Turkish Journal of Agriculture - Food Science and Technology, 13(3): 587-593, 2025
DOI: https://doi.org/10.24925/turjaf.v13i3.587-593.7503

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

A Study Examining the Potential of the 5S Methodology for Improving Efficiency in Agricultural Production Processes

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ARTICLE INFO

Research Article

Received : 23.01.2025
Accepted : 01.02.2025

Keywords:
Agricultural sustainability
Productivity management
Process in agriculture
Operational Efficiency
Agricultural Innovation

ABSTRACT

This study comprehensively examines the applicability of the 5S methodology as a tool for enhancing efficiency, occupational safety, and sustainability in the agricultural sector. The 5S methodology, predicated on the principles of sorting, organising, cleaning, standardising, and sustaining, aims to create safer and more productive workplaces. The research investigates its effects on both indoor agricultural machinery manufacturing processes and outdoor crop production practices. The analysis reveals notable advantages in manufacturing processes, including reduced waste, enhanced occupational safety, and improved product quality, particularly in production, assembly, and quality control processes. However, the methodology faces limitations in outdoor agricultural practices due to seasonal variations and open-field conditions, which challenge the cleaning, sorting, and organising stages. However, its application in maintenance, repair, and equipment storage processes has been shown to prolong the lifespan of machinery and ensure safer working conditions. The 5S methodology aligns with the United Nations Sustainable Development Goals, serving as a practical approach to enhancing efficiency, workplace safety, and resource management in the agricultural sector. This study underscores the 5S methodology's promise as a sustainable solution for enhancing productivity and safety in agriculture.

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Introduction

This study examines the applicability of the 5S method to enhance productivity, occupational safety and sustainability in the agricultural sector. The 5S method is designed to enhance order, safety and efficiency in working environments through the application of the following principles: sorting, organisation, cleaning, standardisation and sustainability (self-discipline). The application of this method allows for the optimisation of resource utilisation throughout the production process, while simultaneously enhancing occupational safety and reducing waste. The agricultural sector is confronted with a multitude of challenges, both in indoor (production of agricultural tools and machinery) and outdoor (use of machinery in the field) environments. Consequently, this study assesses the benefits and limitations of 5S practices in both environments.

For instance, the implementation of 5S in greenhouse agriculture has significantly improved workflow efficiency by ensuring the systematic organisation of tools and equipment. Similarly, in dairy farms, structured cleaning and sorting protocols within the 5S framework have enhanced hygiene management, thereby positively impacting livestock health and milk quality. As outlined by the US Environmental Protection Agency (EPA), the 5S method represents a Lean Thinking tool designed to reduce waste and enhance efficiency within the workplace. The methodology facilitates the organisation and efficiency of the work environment through the implementation of the following steps: sorting, organisation, cleaning, standardisation and sustainability (EPA, 2024). This methodology enhances workplace organisation and efficiency by implementing key steps such as sorting, organising, cleaning, standardising, and sustaining.

The potential of 5S to contribute to production processes in the agricultural sector was previously discussed by Sidhu et al. (2013). This study posited that the implementation of 5S in conjunction with the Plan-Do-Check-Act (PDCA) cycle has the potential to enhance productivity and quality in the agricultural sector, thereby facilitating continuous improvement. The integration of 5S

with the Plan-Do-Check-Act (PDCA) cycle in agricultural production processes provides information regarding the reduction of waste, the optimisation of business processes and the improvement of decision-making processes. Nevertheless, it is primarily confined to delineating the overarching framework for the advantages of 5S in agricultural production. In contrast, this study provides a comprehensive assessment of the impact of 5S practices on a range of working conditions within the agricultural sector, including indoor agricultural machinery production and outdoor agricultural practices. The distinctive challenges inherent to these disparate work environments serve to diversify the applicability and benefits of the 5S methodology.

It is of particular importance to provide a regular and safe working environment, especially in the agricultural sector, for disadvantaged groups such as the elderly or disabled. Those with disabilities, who are among the most disadvantaged groups, are exposed to a range of risks when a safe and healthy working environment is lacking. The provision of suitable working environments for disabled employees enables them to work safely and in an adequately motivated manner (WHO, 2011). In this context, the 5S methodology can be employed to mitigate hazards and risks for disadvantaged groups by ensuring order and cleanliness in workplaces. The 5S methodology can be regarded as a technique that guarantees the security of disadvantaged employees in the agricultural sector with regard to occupational safety and risk reduction (Kurt et al., 2022).

Tractors represent the most significant source of power in agricultural operations, facilitating the execution of a vast array of agricultural activities. A study of the annual usage time of tractors in Turkey has demonstrated the significant role played by these vehicles in enhancing agricultural productivity (Evcim & Ertuğrul, 2017). In this context, the implementation of methodologies such as 5S represents a significant step towards ensuring the effective use of tractors and enhancing occupational safety. By introducing order, efficiency and safety measures into agricultural work processes, it is possible to optimise the utilisation of tractors and improve the safety of those working with them.

Furthermore, the study considers the psychosocial impacts of 5S, including occupational safety, ergonomics and employee satisfaction in the agricultural sector. It assesses the effects of 5S not only in terms of workplace organisation and productivity, but also on employee health and motivation. In this context, the study offers a comprehensive assessment of 5S in the agricultural sector, providing a more nuanced perspective and further elaborating on the potential contributions of the methodology in achieving sustainable development goals in the sector.

In order to successfully integrate 5S practices and achieve more efficient results, the importance of user-oriented approaches is emphasised in different industries. For instance, Toyota's methodologies, including Kaizen and Kaikaku, facilitate the active involvement of employees in business operations, fostering their sense of ownership over the processes and enhancing the efficacy of improvement initiatives. While Kaizen strives for continuous improvement, Kaikaku contemplates more radical alterations. When these two methods are integrated with workplace organisation and efficiency tools such as 5S, they can facilitate high performance and workplace quality (Moi & Sing, 2021). Such user-centred approaches have the potential to enhance the adaptability of the 5S method and facilitate employee adoption in diverse work environments, including the agricultural sector. Furthermore, the literature indicates that approaches centred on user experience (e.g., design thinking) enhance the efficacy of 5S practices and provide solutions aligned with employees' experiences (Muotka et al., 2023).

The study additionally demonstrates the manner in which 5S practices in agriculture can facilitate occupational safety and productivity in alignment with the United Nations' Sustainable Development Goals (SDGs) (United Nations Türkiye, 2024). In particular, the potential of 5S to contribute to sustainable development in agriculture is assessed in relation to the following goals: Goal 8 (Decent Work and Economic Growth), Goal 9 (Industry, Innovation and Infrastructure), Goal 12 (Responsible Consumption and Production) and Goal 13 (Climate Action). The structure of the 5S method is conducive to the simultaneous enhancement of occupational safety and productivity, as well as environmental sustainability, in alignment with the aforementioned goals (Table 1).

Table 1. Relationship between the 5S Method and United Nations Sustainable Development Goals

SDGs Number	SDGs Topic	The 5S Method and Its Impact
Goal 8	Decent Work and Economic Growth	It provides better conditions for employees by increasing safety and efficiency in the workplace
Goal 9	Industry, Innovation and Infrastructure	It facilitates the implementation of innovative production processes, thereby enhancing efficiency and contributing to the development of sustainable infrastructure.
Goal 12	Responsible Consumption and Production	It encourages the efficient utilisation of resources, thereby reducing waste and supporting environmental sustainability.
Goal 13	Climate Action	It contributes to the global effort to mitigate the effects of climate change by minimising its environmental impact through the reduction of waste and the enhancement of efficiency.

Table 2. 5S implementation recommendations in different agricultural practices

Agricultural Application Area	5S Application Recommendation	Advantages	Implementation Challenges
Greenhouse Agriculture	All steps of 5S are recommended (Sorting, Organisation, Cleaning, Standardisation, Sustainability).	The implementation of a closed working area facilitates the assurance of cleanliness, order and quality management.	The process requires a significant input of labour and the use of sophisticated equipment.
Tractor and Agricultural Equipment-Machinery Production	The use of 5S is recommended at all stages to increase efficiency.	Such an environment has been demonstrated to enhance quality, minimise the occurrence of production errors and foster a secure and hygienic working environment.	It is essential to provide training and supervision to ensure the long-term sustainability of the application.
Animal Production (On-Farm)	Only the sorting, cleaning and organising steps are recommended; standardisation can be partially implemented.	A clean and well-organised environment is conducive to the health and safety of animals and workers alike.	The open area is subject to variable conditions, with the presence of animals having an impact on the surrounding environment.
Open Field Agricultural Production (In Field)	Partial implementation of 5S is recommended only in maintenance and storage areas.	Furthermore, it prolongs the lifespan of machinery, ensures secure storage and maintenance.	The variable field conditions and the difficulty of continuous cleaning represent significant challenges.
Storage and Packaging Areas	All 5S steps can be applied, especially order and standardisation are recommended.	Such measures lead to increased productivity, maintained product quality and a reduction in waste.	The level of equipment intensity and the requisite labour input must also be considered.
Open field fruit-garden cultivation	Sorting and organising are partially recommended.	The organisation of the work area facilitates the safe utilisation of equipment.	The open area factor and the restrictions imposed by weather conditions.

Materials and Methods

This study analyses the effects of the 5S method in two main application areas within the agricultural sector (Table 2). The impact of the 5S methodology on productivity, occupational safety and resource efficiency was evaluated in the context of indoor tractor and agricultural machinery production and outdoor agricultural operations. Furthermore, an analysis was conducted to provide recommendations for the implementation of the 5S method in accordance with the diversity of agricultural activities, with a comparison of different implementation conditions in indoor and outdoor areas.

In this analysis, data provided by the US Environmental Protection Agency (EPA) on the 5S approach was employed to ascertain the potential benefits of 5S in the agricultural sector. The United States Environmental Protection Agency (EPA) defines the 5S method as a tool to ensure that workplaces are organised and efficient. The basic steps of this system, as outlined by the EPA, are sorting, organising, cleaning, standardising and ensuring continuity. These principles provide an effective framework for the creation of order in agricultural workplaces with regard to both organisation and occupational safety (EPA, 2023). Moreover, a study on the implementation of Lean Thinking production principles in the Swedish agricultural sector revealed the benefits of Lean Thinking and 5S methodologies for both the physical and psychosocial work environment. The study indicated that the application of Lean Thinking principles contributes to the establishment of a structured work environment, a reduction in occupational accidents and an enhancement of inter-employee collaboration (Andersson et al., 2020).

In evaluating the effects of 5S in agricultural practices, it was considered that user-oriented methods have the potential to enhance the success of 5S.

Below is a chart entitled 5S Implementation Recommendations. This chart presents the applicability of the 5S method and recommendations for different agricultural activities. Considering the effectiveness and advantages of 5S in different agricultural applications, it is stated in which areas it can be more useful (Table 2).

Additionally, a chart entitled "Indoor and Outdoor 5S Principles Comparison" is provided below. The chart illustrates the manner in which the 5S principles are implemented in the context of indoor tractor and agricultural machinery production, as well as in outdoor agricultural practices (Table 3).

Results

The results of the study demonstrate that the 5S method has a marked effect on enhancing productivity, quality control and work safety in confined spaces. The optimisation of production processes was achieved through the reduction of waste and the maintenance of order, particularly during the sorting and cleaning stages. Nevertheless, the implementation of 5S in outdoor agricultural contexts was found to be constrained by certain limitations.

Table 3. Comparison of 5S principles in closed and open environments

5S Principles	Indoor (Tractor and Agricultural Machinery Production)	Outdoor (The utilisation of agricultural machinery in the field)
Sorting	The removal of superfluous materials from the environment is achieved with remarkable swiftness, while the rate of workflow is accelerated and the level of safety is increased.	The variability of the terrain presents a challenge to the sequencing of operations, and the organisation of machinery in the field may be constrained by this factor.
Systematic Organisation	The positioning of tools and materials in fixed locations on the production line is complemented by the implementation of visual management techniques.	The organisation of the vehicles is challenging due to the lack of a fixed positioning system. Furthermore, the applicability of this system is limited in maintenance and storage contexts.
Cleaning	The removal of production waste, such as oil and chips, is facilitated by regular cleaning operations. The implementation of cleaning procedures in closed areas is a relatively straightforward process.	External factors, such as dust and mud, can complicate the cleaning processes, which may require regular attention.
Standardisation	The implementation of standardised processes has been demonstrated to enhance quality and reduce the incidence of errors, which is a crucial objective in the context of quality management.	The implementation of a fully standardised approach is challenging due to the influence of climate and terrain variations. Consequently, this approach is only applicable within the context of maintenance processes.
Sustainability	The 5S system can be implemented on an ongoing basis through the provision of training and the conducting of audits. It is readily sustainable within the context of a factory environment.	The sustainability of this approach is hindered by seasonal and environmental factors, although it is partially applicable in maintenance and storage processes.

The cleaning and organisation steps of 5S are rendered more challenging by seasonal changes and environmental factors. Nevertheless, the implementation of 5S practices in maintenance and storage procedures has been demonstrated to extend the lifespan of the equipment and provide a safe working environment.

Nevertheless, certain constraints were identified with regard to the implementation of 5S in outdoor agricultural contexts. The cleaning and organisation steps of 5S are rendered challenging by environmental factors, including seasonal changes, soil conditions and weather. These conditions render it challenging to regulate soil and environmental contamination in open settings, such as fields, thereby hindering the ability to maintain a consistent level of cleanliness. These findings underscore the significance of user-centred methodologies for the efficacious implementation of 5S in agricultural work environments (Muotka et al., 2023).

Nevertheless, the implementation of 5S practices in maintenance and storage processes has resulted in an extension of equipment lifespan and the provision of a safe working environment. The implementation of standardisation and sustainability (self-discipline) measures, particularly in confined spaces, has proven effective in maintaining and storing equipment, leading to long-term cost savings. Similarly, Chourasia and Nema (2019) emphasised the effects of 5S in increasing order, quality and employee motivation in their study on 5S practices in educational institutions. This study demonstrates that 5S not only engenders physical order and efficiency, but also confers benefits in the psychosocial dimensions of employee satisfaction and job satisfaction by fostering collaboration. These findings indicate that 5S is a valuable tool in the agricultural sector, offering benefits beyond mere physical organisation and efficiency. It has also been shown to enhance employee satisfaction and motivation (Andersson et al., 2020).

Figure 1 provides a summary of the contributions of the 5S method in terms of productivity, safety and sustainability in the agricultural sector. The figure illustrates the applicability and benefits of the method in agricultural activities.

Table 2, presented in the Materials and Methods section, provides a detailed account of the advantages and challenges of the 5S method in agricultural activities, as observed across different geographical areas.

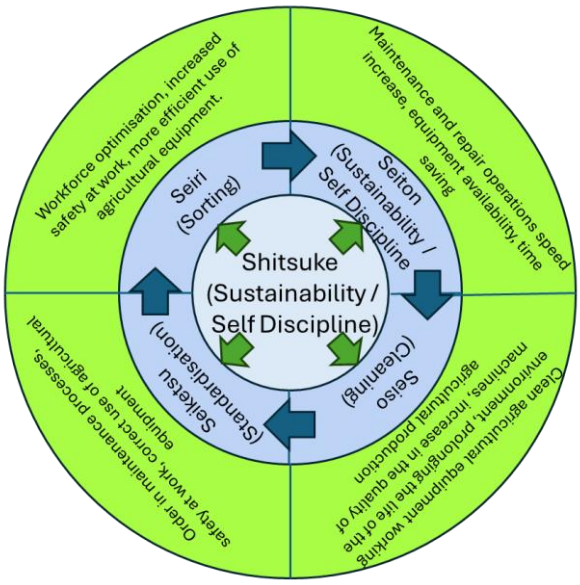

Figure 1. Applicability and contributions of the 5S method in the agricultural sector

Table 4. Effects of 5S implementation recommendations in different agricultural practices (before and after)

Agricultural Application Area	Situation Before 5S Implementation	Situation After 5S Implementation
Greenhouse Agriculture	The absence of cleanliness and order, coupled with the irregular placement of equipment and vehicles, resulted in a disruption to the workflow.	The implementation of the 5S methodology ensures the maintenance of cleanliness and orderliness, with equipment positioned in designated locations. This approach has been shown to enhance productivity and promote a safe working environment.
Tractor and Agricultural Equipment-Machinery Production	Frequent errors were observed during the production process, and the safety measures in place were deemed to be inadequate.	The implementation of 5S has resulted in an enhancement of quality, a reduction in errors, and the provision of a secure working environment for employees.
Animal Production (On-Farm)	The potential risks to animal health and hygiene were significant, and maintaining a hygienic environment was challenging.	The implementation of regular cleaning and organisational procedures has ensured the protection of animal health and occupational safety.
Open Field Agricultural Production (In Field)	The equipment was frequently damaged as a result of exposure to the elements, a lack of organisation and maintenance, and other factors.	The organisation of maintenance and storage areas has resulted in an extension of equipment life and the provision of a safe working environment.
Storage and Packaging Areas	The productivity of the operation was adversely affected by a lack of clarity regarding the spatial configuration of the facilities, which in turn led to a deterioration in the quality of the products.	The implementation of a storage system resulted in the organisation of storage areas, an increase in productivity and the maintenance of product quality.
Open field fruit-garden cultivation	The workflow was disrupted, and it proved challenging to organise according to weather conditions.	The implementation of 5S resulted in the organisation of the workflow and a reduction in the impact of weather-related restrictions.

The results demonstrate that while the 5S method has a positive impact on productivity and safety in enclosed environments, its effectiveness is constrained by environmental factors in open settings. Table 4 illustrates the enhanced productivity and safety outcomes attained in diverse agricultural settings through the deployment of the 5S methodology. The table demonstrates the efficacy of the methodology by contrasting the circumstances preceding and following the implementation of 5S in each area.

Table 4 illustrates the impact of implementing the 5S methodology in diverse agricultural contexts. It can be observed that the implementation of 5S practices in confined areas has a beneficial impact on aspects such as work safety, productivity, and quality control. Additionally, the organisation and cleaning steps have led to enhanced waste management. In particular, the sorting and standardisation processes contributed to the creation of a safer and more organised work environment for employees.

Conversely, the application of the methodology in open spaces revealed certain limitations due to environmental factors. The impact of seasonal changes and weather conditions on agricultural production makes the continuous implementation of some 5S steps challenging. Furthermore, ensuring consistent cleanliness in such environments is also a significant hurdle. This situation demonstrates the necessity for more flexible and user-oriented approaches to 5S applications in open areas.

As evidenced by the findings presented in Table 4, the 5S methodology has been demonstrated to both extend the lifespan of equipment and reduce costs associated with maintenance and storage processes. It can thus be concluded that the implementation of the 5S methodology in the agricultural sector is more straightforward in enclosed areas, whereas adaptations are required in open areas.

Discussion and Conclusion

This study has conducted a comprehensive evaluation of the applicability and benefits of the 5S method in the agricultural sector. While the 5S method has been demonstrated to yield effective results in terms of productivity and occupational safety in closed areas, specifically in the production of agricultural tools and machinery, it has been observed that this method encounters some limitations in open areas, particularly in the context of agricultural applications. In order to overcome these limitations, especially in open field applications, it is becoming increasingly important to adopt a user-oriented approach. In the literature, it is emphasised that methods such as Design Thinking can enhance the applicability of 5S in diverse contexts by prioritising the needs and experiences of employees (Muotka et al., 2023).

Conversely, the beneficial impact of Lean Thinking principles on both physical and psychosocial working conditions in agricultural work environments has been corroborated by studies conducted in the Swedish agricultural sector. The evidence suggests that Lean Thinking and 5S practices not only facilitate order within

the workflow, but also enhance employee cooperation and job satisfaction (Andersson et al., 2020). These findings underscore the significance of 5S benefits in enhancing occupational safety and employee motivation within the agricultural sector, suggesting that the methodology has a broader impact.

The field of ergonomics is becoming increasingly important in agriculture, as a means of improving the safety and comfort of workers engaged in modern farming methods. While traditional farming methods do not prioritise ergonomics, modern agricultural practices have introduced measures to ensure occupational safety and enhance productivity. The implementation of ergonomic practices enables workers to perform their duties in a safer and more productive manner, thereby enhancing the overall efficiency of agricultural production. Ergonomic practices in agriculture are of particular importance for the musculoskeletal health of workers, particularly in roles that require prolonged periods of static postures or involve the manual transportation of heavy loads. The physical demands of agricultural work, coupled with challenging working conditions, render this occupation prone to musculoskeletal discomforts, including back, lumbar and joint pain. The reduction of ergonomic risks has been demonstrated to enhance job satisfaction among workers and to contribute to a reduction in occupational accidents and health problems (Aygün et al., 2022). Consequently, the enhancement of ergonomic standards in agriculture represents a pivotal aspect in the safeguarding of occupational safety and the physical and psychological wellbeing of workers. The implementation of ergonomic principles in agricultural workplaces, in conjunction with workplace organisation methodologies such as 5S, represents an efficacious strategy for the establishment of a sustainable and secure working environment.

The issue of occupational safety in the agricultural sector is of increasing importance, particularly in the context of agricultural activities involving elderly farmers. Öz & Özgünaltay-Ertuğrul (2016) highlight the occupational safety risks faced by elderly farmers. In this study, it was asserted that the primary causes of accidents, such as those involving tractors, pose a significant risk to elderly farmers. In this context, the implementation of the 5S methodology, specifically the cleaning, organising and standardising steps, has the potential to create a safer working environment for older farmers. It is hypothesised that the implementation of the 5S methodology within the workplace will contribute to the prevention of accidents by reducing the potential for distraction.

The field of occupational safety in agricultural production in Turkey is confronted with significant challenges, particularly in the context of tractor accidents. The elevated average age of the tractor fleet in Turkey is a contributing factor to the rising incidence of accidents. The elevated average age of tractors serves to elevate the risks associated with safety, while simultaneously impeding agricultural productivity. Furthermore, data from European Union countries indicate a direct correlation between the age of the tractor and the frequency of accidents. Given that approximately half of the tractors in Turkey are over 25 years old, with an average age of around 40, the necessity for policies aimed at rejuvenating the tractor park in order to prevent accidents becomes evident (Özgünaltay-Ertuğrul et al., 2022). In this context, the implementation of the 5S methodology and regular maintenance of existing equipment represent an additional solution to reduce accident risks.

Furthermore, given the significant impact of tractor accidents on occupational safety in the agricultural sector, it is of paramount importance to ensure the accurate and consistent monitoring of these incidents. There is often a discrepancy between the details of accidents reported in the media and those reflected in official statistics. The aforementioned discrepancies render it challenging to ascertain the true extent of tractor accidents and to implement the requisite preventative measures. It is therefore evident that a more comprehensive and standardised data collection process is required in order to facilitate effective planning of occupational safety measures in the agricultural sector (Öz et al., 2023). A comprehensive approach to the reporting and analysis of tractor accidents will facilitate a more nuanced understanding of the underlying causes, which in turn will inform the development of more effective preventive measures. In this context, the Seiri (Sorting) and Seiton (Organising) steps of the 5S methodology can facilitate the accurate recording and analysis of accidents by regulating the flow of information in the workplace. An orderly and organised work environment can contribute to a reduction in risk by facilitating the implementation of safety measures in a more effective manner. Moreover, the standardisation afforded by the 5S methodology enables a more precise identification of the root causes of accidents and hazards. It is therefore possible to create safe working environments and to minimise risks in order to prevent accidents involving tractors in the agricultural sector.

The agricultural sector is characterised by a number of safety risks, which can be attributed to both biological and chemical hazards. Of particular concern are the risks associated with the use of spraying machines in pesticide applications. As stated by Alkan & Özgünaltay-Ertuğrul (2022), the utilisation of agricultural machinery in pesticide applications may give rise to a multitude of hazards and risks. Such risks include the presence of inadequate warning signage on the machinery itself, as well as the potential for operators to be exposed to chemicals. The 5S methodology has the potential to minimise such risks and can create safe working environments by ensuring the cleanliness and orderliness of machinery and equipment. In particular, the cleaning and organising steps can prevent the accumulation of pesticide residues and ensure that the machinery is properly maintained. Consequently, the probability of worker exposure to pesticides is diminished, thereby enhancing occupational safety.

This study provides a comprehensive examination of the contributions of the 5S method in terms of productivity, occupational safety and sustainability in the agricultural sector. The findings of the study demonstrate that the 5S methodology is particularly efficacious in terms of efficiency and organisation in closed areas. However, in open areas, it encounters challenges due to environmental factors. Nevertheless, it was also noted that the implementation of the 5S methodology has the potential to positively impact various aspects of agricultural operations. These include the extension of equipment

lifespan, a reduction in occupational accidents, and cost savings in maintenance and storage processes. The results demonstrate that the 5S method has considerable potential for enhancing occupational safety and productivity in the agricultural sector.

In particular, the implementation of regular cleaning, sorting and standardisation procedures in enclosed workspaces serves to enhance the safety of personnel and optimise the efficiency of operational processes. Furthermore, the implementation of sophisticated AI-driven systems, such as helmet detection technologies, can significantly enhance safety by facilitating the monitoring of compliance and reducing the incidence of human errors in agricultural machinery production facilities (Özüağ & Ertuğrul, 2024). Conversely, in open environments, it is of the utmost importance to ensure the adaptability of 5S practices in order to accommodate seasonal fluctuations. In this context, the integration of 5S methodology with sustainable and user-oriented approaches in agricultural areas has the potential to positively affect both occupational safety and employee motivation.

In conclusion, this study demonstrates the potential for the application of 5S methodology in the agricultural sector, and emphasises that significant improvements can be achieved in both production processes and occupational health and safety. Further studies should be conducted with the aim of increasing productivity in agricultural activities, with a view to developing a 5S implementation model that is flexible and suitable for environmental conditions, thus enhancing the effectiveness of the methodology.

Declarations

Author Contribution Statement

In this study, three authors were involved at different stages of the research process. The primary author, G.Ö.E., made significant contributions to the development of the research concept, the synthesis of relevant literature, the general composition of the study, the collection and analysis of data, and the preparation of comparative tables on the applicability of 5S practices in agricultural contexts. Additionally, İ.A. and E.U. contributed to the discussion of the study's findings, their alignment with the Sustainable Development Goals, and the finalisation of the manuscript. All authors were actively engaged in the writing process and approved the final version of the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

References

Alkan, B., & Özgünaltay-Ertuğrul G. (2022). Pestisit uygulamalarında kullanılan tarım makinalarında oluşabilecek tehlikeler ve riskler. Yücel, B., & Tolon, M, T. (Ed.), Ziraat ve su ürünlerınde kavramsal ve olgusal yaklaşımlar. (s.161-170). Akademisyen Kitabevi.

Andersson, K., Eklund, J., & Rydberg, A. (2020). Lean-inspired development work in agriculture: Implications for the work environment. Agronomy Research, 18(2), 324–345. https://doi.org/10.15159/AR.20.043

Aygün İ., Urkan E., & Özgünaltay-Ertuğrul G. (2022). Tarımsal üretimde ergonomiye bir bakış. Atılgan A. (Ed.), Biyosistem mühendisliği III. (s.155-171). Akademisyen Kitabevi.

United Nations Türkiye. (05, November 2024) Türkiye Sürdürülebilir Kalkınma Amaçları çalışmalarımız. https://turkiye.un.org/tr/sdgs

Chourasia, R., & Nema, A. (2019). Implementation of 5S methodology in higher education institute. International Research Journal of Engineering and Technology. 1795–1799.

EPA (United States Enviromental Protection Agency). (01, October 2024) Lean Thinking and Methods-5S. https://www.epa.gov/sustainability/lean-thinking-and-methods-5s#intro

Evcim, H. Ü., & Ertuğrul, G. Ö. (2017). Türkiye tarımında traktör kullanımı (2010). Tarım Makinaları Bilimi Dergisi, 13(1), 21-31.

Kurt, D., Karataş, Y., & Özgünaltay-Ertuğrul G. (2022). İş Sağlığı ve Güvenliği Bakımından Engelli Çalışanlar. İyit, N., Akyıldız, Y., & Hastaoğlu-Özbek, B. (Ed.), Sosyal ve Beşerî Bilimlerde Güncel Araştırmalar- II. (s.341-350). Gece Kitaplığı.

Moi, W. A., & Sing, S. H. (2021). Application of Toyota way incorporating kaizen, Kaikaku and 5S in agricultural sector. International Journal for Research in Applied Science and Engineering Technology, 9(10), 1565-1579.

Muotka, S., Togiani, A., & Varis, J. (2023). A design thinking approach: Applying 5S methodology effectively in an industrial work environment. Procedia CIRP, 119, 363-370. https://doi.org/10.1016/j.procir.2023.03.103

Öz, E., & Özgünaltay-Ertuğrul, G. (2016). İleri Yaşlı Çiftçilerin Tarımsal İş Güvenliğine Yaklaşımı. Tarım Makinaları Bilimi Dergisi, 12(4), 221-227. https://dergipark.org.tr/en/download/article-file/421372

Öz, E., Özgünaltay-Ertuğrul G., & Öz, H. (2023). Medyada yayınlanan traktör kaza haber içeriklerinin resmi istatistiklere uyumunun değerlendirilmesi. Özgünaltay-Ertuğrul G. (Ed.), İş Sağlığı ve Güvenliğinde Güncel Araştırmalar. (s.89-104). Akademisyen Kitabevi.

Özgünaltay-Ertuğrul G., Ertuğrul Ö., & Öz, E. (2022). Tarım traktörleri kazaları ve tarımsal mekanizasyon düzeyi ilişkisi: Türkiye örneği. Kazankaya A. & Doğan, A., (Ed.), Tarımsal Perspektif. (s.289-305). Iksad Publications.

Özüağ, S., & Ertuğrul, Ö. (2024). Enhanced Occupational Safety in Agricultural Machinery Factories: Artificial Intelligence-Driven Helmet Detection Using Transfer Learning and Majority Voting. Applied Sciences, 14(23), 11278. https://doi.org/10.3390/app142311278

Sidhu, B. S., Kumar, V., & Bajaj, A. (2013). The" 5S" Strategy by using PDCA cycle for continuous improvement of the manufacturing processes in agriculture industry. International Journal of Research in Industrial Engineering, 2(3), 10.

World Health Organization – WHO (2011). World Report on Disability. https://iris.who.int/bitstream/handle/10665/70670/WHO_NMH_VIP_11.01_eng.pdf?sequence=1