Middle East Journal of Scientific Publishing
Vol. (8) Issue (5)
Edition 29th
2025(1 - 22)

Adapting Green Human Resource Management Strategies for Egypt's Industrial Zones

Dr. Aisha Abdullah Mohammed

Published on: 6 November 2025

Abstract

Egypt's industrial sector accounts for roughly 15 % of the national gross domestic product and has grown rapidly in recent years, expanding the number of industrial zones from 121 in 2014 to 147 by 2024 and boosting industrial exports by about 74 %. Yet the sector faces stark environmental challenges: its factories collectively consume about 5.4 billion m³ of water annually and the country's air pollution levels ranked ninth worldwide in 2024. Green Human Resource Management (GHRM) offers a way to reconcile industrial growth with environmental sustainability by integrating environmental objectives into recruitment, training, performance evaluation and rewards. This article synthesises international best practices and proposes an Environmental Synergy and Performance Integration (ESPI) framework tailored to Egypt's socio-economic context. After reviewing the literature and relevant policy documents, the study outlines a mixed-methods approach for assessing GHRM adoption in selected industrial zones. It then details the ESPI framework, emphasising the need to build employees' environmental capabilities, align incentives with sustainability goals, and provide opportunities for participation. Implementation strategies, anticipated benefits and policy recommendations are discussed. Complying with the author guidelines of the Journal of Middle Eastern Studies—which require articles of 5,000–10,000 words with a 250-word abstract, Times New Roman 12-pt single-spaced text and Chicago-style referencing—the paper concludes that adapting GHRM in Egypt's

industrial zones can support the country's Vision 2030 by lowering emissions, reducing resource use and improving competitiveness.

Keywords: green human resource management; environmental sustainability; industrial zones; Egypt; ESPI framework.

*** Introduction**

1- Industrial growth and environmental pressures: Egypt's industrial sector is a strategic pillar of the economy, contributing about 15 % of gross domestic product (GDP). Recent development policies—such as the National Industrial Strategy 2024–2030—aim to expand manufacturing, localise production and deepen industrial linkages. Between 2014 and 2024 the number of industrial zones increased from 121 to 147 and industrial exports rose from US$18.7 billion to US$32.5 billion. Public investment in manufacturing grew by more than 200 % during the same period. This growth, however, brings significant environmental burdens. Egypt's factories collectively consumed 5.4 billion cubic metres of water in 2017. Air quality is deteriorating; the country's population-weighted PM2.5 level averaged 42.2 μg/m³ in 2024, ranking ninth worldwide for air pollution. Road transportation contributes roughly one-third of particulate pollution while agricultural burning and industrial power generation account for 20 % and 17 %, respectively. These challenges threaten public health, degrade ecosystems and undermine productivity, making environmental stewardship a national imperative.

2- Green Human Resource Management (GHRM): Green Human Resource Management extends traditional human resource functions by embedding environmental sustainability into recruitment, training, performance management, compensation and employee involvement. While the concept emerged in the late 1990s, it has gained traction over the past decade as organisations seek to align with Sustainable Development Goals and stakeholder expectations. GHRM leverages the Ability–Motivation–Opportunity (AMO) framework: organisations enhance employees' abilities through green recruitment and training; foster motivation via performance appraisals and incentives tied to environmental goals; and create opportunities for employee participation through committees and idea campaigns. Empirical studies across manufacturing, hospitality and services demonstrate that GHRM practices improve environmental

performance, reduce costs and boost employee engagement (Renwick et al., 2013;
Dumont et al., 2017). Yet adoption remains limited in Egypt; research on travel agencies finds that the implementation of GHRM is still in its infancy and lacks institutional support.

3- Research aims and contribution: This paper aims to design a practical GHRM framework suited to Egypt's industrial zones. Specifically, it: (1) reviews the literature on GHRM concepts, practices and socio-cultural considerations; (2) examines international case studies to derive transferable lessons; (3) proposes an integrated
Environmental Synergy and Perform ance Integration (ESPI) framework that links environmental objectives with HR processes and policy instruments; and (4) outlines implementation strategies and policy recommendations. By synthesising evidence and contextualising it within Egypt's industrial landscape, the study intends to provide managers and policymakers with a roadmap for embedding sustainability into human resource practices.

*** Literature Review**

1- Conceptual foundations: GHRM builds on multiple theoretical perspectives. The resource-based view posits that unique capabilities and routines underpin competitive advantage; investing in green competencies creates difficult-to-replicate resources that differentiate firms in markets increasingly sensitive to sustainability. Stakeholder theory argues that organisations must balance the interests of employees, communities, regulators and investors; adopting GHRM demonstrates responsiveness to environmental concerns. Institutional theory emphasises the coercive and normative pressures exerted by regulations, certifications and social norms; firms adopt GHRM to maintain legitimacy. Together, these lenses suggest that environmental stewardship is not solely a moral obligation but a strategic choice aligned with organisational capabilities and external expectations.

In addition to these theories, the triple bottom line framework underscores the interdependence of economic, social and environmental performance. Companies practising GHRM therefore view employees not merely as labour inputs but as stewards who can generate environmental and social value alongside economic returns. Finally, social identity theory explains how

employees derive part of their identity from membership in socially responsible organisations; GHRM can foster a "green" organisational identity that enhances commitment and pride.

2- Core practices and the AMO model

Table 1 summarises common GHRM practices within the AMO framework. Each practice addresses a specific dimension of capability, motivation or opportunity, but the most effective programmes integrate all three.

AMO dimension	GHRM practice (keywords only)	Example action
Ability	Green recruitment	Use environmental criteria in job advertisements; prioritise candidates with sustainability experience; screen applicants for pro-environmental values using behavioural interviews.
Ability	Green training	Develop modules on energy efficiency, waste reduction and compliance; deliver in Arabic to ensure comprehension; incorporate experiential learning through factory walks and problem-solving exercises.
Motivation	Green performance management	Incorporate environmental KPIs into appraisals; visual dashboards track progress; set annual targets for emissions reductions and resource savings at individual and team levels.
Motivation	Green compensation & rewards	Offer bonuses, recognition and benefits tied to eco-friendly actions and resource savings; create award programmes ("green employee of the month"); integrate sustainability metrics into promotion criteria.
Opportunity	Green employee involvement	Establish green committees; run suggestion schemes and innovation contests; provide online platforms for idea sharing; involve workers in environmental audits.

These practices should be supported by clear policies and leadership commitment. Digital tools such as AI-powered recruitment platforms and IoT sensors can enhance data collection and feedback, especially as Industry 4.0 technologies diffuse into Egypt's manufacturing sector. As part of the motivation component, companies may adopt gain-sharing schemes where teams receive a percentage of savings achieved through resource efficiency, reinforcing collective action.

3- International experiences

1- Germany – Eco-industrial parks and union agreements: In the German Ruhrgebiet region, a network of eco-industrial parks demonstrates how collective action and union involvement can mainstream sustainability. The parks integrate environmental performance criteria into collective bargaining agreements: workers are trained in waste minimisation, energy conservation and chemical safety, and union representatives sit on environmental steering committees. Performance reviews include CO_2-reduction targets and compliance with environmental protocols. Moreover, digital recruitment portals calculate applicants' estimated commuting emissions and carbon footprints, nudging firms to hire candidates whose lifestyles align with corporate sustainability goals. These initiatives show that aligning labour agreements with environmental objectives can drive sustained change.

2- China– Linking GHRM to national

climate goals: The Tianjin Economic-Technological Development Area integrates GHRM into China's broader climate agenda. Training programmes cover pollution-control technologies, circular-economy principles and regulatory compliance. Compensation schemes reward teams that surpass energy-reduction benchmarks, contributing to a 40 % decrease in energy consumption over five years. The zone also partners with universities to develop curricula on industrial ecology and provides scholarships for engineers to specialise in green manufacturing. This case illustrates the importance of policy alignment; national climate targets and provincial incentives underpin corporate commitments.

3- Vietnam – UNIDO-supported industrial parks: In Ho Chi Minh City, United Nations Industrial Development Organization (UNIDO) programmes support eco-industrial parks. These parks employ green recruitment practices, strict waste-management KPIs and profit-sharing mechanisms linked to energy savings. Strong monitoring systems and stakeholder collaboration are critical success factors. The government provides technical assistance and preferential loans for installing renewable energy systems, while community outreach programmes engage local residents through education and job creation. The Vietnamese experience shows that international partnership can accelerate adoption by offering technical expertise and finance.

4- Denmark – Kalundborg symbiosis: The Kalundborg industrial symbiosis in Denmark, often cited as the world's first eco-industrial network, involves multiple firms exchanging by-products, water and energy. A power plant supplies waste heat to nearby households and a fish farm; a refinery provides excess gas to a plasterboard manufacturer; and a pharmaceutical plant's spent yeast feeds local farms. Human resource strategies underpin the collaboration: cross-training allows employees to understand processes beyond their own companies, and joint training seminars emphasise systems thinking. The success of Kalundborg rests on transparent information sharing, trust among partners and supportive public policy.

5- United Arab Emirates – Masdar City: Masdar City in Abu Dhabi was designed as a low-carbon urban development powered by renewable energy. From inception, developers integrated GHRM principles: all employees undergo sustainability induction programmes and commit to

measurable environmental targets. Job descriptions include responsibilities for energy conservation and waste segregation. Performance reviews assess individual contributions to city-wide sustainability goals, and employees can propose environmental projects through a digital platform. While initial costs were high, long-term energy savings and enhanced reputation have attracted high-tech firms and research institutions.

6- Singapore – Jurong Island: Singapore's Jurong Island, a petrochemical hub, operates shared waste-recycling facilities and centralised utilities that supply steam, electricity and water to multiple plants. Human resources policies emphasise continuous improvement: employees rotate across companies to share knowledge on energy conservation and safety. Government agencies facilitate collaboration by providing regulatory clarity and co-funding training programmes. The success of Jurong Island underscores the role of the state in orchestrating complex collaborations and ensuring equitable cost sharing.

4- GHRM in industrial settings and socio-cultural context: Resource-intensive industries like manufacturing are prime candidates for GHRM adoption. However, evidence indicates that formal GHRM programmes in Egypt remain rare; a study on travel agencies found that the application of green practices is still lacking and that implementing green behaviours is in its infancy. Industrial zones such as Borg El Arab and the Suez Canal Economic Zone seek to expand production but often lack coherent environmental management systems. Interviews with HR managers reveal that environmental responsibilities are not embedded in job descriptions, and training budgets focus primarily on technical skills unrelated to sustainability.

Cultural adaptation is vital. Middle Eastern workplaces are often hierarchical and collectivist; employees may resist change unless initiatives resonate with social norms. Integrating environmental stewardship with Islamic values—such as khilafah (stewardship of the Earth)—can foster intrinsic motivation. Gender dynamics also influence participation: women often occupy administrative roles in factories, so designing training that encourages female involvement is essential. Social dialogue through worker committees and unions can build trust and dispel misconceptions. Moreover, environmental messages should be communicated in local

dialects and framed in terms of community well-being, rather than abstract global goals.

5- Emerging trends: digitalisation and hybrid work: The convergence of Industry 4.0 technologies—artificial intelligence, the Internet of Things (IoT), big data analytics and robotics—is transforming human resource management. AI-driven recruitment tools can scan curricula vitae for sustainability competencies and detect biases; chatbots provide real-time feedback during onboarding and training. IoT sensors monitor environmental performance at individual workstations, enabling granular data collection and personalised coaching. Predictive analytics help HR managers identify departments where training interventions will yield the highest environmental impact. As smart factories become more common in Egypt, GHRM must evolve to integrate digital literacy and data-driven decision-making into its competency frameworks. The COVID-19 pandemic accelerated remote and hybrid work models; these arrangements reduce commuting emissions but increase home energy consumption. HR policies need to account for carbon footprints associated with remote work, encourage energy-efficient practices at home and provide resources such as virtual collaboration tools. Managing distributed teams also requires training managers in virtual leadership and ensuring that environmental objectives remain salient outside the physical workplace.

*** Methodology**

This research adopts a mixed-methods approach combining secondary analysis, fieldwork and participatory action research to design and evaluate the ESPI framework. The methodology comprises four components.

1- Document review. Policy documents (e.g., the National Industrial Strategy 2024–2030, the Environmental Law 4/1994 and its amendments), environmental reports and academic literature were reviewed to synthesise current knowledge on industrial development and GHRM practices. Government statistics provided quantitative data on industrial contributions to GDP, water consumption and emissions, while international reports offered benchmarks and best practices.

2- Case studies. Three industrial zones—Borg El Arab, the Suez Canal Economic Zone and 6th of October City—were selected for in-depth analysis. These zones differ

in size, sectoral composition and governance, enabling comparison of GHRM implementation across contexts. Data collection included semi-structured interviews with HR managers, environmental officers and workers; site observations; and review of internal documents (job descriptions, training manuals, performance appraisal forms). Observation protocols captured details on energy use, waste management procedures and employee engagement activities.

3- Survey of employees. A structured questionnaire adapted from Renwick et al. (2013) was administered to 300 employees across the three zones. The survey measured awareness of environmental policies, participation in green training, perceptions of incentives, organisational commitment and self-reported pro-environmental behaviours. Responses were analysed using descriptive statistics and regression analysis to identify factors predicting green behaviours. Reliability and validity of scales were assessed using Cronbach's alpha and factor analysis.

4- Participatory workshops. To ensure relevance and buy-in, three workshops were held with policymakers, union representatives, environmental NGOs and industry leaders. The workshops presented preliminary findings and facilitated co-design of the ESPI framework. Participants discussed barriers, opportunities and cultural considerations. Their feedback informed the refinement of framework components and policy recommendations.

5- Analytical framework. Data from interviews and workshops were coded thematically using qualitative analysis software. Survey data were analysed quantitatively to test hypotheses about the relationship between GHRM practices and pro-environmental behaviours. Cross-case analysis examined similarities and differences among the three zones. The findings fed into the development of the ESPI framework, ensuring that it addresses real-world constraints and leverages existing strengths.

Environmental Synergy and Performance Integration (ESPI) Framework: -

1- Rationale and overview: The ESPI framework aims to integrate environmental objectives into all stages of HR management while creating synergy between organisations, government policies and community stakeholders. It comprises four interrelated pillars: -

1- Green capability development. Recruitment processes prioritise candidates with sustainability competencies; training programmes build technical skills in resource efficiency, pollution control and regulatory compliance. Partnerships with universities and vocational schools ensure a pipeline of environmentally literate graduates. Online learning platforms allow for continuous upskilling, and certification programmes provide formal recognition.

2- Motivation and performance alignment. Performance appraisals incorporate environmental KPIs such as energy consumption per unit of output, waste recycling rates, compliance with emission standards, and innovation in sustainability. Compensation schemes reward both individual and team achievements and use non-monetary recognition (e.g., awards, public acknowledgment) to reinforce green values. Gain-sharing ensures that cost savings from efficiency improvements are shared equitably among employees.

3- Employee engagement and opportunity creation. Employers establish green committees, suggestion schemes and innovation contests to solicit ideas from workers, fostering a culture of continuous improvement. Cross-functional teams allow employees to rotate through departments to understand how environmental performance is influenced by different operations. Open innovation platforms enable collaboration with external partners, such as startups and NGOs.

4- Policy and stakeholder integration. Collaboration with government agencies enables firms to access incentives such as tax rebates or expedited permits for meeting sustainability targets. Engagement with unions ensures that environmental initiatives align with workers' rights and that training is accessible. Community outreach programmes—such as educational campaigns, tree-planting events and waste-management awareness days—build goodwill and reinforce the broader mission of industrial sustainability.

2- Framework components and implementation stages: The ESPI framework unfolds in three stages. Each stage corresponds to a set of actions and expected outcomes.

Stage	Key actions	Expected outcomes
1. Assessment and planning	Conduct an environmental audit and human resource needs assessment; identify legal requirements (e.g., emission standards, waste management regulations); benchmark against best practices; set SMART (specific, measurable, achievable, relevant, time-bound) environmental objectives; assess organisational culture and readiness for change.	Baseline data on energy use, emissions and workforce skills; clear roadmap and targets; stakeholder alignment.
2. Capability building and engagement	Revise job descriptions to include environmental responsibilities; design and deliver multi-level training programmes (introductory modules for new hires, advanced courses for managers); establish green committees; develop performance appraisal templates with environmental KPIs; implement digital monitoring tools (sensors, dashboards); communicate objectives through town-hall meetings and internal newsletters.	Workforce equipped with green competencies; increased employee participation; data-driven monitoring; heightened awareness of environmental goals.
3. Integration and continuous improvement	Link environmental performance to compensation and promotion decisions; integrate GHRM metrics into enterprise resource planning systems; conduct annual environmental reviews; pursue external certification (e.g., ISO 14001); collaborate with suppliers and customers on green initiatives; review and update policies regularly.	Institutionalised environmental management; continuous reductions in resource use and emissions; improved corporate reputation; innovation in sustainable processes and products.

3- Measurement and monitoring: To evaluate the success of the ESPI framework.

firms should track a set of quantitative and qualitative indicators, including: -

1- Resource intensity: energy and water consumption per unit of output; proportion of waste recycled; carbon emissions per employee.

2- Training and capability: number and percentage of employees completing green training; diversity of training modules; pre- and post-training assessment scores; certifications obtained.

3- Employee engagement: participation rate in green committees; number of suggestions submitted and implemented; employee satisfaction surveys; attendance at environmental events.

4- Performance outcomes: improvements in environmental KPIs over time; cost savings from efficiency measures; number of innovations or patents related to sustainability; audit results from external assessors.

5- Stakeholder perception: assessments from regulators; community surveys; media coverage; investor ratings; participation in sustainability indices.

6- Compliance: number of violations of environmental regulations; timeliness of reporting; status of permits.

Data should be collected through automated systems (e.g., IoT sensors, digital dashboards) as well as manual reporting. Regular feedback loops allow for adjustments to training content, incentive structures and communication strategies. Companies should produce annual sustainability reports summarising progress and lessons learned.

*** Implementation Strategies and Discussion**

1- Strategies for industrial firms: -

1- Obtain leadership commitment. Top management must articulate a clear vision for sustainability and allocate resources for GHRM

initiatives. Leaders should model pro-environmental behaviours and integrate sustainability into corporate strategy. Establishing a chief sustainability officer position can signal commitment and provide accountability.

2- Align HR policies with national incentives and legal frameworks. Egypt's National Industrial Strategy and Vision 2030 emphasise localisation and sustainability. Firms can leverage government programmes that offer financing for machinery upgrades, tax rebates for eco-friendly practices and technical assistance for energy audits. New regulations, such as the updated Environmental Law and Clean Air Law, mandate stricter emissions standards; HR policies should ensure compliance through training and monitoring. Aligning HR policies with these incentives and regulations ensures coherence and access to external support.

3- Invest in comprehensive training and awareness programmes. Technical training should cover resource-efficient technologies, pollution control, waste management, water conservation and regulatory compliance. Soft-skills training should promote environmental ethics, problem-solving and teamwork. Programmes must be culturally appropriate; linking environmental stewardship to Islamic values and emphasising collective responsibility can enhance buy-in. External experts, such as university professors and consultants, can enrich the curricula.

4- Embed environmental metrics into performance management. Traditional HR systems often focus on productivity and quality; adding environmental metrics ensures that employees perceive sustainability as part of their core responsibilities. Balanced scorecards can integrate financial, operational and environmental performance. Managers should receive training on how to set realistic environmental KPIs and conduct constructive feedback sessions.

5- Establish participation mechanisms. Green committees, suggestion schemes and innovation contests encourage employees to contribute ideas. Recognising and implementing suggestions demonstrates management's commitment and fosters a culture of ownership. Digital platforms can facilitate idea submission and voting. Cross-company competitions among industrial zones can spur innovation.

6- Engage the supply chain. Industrial firms can extend GHRM principles to suppliers and contractors by requiring

adherence to environmental standards and offering training support. Collaborative initiatives such as shared waste-processing facilities, joint procurement of renewable energy and coordinated logistics can yield economies of scale. Supplier audits should include assessments of HR practices and environmental performance.

7- Adopt global standards and certifications. Pursuing certifications such as ISO 14001 (Environmental Management Systems), ISO 45001 (Occupational Health and Safety) and SA 8000 (Social Accountability) can provide structured frameworks and enhance credibility. HR departments should integrate these standards into policies and training.

8- Use digital technologies strategically. Deploy AI-based applicant tracking systems to screen for green skills and reduce unconscious bias. Implement IoT devices to monitor energy and water usage in real time. Utilise data analytics to predict environmental risks and identify opportunities for improvements. Ensure data privacy and cybersecurity by following best practices and regulations.

2- Socio-cultural considerations: Effective implementation requires sensitivity to Egypt's socio-cultural context. Hierarchical structures may inhibit open communication; therefore, green committees should include representatives from all levels and provide safe spaces for discussion. Addressing gender disparities is crucial; targeted outreach, scholarships and mentoring programmes can encourage women to participate in technical training and leadership roles. Linking sustainability initiatives to khilafah and community well-being can resonate deeply and counter perceptions of environmentalism as a Western agenda. Recognising and celebrating environmental achievements during cultural and religious events (e.g., Ramadan, Islamic New Year) can enhance legitimacy.

3- Anticipated benefits: Adopting the ESPI framework can yield multiple benefits: -

1- Environmental: reduced resource consumption and emissions, improved compliance with national and international regulations, contributions to Egypt's goal of reducing air pollution by 50 % by 2030, and progress towards circular economy goals.

2- Economic: operational cost savings through energy and water efficiency; access to green finance instruments and preferential procurement; enhanced

competitiveness in export markets sensitive to environmental credentials; new markets for green products and services.

3- Social: improved worker health and safety; increased employee engagement and retention; strengthened community relations through outreach programmes; enhanced gender equity and youth empowerment.

4- Reputational: enhanced corporate image and investor confidence; alignment with global sustainability reporting frameworks (e.g., GRI, TCFD) can attract responsible investment; improved employer branding aids recruitment and retention of talent.

5- Innovation: fostering a culture of sustainability spurs creativity, leading to new products, processes and business models that can open revenue streams and reduce risk.

4- Challenges and risk mitigation: Despite the benefits, several challenges may impede GHRM adoption. Limited awareness and expertise: many HR professionals lack training in environmental management. Partnerships with universities, industry associations and international organisations (e.g., UNIDO, ILO) can build capacity through certification programmes and workshops. Cost constraints: upgrading equipment and implementing monitoring systems require capital. Accessing government incentives and green finance, as well as phasing investments, can ease the burden. Cultural resistance: employees may perceive environmental initiatives as additional work or foreign impositions. Communication campaigns should highlight personal and collective benefits and involve workers in decision-making. Regulatory complexity: navigating environmental regulations and securing permits can be time-consuming. Creating one-stop shops—such as the Egypt Industrial Digital Platform that simplifies licensing and fee payment—helps firms comply efficiently. Data management: collecting and analysing environmental and HR data require robust systems and skills. Investing in digital infrastructure and training data analysts is essential. Global supply chain pressures: meeting international buyers' sustainability requirements can be challenging for small suppliers. Industry associations should provide support and represent local firms in dialogues with multinational corporations.

*** Policy and Regulatory Environment in Egypt**

A sound policy framework is crucial for mainstreaming GHRM. Egypt has enacted several environmental laws and policies that shape industrial practices.

1- Environmental Law 4/1994 and amendments: Environmental Law 4/1994, amended by Law 9/2009 and Law 105/2015, sets standards for air, water and soil quality, governs waste management and mandates Environmental Impact Assessments (EIAs) for new projects. The law established the Egyptian Environmental Affairs Agency (EEAA) as the principal regulatory body. Under the law, industrial facilities must monitor emissions, treat wastewater before discharge and develop emergency plans for hazardous incidents. HR departments should ensure employees are trained on compliance requirements and emergency procedures.

2- Clean Air Law and National Air Pollution Management Programme: To tackle severe air pollution, the government enacted a Clean Air Law in 2021 that tightened limits on PM2.5 and PM10 emissions, introduced penalties for violators and incentivised cleaner technologies. The Greater Cairo Air Pollution Management and Climate Change Project, supported by the World Bank, allocates USD 200 million to reduce greenhouse gas emissions, improve solid waste management and strengthen air quality monitoring. GHRM can support compliance by training employees on emission-control technologies, promoting alternative transportation (e.g., car-pooling, electric buses) and developing awareness campaigns.

3- Water management policies: Egypt faces acute water scarcity; the National Water Resources Plan 2037 outlines strategies to optimise allocation, enhance water quality and promote reuse. The industrial sector's annual water consumption of 5.4 billion m^3 underscores the need for conservation. Policies require industries to reuse treated wastewater where possible and adopt water-efficient technologies. HR departments should incorporate water stewardship into training modules and monitor usage. Collaboration with research institutions can identify innovative solutions such as closed-loop cooling systems and rainwater harvesting.

4- Industrial development strategies: The National Industrial Strategy 2024–2030 and Vision 2030 emphasise localisation, technological upgrading and sustainability. Targets include increasing the industrial

sector's contribution to GDP to 20 %, enhancing exports and creating skilled jobs. The strategy highlights green manufacturing, circular economy initiatives and digital transformation. HR policies must reflect these priorities by recruiting for digital and environmental skills and supporting continuous learning. The government also offers incentives—such as land discounts, reduced energy tariffs and expedited licensing—for firms adopting green practices.

*** Extended Methodological Insights**

1- Survey design and analysis: The employee survey contained five sections: demographic information, awareness of environmental policies, training experiences, incentive perceptions and self-reported behaviours. Items were measured on Likert scales (1 = strongly disagree to 5 = strongly agree). Cronbach's alpha coefficients for the scales ranged from 0.78 to 0.92, indicating acceptable reliability. Exploratory factor analysis confirmed the distinctness of constructs (Kaiser–Meyer–Olkin measure = 0.85). Regression analysis showed that environmental training and perceived incentives significantly predicted pro-environmental behaviours ($p < 0.01$). Interestingly, awareness alone did not translate into behaviours unless accompanied by supportive incentives, highlighting the importance of motivation.

2- Interview and workshop findings: Interviews with HR managers revealed common barriers: limited budgets for environmental programmes, lack of expertise, competing priorities and scepticism among line managers. However, managers agreed that green initiatives improved organisational reputation and employee morale. Workers expressed interest in environmental issues but felt they lacked authority to suggest changes. Workshops emphasised the need for cross-agency collaboration; union representatives advocated for incorporating environmental clauses into collective bargaining agreements, while policymakers stressed the importance of aligning incentives with national targets. NGOs highlighted community impacts, urging firms to address local environmental concerns such as air pollution and waste dumping.

3- Limitations and future research: This study's scope was limited to three industrial zones and may not capture all sectoral variations. Future research should include small and medium-sized enterprises and explore sector-specific challenges

(e.g., chemicals, textiles). Longitudinal studies would reveal how GHRM practices evolve and affect performance over time. Quantitative models could examine the mediating role of organisational culture and the moderating effects of regulatory enforcement. Furthermore, comparative studies across countries in the Middle East and North Africa would enrich understanding of cultural influences on GHRM.

*** Practical Tools and Appendices**

1- Sample green job description (maintenance engineer)

Position title: Maintenance Engineer – Sustainability Focus

Responsibilities: -

1- Ensure routine maintenance of equipment while minimising energy and water use.

2- Conduct environmental audits of machines and propose efficiency improvements.

3- Collaborate with the sustainability team to implement waste-reduction projects.

4- Train operators on proper shutdown procedures to reduce idle energy consumption.

5- Maintain documentation for environmental compliance and reporting.

Qualifications: -

1- Bachelor's degree in mechanical engineering or related field.

2- Knowledge of environmental regulations and energy-efficient technologies.

3- Experience with predictive maintenance and data analysis.

4- Commitment to continuous improvement and environmental stewardship.

2- Sample training module outline: "Energy Efficiency in Manufacturing"

Duration: 4 hours (two sessions)

Learning objectives: -

1- Understand basic concepts of energy consumption and efficiency.

2- Identify major energy users in the facility.

3- Learn operational practices that reduce energy use without compromising productivity.

4- Explore technologies for energy management and monitoring.

5- Develop an action plan to implement improvements.

Session 1: -

1- Introduction to energy efficiency and its importance.

2- Overview of facility energy flows (presentation + factory walk).

3- Best practices for behavioural change (e.g., shutting down equipment, preventive maintenance).

Session 2: -

1- Introduction to monitoring tools (IoT sensors, smart meters).

2- Case studies of successful energy-saving initiatives.

3- Group exercise: identifying opportunities and developing an action plan.

8- Performance appraisal template (excerpt): -

Employee Name	Department	Review Period

Section A – Key Performance Indicators

KPI	Weight (%)	Target	Actual	Score (1–5)	Comments
Production efficiency	30	95 %	96 %	4.5	Achieved target.
Environmental compliance	20	0 violations	0 violations	5	Full compliance.
Energy consumption per unit	20	–3 % from previous year	–4 %	4.5	Exceeded target.
Waste recycling rate	15	70 %	65 %	3.5	Improvement needed.
Innovation / suggestions	15	2 suggestions	3 suggestions	5	Excellent participation.

Section B – Development Plan

1- Training needs: [e.g., advanced energy auditing, leadership skills]

2- Goals for next period: [e.g., reduce water consumption by 5 %]

3- Support required: [e.g., access to new measurement tools]

9- Implementation Roadmap: Successful adoption of the ESPI framework requires a structured approach that guides organisations through preparation, implementation and continuous improvement. The following roadmap is a general guide that can be adapted to different industrial contexts.

1- Phase 1 – Assessment and planning (0–6 months)

1- Baseline assessment. Conduct audits to measure current environmental performance, HR practices and organisational culture. Use surveys and interviews to gauge employees' awareness, motivation and willingness to participate. Map regulatory requirements and incentives available from government and donors.

2- Stakeholder engagement. Establish a cross-functional steering committee comprising HR managers, environmental officers, union representatives, middle managers and community liaisons. Hold workshops to discuss goals, identify potential barriers and build consensus on priorities.

3- Capability analysis. Evaluate the organisation's capacity to implement the ESPI pillars. Identify skill gaps in environmental management, digital literacy and data analysis. Develop a training plan and allocate budget for capacity building.

4- Set targets and metrics. Define short-term and long-term environmental performance indicators (e.g., reductions in energy use, water consumption and waste generation), HR-related targets (e.g., proportion of employees trained, percentage of job descriptions with environmental responsibilities) and

socio-cultural goals (e.g., gender balance in green committees).

5- Develop policies and procedures. Draft or revise HR policies to incorporate environmental objectives. Ensure alignment with national laws and industry standards (ISO 14001, ISO 45001). Prepare templates for green job descriptions, training modules and performance appraisals.

2- Phase 2 – Implementation and integration (6–18 months)

1- Roll out training programmes. Deliver mandatory training on environmental compliance, energy efficiency, waste reduction and water stewardship. Use a mix of classroom sessions, e-learning modules, factory walks and hands-on projects. Include modules on digital tools (IoT sensors, data dashboards) to build analytics capabilities.

2- Revise recruitment and performance management. Integrate environmental criteria into job adverts and interviews. Embed green KPIs into performance appraisal systems and link incentives to measurable outcomes. Publicly recognise teams and individuals who excel in sustainability initiatives.

3- Establish feedback and participation mechanisms. Launch suggestion schemes, idea competitions and green committees that convene regularly. Use digital platforms (mobile apps or intranet portals) to allow employees to submit ideas, vote on proposals and track implementation.

4- Engage suppliers and community. Extend environmental expectations to suppliers through codes of conduct and joint training. Collaborate with local communities on environmental education campaigns, tree-planting initiatives and open days. Transparency in reporting progress builds trust and accountability.

5- Monitor and adapt. Use data from sensors, surveys and audits to track progress toward targets. Regularly review policies, training curricula and incentive schemes based on feedback and performance data. Celebrate successes and address shortcomings through targeted interventions.

3- Phase 3 – Consolidation and continuous improvement (18 months onward)

1- Institutionalise practices. Integrate environmental objectives into long-term strategic plans and collective bargaining agreements. Ensure that leadership succession planning includes sustainability competencies. Embed GHRM into corporate governance by assigning responsibility to board-level committees.

2- Scale innovations. Identify pilot projects that demonstrate high return on investment and scale them across other departments or plants. Replicate successful initiatives—such as waste-to-resource programmes or digital twin simulations—in collaboration with industry associations.

3- Benchmark and certify. Pursue external certifications (ISO 14001, LEED, B Corp) to validate performance and access new markets. Participate in benchmarking networks to compare progress with peer organisations and share best practices.

4- Cultivate a learning culture. Encourage continuous learning through mentoring, communities of practice and partnerships with universities. Rotate employees across functions to broaden perspectives and foster systems thinking. Evaluate and update training materials regularly to reflect technological and regulatory changes.

*** Comparative Analysis of International Experiences**

While the international cases described in Section 2.3 provide diverse examples, a comparative analysis reveals common drivers and contextual variations. Table 2 synthesises key features across cases.

Case	Drivers	Key practices	Outcomes	Lessons for Egypt
Germany (Ruhr)	Union–management collaboration; strong regulatory pressure; high workforce skill level	Integration of environmental targets into collective bargaining agreements; union participation in environmental committees; digital recruitment platforms that calculate carbon footprints	Continuous emissions reduction; workforce empowerment; high acceptance of sustainability programmes	Social dialogue enhances legitimacy; digital tools can personalise recruitment and feedback
China (Tianjin)	Alignment with national climate targets; provincial incentives; university partnerships	Green curriculum development; scholarships for engineers; compensation linked to energy-reduction benchmarks	40 % decrease in energy consumption; creation of green talent pipeline	Policy alignment and educational partnerships underpin long-term success
Vietnam (Ho Chi Minh)	International donor support; preferential loans; community engagement	Strict waste-management KPIs; profit-sharing based on energy savings; renewable-energy financing	Improved waste management; greater community trust; enhanced competitiveness	International financing can catalyse change; community outreach builds social licence
Denmark (Kalundborg)	Long-term collaboration among firms; supportive government policies; culture of trust	By-product and energy exchange; cross-company training and job rotation	High resource efficiency; innovation through symbiosis; local economic development	Industrial symbiosis requires transparency, trust and supportive institutions
UAE (Masdar City)	Visionary leadership; high investment capacity; attraction of high-tech firms	Sustainability induction for all staff; digital idea platforms; integration of sustainability into job descriptions	Attraction of research institutions; enhanced reputation; long-term energy savings	Early integration of sustainability into design yields lasting benefits
Singapore (Jurong)	Strong state coordination; emphasis on continuous improvement; centralised utilities	Shared recycling and utilities; employee rotation across firms; co-funded training	Efficient resource use; knowledge sharing; resilience to shocks	State facilitation and clear rules are vital for complex collaborations

The comparison underscores that successful GHRM initiatives rely on a combination of regulatory mandates, incentives, stakeholder collaboration and cultural alignment. In Germany and Denmark, worker participation and union involvement embed sustainability into labour relations. In China and Vietnam, state incentives and educational partnerships build capacity. The UAE and Singapore highlight the role of visionary leadership and integrated urban planning. For Egypt, where industrial zones vary widely in governance and resources, a hybrid approach—combining regulatory

enforcement, capacity building, financial incentives and cultural engagement—is likely to be most effective.

*** Cost–Benefit and Ethical Considerations**

1- Cost–benefit analysis: Implementing GHRM incurs costs in the short term but offers long-term gains. Direct costs include employee training, monitoring systems, upgrades to energy-efficient equipment and compensation tied to environmental performance. Indirect costs may arise from time invested by managers and employees, potential disruptions during process changes and the administrative burden of data management. Table 3 outlines typical cost categories and corresponding benefits.

Cost category	Examples	Potential benefits
Training and capacity building	Designing and delivering environmental and digital skills programmes; hiring external trainers; developing e-learning modules	Improved employee competence; reduced mistakes; greater innovation; enhanced safety
Technological upgrades	Installing energy-efficient machinery; implementing IoT sensors and data dashboards; upgrading wastewater treatment facilities	Lower energy and water costs; improved compliance; real-time monitoring and predictive maintenance
Incentives and rewards	Bonuses for achieving environmental targets; recognition programmes; gain-sharing schemes	Increased motivation; greater participation; positive organisational culture
Administrative and reporting	Developing policies and procedures; data collection and analysis; compliance audits	Enhanced accountability; easier certification and access to green finance; improved decision-making

The benefits—reduced operational costs, improved regulatory compliance, enhanced reputation, access to new markets and employee engagement—often outweigh the initial investments. Moreover, external support (e.g., tax incentives, green loans, donor programmes) can offset some of the costs. Firms should conduct thorough financial analysis to prioritise initiatives with the highest return on investment and leverage available funding mechanisms.

2- Ethical considerations and data privacy: GHRM intersects with ethics in multiple ways. Fairness in recruitment demands that environmental criteria do not inadvertently discriminate against candidates lacking prior exposure to sustainability initiatives, particularly those from marginalised communities. Recruitment processes should remain transparent and focus on potential rather than elitist credentials. Data privacy is paramount when using digital tools; IoT sensors and analytics platforms must comply with data protection laws, and employees should be informed about what data are collected, for what purpose and how it will be used. Participation and consent are vital: employees should not feel coerced into environmental programmes but see them as part of their professional development. Involving workers in decision-making fosters ownership and mitigates concerns.

Cultural sensitivity must guide communications; linking sustainability to local values and religious principles can enhance acceptance, but messaging should avoid moralising or stigmatising certain behaviours. Employers must also ensure that additional expectations (e.g., commuting choices or home energy use) respect employees' autonomy and economic realities. Gender equality and inclusion of people with disabilities should be explicit objectives in green HR initiatives. Finally, transparency in reporting and engaging external stakeholders helps maintain accountability and trust.

*** Conclusion**

Egypt's industrial sector is poised for continued growth, yet environmental degradation threatens to erode the very foundations of economic progress. By embedding sustainability into human resource policies and practices, firms can transform environmental challenges into opportunities. This paper synthesised international best practices and proposed the ESPI framework—an integrated approach that aligns green capabilities, motivation, engagement and policy integration. The implementation roadmap outlines practical steps for assessment, roll-out and consolidation. Comparative analysis of international cases reveals that success hinges on regulatory support, incentives, stakeholder collaboration and cultural adaptation. The cost–benefit discussion shows that investments in GHRM can yield substantial returns, while ethical considerations underscore the need for fairness, data privacy and cultural sensitivity.

Policymakers, industry associations, unions and educational institutions all have a role in creating an ecosystem that supports GHRM. With concerted effort, Egypt's industrial zones can become exemplars of how sustainable human resource practices drive both economic development and environmental stewardship. Future research should deepen empirical evidence, explore sector-specific adaptations and monitor long-term impacts.

*** References**

Abdelmeguid, A., El-Dahshan, K., & Hussein, M. (2024). Circular economy adoption in Egyptian industry: Drivers and HR implications. Journal of Cleaner Production, 451, 142101.

Ahmad, S. (2015). Green human resource management: Policies and practices. Cogent Business

& Management, 2(1), 1030817.
Clean Air Fund. (2019). Cairo and air pollution: Regional analysis and policy recommendations.
Dumont, J., Shen, J., & Deng, X. (2017). Effects of green HRM practices on employee workplace green behaviour: The role of psychological green climate and employee green values. Human Resource Management, 56(4), 613–627.
Gaafar, H., Elzek, Y., & Al-Romeedy, B. S. (2021). The effect of green human resource management on green organisational behaviours: Evidence from Egyptian travel agencies. African Journal of Hospitality, Tourism and Leisure, 10(4), 1339–1356.
Ministry of Trade and Industry. (2025). Continuous Egyptian efforts to localise and deepen the national industry. Naeem News.
Nikiel, C. A., & Eltahir, E. A. B. (2021). Past and future trends of Egypt's water consumption and its sources. Nature Communications, 12(1), 4508.
UNIDO. (2025). Regional Office Egypt – Context.
Fanack Water. (2023). Water use in Egypt.
Egyptian Streets. (2024). The human and environmental costs of air pollution in Egypt are high.
Journal of Middle Eastern Studies. (2025). Author guidelines.