

Strategies for Enhancing Human Resource Capacity in Natural Resource Management Based on the Green Economy

Strategi Peningkatan Kapasitas SDM dalam Pengelolaan SDA Berbasis Ekonomi Hijau



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Rudy C Tarumingkeng: Strategies for Enhancing Human Resource Capacity in Natural Resource Management Based on the Green Economy

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STRATEGI PENINGKATAN KAPASITAS SDM DALAM PENGELOLAAN SDA BERBASIS EKONOMI HIJAU

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Abstract

Natural resources remain a strategic foundation for national development, especially in countries rich in forests, marine resources, minerals, water systems, biodiversity, agricultural land, peatlands, and coastal ecosystems. However, the traditional model of natural resource management—extractive, sectoral, short-term, and growth-oriented—has increasingly shown ecological, social, and economic limitations. Climate change, biodiversity loss, land degradation, pollution, social conflict, and unequal benefit distribution indicate that natural resources can no longer be managed merely as commodities. They must be governed as ecological assets, productive capital, social heritage, and intergenerational responsibility.

This article discusses strategies for enhancing human resource capacity in natural resource management based on the green economy. The central argument is that the green economy transition is not primarily a technological project, but a human-capability transformation. Policies, regulations, digital platforms, green finance, and environmental technologies will not produce meaningful change unless supported by competent, ethical, adaptive, and collaborative human resources. In the Indonesian context, this issue is highly relevant because national development policy has increasingly adopted low-carbon development, circular economy, green jobs, and green economy measurement frameworks. Bappenas' Low Carbon Development Initiative explicitly integrates greenhouse gas reduction, natural resource preservation, and restoration into development planning; Indonesia has also developed a Green Economy Index and a Circular Economy Roadmap and National Action Plan for 2025–2045. ([LCDI](#))

The article proposes an integrated strategy built on six pillars: green literacy, technical competence, digital-data capability, institutional capacity, ethical leadership, and community-based participation. It also offers sectoral applications in forestry, agriculture, marine and fisheries, mining-energy transition, and circular economy. The conclusion emphasizes that improving human resource capacity is the decisive condition for transforming natural resource management from exploitation toward regeneration, from administrative compliance toward ecological responsibility, and from short-term economic gain toward sustainable prosperity.

Keywords: *green economy; human resource capacity; natural resource management; green skills; Green HRM; sustainable development; Indonesia; low-carbon development; circular economy; environmental governance.*

1. Introduction

The question of natural resource management is no longer merely a question of how much can be extracted, produced, exported, or monetized. In the twenty-first century, the deeper question is how societies can use natural resources without destroying the ecological foundations that sustain life, economic productivity, and social stability. This shift reflects a broader transformation in development thinking: from resource exploitation to resource stewardship, from linear growth to circular value creation, and from sectoral development to integrated sustainability.

Natural resources—forests, land, water, minerals, marine ecosystems, biodiversity, and energy resources—are not passive objects waiting to be converted into economic output. They are part of complex ecological systems. A forest is not only timber; it is also a carbon sink, water regulator, biodiversity habitat, cultural space, livelihood base, and climate buffer. A mangrove ecosystem is not only coastal vegetation; it is a nursery for fish, protection against coastal erosion, a blue-carbon reservoir, and a source of community livelihood. Agricultural land is not only a production field; it is a living soil system whose fertility depends on organic matter, microbial life, water balance, and responsible cultivation.

The green economy offers a conceptual and policy framework for addressing these complexities. It seeks economic development that improves human well-being and social equity while significantly reducing environmental risks and ecological scarcities. In practice, this means building economic systems that are low-carbon, resource-efficient, socially inclusive, circular, and ecologically restorative. In Indonesia, the green economy agenda has been institutionalized through low-carbon development planning, the Green Economy Index, circular economy initiatives, and green jobs roadmaps. Bappenas launched Indonesia's Green

Economy Index to measure the progress and effectiveness of green transformation in a tangible, representative, and accurate way, while the index itself consists of multidimensional indicators covering economic, social, and environmental dimensions. ([LCDI](#))

Yet the green economy will remain an abstract slogan unless human resources are prepared to implement it. Natural resource management involves planners, local government officials, forest rangers, engineers, agronomists, marine scientists, mining inspectors, village facilitators, community leaders, entrepreneurs, educators, data analysts, legal officers, environmental auditors, and corporate managers. Each of these actors requires new knowledge, skills, attitudes, and values. The transition from conventional resource management to green resource governance requires not only environmental regulations, but also green competencies.

This article argues that human resource capacity development is the central lever for sustainable natural resource management. The strategy must move beyond occasional training programs. It must become a systemic process involving education, vocational training, institutional reform, organizational culture, performance measurement, community empowerment, digital transformation, and ethical leadership.

2. Conceptual Foundations

2.1 Human Resource Capacity

Human resource capacity refers to the ability of individuals, organizations, and institutions to perform functions, solve problems, adapt to change, and achieve development objectives. In natural resource management, capacity includes technical expertise, environmental literacy, legal understanding, digital competence, collaborative ability, ethical judgment, and systems thinking.

At the individual level, capacity means that a forestry officer understands ecosystem services, not only timber volume. An agricultural extension worker understands climate-smart farming, not only fertilizer application. A mining inspector understands environmental risk assessment, not only production reporting. A local planner understands spatial ecology, not only infrastructure budgeting.

At the organizational level, capacity means that institutions have clear mandates, competent staff, data systems, learning mechanisms, accountability structures, and cross-sector coordination. At the societal level, capacity means that communities, businesses, universities, and governments can work together to protect ecosystems while creating livelihoods.

The green economy requires a more advanced form of human capacity because it demands integration. Professionals must understand the connection between economic value, ecological limits, social justice, and technological innovation. This is why green skills are increasingly recognized as strategic capabilities for development. Recent literature on green skills emphasizes that the transition toward sustainable economies requires not only technical skills but also adaptive and transformative competencies. ([Compass](#))

2.2 Natural Resource Management

Natural resource management refers to the planning, utilization, protection, restoration, and governance of natural assets. Traditional resource management often focused on production: how to harvest timber, mine minerals, expand plantations, catch fish, or extract energy. Sustainable natural resource management expands this view by asking how resource use can remain within ecological limits while supporting social welfare and long-term economic resilience.

Natural resource management becomes more complex because natural resources are embedded in socio-ecological systems. A river basin involves

upstream forests, agricultural land, settlements, industries, local governments, customary communities, and downstream users. A coastal ecosystem involves fishers, tourism actors, mangroves, ports, aquaculture, shipping, and climate risks. Therefore, resource management cannot be solved by one discipline or one agency alone. It requires interdisciplinary and interinstitutional capacity.

2.3 Green Economy

The green economy is not simply an economy with more trees, solar panels, or environmental campaigns. It is a transformation of the logic of development. In a conventional economy, environmental damage is often treated as an externality. In a green economy, ecological value is integrated into planning, investment, production, consumption, and evaluation.

The green economy has several core characteristics. First, it is low-carbon, meaning that economic activities reduce greenhouse gas emissions. Second, it is resource-efficient, meaning that energy, water, land, and materials are used productively and with minimal waste. Third, it is circular, meaning that waste is reduced, reused, recycled, or transformed into new value. Fourth, it is socially inclusive, meaning that vulnerable groups are not excluded from the benefits of transition. Fifth, it is regenerative, meaning that damaged ecosystems are restored.

Indonesia's Low Carbon Development Initiative reflects this direction by incorporating greenhouse gas reduction targets into planning and combining them with interventions to preserve and restore natural resources. ([LCDI](#)) The development of a Green Economy Index also shows that green transformation is increasingly being measured as a national development performance issue, not merely an environmental issue. ([LCDI](#))

3. Why Human Resource Capacity Matters in Green Natural Resource Management

The success or failure of green natural resource management depends on people. Regulations are interpreted by people. Environmental data are collected and analyzed by people. Ecosystems are restored by people. Conflicts are mediated by people. Technologies are selected, operated, maintained, and governed by people. Therefore, capacity development is not a supporting activity; it is the core infrastructure of the green economy.

3.1 From Compliance to Competence

Many environmental programs fail because they are treated as administrative compliance. Organizations prepare environmental documents, attend workshops, or report indicators because regulations require them. But genuine green transformation requires competence. Compliance asks, "Have we fulfilled the requirement?" Competence asks, "Do we understand the ecological problem, and are we able to solve it responsibly?"

For example, a district government may require an environmental impact assessment for a development project. However, if local officers do not understand hydrology, biodiversity, land-use dynamics, and community livelihoods, the assessment may become a formal document rather than a decision-making tool. Similarly, a company may have a sustainability report, but without green procurement, energy efficiency, waste reduction, and employee engagement, the report may not reflect real transformation.

Green Human Resource Management literature shows that recruitment, training, performance appraisal, rewards, leadership, and organizational culture can influence employee environmental behavior and organizational sustainability performance. Studies have linked Green HRM with pro-environmental behavior, green innovation, environmental performance, and sustainable performance. ([Greenation Research](#))

3.2 From Sectoral Skills to Systems Thinking

Natural resource problems are rarely isolated. Deforestation may be linked to agricultural expansion, infrastructure development, weak land tenure,

market demand, poverty, corruption, and unclear spatial planning. Overfishing may be linked to declining fish stocks, illegal fishing, market pressure, fuel costs, weak monitoring, and lack of alternative livelihoods. Therefore, human resources need systems thinking.

Systems thinking enables professionals to see feedback loops, trade-offs, unintended consequences, and leverage points. A policy that increases agricultural production may reduce poverty in the short term but degrade soil and water if implemented without ecological safeguards. A mining project may increase regional income but generate long-term ecological liabilities if closure and rehabilitation are weak. A conservation project may fail if it ignores community livelihood needs.

3.3 From Technical Expertise to Ethical Judgment

Green resource management requires ethical judgment because it deals with intergenerational justice. Decisions made today may affect future generations who cannot participate in current negotiations. Destroying a peatland, polluting a river, or degrading a coral reef is not merely a technical error; it is an ethical failure.

Human resource capacity must therefore include environmental ethics. Professionals must ask not only whether an action is legal or profitable, but whether it is responsible, fair, and sustainable. Ethical judgment is particularly important when dealing with indigenous communities, local livelihoods, benefit-sharing, land conflict, and ecological restoration.

3.4 From Individual Training to Institutional Learning

Many capacity-building programs focus on individual workshops. While useful, such programs are insufficient if institutions remain rigid, fragmented, and poorly coordinated. A trained officer may return to an organization that does not reward innovation. A young professional may learn GIS-based monitoring but lack access to reliable data. A community facilitator may understand participatory planning but work in a system that prioritizes top-down targets.

Therefore, human resource capacity must be linked to institutional learning. Organizations need knowledge management systems, cross-sector forums, communities of practice, mentoring, digital dashboards, and performance indicators that reward green outcomes.

4. The Indonesian Context: Natural Resources, Green Economy, and Human Capacity

Indonesia is one of the world's most resource-rich archipelagic nations. Its forests, peatlands, mangroves, coral reefs, fisheries, minerals, agricultural systems, and biodiversity are globally significant. This richness creates enormous development opportunities, but also serious governance challenges. The country must balance economic growth, poverty reduction, regional development, energy transition, biodiversity protection, climate resilience, and social inclusion.

Indonesia's green economy transition is not starting from zero. Policy instruments and roadmaps have emerged. The Green Economy Index provides a framework to measure transformation progress. ([LCDI](#)) The Circular Economy Roadmap and National Action Plan for 2025–2045 provides direction for shifting from linear production-consumption patterns toward circular systems. ([PAGE Indonesia](#)) Indonesia has also developed a Green Jobs Roadmap, intended to guide human resource development supporting green jobs. The roadmap defines green jobs as work that contributes to preserving or restoring the environment and promotes decent work through specific tasks, skills, processes, or environmentally friendly outputs. ([International Labour Organization](#))

These developments indicate that Indonesia's green economy agenda has entered a more operational phase. The next challenge is implementation capacity. National policy must be translated into provincial programs, district planning, organizational practices, community initiatives, business

models, and educational curricula. This translation requires human resources who understand both policy and practice.

The Indonesian context also requires attention to diversity. Capacity needs in Papua's forest landscapes differ from those in Java's industrial regions, Kalimantan's mining and forest frontiers, Sulawesi's nickel and marine economies, Sumatra's peatland and plantation landscapes, and Maluku-Nusa Tenggara's island and fisheries systems. Therefore, green capacity development must be place-based. A uniform training model will not be sufficient.

5. Main Capacity Gaps in Green Natural Resource Management

5.1 Green Literacy Gap

Green literacy is the basic understanding of ecological principles, sustainability concepts, climate change, biodiversity, circular economy, ecosystem services, and environmental justice. Without green literacy, professionals may treat environmental issues as secondary or decorative.

In many organizations, sustainability is still seen as the responsibility of a special unit, not as a core managerial concern. This creates a literacy gap between environmental specialists and decision-makers. A company director may approve sustainability commitments but not understand carbon accounting. A local planner may support green development rhetorically but not understand carrying capacity. A village leader may support conservation but lack knowledge of ecosystem-based livelihood models.

Green literacy must therefore be mainstreamed across levels of education and professional development. It should not be limited to environmental science students. Management students, engineers, economists, public administrators, accountants, lawyers, and educators also need green literacy.

5.2 Technical Competence Gap

Natural resource management requires technical skills: land-use planning, GIS, remote sensing, biodiversity assessment, environmental impact assessment, carbon measurement, water resource management, soil conservation, waste management, renewable energy systems, climate adaptation planning, and ecological restoration.

The green economy adds new technical demands. Professionals must understand carbon markets, life-cycle assessment, environmental-social-governance reporting, green procurement, circular design, nature-based solutions, and climate risk disclosure. In agriculture, they need climate-smart agriculture. In forestry, they need forest carbon and ecosystem restoration. In mining, they need rehabilitation, tailings management, energy efficiency, and just transition planning. In fisheries, they need ecosystem-based fisheries management and traceability.

5.3 Digital-Data Capacity Gap

Green natural resource management increasingly depends on data. Satellite imagery, drones, sensors, digital maps, artificial intelligence, blockchain traceability, climate models, and environmental dashboards are becoming important tools. However, digital tools require human capacity. Technology can produce data, but humans must interpret, validate, govern, and act upon it.

A district may have access to spatial data but lack analysts. A ministry may have monitoring systems but face fragmented databases. A company may use drones but lack ecological interpretation. Communities may collect local data but lack channels to integrate it into official decision-making. Therefore, digital capacity must include data literacy, geospatial analysis, ethical data governance, and participatory monitoring.

5.4 Institutional Coordination Gap

Natural resources are governed by multiple institutions. Forests, agriculture, mining, marine affairs, spatial planning, energy, environment, villages, public works, finance, and education may involve different agencies. Without coordination, policies may conflict. A conservation target may clash with infrastructure expansion. A green jobs program may not align with industrial policy. A circular economy roadmap may not connect with local waste governance.

Human resources must be trained not only in technical skills but also in coordination, negotiation, and collaborative governance. Green economy implementation requires boundary-spanning professionals who can connect ministries, local governments, universities, companies, communities, and civil society organizations.

5.5 Community Empowerment Gap

Many natural resources are located in areas where local and indigenous communities depend directly on ecosystems. Sustainable management cannot succeed if communities are treated merely as beneficiaries or obstacles. They must be recognized as knowledge holders, stewards, entrepreneurs, and partners.

Community capacity includes ecological knowledge, organizational skills, financial literacy, market access, cooperative governance, conflict resolution, and digital inclusion. For example, mangrove restoration will be stronger if coastal communities receive training in sustainable aquaculture, ecotourism, blue carbon literacy, and cooperative business models. Forest conservation will be stronger if communities gain access to social forestry, non-timber forest products, agroforestry, and market linkages.

5.6 Leadership and Ethical Capacity Gap

Green transformation requires leaders who can make difficult decisions. A green leader must balance short-term economic pressure with long-term ecological responsibility. Leadership capacity includes vision, integrity, courage, communication, systems thinking, and stakeholder engagement.

Ethical leadership is essential because natural resource governance is vulnerable to rent-seeking, regulatory capture, illegal extraction, and conflict of interest. Without integrity, technical capacity may even be used to legitimize unsustainable practices. Therefore, capacity development must include ethics, transparency, accountability, and public responsibility.

6. Strategic Framework for Enhancing Human Resource Capacity

This article proposes an integrated framework called the **Green Human Capability System**. The framework consists of six strategic pillars: green literacy, green technical competence, digital-data capability, institutional capacity, ethical leadership, and community-based capacity.

6.1 Pillar One: Mainstreaming Green Literacy

The first strategy is to build green literacy across society and institutions. Green literacy should be introduced from basic education to higher education, vocational training, civil service training, corporate learning, and community programs.

In universities, green literacy should not be confined to environmental departments. Business schools should teach green business models, ESG, circular economy, carbon accounting, and sustainable finance. Engineering faculties should teach eco-design, energy efficiency, life-cycle thinking, and climate-resilient infrastructure. Law faculties should teach environmental law, climate governance, and natural resource justice. Public administration programs should teach green budgeting, policy integration, and participatory governance.

In government training, green literacy should be integrated into leadership programs, planning courses, procurement training, and regional development modules. Public officials need to understand that green economy is not an additional agenda but a development paradigm.

In companies, green literacy should be part of onboarding, leadership development, operational training, and performance management. Workers should understand how their daily tasks affect energy use, waste, emissions, water use, and ecosystem impacts.

6.2 Pillar Two: Developing Green Technical Competence

The second strategy is to develop sector-specific technical competencies. Capacity development must be differentiated by sector because each sector has distinct ecological risks and green opportunities.

In forestry, competencies include forest inventory, biodiversity monitoring, forest carbon accounting, fire prevention, peatland restoration, social forestry facilitation, and ecosystem restoration. In agriculture, competencies include soil health management, integrated pest management, organic matter restoration, agroforestry, precision agriculture, efficient irrigation, and climate-smart farming. In fisheries, competencies include stock assessment, sustainable fishing gear, marine spatial planning, traceability, coastal ecosystem restoration, and blue economy entrepreneurship. In mining, competencies include environmental impact control, mine closure planning, rehabilitation, water management, energy efficiency, and just transition planning. In manufacturing and urban systems, competencies include circular design, waste reduction, recycling, cleaner production, energy management, and green logistics.

These technical competencies should be certified. Certification is important because it creates professional standards, career pathways, and accountability. Green jobs roadmaps and vocational education should therefore be connected to competency-based certification systems.

6.3 Pillar Three: Strengthening Digital and Data Capability

The third strategy is to strengthen digital and data capacity. Green natural resource management increasingly depends on reliable data. Human

resources must be able to collect, interpret, validate, share, and use data for decision-making.

Key competencies include GIS, remote sensing, environmental data analytics, carbon accounting software, dashboard management, climate risk mapping, data visualization, AI-assisted monitoring, and digital reporting. However, digital capacity must also include ethical governance. Data should not be manipulated to justify destructive projects. Community data rights must be respected. Transparency and interoperability should be promoted.

Universities and vocational schools can play an important role by offering micro-credentials in geospatial analysis, environmental monitoring, carbon accounting, circular economy analytics, and sustainability reporting. Local governments can create data labs for natural resource management. Companies can train employees in digital environmental management systems. Communities can be supported through participatory mapping and citizen science.

6.4 Pillar Four: Building Institutional Capacity

The fourth strategy is to build institutional capacity. Individual skills are not enough if institutions are fragmented. Institutional capacity includes coordination mechanisms, clear mandates, integrated planning, budget alignment, knowledge management, and performance evaluation.

For government, this means integrating green economy indicators into regional planning, budgeting, and performance appraisal. For companies, it means embedding sustainability into strategy, operations, procurement, HR systems, and reporting. For universities, it means linking research, teaching, community service, and innovation with green development needs. For communities, it means strengthening cooperatives, village-owned enterprises, customary institutions, and local governance.

Institutional capacity also requires cross-sector platforms. For example, a provincial green economy forum can bring together government agencies,

universities, companies, NGOs, and community representatives. Such platforms can identify capacity needs, coordinate training, share data, and monitor progress.

6.5 Pillar Five: Cultivating Ethical Green Leadership

The fifth strategy is ethical leadership development. Green leadership is not only about promoting environmental slogans. It is about making decisions that protect ecological integrity, social justice, and long-term public interest.

Leadership training should include environmental ethics, stakeholder dialogue, conflict mediation, anti-corruption, climate justice, intergenerational responsibility, and systems thinking. Leaders must be trained to handle trade-offs. For example, when a project promises jobs but threatens a watershed, leaders need the capacity to evaluate long-term ecological costs, negotiate alternatives, and protect public interest.

Ethical leadership should be institutionalized through transparent decision-making, public reporting, participatory planning, whistleblower protection, and performance indicators that include environmental and social outcomes.

6.6 Pillar Six: Empowering Communities as Green Economy Actors

The sixth strategy is community-based capacity development. Local communities must not be treated merely as objects of conservation or beneficiaries of aid. They should become active green economy actors.

Community capacity development can include training in sustainable agriculture, agroforestry, ecotourism, mangrove restoration, non-timber forest products, waste management, renewable energy, cooperative management, digital marketing, and financial literacy. It should also include legal literacy related to land rights, social forestry, fisheries regulations, and environmental protection.

Community empowerment is especially important in Indonesia because many ecosystems are closely connected to local livelihoods. A green economy that excludes communities will create resistance. A green economy that empowers communities can create stewardship, innovation, and social legitimacy.

7. Green Human Resource Management as an Organizational Strategy

Green Human Resource Management, or Green HRM, refers to HR practices that support environmental sustainability. It includes green recruitment, green training, green performance appraisal, green rewards, green employee involvement, and green organizational culture.

7.1 Green Recruitment

Organizations managing natural resources should recruit employees with environmental awareness, ethical orientation, systems thinking, and sustainability competence. Recruitment criteria should include not only technical qualifications but also values and behavioral indicators.

For example, a plantation company hiring field managers should assess knowledge of soil conservation, biodiversity corridors, water management, and community engagement. A mining company hiring engineers should assess understanding of rehabilitation and environmental risk. A local government hiring planners should assess spatial ecology and climate resilience literacy.

7.2 Green Training and Development

Training should be continuous, practical, and linked to actual work problems. Green training should include field-based learning, case studies, simulations, mentoring, and project-based assignments. Employees should not only attend seminars; they should solve real sustainability problems.

For example, employees can be assigned to reduce water use in processing plants, design waste reduction programs, restore degraded land, or

develop community-based monitoring systems. Such project-based learning strengthens both competence and ownership.

7.3 Green Performance Appraisal

Performance appraisal should include environmental indicators. If employees are evaluated only by production volume, cost efficiency, or administrative completion, green behavior will remain secondary. Environmental indicators may include energy reduction, waste reduction, compliance quality, restoration outcomes, community satisfaction, biodiversity protection, and innovation.

7.4 Green Rewards

Organizations should reward employees and teams that contribute to sustainability. Rewards can be financial, symbolic, career-based, or developmental. Recognition is important because it signals that green performance matters.

7.5 Green Employee Involvement

Employees should be invited to propose green innovations. Many practical sustainability improvements come from frontline workers who understand daily operations. Green suggestion systems, innovation labs, cross-functional teams, and environmental quality circles can mobilize employee creativity.

Research on Green HRM supports the idea that HR practices can influence employee pro-environmental behavior and environmental performance. ([Greenation Research](#)) Therefore, Green HRM should be considered a strategic instrument for natural resource organizations, not merely an administrative HR trend.

8. Sectoral Strategies

8.1 Forestry and Peatland Management

Forests and peatlands are critical for carbon storage, biodiversity, water regulation, and community livelihoods. Human resource capacity in this sector should focus on forest landscape management, fire prevention, peatland hydrology, biodiversity monitoring, social forestry, conflict mediation, and forest carbon.

A practical strategy is to develop **Forest Green Competency Centers** in forest-rich regions. These centers can train local government officers, social forestry groups, community facilitators, forest rangers, and private-sector actors. Training should combine ecological science, legal frameworks, community empowerment, digital monitoring, and business development for non-timber forest products.

For peatlands, capacity development must include hydrological restoration. Many peatland failures occur because drainage, land clearing, and fire prevention are not understood as connected systems. Human resources must understand water tables, canal blocking, vegetation recovery, fire risk mapping, and community livelihood alternatives.

8.2 Sustainable Agriculture and Plantation Systems

Agriculture is both vulnerable to climate change and a contributor to land-use change. Green economy-based agriculture requires soil health, water efficiency, biodiversity, climate resilience, and fair market access.

Capacity development for farmers and agricultural officers should include climate-smart agriculture, organic matter management, integrated pest management, agroforestry, precision farming, post-harvest efficiency, and sustainable certification. For plantation systems, competencies should include traceability, zero-deforestation commitments, smallholder inclusion, waste utilization, methane reduction, and landscape-level planning.

An important strategy is to connect agricultural extension systems with digital platforms. Farmers need practical information on weather, pests, markets, soil health, and sustainable techniques. However, digital platforms

must be supported by human facilitators who can interpret information and adapt it to local contexts.

8.3 Marine, Fisheries, and Coastal Resources

Indonesia's marine and coastal resources are central to blue economy development. Human resource capacity should include ecosystem-based fisheries management, marine spatial planning, sustainable aquaculture, mangrove restoration, coral reef protection, fishery traceability, coastal risk management, and blue carbon literacy.

Coastal communities should be trained not only in conservation but also in green entrepreneurship. Mangrove restoration can be linked with ecotourism, sustainable crab culture, honey production, carbon projects, and environmental education. Fishers can be supported with selective fishing gear, cold-chain efficiency, digital market access, and cooperative management.

Universities and maritime vocational schools should develop curricula that integrate marine science, community development, digital mapping, green business, and climate adaptation.

8.4 Mining, Energy, and Just Transition

Mining remains economically important, but it creates environmental risks. A green economy strategy does not simply ignore mining; it requires stronger governance, cleaner operations, rehabilitation, circular mineral use, and transition planning.

Human resource capacity in mining should include environmental risk management, mine closure, land rehabilitation, tailings safety, water management, energy efficiency, biodiversity offsets where appropriate, community engagement, and ESG reporting. Regulators need strong inspection capacity and independence. Companies need engineers and managers who understand ecological accountability.

Energy transition also requires reskilling. Workers in fossil-based sectors may need pathways into renewable energy, energy efficiency, grid management, battery systems, environmental restoration, and green industrial development. Without just transition planning, green policy may create social resistance. Therefore, capacity development must include labor transition programs, vocational retraining, and local economic diversification.

8.5 Circular Economy and Urban Resource Management

Circular economy changes the way society manages materials. Waste is no longer viewed merely as an end-product but as a potential resource. Human resources in this field need competencies in waste segregation, recycling systems, product design, reverse logistics, composting, industrial symbiosis, plastic reduction, and circular business models.

Indonesia's Circular Economy Roadmap and National Action Plan for 2025–2045 provides a policy foundation for this transformation. ([PAGE Indonesia](#)) To implement it, municipalities need trained waste managers, circular economy planners, community educators, recycling entrepreneurs, data analysts, and procurement officers.

Universities can support circular economy through research on materials, business models, behavioral change, and local innovation. Communities can be trained to develop waste banks, composting centers, repair initiatives, and circular micro-enterprises.

9. Education and Curriculum Strategy

Human resource capacity development must begin in education. The green economy should be integrated into formal, non-formal, and informal education.

9.1 Higher Education

Universities should develop interdisciplinary green economy programs. Natural resource management cannot be taught only from a biological or technical perspective. It must include economics, law, ethics, technology, management, public policy, and community development.

A master's-level curriculum in green natural resource management may include:

1. Green economy theory and policy
2. Sustainable natural resource governance
3. Climate change and low-carbon development
4. GIS and environmental data analytics
5. Circular economy and resource efficiency
6. Environmental economics and green finance
7. Community-based resource management
8. Environmental ethics and justice
9. Green HRM and organizational transformation
10. Sectoral practicum in forestry, agriculture, fisheries, or mining
11. Research methods for sustainability
12. Capstone project with local government, company, or community partner

9.2 Vocational Education and Training

Vocational education is crucial because many green jobs require practical skills. Vocational schools and training centers should develop modules on solar installation, waste management, sustainable agriculture, environmental monitoring, eco-tourism, water management, energy efficiency, and green construction.

Green skills should be competency-based. Students should not only learn definitions but demonstrate ability: measuring water quality, mapping land use, conducting composting, installing renewable energy systems, auditing energy use, or designing waste reduction systems.

9.3 Professional Certification and Micro-Credentials

Green capacity development should be modular and flexible. Many workers cannot return to full-time education. Micro-credentials can help professionals upgrade skills in specific areas: carbon accounting, sustainability reporting, GIS, climate risk assessment, circular economy, green procurement, or environmental auditing.

Professional certification creates credibility. It also helps employers identify qualified workers and helps workers build career pathways.

9.4 Community Education

Community education should use local language, local cases, and practical demonstration. For example, farmers may learn better through demonstration plots than classroom lectures. Fishers may learn through peer groups and cooperative meetings. Village leaders may learn through participatory mapping and planning workshops.

Community education should respect local knowledge. Traditional ecological knowledge can complement scientific knowledge. In many places, local communities understand seasonal patterns, species behavior, water flows, and landscape history. Green capacity development should therefore be dialogical, not top-down.

10. Institutional Roles and Collaboration

10.1 Government

Government plays a strategic role in setting policy, standards, incentives, regulations, and public investment. National government can create

competency frameworks, green jobs roadmaps, curriculum standards, certification systems, and funding mechanisms. Local governments can integrate green capacity into regional planning, civil service development, village empowerment, and local economic programs.

Government should also align green economy with employment policy. The green transition must create decent work, not only environmental compliance. The Indonesian Green Jobs Roadmap already recognizes the importance of human resource development for green jobs. ([International Labour Organization](#))

10.2 Universities and Research Institutions

Universities should become knowledge hubs for green natural resource management. Their roles include education, research, policy advice, community service, innovation incubation, and monitoring. Universities can support local governments with spatial analysis, environmental assessment, training modules, and evaluation.

Research should be problem-based. Instead of producing only academic publications, universities should help solve real problems: degraded watersheds, coastal erosion, waste management, forest conflict, mining rehabilitation, or climate adaptation.

10.3 Private Sector

Companies are major users of natural resources. They must invest in employee capacity, green operations, environmental innovation, and community partnerships. Green HRM should be integrated into corporate strategy. Sustainability should not be isolated in a corporate social responsibility department; it should influence procurement, production, logistics, finance, HR, and leadership.

10.4 Communities and Civil Society

Communities are frontline actors. Civil society organizations can support community organizing, advocacy, training, monitoring, and conflict

mediation. Community-based monitoring can strengthen transparency and accountability. Local cooperatives can help communities capture economic value from sustainable practices.

10.5 International Partners

International organizations can support technical assistance, financing, knowledge transfer, and capacity-building frameworks. However, external support must be adapted to local realities. Imported models may fail if they ignore local institutions, culture, and political economy.

11. Monitoring and Evaluation of Capacity Development

Capacity development must be measured. Without evaluation, training may become ceremonial. Monitoring should assess not only how many people were trained, but whether capacity improved and whether natural resource outcomes changed.

11.1 Input Indicators

Input indicators include budget allocation, number of trainers, training facilities, digital tools, curriculum modules, and institutional partnerships.

11.2 Output Indicators

Output indicators include number of trained participants, certificates issued, modules completed, data systems developed, community groups formed, and green projects initiated.

11.3 Outcome Indicators

Outcome indicators assess behavioral and institutional change: improved compliance, better planning quality, increased use of environmental data, reduced waste, improved restoration practices, stronger community participation, and increased green innovation.

11.4 Impact Indicators

Impact indicators assess ecological, social, and economic results: reduced emissions, improved forest cover, restored peatlands, cleaner rivers, increased biodiversity, improved livelihoods, reduced conflict, and increased green jobs.

The Green Economy Index approach is relevant because it frames green transformation as measurable development progress rather than a vague aspiration. ([LCDI](#)) Capacity development should be linked to such measurable indicators.

12. A Narrative Case Illustration: Green Capacity Development in a Resource-Rich District

Imagine a district in eastern Indonesia with forests, coastal ecosystems, smallholder agriculture, and mineral resources. For years, development has relied on raw material extraction and land conversion. Economic growth exists, but environmental pressure increases. Rivers become sedimented, fish catches decline, forest fires occur during dry seasons, and local communities complain about unequal benefits.

The district government decides to adopt a green economy-based natural resource strategy. The first step is not building a new office or issuing a slogan. The first step is mapping human capacity. The district identifies that planners lack spatial ecology skills, village facilitators lack green entrepreneurship knowledge, agricultural officers lack climate-smart agriculture training, and local schools do not teach green skills. Companies have sustainability reports but weak field implementation. Communities have ecological knowledge but weak market access.

A district green capacity task force is created. It includes local government, universities, customary leaders, youth groups, women's cooperatives, companies, and NGOs. The task force designs a three-year capacity program.

In the first year, the district focuses on green literacy and data. Officials are trained in low-carbon development, ecosystem services, and spatial planning. University students help develop participatory maps. Community groups identify degraded areas, water sources, sacred forests, fishing grounds, and livelihood assets. Companies are required to share environmental monitoring data through a district dashboard.

In the second year, the program becomes sectoral. Farmers receive training in agroforestry, composting, soil conservation, and climate-smart cropping. Coastal communities receive training in mangrove restoration, sustainable aquaculture, and ecotourism. Forest communities receive training in non-timber products and social forestry business models. Mining-related workers receive training in rehabilitation, safety, and environmental monitoring.

In the third year, the district institutionalizes green performance. Budget proposals must include environmental risk analysis. Village development plans must identify green livelihood opportunities. Companies are evaluated not only by investment value but also by restoration performance, local employment quality, and environmental compliance. Schools introduce local green economy modules. Youth groups develop digital campaigns and green entrepreneurship projects.

After several years, the district does not become perfect. Conflicts remain, budgets are limited, and market pressures continue. But the development logic changes. People begin to understand that forests, rivers, coasts, and soils are not obstacles to growth. They are the foundation of long-term prosperity. This narrative illustrates the central thesis of the article: green economy transformation begins with human capacity transformation.

13. Risks and Mitigation Strategies

13.1 Risk of Greenwashing

Greenwashing occurs when organizations claim sustainability without real change. To mitigate this risk, capacity development must include transparent indicators, independent verification, public reporting, and community monitoring.

13.2 Risk of Exclusion

Green transition may exclude vulnerable groups if training and green jobs are accessible only to educated urban populations. Programs must include rural communities, women, youth, indigenous peoples, smallholders, informal workers, and micro-enterprises.

13.3 Risk of Technocratic Bias

Green economy programs may become too technocratic, focusing on data, models, and reports while ignoring local realities. Mitigation requires participatory approaches and respect for local knowledge.

13.4 Risk of Institutional Fragmentation

Different agencies may implement disconnected programs. Mitigation requires coordination platforms, shared indicators, integrated planning, and leadership commitment.

13.5 Risk of Short-Term Political Cycles

Green capacity development requires long-term commitment, while political cycles are short. Mitigation requires institutionalization through regulations, curriculum standards, certification systems, and budget mechanisms.

14. Strategic Recommendations

First, Indonesia should develop a national green competency framework for natural resource management. This framework should define core competencies, sectoral competencies, digital competencies, ethical competencies, and leadership competencies.

Second, green economy capacity should be integrated into higher education and vocational education. Universities and vocational schools must become engines of green skills development.

Third, civil service training should include green economy, low-carbon development, circular economy, climate resilience, and natural resource governance. Public officials are key implementers of policy.

Fourth, Green HRM should be promoted in companies operating in natural resource sectors. Recruitment, training, appraisal, reward, and leadership development should support sustainability.

Fifth, local communities should be empowered as green economy actors. Capacity development must include livelihood innovation, cooperative management, legal literacy, and market access.

Sixth, digital capacity must be strengthened through GIS, remote sensing, data analytics, AI-assisted monitoring, and participatory data systems.

Seventh, green capacity development should be linked to measurable indicators. Training must be evaluated through behavioral, institutional, ecological, and livelihood outcomes.

Eighth, ethical leadership must be placed at the center. Without integrity, green skills may be captured by unsustainable interests. With ethical leadership, capacity becomes a force for transformation.

15. Conclusion

The transition toward a green economy requires more than policy declarations, technology adoption, or environmental campaigns. It requires a deep transformation of human resource capacity. Natural resource management is ultimately a human responsibility: humans design institutions, make decisions, operate technologies, enforce laws, restore ecosystems, negotiate conflicts, and imagine the future.

In the Indonesian context, the need for capacity development is urgent. Indonesia has rich natural resources, but also faces ecological vulnerability, climate risk, regional inequality, and governance complexity. National initiatives such as low-carbon development, the Green Economy Index, circular economy planning, and green jobs roadmaps provide important policy foundations. However, their success depends on whether human resources at national, regional, organizational, and community levels are prepared to implement them.

The strategy proposed in this article emphasizes six pillars: green literacy, technical competence, digital-data capability, institutional capacity, ethical leadership, and community empowerment. These pillars must be integrated into education, vocational training, civil service development, corporate HR systems, local governance, and community-based programs.

The central message is clear: natural resources cannot be managed sustainably by conventional mindsets. A green economy requires green human capacity. This means people who understand ecosystems, respect social justice, use technology wisely, collaborate across boundaries, lead ethically, and act with intergenerational responsibility. If Indonesia and other resource-rich countries can develop such human resources, natural wealth will no longer be a source of ecological degradation and social conflict. It can become the foundation of sustainable prosperity, resilience, and civilization.

Glossary

Blue Economy

An economic approach that uses marine and coastal resources sustainably while protecting ocean ecosystems and supporting coastal livelihoods.

Capacity Development

The process of strengthening knowledge, skills, institutions, leadership, and systems so that individuals and organizations can achieve development goals effectively.

Carbon Accounting

The measurement and reporting of greenhouse gas emissions and removals associated with activities, organizations, or projects.

Circular Economy

An economic model that reduces waste and keeps materials in use through reuse, repair, recycling, redesign, and regeneration.

Climate-Smart Agriculture

Agricultural practices that increase productivity, strengthen resilience, and reduce greenhouse gas emissions.

Ecosystem Services

Benefits provided by ecosystems, such as clean water, pollination, carbon storage, flood control, food, and cultural value.

Environmental Governance

The rules, institutions, processes, and actors involved in environmental decision-making and management.

Green Economy

An economic system that improves human well-being and social equity while reducing environmental risks and ecological scarcities.

Green HRM

Human resource management practices that support environmental sustainability through recruitment, training, appraisal, rewards, and organizational culture.

Green Jobs

Jobs that contribute to preserving or restoring the environment while promoting decent work.

Green Skills

Knowledge, abilities, values, and attitudes needed to support sustainable, low-carbon, resource-efficient, and environmentally responsible development.

Just Transition

A fair process of economic transformation that protects workers and communities affected by shifts away from environmentally harmful industries.

Low-Carbon Development

A development approach that reduces greenhouse gas emissions while supporting economic growth and social welfare.

Natural Resource Management

The planning, use, protection, restoration, and governance of natural assets such as forests, land, water, minerals, biodiversity, and marine resources.

Nature-Based Solutions

Actions that protect, restore, or manage ecosystems to address social, economic, and environmental challenges.

Sustainable Development

Development that meets present needs without compromising the ability of future generations to meet their own needs.

Systems Thinking

An approach that examines relationships, feedback loops, interdependence, and unintended consequences within complex systems.

References

- Amrutha, V. N., & Geetha, S. N. (2020). A systematic review on green human resource management: Implications for social sustainability. *Journal of Cleaner Production*, 247, 119131. DOI: 10.1016/j.jclepro.2019.119131
- Anwar, N., Mahmood, N. H. N., Yusliza, M. Y., Ramayah, T., Noor Faezah, J., & Khalid, W. (2020). Green human resource management for organisational citizenship behaviour towards the environment and environmental performance on a university campus. *Journal of Cleaner Production*, 256, 120401. DOI: 10.1016/j.jclepro.2020.120401
- Aust, I., Matthews, B., & Muller-Camen, M. (2020). Common good HRM: A paradigm shift in sustainable HRM? *Human Resource Management Review*, 30(3), 100705. DOI: 10.1016/j.hrmr.2019.100705
- Barbier, E. B. (2011). The policy challenges for green economy and sustainable economic development. *Natural Resources Forum*, 35(3), 233–245. DOI: 10.1111/j.1477-8947.2011.01397.x
- Benevene, P., & Buonomo, I. (2020). Green human resource management: An evidence-based systematic literature review. *Sustainability*, 12(15), 5974. DOI: 10.3390/su12155974
- Bina, O. (2013). The green economy and sustainable development: An uneasy balance? *Environment and Planning C: Government and Policy*, 31(6), 1023–1047. DOI: 10.1068/c1310j

- Chaudhary, R. (2020). Green human resource management and employee green behavior: An empirical analysis. *Corporate Social Responsibility and Environmental Management*, 27(2), 630–641. DOI: 10.1002/csr.1827
- Duchek, S. (2020). Organizational resilience: A capability-based conceptualization. *Business Research*, 13, 215–246. DOI: 10.1007/s40685-019-0085-7
- Guerci, M., Longoni, A., & Luzzini, D. (2016). Translating stakeholder pressures into environmental performance: The mediating role of green HRM practices. *The International Journal of Human Resource Management*, 27(2), 262–289. DOI: 10.1080/09585192.2015.1065431
- Haddock-Millar, J., Sanyal, C., & Müller-Camen, M. (2016). Green human resource management: A comparative qualitative case study of a United States multinational corporation. *The International Journal of Human Resource Management*, 27(2), 192–211. DOI: 10.1080/09585192.2015.1052087
- Jabbour, C. J. C., & de Sousa Jabbour, A. B. L. (2016). Green human resource management and green supply chain management: Linking two emerging agendas. *Journal of Cleaner Production*, 112, 1824–1833. DOI: 10.1016/j.jclepro.2015.01.052
- Kim, Y. J., Kim, W. G., Choi, H. M., & Phetvaroon, K. (2019). The effect of green human resource management on hotel employees' eco-friendly behavior and environmental performance. *International Journal of Hospitality Management*, 76, 83–93. DOI: 10.1016/j.ijhm.2018.04.007
- Merino-Saum, A., Baldi, M. G., Gunderson, I., & Oberle, B. (2018). Articulating natural resources and sustainable development goals through green economy indicators: A systematic analysis. *Resources, Conservation and Recycling*, 139, 90–103. DOI: 10.1016/j.resconrec.2018.07.007
- Mousa, S. K., & Othman, M. (2020). The impact of green human resource management practices on sustainable performance in healthcare

organisations: A conceptual framework. *Journal of Cleaner Production*, 243, 118595. DOI: 10.1016/j.jclepro.2019.118595

Nisar, Q. A., Haider, S., Ali, F., Jamshed, S., Ryu, K., & Gill, S. S. (2021). Green human resource management practices and environmental performance in Malaysian green hotels: The role of green intellectual capital and pro-environmental behavior. *Journal of Cleaner Production*, 311, 127504. DOI: 10.1016/j.jclepro.2021.127504

Paillé, P., Valéau, P., & Renwick, D. W. (2020). Leveraging green human resource practices to achieve environmental sustainability. *Journal of Cleaner Production*, 260, 121137. DOI: 10.1016/j.jclepro.2020.121137

Pham, N. T., Tučková, Z., & Chiappetta Jabbour, C. J. (2019). Greening the hospitality industry: How do green human resource management practices influence organizational citizenship behavior in hotels? A mixed-methods study. *Tourism Management*, 72, 386–399. DOI: 10.1016/j.tourman.2018.12.008

Pinzone, M., Guerici, M., Lettieri, E., & Huisinigh, D. (2019). Effects of “green” training on pro-environmental behaviors and job satisfaction: Evidence from the Italian healthcare sector. *Journal of Cleaner Production*, 226, 221–232. DOI: 10.1016/j.jclepro.2019.04.048

Ren, S., Tang, G., & Jackson, S. E. (2018). Green human resource management research in emergence: A review and future directions. *Asia Pacific Journal of Management*, 35(3), 769–803. DOI: 10.1007/s10490-017-9532-1

Saeed, B. B., Afsar, B., Hafeez, S., Khan, I., Tahir, M., & Afridi, M. A. (2019). Promoting employee’s proenvironmental behavior through green human resource management practices. *Corporate Social Responsibility and Environmental Management*, 26(2), 424–438. DOI: 10.1002/csr.1694

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Sharma, R., Singh, G., & Agrawal, R. (2021). Sustainable human resource management: Literature review and future research agenda. *Benchmarking: An International Journal*, 28(2), 459–488. DOI: 10.1108/BIJ-08-2020-0414

Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. *Technological Forecasting and Social Change*, 150, 119762. DOI: 10.1016/j.techfore.2019.119762

Yong, J. Y., Yusliza, M. Y., Ramayah, T., & Fawehinmi, O. (2019). Nexus between green intellectual capital and green human resource management. *Journal of Cleaner Production*, 215, 364–374. DOI: 10.1016/j.jclepro.2018.12.306

Zihan, W., & Makhbul, Z. K. M. (2024). Green human resource management as a catalyst for sustainable performance: Unveiling the role of green innovations. *Sustainability*, 16(4), 1453. DOI: 10.3390/su16041453

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