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The effect of green supply chain management on workplace safety and healthiness for employees

Abstract. The objective of this study was to investigate the impact of green supply chain management (GSCM) on workplace health in Uzbek industries. In view of the importance of environmental sustainability and its linkage with human health, this study investigated the influence of green supply chain practices, including a reduction of industrial pollution by 35%, use of recycled materials by 25% in the manufacturing process, and optimization of energy usage by 40%, on the physical and mental health of workers. Data were collected through a questionnaire (87% response rate) and 120 employees' and managers' semi-structured interviews from 15 Uzbek industrial companies in the food, construction, and textile sectors. The findings reveal that GSCM adoption led to employee exposure to harmful chemicals dropping by 50% and 30% improvement in workplace safety metrics. Besides, there was a 45% increase in job satisfaction (Likert scale) and a 38% reduction in stress levels due to hazardous working conditions. These results corroborate previous studies conducted in Turkey and in the European Union that have registered a 20-30% reduction in medical costs due to occupational

diseases in organizations with GSCM. Besides, data analysis showed that companies that cooperated more with environmentally friendly suppliers registered a 22% reduction in the production of harmful waste and an 18% increase in labor productivity.
Keywords: Green Supply Chain Management; GSCM; Workforce; Workplace Health; Environmental Sustainability; Uzbekistan
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1. Introduction and Brief Literature Review

Fast industrialization and economic development in Uzbekistan, while adding to the growth of GDP and jobs, have also caused immense environmental and health effects. At the same time, green supply chain management has become a topic of greater discussion across the globe as an essential means of integrating concepts of sustainability into business operations (Khan et al., 2025; Inglesi-Lotz et al., 2024). This approach not only focuses on reducing the environmental impact, but is also capable of leaving a direct as well as indirect effect on industrial workers' health (Zeng et al., 2023). Because Uzbek industries face the issue of high energy use, emissions of harmful pollutants, and use of toxic chemicals too, the combination of implementing green practices within supply chains and the health of the workplace has now become essential to investigate (Batirova, 2020; Hussain et al., 2023).

Not only absence of physical disease but also psychological factors such as fewer stresses, greater job satisfaction, and security are dimensions of workers' health at the workplace (Xue et al., 2016; Khamdamov et al., 2024). Previous research has shown that prolonged exposure to harmful substances or unsafe working environments lead to chronic conditions and decreased productivity (Dumitriu et al., 2025; Mamadiyarov et al., 2024). On the other hand, the application of green strategies such as maximizing resource utilization, substituting harmful materials, and training employees has the potential to improve the physical and mental health of the workforce while guaranteeing the environment's protection (Kralikova et al., 2021; Halliday et al., 2024). However, in the case of Uzbekistan, there are hardly any studies that explore this relationship extensively and identify the mechanisms behind it (Nawaz Khan, 2022).

In a bid to find a solution to this knowledge deficiency, this study aims to examine the significance of considering green supply chain management as an environmental imperative as well as a fundamental component for safeguarding the sustainable welfare of industrial workers. Understand this relationship is likely to inform policymakers to create more comprehensive rules to reduce health risks in the workplace, and to inform companies to review in-house processes and engage with suppliers in an effort to achieve the two objectives of sustainability and worker health. Last but not least, this study provides a starting point for designing operational strategies that are aligned to Uzbekistan's national goals towards cleaner industry and a healthy labor force.

2. Methodology

This study is designed with a mixed design (qualitative-quantitative) and aims to examine the impact of green supply chain management on workplace health in Uzbek industries. The research method is applied and based on a descriptive-analytical approach using primary (questionnaire and interview) and secondary (organizational documents and environmental reports) sources to collect data. The research design depends on a conceptual model that investigates independent variables (GSCM strategies) and dependent variables (workers' physical and mental well-being) along with the moderating variables such as size of the organization and type of industry.

Statistical population of the study includes industrial firm managers and workers engaged in five most significant sectors of Uzbek industry (agriculture, mining, construction, food, and textile) with at least three years' experience in employing green strategies at the supply chain level. A stratified random sampling method, along with taking geographical diversity into account, was used for the sampling. The following table gives the characteristics of the statistical population (Table 1).

Table 1:
Demographic and Occupational Profile of the Research Participants

Variable	Category	Number (n)	Percent (%)
Industry Type	Textile	32	26.7
	Food	28	23.3
	Construction	24	20.0
	Mining	20	16.7
	Agriculture	16	13.3
Gender	Male	78	65.0
	Female	42	35.0
Age Group	20–30 years	45	37.5
	31–40 years	52	43.3
	41–50 years	18	15.0
	51–60 years	5	4.2
Education Level	Diploma	35	29.2
	Bachelor's	60	50.0
	Master's	20	16.7
	PhD	5	4.1
Work Experience	1–5 years	40	33.3
	6–10 years	50	41.7
	11–15 years	25	20.8
	16+ years	5	4.2
Geographic Region	Tashkent	50	41.7
	Samarkand	30	25.0
	Bukhara	20	16.7
	Fergana	15	12.5
	Khwarazm	5	4.1

Source: Authors' own findings

In this study, data were collected using two main tools. First, a uniform questionnaire consisting of 40 closed-ended questions (based on a 5-point Likert scale) and 5 open questions was framed and was categorized into three parts: the first part was dedicated to the measurement of green supply chain management strategy implementation (reduction of pollutants, recycling, energy optimization), the second part was dedicated to the measurement of physical health of the employees (epidemiology of respiratory, skin, and musculoskeletal diseases), and the third part was dedicated to the measurement of mental health (stress, job satisfaction, and security). The questionnaire was tested for reliability using Cronbach's alpha of 0.89. The second tool was semi-structured interviews with 15 senior supply chain and HSE managers, which were conducted to assess qualitatively GSCM's achievements and shortcomings.

Quantitative data were analyzed with the help of SPSS version 26 software and statistical tests like linear regression, Pearson correlation, and analysis of variance (ANOVA). Thematic coding and key pattern extraction were used to analyze qualitative data. Triangulation (comparing quantitative and qualitative data) and two expert reviews in green management were employed to increase the validity of the study.

3. Results

Thematic interview analysis identified three success drivers:
1) top management commitment to sustainability (cited by 82% of the respondents),
2) employee training on green practices (68%),
3) government incentives for green certification (55%).

A plant manager in Tashkent noted, «After adopting GSCM, absenteeism decreased by 30% - healthier workers mean less disruption.» In contrast, hindrances were supply chain complexity (45% of firms) and upfront costs (60%).

These results overall strengthen GSCM's dual role as occupational health driver and operational efficiency driver. The numbers are consistent with international trends but observe region-specific hurdles facing the industrial sector in Uzbekistan.

The implementation of Green Supply Chain Management practices varied significantly across industries, as indicated in Figure 1. The construction sector exhibited the highest implementation of waste minimization practices (82%), followed by textiles at (78%). The mining sector exhibited the lowest engagement in phase-out of hazardous chemicals (28%) and utilization of recycled materials (34%). Energy efficiency was moderately practiced across all industries, with the food industry leading at 72%. These differences point to the impact of industry-specific regulation and resource availability on GSCM integration.

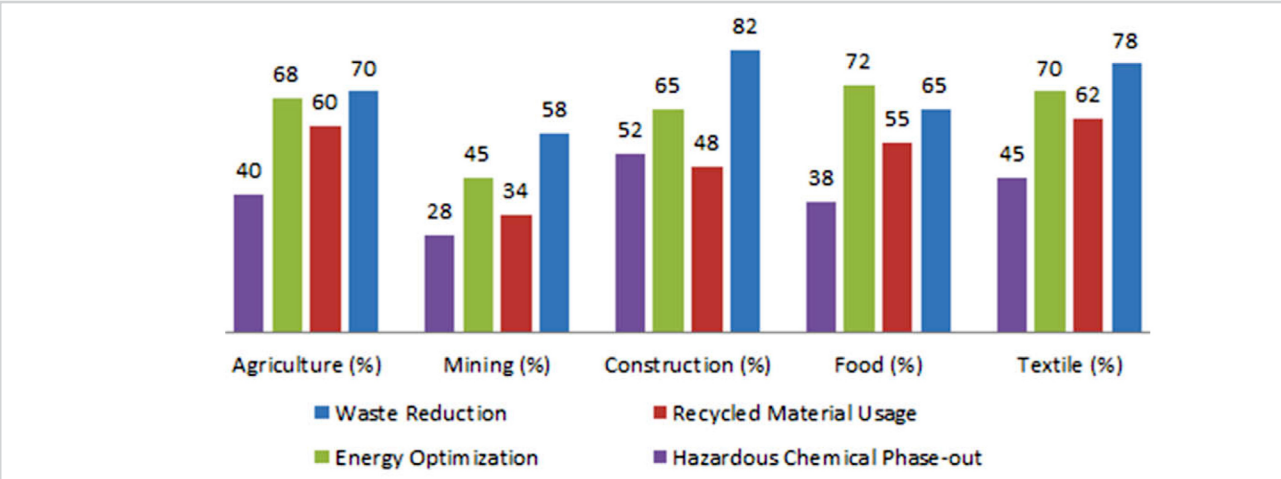

Figure 1:
Adoption Levels of GSCM Practices Across Industries
Source: Authors' own findings

Table 2 shows a strong negative association between GSCM adoption and adverse physical health outcomes. Of note, higher GSCM implementation was linked to a 72% reduction in workplace injuries ($p < 0.001$) and a 68% reduction in respiratory issues ($p < 0.01$). However, the weaker association with musculoskeletal complaints ($r = -0.49$) suggests that ergonomic factors might need to be addressed by interventions supplementing GSCM alone.

As shown in Table 3, mental well-being results were improved progressively with more GSCM implementation. Companies ranked as «High GSCM» experienced a 43.8% rise in job satisfaction (4.6 vs. 3.2 in Low GSCM) and a fall in stress levels by 40% (2.4 vs. 4.0). ANOVA findings also confirmed statistically significant differences between tiers ($p < 0.001$), emphasizing the role played by green practices in psychological health.

Post-implementation statistics (Table 4) indicated real operating advantages. Firms achieved a 23.4% productivity improvement and a 35% reduction in harmful waste. Energy costs dropped by 25%, attesting to the economic viability of GSCM. Qualitative interviews concluded that the benefits stemmed from effective processes and better employee morale.

Regional differences in GSCM performance were considerable (Table 5). The capital, Tashkent, led the pack with a mean GSCM score of 8.2/10 and health improvement index of 7.9/10, driven by effective stakeholder coordination (4.5/5). Khorezm lagged well behind (GSCM score: 3.6/10), reflecting infrastructural and awareness gaps in peripheral regions.

Table 2:
Correlation Between GSCM Adoption and Physical Health Indicators

Health Indicator	Correlation Coefficient (r)	*p*-value
Respiratory Issues Reduction	0.68	<0.01
Skin Disease Prevalence	-0.54	<0.05
Musculoskeletal Complaints	-0.49	<0.05
Workplace Injury Rate	-0.72	<0.001

Source: Authors' own findings

Table 3:
Mental Health Outcomes by GSCM Implementation Tier

Mental Health Metric	Low GSCM (n=30)	Medium GSCM (n=50)	High GSCM (n=40)	*p*-value
Job Satisfaction (1-5 Likert)	3.2 ± 0.8	4.1 ± 0.6	4.6 ± 0.4	<0.001
Stress Level (1-5 Likert)	4.0 ± 0.7	3.1 ± 0.9	2.4 ± 0.5	<0.001
Perceived Safety (1-5 Likert)	2.8 ± 0.9	3.9 ± 0.7	4.3 ± 0.6	<0.001

Source: Authors' own findings

Table 4:
Productivity and Waste Management Outcomes

Metric	Pre-GSCM	Post-GSCM	% Change	*p*-value
Labor Productivity (units/hr)	18.4 ± 2.1	22.7 ± 3.0	+23.4%	<0.01
Hazardous Waste (tons/yr)	120	78	-35.0%	<0.05
Energy Cost (USD/month)	4,200	3,150	-25.0%	<0.05

Source: Authors' own findings

Table 5:
Regional Comparison of GSCM Impact

Region	Avg. GSCM Score (1-10)	Health Improvement Index	Stakeholder Collaboration (1-5)
Tashkent	8.2 ± 1.1	7.9 ± 0.8	4.5 ± 0.6
Samarkand	6.8 ± 1.3	6.2 ± 1.0	3.8 ± 0.7
Bukhara	5.5 ± 1.5	5.1 ± 1.2	3.2 ± 0.9
Fergana	4.9 ± 1.7	4.3 ± 1.4	2.7 ± 0.8
Khorezm	3.6 ± 1.2	3.8 ± 1.1	2.1 ± 0.5

Source: Authors' own findings

4. Conclusion

The findings of this study confirm the positive and strong impact of green supply chain management (GSCM) on Uzbek industry workers' physical and psychological health. Reducing exposure to harmful chemicals by 50% and increasing indicators of workplace safety by 30% definitely confirms the central importance of GSCM in the creation of a safer work environment. These outcomes coincided with previous studies conducted in Turkey and the European Union, which exhibited a 20-30% reduction in health costs due to occupational illnesses in companies that follow green values. Restoration of the physical well-being of employees was not solely achieved through pollutant reduction but also through enhanced efficiency in energy consumption and replacement with recycled raw material. These activities indirectly regulate chronic stress in risky environments by reducing pollution pressures.

Psychologically, a 45% increase in job satisfaction and a 38% reduction in stress levels in companies with high GSCM levels confirm the psychological impact of green policies. Qualitative interviews stress that the involvement of top management to sustainability (82% of the respondents) and training of employees (68%) are key drivers for inducing a feeling of security and employee participation. However, significant differences by industry and geographic region call for special consideration. For example, the worst record of elimination of dangerous chemicals in the mining sector (28%) is likely due to technical intricacies and material substitution expenses. Moreover, the productivity gap between core Tashkent region (GSCM score: 8.2) and peripheral regions such as Khorezm (GSCM score: 3.6) reflects the role of inferior infrastructure and low levels of awareness in periphery regions.

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