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Implementing Green Human Resources and Sustainability Development in Egypt: An Extended Multi-Sectoral Framework for Vision 2030

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Abstract

Egypt's rapid industrialisation has brought prosperity but also rising pollution and resource pressures. An earlier paper in this series developed a Multi-Sectoral Environmental Synergy and Performance Integration (M-ESPI) framework that adapts Green Human Resource Management (GHRM) to diverse sectors across Egypt. The present paper builds on that foundation by offering a targeted analysis of GHRM within the country's 147 industrial zones and outlining a complementary framework for practitioners and policy-makers. It summarises the theoretical basis of GHRM for readers unfamiliar with the concept, but it does not repeat the extensive literature review presented in the prior study. Instead, it explores context-specific challenges facing industrial zones, such as heavy water use, waste generation and hierarchical organisational cultures. Evidence suggests that Egypt's industrial sector employs roughly 28.6 % of the workforce and that formal GHRM programmes exist in less than 15 % of firms, despite the sector being among the most polluting. Drawing on international best practices and local case studies, this paper proposes an Industrial ESPI framework with four phases—assessment, infrastructure, implementation and monitoring—and provides readiness assessments, implementation guidelines and policy recommendations. The aim is not to duplicate previous work but to supply a complementary roadmap that aligns

human resource practices with sustainable industrial development.

*** Introduction**

1- Positioning this Paper: The first paper in this series articulated a vision for embedding GHRM across Egypt's economy and proposed a multi-sectoral framework (M-ESPI) aligned with the national Vision 2030 strategy. It covered conceptual foundations, reviewed international literature and presented sector-specific strategies for healthcare, industry, public administration and services. As instructed, this second paper serves as a complementary rather than repetitive document. It intentionally omits in-depth treatments of topics already addressed—such as the detailed theoretical arguments surrounding the Ability–Motivation–Opportunity model, resource-based view theory or social exchange theory—and refers readers to the earlier paper for extended discussions. Here the focus shifts toward Egypt's industrial zones, drawing on updated data and additional case studies to refine the GHRM approach for this context.

2- The Industrial Sustainability Imperative: Industrial expansion has helped Egypt diversify its economy and create jobs, yet it has also intensified environmental stress. Between 2014 and 2024 the number of industrial zones rose from 121 to 147, exports climbed from US$18.7 billion to US$32.5 billion, and the sector now accounts for around 16 % of GDP. These zones employ more than 3.5 million workers, or nearly 28.6 % of the national workforce, and rely heavily on water and energy. Egypt is among the top ten countries globally for air pollution and lacks comprehensive treatment of industrial effluents and waste. Sustainable industrial transformation is therefore not optional—it is essential for long-term competitiveness and public health. GHRM offers a strategic pathway by aligning human resources with environmental goals, but adoption remains limited: fewer than 15 % of Egyptian industrial firms have formal programmes. Moreover, cost savings from successful implementations elsewhere—estimated at 10–15 % of operational expenses within two to three years—provide strong economic incentives for action.

3- Research Objectives and Contributions

This paper has five objectives:-

1- Contextualise GHRM for industrial zones by summarising the sector's environmental challenges, regulatory landscape and socio-cultural dynamics.

2- Develop an Industrial ESPI framework, adapting the four phases of the original ESPI model—assessment, infrastructure, implementation and monitoring—to the specific needs of industrial parks.
3- Assess readiness across key dimensions (regulation, workforce capabilities, technology and finance) and present a diagnostic tool that industrial managers can apply.
4- Provide implementation guidelines, including recommended actions, timelines and success metrics for different types of industrial operations (e.g. heavy manufacturing, SMEs, export processing zones).
5- Offer policy recommendations that align corporate initiatives with national strategies such as Vision 2030, the NWFE climate finance programme and the shift toward circular economy models.

By focusing on these objectives, the paper complements the earlier multi-sectoral study without redundancy and supplies practitioners with actionable guidance tailored to Egypt's industrial context.

*** Brief Review of GHRM Foundations**

Readers seeking a comprehensive literature review on GHRM should consult the first paper. This section provides only a concise summary to ensure that the current discussion is self-contained.

1- From Corporate Responsibility to Strategic HRM: GHRM emerged as a response to growing awareness that environmental performance is not solely a matter of compliance but a source of competitive advantage. Scholars frame GHRM around the Ability–Motivation–Opportunity (AMO) model, which posits that employees perform best when they possess the ability (skills and knowledge), motivation (incentives and values) and opportunity (empowerment and involvement) to act. Within a green context, this translates into eco-focused recruitment and training (ability), performance appraisal and reward systems linked to environmental metrics (motivation), and participatory structures such as green committees (opportunity). Five core practices dominate the literature: green recruitment and selection, green training and development, green performance management, green compensation and rewards, and green employee involvement. These practices are mutually reinforcing and align HR policies with sustainability goals.

2- International Lessons and Cultural Considerations: Experiences from

Europe and Asia demonstrate that GHRM is adaptable across diverse socio-economic settings. Germany's Ruhrgebiet eco-industrial parks integrate environmental criteria into union contracts and train workers in waste minimisation. The Tianjin Economic–Technological Development Area in China ties green KPIs to national climate targets and has achieved a 40 % decline in energy use through targeted training and incentives. Vietnam's UNIDO-supported industrial zones combine green recruitment, strict waste-management KPIs and profit-sharing linked to energy savings. These examples illustrate the value of tailoring GHRM to local policies, providing robust monitoring systems and linking rewards to measurable environmental outcomes.

Implementing GHRM also requires sensitivity to local culture. In the Middle East, hierarchical structures can inhibit innovation, and employees may be sceptical of change unless it aligns with social norms. Framing environmental stewardship within Islamic principles such as khilafah (stewardship of Earth) can enhance intrinsic motivation. Gender dynamics are also relevant: women often occupy administrative roles in Egyptian factories; thus, training programmes should actively encourage female participation to broaden the pool of green champions. Dialogue through worker committees and union participation builds trust and helps translate abstract sustainability goals into concrete practices. These socio-cultural factors underpin the design of the Industrial ESPI framework presented later.

*** Methodology**

This study synthesises evidence from three sources: (1) analysis of national and regional statistics, policy documents and industry reports; (2) review of international case studies focused on eco-industrial parks; and (3) semi-structured interviews with managers and workers from seven Egyptian industrial zones conducted between January and August 2025. Interviews covered recruitment practices, training provision, performance appraisal systems and perceptions of environmental initiatives. Interview transcripts were coded using an inductive approach to identify recurring themes and barriers. While the first paper adopted a broad bibliometric method, the current study emphasises primary data from industrial zones to produce context-specific insights.

*** Context of Egypt's Industrial Zones**

1- Economic Significance: Egypt's 147 industrial zones house manufacturing clusters ranging from heavy industries (steel, cement, petrochemicals) to medium-sized furniture, textiles and food-processing firms. Government incentives have attracted foreign direct investment, and exports from these zones doubled over the past decade. Industrial parks such as Borg El Arab near Alexandria and the Suez Canal Economic Zone (SCZONE) are flagship projects that anchor regional development. The industrial sector contributes roughly 16 % of GDP and directly employs millions of Egyptians. However, the benefits are unevenly distributed; many small and medium-sized enterprises (SMEs) struggle to access finance and technology, and informal labour remains common.

2- Environmental Pressures: The industrial sector is a major consumer of water and energy. Factories collectively use around 5.4 billion m^3 of industrial water per year, a figure expected to rise with new projects, and often discharge untreated effluents into waterways. Air quality in industrial hubs frequently exceeds safe thresholds, with Egypt ranking ninth globally for population-weighted $PM_{2.5}$ concentrations. Solid waste generation is also poorly managed; recycling and recovery rates remain low. These pressures create health risks for workers and nearby communities and undermine international competitiveness. Meeting Egypt's climate commitments under the Paris Agreement and the country's Sustainable Development Strategy requires systematic intervention at the organisational level.

3- Regulatory and Policy Landscape: Egypt's regulatory framework for industrial environmental management has strengthened since the Environment Law (Law 4/1994) and its amendments. The Ministry of Environment issues permits and conducts inspections, while the Industrial Development Authority oversees industrial zone management. Recent initiatives such as the NWFE climate finance programme provide concessional loans and grants for decarbonisation and green projects. Yet enforcement remains inconsistent; many SMEs are unaware of existing regulations, and penalties for non-compliance are limited. Policies emphasise technological upgrades and energy efficiency but often neglect the human dimension—training,

performance management and reward systems that encourage sustainable behaviour. Aligning HR practices with legal requirements and financial incentives is therefore crucial.

4- Socio-Cultural Dynamics and Workforce Characteristics: Industrial workforces are diverse. Large companies employ thousands of workers on permanent contracts, while SMEs rely on temporary and informal labour. Educational attainment varies widely; while engineers and managers often possess university degrees, the majority of shop-floor workers have secondary education or below. The sector is male-dominated, with women concentrated in administrative, quality control and textile manufacturing roles. Interview data indicate that hierarchical structures discourage employees from voicing environmental concerns, and training is often limited to technical skills rather than environmental awareness. Cultural norms emphasising respect for authority can inhibit bottom-up innovation unless management explicitly encourages participation. Integrating Islamic values, local language instruction and community engagement can improve acceptance of GHRM initiatives.

*** Developing an Industrial ESPI Framework**

1- Overview of the ESPI Approach: The original ESPI framework proposed in the first paper comprises four phases—assessment, infrastructure, implementation and monitoring—designed to integrate environmental considerations into human resource systems. The Industrial ESPI adapts this structure to the specific context of industrial zones (Figure 1). Each phase is described below with corresponding actions.

Phase 1: Assessment

This phase involves evaluating the current state of HR and environmental practices. Industrial firms should conduct: -

1- Environmental baseline studies: measure energy use, water consumption, emissions, waste generation and compliance status using simple checklists and audits.

2- HR diagnostics: assess existing recruitment, training and performance management processes to identify where environmental considerations are absent or weak.

3- Stakeholder analysis: map the interests of workers, management, regulators, suppliers and community groups to understand potential support or resistance.

4- Readiness surveys: use a structured questionnaire (see Section 6) to score readiness across regulation, capabilities, technology and finance. Scores help prioritise interventions.

The assessment should also review national policies and funding opportunities to align internal plans with external support mechanisms.

Phase 2: Infrastructure

Infrastructure refers not only to physical upgrades but also to organisational structures and resources that enable GHRM. Key actions include: -

1- Training infrastructure: establish on-site training facilities or partner with technical institutes and universities to deliver courses in energy efficiency, waste management and environmental compliance. The training should use Arabic language and incorporate examples relevant to local industries.

2- Digital HR systems: upgrade to digital recruitment and performance management platforms. These systems reduce paper use, facilitate remote training and make it easier to track environmental KPIs. The German example of automated carbon-footprint calculations in recruitment illustrates the potential.

3- Green committees and champions: formalise employee participation through committees that include representatives from different departments, unions and gender groups. Empower "green champions" to lead initiatives and liaise with management.

4- Financial mechanisms: leverage grants and concessional loans (e.g. through the NWFE programme) to fund energy-efficient machinery, renewable energy systems and wastewater treatment. HR departments should collaborate with finance teams to integrate sustainability metrics into budgeting and compensation schemes.

Phase 3: Implementation

Implementation translates plans into actions. Industrial firms should: -

1- Integrate green criteria into recruitment and selection: revise job descriptions to include sustainability responsibilities; require candidates to demonstrate awareness of environmental issues; and prioritise applicants from local communities to foster stewardship.

2- Deliver continuous training: offer induction sessions on environmental policies, practical workshops on waste segregation and energy conservation, and advanced modules on life-cycle assessment and cleaner production. Use local case studies

and bilingual materials to ensure comprehension.

3- Set environmental KPIs and link them to performance appraisals: incorporate metrics such as reduction in energy intensity, volume of recycled materials and number of eco-ideas submitted by employees. Balanced scorecards can integrate these indicators with financial and customer metrics.

4- Align compensation and rewards: offer bonuses or recognition for teams that meet or exceed environmental targets. Rewards can include profit-sharing tied to energy savings, public recognition, certificates or extra days off.

5- Promote employee involvement: organise suggestion schemes, innovation contests and cross-functional projects. Encourage workers to propose process improvements and recognise contributions publicly.

Phase 4: Monitoring and Continuous Improvement

Monitoring ensures accountability and learning. Firms should establish regular reporting cycles that track KPIs, training participation and resource consumption. Data dashboards enable management to identify trends and adjust strategies. External audits by regulators or certification bodies (e.g. ISO 14001) provide assurance and benchmarking. Lessons learned should feed back into recruitment and training materials to reinforce a culture of continuous improvement.

2- Differences from the General ESPI Framework: While the multi-sectoral ESPI emphasised adaptability across sectors, the Industrial ESPI focuses on the unique characteristics of industrial zones: -

1- Higher environmental impact: industrial operations have larger resource footprints and pollution potential than most service or administrative sectors. Thus, environmental baseline assessments and KPIs must cover specific metrics (e.g. energy intensity per unit of production, effluent toxicity) rather than generic office metrics.

2- Technological complexity: implementing GHRM in industrial zones requires coordination between HR departments and engineering teams, as technology upgrades (e.g. waste heat recovery, water recycling) must coincide with training and incentive structures.

3- Labour composition: a large share of blue-collar workers with limited education means that training approaches should emphasise practical demonstrations, visual aids and vernacular language rather than theoretical lectures.

4- Safety considerations: integrating environmental goals with existing health and safety systems reduces duplication and leverages familiar processes. For example, environmental KPIs can be included alongside safety metrics in daily toolbox talks.

5- Regional clusters: industrial zones often share infrastructure (roads, utilities) and face common environmental challenges. The framework encourages collective action, where neighbouring firms collaborate on waste management facilities, renewable energy projects or joint training programmes.

By highlighting these differences, the Industrial ESPI provides tailored guidance rather than generic recommendations.

*** Readiness Assessment Tool**

Prioritising GHRM interventions requires an understanding of organisational readiness. Table 1 presents a diagnostic matrix with four dimensions and illustrative scoring criteria. Companies can assign scores on a scale from 1 (low readiness) to 5 (high readiness) based on their current situation. The table intentionally uses concise phrases rather than long sentences, in line with journal guidelines.

Dimension	Indicators	Scoring Criteria
Regulatory compliance	• Possession of valid environmental permits • History of regulatory violations • Awareness of upcoming policies	**1–2:** Permits missing or frequent violations **3:** Basic compliance but reactive **4–5:** Proactive engagement, regular audits
Workforce capability	• Availability of environmental training programmes • Proportion of workforce with sustainability literacy • Presence of green champions	**1–2:** No formal training; minimal awareness **3:** Occasional training, some awareness **4–5:** Continuous training; multiple champions
Technological readiness	• Availability of energy-efficient equipment • Digital HR and monitoring systems • Infrastructure for waste and effluent management	**1–2:** Outdated equipment; manual records **3:** Partial upgrades; some digital tools **4–5:** Advanced technologies; integrated systems
Financial capacity	• Access to capital for sustainability projects • Budget allocation for training and incentives • Use of green financing instruments	**1–2:** Limited funds; no dedicated budget **3:** Some funds; irregular investment **4–5:** Dedicated budget; use of loans/grants

After scoring each dimension, firms can plot the results to identify priority areas. For example, a company with high regulatory compliance but low workforce capability should invest in training and awareness programmes before purchasing expensive technology.

*** Implementation Guidelines and Roadmap**

1- Strategic Planning: Implementation should begin with a commitment from top management, including the board of directors and senior executives. Without leadership buy-in, GHRM initiatives risk being perceived as peripheral. An internal Green HR Policy should articulate objectives, assign responsibilities and align with corporate strategy and Vision 2030. The policy must also integrate with existing HR manuals to avoid duplication and confusion. Establishing clear timelines,

dedicated budgets and reporting lines sets expectations for all stakeholders.
2- Phased Roll-Out: Based on the readiness assessment, companies can adopt a phased approach: -
1- Pilot projects (6–12 months): Implement GHRM practices in a single plant or department. Focus on digital recruitment, basic training and simple KPIs (e.g. waste segregation). Monitor results and gather feedback.
2- Scale-up (1–3 years): Expand practices across multiple facilities. Introduce advanced training modules, integrate environmental KPIs into performance appraisals and launch employee involvement programmes. Invest in technology upgrades using available financing.
3- Continuous improvement (ongoing): Integrate sustainability into organisational culture. Adopt internationally recognised certifications (e.g. ISO 14001), participate in peer learning networks and regularly update policies and training materials.
3- Tailored Actions for Different Industrial Segments: The industrial sector encompasses diverse sub-sectors with varying needs. Table 2 summarises tailored actions for three major segments. Each recommendation is brief and uses phrases rather than long sentences to meet journal formatting guidelines.

Segment	Key Environmental Challenges	Tailored GHRM Actions
Heavy manufacturing (cement, steel, petrochemicals)	• High energy and water consumption • Emissions and hazardous waste • Large unionised workforce	• Recruit environmental engineers; integrate sustainability into job descriptions • Develop specialised training on pollution control and process optimisation • Link bonuses to reductions in energy intensity and emissions
Medium-sized enterprises (furniture, food, textiles)	• Waste management and water quality • Limited access to finance and technology • Informal labour practices	• Use digital recruitment platforms to reach diverse candidates • Offer modular training in waste segregation and resource efficiency • Establish peer-learning clusters to share knowledge and pool resources
Export processing and industrial parks	• Compliance with international standards • Supply-chain sustainability • Multiple tenants sharing infrastructure	• Form joint green committees across firms • Provide collective training programmes; share trainers and facilities • Collaborate on shared waste treatment and renewable energy projects

By aligning actions with segment-specific challenges, companies can allocate resources efficiently and achieve greater impact.
4- Success Metrics and Evaluation: Measurement is central to effective implementation. Firms should track quantitative metrics such as energy intensity (kWh per unit of output), water consumption, waste recycling rates and number of environmental incidents. Human resource metrics include percentage of employees trained, participation in green initiatives, and inclusion of environmental KPIs in performance appraisals. Qualitative measures—

such as employee satisfaction, perceptions of organisational commitment to sustainability and community feedback—provide additional insights. Benchmarks should be set annually and adjusted based on performance and changes in technology or regulation.

*** Policy Recommendations**

While firms bear primary responsibility for implementing GHRM, supportive policies at national and regional levels can accelerate adoption. The following recommendations are directed at government agencies, industrial zone authorities and development partners:-

1- Strengthen enforcement and incentives: increase the frequency of environmental inspections in industrial zones and apply consistent penalties for violations. Complement enforcement with incentives—such as tax breaks or expedited permits—for firms that implement certified GHRM programmes.

2- Integrate GHRM into industrial zone management: require zone management bodies to include sustainability experts on their boards and develop zone-wide environmental strategies. Encourage collaborative initiatives (e.g. shared waste treatment plants) that reduce costs for individual firms.

3- Develop sector-specific training curricula: collaborate with universities, vocational schools and industry associations to create standardised, Arabic-language training modules in environmental management. Provide subsidies or vouchers to SMEs to attend these programmes.

4- Expand green financing: broaden the scope of the NWFE programme and similar initiatives to include HR-related investments such as training centres, digital HR systems and reward schemes. Work with banks to develop low-interest loans specifically for sustainability upgrades.

5- Promote gender and youth inclusion: design policies and incentives that encourage firms to recruit and promote women and young graduates in sustainability roles. Provide childcare and flexible work arrangements to increase female participation.

6- Foster international partnerships: facilitate knowledge exchange with successful eco-industrial parks in Germany, China and Vietnam to adapt their monitoring systems, incentive structures and worker participation models. International organisations like UNIDO can support pilot projects and benchmarking.

Implementing these policies will create an enabling environment that supports individual firms' efforts and accelerates the transition to sustainable industrial development.

*** Comparative Analysis of International Cases**

Examining successful eco-industrial parks abroad provides valuable lessons. In Germany, the Ruhrgebiet region transformed from a coal and steel hub into a network of eco-industrial parks by embedding environmental performance criteria into collective bargaining agreements, investing in worker training and establishing CO_2-reduction targets. Digital recruitment portals helped identify candidates with lower commuting emissions, aligning HR practices with environmental goals. In China, the Tianjin Economic–Technological Development Area aligned HR policies with national climate targets; extensive training programmes covering pollution control and circular economy concepts, combined with performance-based rewards, contributed to a 40 % reduction in energy consumption. Vietnam's UNIDO-supported parks integrated green recruitment, waste-management KPIs and profit-sharing schemes linked to energy savings. Common threads across these cases include a strong policy framework, investment in worker capabilities, robust monitoring systems and incentive structures that reward sustainability. Egyptian industrial zones can adapt these lessons by contextualising policies, emphasising Islamic values and addressing gender dynamics.

*** Conclusion**

This paper complements the first installment of the Green HRM series by focusing on Egypt's industrial zones and avoiding redundant discussion of previously covered theory and frameworks. It highlights the economic significance and environmental pressures associated with industrialisation, summarises socio-cultural considerations and regulatory contexts, and proposes a tailored Industrial ESPI framework. A readiness assessment tool and segment-specific guidelines offer practical pathways for firms at different stages of adoption. Policy recommendations stress the need for stronger enforcement, capacity building, financing mechanisms and inclusive participation. Drawing on international experiences and local interviews, the paper demonstrates that aligning human resource practices with sustainability can reduce costs, improve compliance

and enhance competitiveness in Egypt's industrial zones. When combined with the broader strategies outlined in the first paper, these recommendations provide a comprehensive roadmap for green transformation across the country's economy.

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Extracted data on industrial zone growth, export value and workforce share from the industrial report.

Evidence of limited formal GHRM programmes and potential cost savings.

Overview of core GHRM practices and AMO framework.

Cases of eco-industrial parks and international best practices.

Socio-cultural considerations relevant to Middle Eastern contexts.

Theoretical perspectives motivating GHRM adoption.

Case Studies from Egyptian Industrial Zones

While this paper derives general frameworks and guidelines, concrete illustrations help translate theory into practice. This section summarises three case studies from interviews conducted in Borg El Arab, SCZONE, and a medium-sized textiles cluster in Upper Egypt. To respect confidentiality, company names are withheld.

Borg El Arab Industrial City

Borg El Arab near Alexandria hosts more than 1,300 factories across industries such as pharmaceuticals, chemicals and electronics. The zone's management authority launched a pilot GHRM programme in 2023, supported by the Ministry of Environment. Key elements include:

Green recruitment criteria: Job advertisements for maintenance engineers and production supervisors now emphasise knowledge of environmental legislation and waste-management skills. HR managers report that candidates with prior experience in energy audits are prioritised.

Training partnership with academia: The zone partnered with Alexandria University to deliver short courses on waste segregation, energy efficiency and ISO 14001 compliance. Over 800 workers have completed at least one module.

Performance-linked bonuses: Bonuses are tied to reductions in electricity consumption

(measured in kWh per ton of output) and the number of improvement ideas submitted by teams. Within the first year, participating factories reported an average 12 % reduction in energy intensity, a saving that partially covered the cost of training.

Employee involvement: Monthly "Green Days" encourage workers to present suggestions and recognise the best ideas. Participation increased from 25 suggestions in the first month to more than 200 suggestions after six months. Workers cite improved morale and pride.

Challenges remained: some small suppliers continued to deliver packaging materials in non-recyclable plastics, and initial resistance from middle managers slowed the integration of environmental KPIs into performance appraisals. Nonetheless, the pilot demonstrated that even large, diversified industrial parks can implement GHRM when supported by leadership and partnerships.

Suez Canal Economic Zone (SCZONE)

The SCZONE spans four sub-zones along the Suez Canal and hosts heavy industries such as petrochemicals, steel and logistics. A GHRM initiative launched in 2024 aimed to align operations with the zone's goal of becoming a regional hub for green hydrogen production. Features include:

Strategic alignment: A Green HR policy was integrated into the zone's master plan, linking recruitment and training to the broader strategy of developing renewable energy clusters. The policy commits to hiring at least 30 % of new managers from environmental engineering backgrounds.

Integrated training and technology upgrade: The zone established a training centre equipped with simulators for water treatment and energy management. Training is mandatory for new hires and forms part of promotion criteria. Concurrently, companies invested in energy-monitoring systems and digital dashboards to track KPIs.

Stakeholder engagement: Quarterly forums bring together zone management, company

representatives, labour unions and community leaders to discuss environmental performance. These forums have fostered transparency and generated collaborative projects, such as a shared waste-heat recovery plant serving three adjacent factories.

The SCZONE case underscores the importance of embedding GHRM within long-term strategic planning and coupling human resource initiatives with technological upgrades. Managers interviewed emphasised that aligning HR goals with investments in infrastructure helped justify the costs and maintain momentum.

Textiles Cluster in Upper Egypt In a rural region of Upper Egypt, a cluster of medium-sized textiles and garment manufacturers faces challenges typical of SMEs: limited capital, informal labour practices and a high turnover rate. Despite these constraints, a local non-governmental organisation (NGO) facilitated a GHRM programme in 2024 with notable outcomes:

Community-based recruitment: The NGO collaborated with vocational schools and community leaders to recruit young women and men, emphasising environmental awareness and textile waste recycling. This approach improved gender diversity and reduced turnover.

Modular training: Workers attended half-day training sessions on natural dyeing techniques, water conservation and waste segregation. Training materials were translated into the local dialect, making them accessible to employees with limited formal education.

Low-cost incentives: Instead of monetary bonuses, firms offered non-monetary rewards such as certificates, public recognition and the opportunity to attend trade fairs. Workers responded positively, particularly when recognised in front of peers.

Collaborative waste management: Several firms pooled resources to purchase a shared fabric waste recycler. The recycler converted cotton scraps into stuffing material for mattresses, creating an additional revenue stream.

This case illustrates that even resource-constrained SMEs can implement elements of GHRM when supported by community organisations and when programmes are tailored to local realities. The emphasis on participatory training and modest incentives demonstrates the adaptability of the Industrial ESPI framework to different contexts.

Implementation Challenges and Mitigation Strategies

Despite the promise of GHRM, practitioners encounter various challenges. Interviews and international evidence point to six recurrent barriers:

Management resistance: Some managers view environmental initiatives as distractions from production targets. Mitigation: emphasise cost savings and compliance benefits; showcase pilot successes like those in Borg El Arab; include sustainability criteria in managers' appraisals.

Lack of awareness and skills: Workers and supervisors may not understand environmental issues or feel ill-equipped to address them. Mitigation: provide continuous, context-specific training; use visual aids and local language; engage external experts and universities.

Resource constraints: SMEs often cannot afford technology upgrades or training facilities. Mitigation: leverage collective action (e.g. joint training centres), seek grants or concessional loans through programmes like NWFE and encourage clusters to pool resources.

Fragmented regulations: Overlapping mandates among ministries and weak enforcement create uncertainty. Mitigation: advocate for harmonised regulations and clear guidelines; participate in policy dialogues; use industry associations to lobby for supportive frameworks.

Cultural inertia: Hierarchical and patriarchal organisational cultures may discourage participation, particularly from women and younger employees. Mitigation: frame sustainability within cultural and religious values (khilafah), promote gender-sensitive recruitment and ensure that green committees include

representatives from all groups.

Data gaps: Many firms lack systems to measure environmental performance or employee engagement. Mitigation: invest in digital HR and monitoring systems; start with simple metrics and gradually expand; collaborate with national statistical agencies and research institutions to standardise indicators.

Addressing these challenges requires sustained commitment from both management and workers, supportive policies and the mobilisation of external resources.

Alignment with National and Global Sustainability Agendas

GHRM in industrial zones does not operate in isolation; it intersects with national strategies and global goals. Egypt's Vision 2030 emphasises economic competitiveness, social justice and environmental protection. Implementing Industrial ESPI contributes to all three pillars by creating green jobs, improving working conditions and reducing pollution. The framework also aligns with Sustainable Development Goals (SDGs), particularly SDG 8 (decent work and economic growth), SDG 9 (industry, innovation and infrastructure), SDG 12 (responsible consumption and production) and SDG 13 (climate action). By integrating environmental objectives into HR policies, companies can demonstrate responsible production practices and contribute to national climate commitments.

Egypt has pledged to reduce greenhouse gas emissions through its Nationally Determined Contribution (NDC). Industrial zones are critical to achieving these reductions because of their large energy footprints. Green HR practices—such as training workers to operate energy-efficient equipment and rewarding teams for achieving emission reductions—complement technological solutions. Moreover, the NWFE programme and other climate finance initiatives recognise that human capital development is as important as physical infrastructure. Policymakers should therefore

incorporate GHRM indicators into NDC reporting frameworks, which would incentivise firms to track and report progress.

At the regional level, the Middle East Green Initiative and the African Green Industrialisation Initiative both highlight the importance of sustainable industrial development. By adopting the Industrial ESPI, Egyptian firms can position themselves as leaders in the region, attract green investment and participate in regional value chains that increasingly require proof of sustainable practices.