employees and ensuring that employees identify threatening machines, situations or events, and taking protective or protective practices against these events ensure the formation of Occupational Health and Safety conditions. The risk assessments used in our Occupational Health and Safety Law No. 6331, dated 30.06.2012 and numbered 28339, and our Occupational Health and Safety Risk Assessment Regulation No. 28512, dated 29.12.2012 are listed below.

Risk assessment: These are studies that need to be conducted to determine the damages that existing or external hazards in workplaces may cause to employees, the workplace, and the environment, and the precautions that can be taken.

Hazard: It refers to the potential for damage or harm that exists in the workplace or may come from outside and may affect the employee or the workplace.

The purpose of determining the hazard is to determine the problems that may arise due to the work done in the workplace environment and their levels.

Risk: Risk is a concept that includes the possibility of a recognized hazard occurring and the situations that may arise as a result of the hazards (Özkiliç 2005).

Today, more than 150 risk assessment methods are used in risk assessment studies (Çakmak 1999; Yılmaz and Gürbüz 2009). Risk assessment methods can be classified as qualitative, quantitative and mixed methods by considering their specific characteristics. The agricultural machinery manufacturing sector is an area where agriculture and agricultural mechanization develop in tandem, combining with technology. The agricultural machinery sector encompasses the design, production, sales, marketing, maintenance, and repair of machines used in agricultural production. The agricultural machinery manufacturing industry is recognized as a challenging working environment, particularly in terms of occupational health and safety. The increasing machinery manufacturing, coupled with technological developments, also causes many work accidents and occupational diseases. Since the machines, benches, and various hand tools used in the agricultural machinery manufacturing phase are not used in accordance with work safety, many work accidents and occupational diseases occur. In the sector, elements such as mechanical hazards (caused by machinery and equipment), physical hazards (noise, inadequate ventilation, inadequate or excessive lighting), chemical hazards (metals, gases, paints), and hazards originating from hazardous methods and processes come to the fore in the field of occupational health and safety.

Dyjack et al. (2003), in their project study on occupational health and safety management systems, showed that the application tests and the reorganization of these tests are important in the reliability audit of the occupational health and safety management system.

In our country, agricultural machinery manufacturing is generally carried out by medium and small-scale enterprises. When we look at developing countries, we see that occupational safety and health are in a much worse situation compared to industrialized countries. According to research conducted by the International Labor Organization (ILO), as enterprises grow, the number of accidents decreases, whereas accident rates are higher in small and medium-scale enterprises (Uysal et al. 2005)

A new approach in accident risk analyses conducted by Öztaş (2009), in his study titled "Questioning Risks", he presented a new approach, especially aimed at application, regarding risk analysis.

In his study, Can (2010) tried to reveal the status, problems, and solution suggestions of the agricultural equipment and machinery manufacturing industry in Polatlı district. For this purpose, data were obtained from the evaluation of survey forms conducted face-to-face with 41 enterprises in the region, as well as from related research, examinations, compilations, reports prepared by various institutions and organizations, and data obtained from relevant websites.

In Yiğit's (2015) study, it was prepared to determine the hazards and risks encountered in feed production activities classified as "Hazardous" in terms of occupational health and safety and to provide detailed information on the subject. Within the scope of the thesis, general information about the relevant sector and its associated risks, as well as risk assessment steps and methods, was provided. Additionally, the workplace where the study was conducted and the risk assessment methods employed were introduced, along with an explanation of the application stages. The risks identified as a result of the risk assessments carried out with Fine Kinney, Error Types and Effects Analysis and Risk Scoring methods and the statistical distributions of the risks in the business departments were examined together with the risk factors identified in the measurements performed, the similarities and differences of the methods were analyzed, the identified deficiencies were explained and suggestions were presented.

In the study conducted by Gülce (2016), a risk assessment was carried out with the Fine-Kinney method in a structure constructed of steel. Instead of the original coefficients in the Fine-Kinney method, the risk assessment was recalculated using the coefficients determined with the interpolation method. Thus, the aim was to adapt the coefficients according to the sector and area of use. While determining the table values, the reference ranges for the probability and frequency coefficients were taken and changed with a different approach. Then, the risk assessment calculated with the classical Fine-Kinney method was compared with the risk assessments calculated with the new approach.

In the study by Ateş (2018), risk analysis and assessment were made for the use and design of the hardware and equipment required for the safe use of conventional machine technologies in many furniture enterprises. Among the machines where many work accidents occur, the hazards that cause work accidents and occupational diseases in the workplace were determined for milling machines, circular saws, band saws, planers, etc., and the factors that cause these hazards to turn into risks and the risks arising from the hazards were analyzed and graded, and precautions were taken against these risks.

Advanced stochastic risk assessment approaches, such as the integration of quality function deployment (QFD) and Kemeny Median Indicator Rank Accordance (KEMIRA-M), have been proposed to enhance the FINE-KINNEY method. These approaches enable a more dynamic and robust risk assessment process (Can and Toktaş 2021).

Duran and Topuz (2023) conducted a survey study to compare the occupational health and safety practices of some agricultural machinery manufacturers in Aydın province and to determine the deficiencies and the current situation. It was observed that the agricultural machinery manufacturers generally fulfilled occupational health and safety practices, but some deficiencies were detected. It was observed that the company managers who participated in the survey had a lack of knowledge about the occupational health and safety law, the level of implementation of measures in the companies was not sufficient, the employer and employee did not fully know their obligations, and the controls and inspections were not carried out effectively.

The FINE-KINNEY method is used to identify potential hazards in agricultural machinery factories, such as equipment failure, inadequate safety guards, and operator error. Once hazards are identified, the method calculates a risk score for each hazard, allowing for the prioritization of risks based on their severity and likelihood of occurrence.-Between 2021 and 2025, the Fine-Kinney method was applied across various sectors, including metal industries using fuzzy logic, nursing homes through a hybrid Fine-Kinney and ANFIS approach (Gökler et al. 2022), dairy factories in Iğdır, and agricultural machinery risk analysis via FMEA (Pilarczyk and Ulewicz 2024). Comparative studies were conducted with the 3T method in Ağrı Cement Factory (Inanlı and Özbakır 2024) and with FMEA in textile manufacturing. Additional applications included sub-leather processing (Milli et al. 2021), forestry hazard analysis, environmental laboratories combining AHP and Fine-Kinney, energy company winding sections, and natural disaster risk assessment in Van Province, Turkey, focusing on avalanche, landslide, rockfall, and flood hazards.

This study was conducted to examine medium-sized enterprises in terms of occupational health and safety and to assist in the evaluation of the precautions to be taken against the identified risks.

2. Materials and Methods

2.1. Material

In this study, medium-sized factories manufacturing agricultural machinery in Konya Province were used as models for our research. The fact that the Konya industrial zone is at the forefront of agricultural machinery manufacturing in our country, and that there are many enterprises, has been effective in selecting the relevant region.

Five medium-sized enterprises out of 11 manufacturing agricultural machinery in Konya province, which has 35% of the Turkish market in the agricultural machinery manufacturing industry sector, were selected for our study. To simplify, understand, and apply the study, the FINE-KINNEY risk assessment method, a frequently used method in the factory and industry field, was employed.

The Factories and Production Areas Analyzed are in the Organized Industrial Zone, and information about the enterprises is given in Table 1. In the closed area, there are management and administrative works, a machining and chipless manufacturing department, cutting, welding, a paint shop, and sandblasting departments. In the open area, there are manufactured products, scrap, and stacked waste materials.

Table 1. Factories, production areas and produced materials.

Factories	Closed Space	Open Space	Produced Material	Number of Employees
A	12000	9000	Agricultural machinery	150
B	40000	24000	Corn Silage Machine, Drum Mower and Grass Silage Machine	210
C	30000	13000	Agricultural Equipment and Machinery	105
D	25000	20000	Agricultural Equipment and Machinery	140
E	50000	25000	Agricultural Equipment and Machinery	120

2.2. Method

2.2.1. Risk Assessment Method Applied in Factories

FINE -KINNEY risk analysis method applied in factories is calculated with the help of the following equation. Here;

$$Risk = P \times F \times C, \quad (1)$$

Pu: Possibility (0,1 – 10 a value between)

F:Frequency (0,5 – 10 a value between)

C: Severity of Consequences (1 - 100)

Categories related to the probability value, which is the probability of damage or loss occurring over time, are given in Table 2.

Table 2. Fine-Kinney method probability ranking

Probability Value	Categories For Probability Value
0,1	Impossible
0,2	Unexpected
0,5	Unexpected but possible
1	Possible but unlikely
3	Rare but possible
6	Very possible, highly probable
10	Very strong probability, expected

The values of the category and rating of frequency, which is the frequency of exposure to danger, are given in Table 3.

Table 3. Fine Kinney method frequency ranking

Frequency	Categories For Frequency Value	Rating
0,5	Rare	Once a year or less
1	Very rare	Once a year or a few times
2	Rare	Once a month or a few times
3	Occasionally	Once a week or a few times
6	Frequently	Once a day or more
10	Constantly	Constantly, more than once an hour

The values and categories regarding the severity of the damage or harm that will occur to people, workplaces, and the environment in case of a hazard are given in Table 4.

Table 4. Fine Kinney method severity rating

Intensity Value	Categories For Intensity Value	Description
1	Considerable	No harm
3	Significant	Injury, internal first aid
7	Serious	Injury, external treatment, lost workday
15	Very serious	Disability, loss of limb, loss of work
40	Very bad	Death
100	Catastrophic	Multiple deaths, permanent damage

The expressions used in determining the risk score, evaluation and categories are given in Table 5.

Table 5. Fine-Kinney method risk score rating

Risk Score	Risk Assessment Categories	Description
R ≥ 400	Very High Risk	Necessary measures should be taken immediately.
200 ≤ R < 400	High Risk	Should be improved in the short term (within a few months).
70 ≤ R < 200	Significant Risk	Should be monitored carefully and improved in the long term (within a year).
20 ≤ R < 70	Possible Risk	Should be kept under surveillance. Control methods should be developed.
R < 20	Acceptable Risk	Current protection measures should be continued.

2.2.2. Risk Assessment Application

The weld of danger identified in the factories, the consequences of possible accidents and the existing precautions were evaluated using the risk assessment template created according to Table 6.

Table 6. Occupational safety risk analysis and action plan

		Fine Kinney Method Work Safety Risk Analysis And Action Plan									
Activity	**Danger**	**Risk**	**Those At Risk**	**Current Control Measures**	**Risk Assessment**			**Risk Value**	**Priority Order**	**Legal Condition**	**Precautions To Be Taken**
					POSSIBILITY	**FREQUENCY**	**SEVERITY**				
Sources of Danger											

The sources of danger and possible dangers in the occupational safety risk analysis and action plan given in Table 6 have been observed. The results of these observations are given in Table 7.

Table 7. Source of danger in Businesses

Serial No	Source of Danger	Danger
1	Inputs-Outputs	Falling Door Hits Door Touching Door
2	Administrative Office	Tripping Falling Thermal Comfort Eye Disorders Joint Diseases
3	General Working Environment	Tripping Falling Thermal Comfort Fire Electrical
4	Electrical Installations	Electric Shock
5	Machines And Machines	Spreading Pieces Crushing Respiratory System Disorders Electric Shock Hearing Loss Spreading Burrs Hand Fracture Limb Interruption Joint-Waist Disorders
6	Weld	Fire Electricity Explosion Respiratory Disorders Eye Disorders
7	Lifting Vehicles	Falling From A Height Crushing-Fracture Vehicle Crash Respiratory Disorder Vehicle Overturning Waist-Joint Disorders
8	Dyehouse	Explosion Fire Eye And Skin Diseases Electricity Poisoning
9	Chemical Substances	Fire Occupational Diseases Skin Diseases Respiratory Diseases
10	Pressure Vessels	Explosion Hearing Loss Electric Shock
11	Refectory	Fire Tripping-Falling Electricity Infectious Disease Poisoning Gas Leakage
12	Dressing Rooms-Shower-Wc	Infectious Disease
13	Fire System	Fire
14	Warehouse Area	Material Falling Sticking-Falling

After the source of danger observed in the factories and the possible risks were determined, they were evaluated using the Fine-Kinney method and an occupational safety risk analysis was created for each factory.

3. Results

3.1. Source of danger risk table for Factory A

The risk assessment of factory A according to Fine-Kinney is shown in Table 8.

Table 8. The risk assessment of factory A to Fine-Kinney

Source of Danger	Very High Risk R≥400	High Risk 200≤R<400	Significant Risk 70≤R<200	Possible Risk 20≤R<70	Acceptable Risk R<20	Total
Entrance	-	-	-	1	-	**1**
Administrative Office	-	-	-	1	5	**6**
General Work Area	-	-	-	3	-	**3**
Machines And Machines	11	5	21	18	-	**55**
Dyehouse	1	2	-	1	-	**4**
Lifting Vehicles	-	-	4	2	-	**6**
Pressure Vessels	1	-	1	1	1	**4**
Weld	-	3	4	4	-	**11**
Warehouse Area	-	-	1	3	-	**4**
Electrical Installations	-	-	1	1	-	**2**
Fire System	-	-	1	-	-	**1**
Refectory	-	-	1	4	1	**6**
Locker Area, Shower and Wc	-	-	2	-	-	**2**
Chemicals	-	1	-	2	-	**3**
Others	-	-	6	3	-	**9**
Total	**13**	**11**	**42**	**44**	**7**	**117**

Factory A was classified according to 15 sources of danger, and the total number of risks was determined as 117. A total of 13 risks were determined in the "very high risk" group, 11 of which were observed to originate from machinery and benches. 1 hazardous situation was observed in the paint shop section, and 1 related to pressure vessels. A total of 11 risks were observed in the "high risk" group, 5 of which were determined to originate from machinery and equipment. There were 2 hazardous situations in the paint shops, 3 in the welding section, and 1 in the working with chemicals. A total of 42 risks were determined in the "significant risk" group, 21 of which were risks originating from machinery and benches, and 4 were observed in lifting equipment and welding; 2 in the changing area, shower and WC section; 1 risky situation was observed in the storage area, electrical installation, fire system and dining hall section. 6 significant risks were determined in the section examined under the title "Others". A total of 44 risky situations were determined in the "possible risk" group. The highest number of risks was determined to be from machines and benches, 18 of which were identified. 4 in the welding section and dining hall; 3 in the general work area, storage area, and others; 2 in working with chemicals and lifting equipment; 1 in the factory entrance, administrative office, paint shop, pressure vessels, and electrical installation. There are a total of 7 risks in the "acceptable risk" group, with the highest number of risks identified in the administrative office. In addition, there is 1 acceptable risk in the pressure vessels and dining hall section.

As a result of the risk assessment conducted at Factory A, "Very high risk" was observed in three hazardous welding operations.

Fatal accidents may occur when electricity passes to the machine body due to the lack of grounding or inability to inspect the metal parts of the machines and benches. The presence of materials in front of the electrical panels that will prevent the passage of employees, the absence of an insulating mat in front of the panel, and the absence of a residual current relay in the main panel and secondary electrical panels in the plant increase the risk of accidents.

The fact that the materials used in the paint shop of the plant exceed daily needs and that there is an electrical leak in the storage area increases the risk of fire.

3.2. Source of danger risk table for Factory B

The risk assessment of Factory B according to Fine-Kinney is shown in Table 9.

Table 9. Risk table according to weld of danger for factory B

Source of Danger	Very High Risk R≥400	High Risk 200≤R<400	Significant Risk 70≤R<200	Possible Risk 20≤R<70	Acceptable Risk R<20	Total
Entrance	-	-	1	-	-	**1**
Administrative Office	-	-	1	1	3	**5**
General Work Area	-	-	-	3	-	**3**
Machines And Machines	-	8	16	16	-	**40**
Dyehouse	-	2	1	1	-	**4**
Lifting Vehicles	-	1	4	2	-	**7**
Pressure Vessels	-	1	1	-	1	**3**
Weld	-	1	1	2	-	**4**
Warehouse Area	-	1	1	2	-	**4**
Electrical Installations	-	-	1	1	-	**2**
Fire System	-	1	-	-	-	**1**
Refectory	-	-	1	5	1	**7**
Locker Area, Shower and Wc	-	-	2	-	-	**2**
Chemicals	-	-	1	2	-	**3**
Others	-	-	5	5	-	**10**
Total	**-**	**15**	**36**	**40**	**5**	**96**

Factory B was classified according to 15 sources of danger, and the total number of risks was determined as 96. No risk was detected in the "very high risk" group. A total of 15 risks were observed in the "high risk" group, 8 of which were identified as risks originating from machinery and equipment. There were two hazardous situations in the paint shops: one in the welding section, involving lifting devices, pressure vessels, welding, storage areas, and the fire system. A total of 36 risks were detected in the "significant risk" group, 16 of which were identified as risks originating from machinery and benches. 4 risks were detected in lifting devices; 1 risk in the entrance, administrative office, paint shop, pressure vessels, welding, storage area, electrical installation, dining hall, and chemical use; 2 in the changing area, shower, and WC section; and 5 significant risks were detected in other sections. A total of 40 risky situations were detected in the "possible risk" group. The highest number of risks among these was identified as 16 risks originating from machinery and benches. 5 in the section addressed as dining hall and other sections; 3 risky situations were observed in the general work area; 2 in the lifting equipment, welding, storage area, and chemical substance working section; 1 risky situation was observed in the administrative office, paint shop section, and electrical installation. There are a total of 5 risks in the "acceptable risk" group, with the majority detected in the administrative office. In addition, there is 1 acceptable risk in the pressure vessels and the dining hall section.

15 "High Risk" were identified in Factory B. Personnel working on machines and benches do not use personal protective equipment and do not take precautions when working with rotating parts on machines and benches. Tearing and crushing of electrical cables in the machines used, lack of local ventilation in welding areas, and failure to perform daily checks of load lifting and carrying equipment increase the possibility of work accidents.

3.3. Source of danger risk table for Factory C

The risk assessment of Factory C according to Fine-Kinney is shown in Table 10. Factory C was classified according to 15 sources of danger, and the total number of risks was determined as 102. A total of 4 risks were identified in the "very high risk" group, with 2 located in the paint shop section and the other 2 in the fire system and the cafeteria. A total of 9 risks were observed in the "high risk" group, and 4 of them were determined to be risks originating from machinery and equipment. A total of 2 risks were identified in the lifting of vehicles, with 1 risk in the pressure vessels and storage area. A total of 34 risks were determined in the "significant risk" group and 19 of these risks were risks originating from machinery and benches. 2 in lifting vehicles, welding and changing area, shower and WC; 1 risk in the paint shop, pressure vessels, storage area and electrical installation; and 4 significant risks were determined in other sections. A total of 49 risky situations were determined in the "possible risk" group. The most risky situations were observed in 23 of these, originating from machinery and benches. 4 in the cafeteria section; 3 risks were identified separately in the general work area and lifting equipment. 2 risks were observed in the administrative office, working with welding, the storage area and working with chemicals; 1 risk in the entrance and paint shop and a total of 6 risky situations were observed in other sections. 5 were observed in the section considered as the cafeteria and other sections; 3 in the general work area; 2 in the section where lifting tools, welding, storage area and chemicals are worked; 1 risky situation was observed in the administrative office, paint shop and electrical installation. There are a total of 6 risks in the "acceptable risk" group, with the administrative office having the maximum of 4 risks. In addition, 2 acceptable risks were identified in the cafeteria section.

Table 10. Risk table for Factory C according to the source of danger.

Source of Danger	Very High Risk R≥400	High Risk 200≤R<400	Significant Risk 70≤R<200	Possible Risk 20≤R<70	Acceptable Risk R<20	Total
Entrance	-	-	-	1	-	**1**
Administrative Office	-	-	-	2	4	**6**
General Work Area	-	-	-	3	-	**3**
Machines And Machines	-	4	19	23	-	**46**
Dyehouse	2	-	1	1	-	**4**
Lifting Vehicles	-	3	2	3	-	**8**
Pressure Vessels	-	1	1	-	-	**2**
Weld	-	-	2	2	-	**4**
Warehouse Area	-	1	1	2	-	**4**
Electrical Installations	-	-	1	-	-	**1**
Fire System	1	-	-	-	-	**1**
Refectory	1	-	1	4	2	**8**
Locker Area, Shower and Wc	-	-	2	-	-	**2**
Chemicals	-	-	-	2	-	**2**
Others	-	-	4	6	-	**10**
Total	**4**	**9**	**34**	**49**	**6**	**102**

4 "Very High Risk" was observed in Factory C. The inadequacy of lighting in the paint shop, the failure of personnel to use personal protective equipment, the absence of a fire detector, and the lack of a gas leakage detector in the cafeterias increase the risk of fire, loss of life, and material damage.

3.4. Source of danger risk table for Factory D

The risk assessment of Factory D according to Fine-Kinney is shown in Table 11. Factory D was classified according to 15 sources of danger, and the total number of risks was determined as 91. In the "very high risk" group, a total of 3 risks were determined, including 1 in the machinery and benches, the paint shop, and the electrical installations. In the "high risk" group, a total of 15 risks were observed, 11 of which were risks originating from machinery and equipment. 1 risk was determined in the lifting equipment, welding, storage area, and fire system. In the "significant risk" group, a total of 34 risks were determined, 15 of which were risks originating from machinery and benches, and 4 in lifting equipment; 2 in the paint shop, welding, and dining hall section; 1 risk was determined in pressure vessels, storage area, and working with chemicals. In other sections, a total of 6 significant risks were encountered. In the "possible risk" group, a total of 35 risky situations were determined. Of these, 12 risky situations originating from machinery and benches were observed the most. 3 in the work area and welding section; 2 in the administrative office, dining hall and changing rooms, shower and WC section; 1 risk was identified in the entrance, paint shop, lifting equipment, pressure vessels, storage area and working with chemicals. 4 risks were identified in the sections described as other sections. In the "acceptable risk" group, there are a total of 4 risks and the most were identified in the administrative office, 3 risks. In addition, 1 acceptable risk was identified in the cafeteria section.

Table 11. Risk table for Factory D according to source of danger

Source of Danger	**Very High Risk R≥400**	**High Risk 200≤R<400**	**Significant Risk 70≤R<200**	**Possible Risk 20≤R<70**	**Acceptable Risk R<20**	**Total**
Entrance	-	-	-	1	-	**1**
Administrative Office	-	-	-	2	3	**5**
General Work Area	-	-	-	3	-	**3**
Machines And Machines	1	11	15	12	-	**39**
Dyehouse	1	-	2	1	-	**4**
Lifting Vehicles	-	1	4	1	-	**6**
Pressure Vessels	-	-	1	1	-	**2**
Weld	-	1	2	3	-	**6**
Warehouse Area	-	1	1	1	-	**3**
Electrical Installations	1	-	-	1	-	**2**
Fire System	-	1	-	-	-	**1**
Refectory	-	-	2	2	1	**5**
Locker Area, Shower and Wc	-	-	-	2	-	**2**
Chemicals	-	-	1	1	-	**2**
Others	-	-	6	4	-	**10**
Total	**3**	**15**	**34**	**35**	**4**	**91**

3 "Very High Risks" were identified in Factory D. It was observed that personal protective equipment was not used while using the machines and equipment, there were no visors, operating instructions, warning lights on the machines, personal protective equipment was insufficient and not specific to the person. Irregular storage was observed in the storage areas.

3.5. Source of danger risk table for Factory E

The risk assessment of Factory E according to Fine-Kinney is shown in Table 12.

Table 12. Risk table for Factory E according to source of danger

Source of Danger	**Very High Risk R≥400**	**High Risk 200≤R<400**	**Significant Risk 70≤R<200**	**Possible Risk 20≤R<70**	**Acceptable Risk R<20**	**Total**
Entrance	-	-	-	1	-	**1**
Administrative Office	-	-	1	1	4	**6**
General Work Area	-	-	-	4	-	**4**
Machines And Machines	1	6	16	24	-	**47**
Dyehouse	1	-	2	1	-	**4**
Lifting Vehicles	-	1	3	2	-	**6**
Pressure Vessels	-	-	2	-	-	**2**
Weld	-	2	3	4	-	**9**
Warehouse Area	-	-	-	2	-	**2**
Electrical Installations	1	-	-	1	-	**2**
Fire System	-	-	1	-	-	**1**
Refectory	1	-	3	2	1	**7**
Locker Area, Shower and Wc	-	-	2	-	-	**2**
Chemicals	-	1	-	1	-	**2**
Others	-	-	5	4	-	**9**
Total	**4**	**10**	**38**	**47**	**5**	**104**

Factory E was classified according to 15 hazard sources and the total number of risks was determined as 104. In the "very high risk" group, a total of 4 risks were determined, including 1 in the machinery and benches, paint shop and electrical installation and cafeteria. In the "high risk" group, a total of 10 risks were observed and 6 of these were determined to be risks originating from machinery and equipment. 2 in the source; 1 high risk was encountered in lifting equipment and working with chemicals. A total of 38 risks were detected in the "significant risk" group and 16 of these risks were risks originating from machinery and benches, 3 in lifting equipment, source and cafeteria; 2 in the paint shop, pressure vessels, changing area, shower and WC; 1 in administrative office and fire systems; 5 significant risks were encountered in the sections called others. A total of 47 risky situations were detected in the "possible risk" group. The most risky situations were observed to be 24 from machinery and benches. 4 in the work area and welding section and other sections; 2 possible risks were found in the lifting equipment, storage area and cafeteria section; 1 possible risk was found in the entrance, administrative office, paint shop, working with chemicals and electrical installation. In the "acceptable risk" group, there are a total of 5 risks and the most risks were found in the administrative office, 4. In addition, 1 acceptable risk was found in the cafeteria section.

4 "Very High Risks" were identified in Factory E. It was observed that the electrical cables in the Machinery and Equipment used in the facility were not in protective covers, workers in the paint shops did not use personal protective masks, there was no E-type fire extinguisher for fires that could arise from electrical panels in the machines and benches, and there was no leakage gas detector and fire extinguisher in the cafeteria section.

In this study, a total of 512 hazards were identified as a result of the risk analyses conducted in Factories A, B, C, D, E. The identified hazards are evaluated according to their risk levels in Table 13.

Table 13. Risk Score Assessment

Risk Score	Risk Assessment Categories	A Factory	B Factory	C Factory	D Factory	E Factory
R ≥ 400	Very High Risk	13	-	4	3	4
200 ≤ R < 400	High Risk	11	15	9	15	10
70 ≤ R < 200	Significant Risk	42	36	34	37	38
20 ≤ R < 70	Possible Risk	44	40	49	32	47
R < 20	Acceptable Risk	7	5	6	4	5
Total Risk		**117**	**98**	**102**	**91**	**104**

The hazards observed in factories A, B, C, D, E are generally listed below, according to the risk score values created according to the Fine-Kinney risk assessment method given in Tables 4 and 5 according to the risk rating.

At the entrance;

- No warning and emergency exit direction signs on transparent doors,
- No shapes visible to personnel on the door,

In the administrative office;

- Not performing eye examinations on personnel working with screened vehicles,

In working with machines and looms;

- In an environment where there are noisy machines and benches, no noise measurement is performed,
- The cables of the machines and benches are irregular and not in a casing,
- There is no protective shield to protect the eyes of the workers in some machines and benches,
- The personnel uses gloves in some machines and benches where they should not use gloves,

Risks in the examined factories were classified according to the source of danger and are given in Table 14.

Table 14. Risk scores according to hazard sources

Source Of Danger	**Very High Risk**					**High Risk**					**Significant Risk**					**Possible Risk**					**Acceptable Risk**				
	R ≥ 400					**200 ≤ R < 400**					**70 ≤ R < 200**					**20 ≤ R < 70**					**R < 20**				
	A	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
Entrance	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	1	1	-	-	-	-	-
Administrative Office	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	1	2	2	1	5	3	4	3	4
General Work Area	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	3	3	-	4	-	-	-	-	-
Machines And Machines	11	-	1	1		5	8	4	11	6	21	16	19	15	16	18	16	23	12	24	-	-	-	-	-
Dye Shop	1	-	2	1	1	2	2	-	-	-	-	1	1	2	2	1	1	1	1	1	-	-	-	-	-
Lifting Vehicles	-	-	-	-	-	-	1	3	1	1	4	4	2	4	3	2	2	3	1	2	-	-	-	-	-
Pressure Vessels	1	-	-	-	-	-	1	1	-	-	1	1	1	1	2	1	-	-	1	-	1	1	-	-	-
Welding Machine	-	-	-	-	-	3	1	-	1	2	4	1	2	2	3	4	2	2	3	4	-	-	-	-	-
Warehouse Area	-	-	-	-	-	-	1	1	1	-	1	1	1	1	-	3	2	2	1	2	-	-	-	-	-
Electrical Installations	-	-	-	1	1	-	-	-	-	-	1	1	1	-	-	1	1	-	1	1	-	-	-	-	-
Fire System	-	-	1	-	-	-	1	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Dining Halls	-	-	1	-	1	-	-	-	-	-	1	1	1	2	3	4	5	4	2	2	1	1	2	1	1
Locker Area, Shower and Wc	-	-	-	-	-	-	-	-	-	-	2	2	2	-	2	-	-	-	2	-	-	-	-	-	-
Chemicals	-	-	-	-	-	1	-	-	-	1	-	1	-	1	-	2	2	2	1	1	-	-	-	-	-
Others	-	-	-	-	-	-	-	-	-	-	6	5	4	6	5	3	5	6	4	4	-	-	-	-	-
Total	**13**	**-**	**4**	**3**	**4**	**11**	**15**	**9**	**15**	**10**	**42**	**36**	**34**	**37**	**38**	**44**	**40**	**49**	**32**	**47**	**7**	**5**	**6**	**4**	**6**

- There is no protector on the belt pulley section during the use of presses,
- There is no two-hand button system,
- The personnel does not use glasses against burr splashes,
- The personnel is not given steel-toed shoes that are not suitable for the work being done,
- There is no insulating mat on the base of some machines and benches and it is not fixed to the floor,
- Although headphones are given to the personnel in noisy machines and benches, their use is not ensured,
- The instructions for use are not hung on some machines and benches,
- The personnel wears dust masks in machines that produce metal dust not using,
- No guard on the grinding machine,

In lifting vehicles;

- No warning lights on cranes,
- No road markings in the forklift usage area,
- No maximum load tonnage written on the forklift,
- Personnel using the forklift doing other work while driving

In pressure vessels;

- Pressure vessels are not taken to an explosion-proof area,
- Ventilation is inadequate,

In welding works;

- Personnel do not use masks,
- Lack of local ventilation,
- Personnel do not use heat-resistant gloves,
- Lack of a screen between the source and other workers,

In the paint shop;

- Employees not using protective glasses, uniforms and masks,
- MSDS information forms of the paints used are not hung in the environment,
- There are no safety catches on the hoist hooks in the paint shop,

When working with chemicals;

- They are not stored in a separate room,
- No precautions are taken against chemicals tipping over,
- There is no fire extinguisher in the place where chemicals are located,
- No MSDSs,
- No posters or writings about the storage of chemicals,

In sandblasting;

- Electrical panel covers are not closed while working with sandblasting,
- There is material around the electrical panel,

- No type E fire extinguisher,
- Warning signs are not hung on the panel,
- Employees do not use headphones despite noise measurement while working with sandblasting machines,
- Inappropriateness of slings and hooks on lifting vehicles,
- In the storage area;
- Irregular stacking in the warehouse area,
- Most of the shelf systems do not take precautions against falling materials,
- Lack of warning and caution signs,

Electrical panel;

- Lack of insulating mat in front of the electrical panel,
- Material in front of the electrical panel,
- Panel covers are in open position,

Cafeteria;

- Lack of leakage gas detectors in some cafeterias,
- Open-lidded materials and food in factories,
- Lack of disposable cups in water dispensers,

Locker room;

- Lack of stools in the locker room,
- Inadequate ventilation in most factories,
- Single-compartment cabinets,

Factory guests;

- Not providing personal protective equipment to visitors.

Factory A was classified according to 15 weld of danger and the total number of risks was 117, Factory B was classified according to 15 weld of danger and the total number of risks was 96, Factory C was classified according to 15 weld of danger and the total number of risks was 102, Factory D was classified according to 15 weld of danger and the total number of risks was 91, and Factory E was classified according to 15 weld of danger and the total number of risks was 104.

4. Discussion

As a result of risk assessment studies conducted in factories, 512 hazardous situations were identified across 15 different activities. These hazards were evaluated using the Fine-Kinney risk analysis method, considering the probability and severity of potential accidents. In their research, Över Özçelik et al. (2025) tested the developed fuzzy Fine-Kinney model for 252 cases and compared it with the traditional Fine-Kinney method.

The highest-risk areas were primarily related to machine and bench use. Hazards such as flying parts, sawdust splashes, electric shock, failure to follow instructions, and improper work clothing can lead to serious consequences. In machines with rotating parts, such as band saws and presses, the lack of protective shields, grounding, and proper personal protective equipment (PPE) can result in fatal accidents. In their work, Gül and Çelik (2018) successfully demonstrated the application of a new OSH risk assessment approach, including the Fine-Kinney method and a fuzzy rule-based expert system.

To minimize these risks, safety buttons should be installed, PPE should be properly used, and practical training must be provided. Machines must have protective guards, operating instructions should be clearly posted, and warning signs should be visibly placed. Machines and benches used in factories should have guards, and the instructions for use should be hung on the machine. In addition, warning-caution signs should be hung in appropriate places and employees should be reminded to comply with these rules. In the study by Akman and Koç (2013), many factories were found to have electrical systems that were unsafe, characterized by open panels, poor insulation, and disorganized cables. Electrical work must be supervised by an engineer, and all systems should be properly grounded and clearly labeled.

Lifting devices often lacked warning lights and load indicators. Some forklift operators were observed performing unrelated tasks while driving. PPE provided to workers was often not suitable for their body size or the job, and machine noise levels were not properly managed. In storage areas, irregular stacking and unprotected shelving systems created further hazards. Not providing PPE to visitors was another major concern, as it exposes them to serious risks. Karahan and Aydoğmuş (2023) conducted risk analysis and assessment using the Fine Kinney method within the scope of occupational health and safety.

The FINE-KINNEY method is a valuable tool for risk analysis in agricultural machinery plants. Its simplicity, flexibility, and ability to provide quantitative risk scores make it a popular choice for identifying and prioritizing risks. As a result, the FINE-KINNEY method has been successfully applied in practical settings to reduce risks associated with agricultural machinery and provide a safer and more productive work environment.

5. Conclusions

The risk assessment studies conducted in agricultural machinery manufacturing facilities revealed significant hazards, particularly in areas such as machine and bench use, electrical safety, inadequate personal protective equipment (PPE), and lifting equipment. The Fine-Kinney method proved effective in prioritizing risks and guiding appropriate control measures.

To reduce these hazards, it is essential to:

Ensure the proper implementation of protective systems and guards,

Provide and monitor the use of suitable PPE,

Apply strict electrical safety standards,

Improve training and awareness for all personnel.

This study highlights the importance of a proactive and systematic approach to prevent workplace accidents and create a safer working environment.

Author Contributions: The authors have an equal contribution. All authors have read and agreed to the published version of the manuscript. This research article is summarized from the master's thesis Mine ÇETİNKAYA.

Conflicts of Interest: The authors declare no conflict of interest.

References

Akman A and Koç U (2013). Makinelerin hareketli noktalarına temas riskinin değerlendirilmesi. *Çalışma Dünyası Dergisi 1*, 120–136.

Ateş ÖT (2018). İş sağlığı ve iş güvenliğinde risk analizi: Mobilya sektöründe bir uygulama. *Master Thesis, Süleyman Demirel University*, Türkiye

Can E (2010). Polatlı ilçesinde tarım makineleri imalat durumu, sorunları ve çözüm önerileri. *Master Thesis, Selçuk University*, Türkiye

Can GF, Toktaş A (2021). A stochastic risk assessment approach using QFD and KEMIRA-M for occupational health and safety risks. *Process Safety and Environmental Protection 153*, 242–254.

Çakmak B (1999). Yerli yapım bazı tarım makinalarında malzeme bakımından kalite kavramı ve kalitenin iyileştirilmesi üzerinde bir araştırma. *PhD Thesis, Ege University*, Turkey

Duran E, Topuz N (2022). Aydın ili bazı tarım makinaları imalatçılarının iş sağlığı ve güvenliği uygulamalarının araştırılması. *Adnan Menderes Üniversitesi Ziraat Fakültesi Dergisi 20*(2), 237–246.

Dyjack D, Redinger C, Ridge R (2003). Health and safety management system audit reliability pilot project. *AIHA Journal 64*(6), 785–791.

Gökler SH, Yılmaz D, Ürük ZF, Boran S (2022). A new hybrid risk assessment method based on Fine-Kinney and ANFIS methods for evaluation spatial risks in nursing homes. *Heliyon 8*(10), e11028.

Gül M, Çelik E (2018). Fuzzy rule-based Fine–Kinney risk assessment approach for rail transportation systems. *Human and Ecological Risk Assessment: An International Journal* 24(7), 1786–1812.

Gülce OH (2016). Çelik konstrüksiyon stadyum çatılarında risklerin belirlenmesi ve betonarme yapıları ile karşılaştırılması. *T.C. Çalışma ve Sosyal Güvenlik Bakanlığı.*

Güney G, Kahraman B (2022). Implementation of the analytic hierarchy process (AHP) and Fine–Kinney method (FKM) against risk factors to determine the total cost of occupational health and safety precautions in environmental research laboratories. *International Journal of Occupational Safety and Ergonomics 28*(4), 2606–2622.

İnanlı A, Özbakır O (2024). Ağrı Çimento Fabrikası'nda tehlike tanımlama ve Fine-Kinney ile 3T risk değerlendirme yöntemlerinin karşılaştırılması: Bir kritik inceleme. *Karadeniz Fen Bilimleri Dergisi* 14(2), 448–467.

Karaçizmeli İH (2023). Comparison of FMEA and Fine Kinney methods for risk analysis in textile manufacturing. *Quality 2023*, 173–176.

Karahan V, Aydoğmuş E (2023). Risk analysis and risk assessment of laboratory work by Fine Kinney method. *International Journal of Advanced Natural Sciences and Engineering Researches* 7(4), 442–446.

Matpay B, Mutlu S (2023). Determining the natural disaster diversity of Van province by Fine Kinney Risk Assessment Method (FK-RAM). *Journal of Natural Hazards and Environment 9*(2), 324–340.

Milli A, Salman S, Sancak E (2021). A case of risk assessment by using Fine-Kinney method in sub-leather processing. *Usak University Journal of Engineering Sciences 4*(1), 42–57.

Özçelik ÖT, Yılmaz Yalçıner A, Çetinkaya M, Aker A (2025). Risk assessment with the fuzzy Fine–Kinney method in a business operating in the metal industry. *International Journal of Occupational Safety and Ergonomics* 31(1), 308–317.

Özbakır O (2023). Hazard and risk assessment in a dairy products factory in Iğdır province using the Fine Kinney Risk Method: Recommendations for mitigation. *International Journal of Agriculture Environment and Food Sciences 7*(3), 563–572.

Özçelik TÖ, Yalçiner AY, Çetinkaya M, Aker A (2025). Risk assessment with the fuzzy Fine–Kinney method in a business operating in the metal industry. *International Journal of Occupational Safety and Ergonomics*, *31*(1), 308–317.

Özkılıç Ö (2005). İş sağliği ve güvenliği: Yönetim sistemleri ve risk değerlendirme metodolojileri (Yayın No. 246). *TİSK Yayınları.*

Öztaş S (2009). Kaza risk analizlerinde yeni bir yaklaşım “Risklerin Sorgulanması”. *Maden İşletmelerinde İş Sağlığı ve Güvenliği Sempozyumu*, 19–20.

Pilarczyk B, Ulewicz R (2024). Evaluating risk in the operation of agricultural machinery based on farm size. Scientific papers of Silesian University of technology organization and management series no. 198, 393-408.

Şengül Ü, Tokal A (2021). Risk analysis with Fine Kinney method in forestry production studies. *EJONS International Journal 5*(20), 865–877.

Tümay AK (2023). Determination of high risks and elimination of possible risks in the winding section of an energy company using the Fine-Kinney method. *International Scientific and Vocational Studies Journal 7*(2), 62–71.

Uysal B, Özçiftçi A, Kurt Ş (2005). Türkiye'de küçük ve orta ölçekli mobilya imalat işletmelerinde meydana gelen iş kazalarının analizi. *Gazi Üniversitesi Fen Bilimleri Dergisi 18*(3), 439–451.

Yiğit Ö (2015). Yem üretim proseslerinde üç farklı risk değerlendirme metodunun uygulanması ve yöntemlerin karşılaştırılması. *Çalışma ve Sosyal Güvenlik Bakanlığı.*

Yılmaz G, Gürbüz B (2009). İş kazalarının n edenleri ve maliyeti. *Mühendis ve Makine 592*, 27–32.