Green Innovation with Social Depth in Post-Consumer Waste Management: Livelihood Impacts of Green Worms India

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Abstract

Green economy transitions are typically assessed through environmental performance indicators such as carbon reduction, waste diversion, resource efficiency, and material circularity. While these metrics capture ecological outcomes, they often overlook the labour systems that underpin environmental gains, particularly in labour-intensive sectors such as waste management and material recovery. In many Global South contexts, recycling and material recovery depend on women and marginalized workers engaged in informal or semi-formal structures characterized by income instability, limited social protection, occupational vulnerability, and low social recognition. Consequently, environmental progress may coexist with persistent livelihood precarity, raising critical questions about the distributive justice and inclusiveness of green transitions.

This paper examines Green Worms India as a case of green entrepreneurship that integrates circular economy operations with structured livelihood creation. Operating within decentralized waste recovery systems in Kerala, the enterprise combines material recovery, segregation, and recycling with formalized employment pathways for women from socio-economically vulnerable backgrounds. Unlike conventional waste management models where labour welfare remains peripheral or framed as Corporate Social Responsibility, Green Worms embeds worker welfare within its operational architecture through structured wages, skill development, social security linkages, and partnerships with local governance systems.

Using a mixed-method approach drawing on impact surveys, welfare assessments, and midline livelihood data, the study evaluates outcomes across five domains: income stability, skill development, dignity and social recognition, household financial resilience, and access to social protection. The findings demonstrate measurable improvements in income predictability, skill acquisition, debt repayment capacity, living conditions, and workers perceptions of dignity and community respect. A significant proportion of the workforce comprises women with limited prior formal employment experience, indicating gendered inclusion within circular economy systems.

The study shows that embedding labour welfare within operational design generates impacts beyond income enhancement, including improved household resilience, greater access to banking and insurance mechanisms, and enhanced dignity and societal recognition. The paper contributes to green economy scholarship in three ways. First, it challenges environmentally

reductionist approaches by foregrounding livelihood quality as a core dimension of sustainable business performance. Second, it proposes a conceptual framework that integrates circular economy theory with inclusive entrepreneurship and social protection. Third, it offers empirical evidence from the Global South demonstrating that environmental sustainability and labour dignity can be mutually reinforcing when embedded within business models. By positioning livelihood outcomes as a central performance matrix of green enterprises, this study provides policy-relevant insights for designing inclusive and equitable green transitions.

Introduction

Green innovation and circular economy strategies are increasingly positioned as central responses to climate change, marine pollution, and resource depletion. Across global sustainability frameworks, material recirculation, waste diversion, and carbon mitigation are framed as key mechanisms for decoupling economic growth from environmental degradation (Niinimäki et al., 2020; Roy et al., 2023). In policy and corporate discourse, the circular economy is presented as a transformative model capable of reducing landfill dependence, conserving resources, and mitigating greenhouse gas emissions while sustaining industrial productivity. In the Indian context, waste recovery plays a particularly critical role within environmental governance. With rapid urbanization and increasing consumption patterns, municipal solid waste generation continues to rise significantly (Upaya Social Ventures, 2025). Coastal states such as Kerala face compounded risks due to marine plastic leakage, unmanaged landfill overflow, and decentralized waste flows that threaten both ecosystems and public health. Initiatives focused on waste diversion, segregation, and decentralized recovery systems are therefore central to preventing ocean-bound plastic leakage and reducing landfill dependency. Evidence from field-level implementation demonstrates that structured recovery systems can significantly reduce waste accumulation and promote resource recirculation within local economies (Green Worms, 2022). However, while environmental performance metrics dominate green growth narratives, the labour underpinning these systems remains largely neglected within corporate sustainability debates. Waste recovery in India is highly labour-intensive and historically dependent on informal work arrangements. National estimates indicate that between 1.5 and 4 million informal waste workers operate across the country, many without stable income, formal contracts, occupational safeguards, or access to social protection mechanisms (Upaya Social Ventures, 2025). These workers perform essential tasks, collection, sorting, segregation, transportation, and material aggregation, yet remain economically vulnerable and socially marginalized.

Women constitute a significant share of this workforce, particularly in decentralized collection and segregation roles. In states such as Kerala, women-led self-help groups and community-based recovery teams form the backbone of localized waste management systems (Arshida & Femi, 2024). Despite their central contribution to environmental service delivery, these workers often experience income instability, debt burdens, limited savings, and constrained access to formal social security mechanisms (Upaya Social Ventures, 2022). Gender, caste, and poverty intersect to produce compounded vulnerabilities, reinforcing structural inequities

within green transition processes. This structural contradiction reflects a major flaw within certain interpretations of green growth: environmental gains are achieved, yet the burden of low-paid essential labour is shifted onto socio-economically vulnerable populations. Waste diversion rates may improve, landfill dependency may decline, and carbon metrics may reflect progress, yet employment remains precarious. In such scenarios, sustainability is measured ecologically but not socially. The circular economy, while materially regenerative, risks becoming socially extractive. Theoretical critiques of green economy frameworks have begun to question this imbalance. While life cycle assessments and environmental impact models quantify emission reductions and resource efficiency improvements (Roy et al., 2023), they rarely incorporate labour dignity, income stability, or household resilience as core indicators. Corporate sustainability reporting frequently treats worker welfare as part of Corporate Social Responsibility (CSR), positioned externally to core operational strategy. As a result, labour protection becomes a compliance or philanthropic add-on rather than a structural component of green business design.

Against this backdrop, Green Worms India presents an alternative operational model. Founded as a waste management enterprise and evolving into a circular economy transition organization, Green Worms integrates decentralized waste recovery systems with formalized employment pathways. The enterprise operates across multiple districts in Kerala and associated regions, working in partnership with Local Self Governments (LSGs) and women-led self-help collectives such as Haritha Karma Sena (HKS) (Upaya Social Ventures, 2025). Through structured remuneration systems, skill training, capacity building, and linkages to banking and insurance schemes, the organization embeds livelihood creation directly within its circular service architecture. Rather than treating worker welfare as peripheral CSR, Green Worms incorporates livelihood generation into its core operational model. Waste collection, segregation, and recovery services are delivered alongside structured employment models that aim to provide predictable income streams and institutional support. Welfare assessments conducted among workers associated with Green Worms indicate improvements in income stability, debt repayment capacity, access to financial services, and perceived social dignity (Upaya Social Ventures, 2022). Midline data further demonstrate consistent growth in jobholder numbers over time, suggesting scalability within inclusive operational design (Upaya Social Ventures, 2025).

This study investigates whether and how such embedded models produce measurable livelihood improvements and what their limitations reveal about enterprise-led sustainability. Specifically, the paper examines the multidimensional livelihood impacts generated by Green Worms' inclusive waste management model, situating the analysis within debates on corporate sustainability, CSR, green innovation, and just transitions.

Drawing on multiple independent assessments, including impact surveys, welfare needs analyses, and midline livelihood studies, the paper evaluates outcomes across five interrelated domains:

1. Income stability and predictability
2. Skill acquisition and professionalization

3. Household financial resilience
4. Access to social protection and institutional support
5. Dignity, self-perception, and societal recognition

By triangulating these dimensions, the study seeks to determine whether inclusive green enterprise models can generate both environmental and social value simultaneously. The central argument advanced in this paper is that inclusive outcomes from green innovation are more likely when labour welfare and social protection are embedded within business design rather than treated as peripheral CSR interventions. When employment formalization, skill development, and institutional partnerships are structurally integrated into circular economy operations, green innovation can produce measurable improvements in income stability, skill acquisition, and social recognition among vulnerable workers.

This contribution is significant for three reasons.

First, it expands green economy scholarship beyond environmentally reductionist metrics by foregrounding livelihood quality as a core performance matrix of sustainable business models. Second, it provides empirical evidence from the Global South demonstrating that enterprise-led circular transitions can generate inclusive growth when operationally designed for social protection. Third, it offers practical insights for firms, policymakers, and investors pursuing just transitions, particularly in emerging economies where informal labour underpins environmental service delivery. By repositioning dignity, social protection, and livelihood resilience at the center of green innovation analysis, this paper advances a socially embedded understanding of circular economy transitions and contributes to the growing discourse on equitable green growth in the Global South.

Literature Review

Green Supply Chain Management (GSCM) and broader sustainability scholarship have historically prioritised environmental performance and operational efficiency as primary indicators of sustainable transformation. Foundational studies emphasise resource optimisation, waste minimisation, eco-efficiency, reverse logistics, and carbon reduction as core metrics of green competitiveness (Srivastava, 2007; Seuring & Müller, 2008). While these contributions have significantly advanced environmental accountability within production and distribution systems, labour conditions and livelihood outcomes frequently remain secondary considerations within sustainability models.

The Triple Bottom Line (TBL) framework, which conceptually integrates “People, Planet, and Profit,” was intended to address this imbalance by embedding social equity alongside environmental and economic performance (Elkington, 1997). However, in practice, the social dimension remains under-specified and inconsistently operationalised (Norman & MacDonald, 2004). Social sustainability is often reduced to compliance-based audits, minimum wage adherence, or supplier codes of conduct rather than being treated as a structurally embedded component of supply chain design. As Pal and Sandberg (2017) argue,

sustainability transitions frequently fail to intentionally design for social value creation, even when such value is inherently present within the system. Consequently, economic and environmental value capture tends to dominate strategic decision-making in circular and green supply chains.

This limitation becomes particularly visible in labour-intensive sectors such as recycling and waste management. Global studies of textile recovery and waste economies demonstrate that recycling systems often depend heavily on informal labour characterised by income volatility, occupational hazards, lack of contractual security and absence of social protection (Khan et al., 2023). Informalisation reduces operational costs for downstream actors, thereby enhancing environmental efficiency metrics while externalising labour risks. In this sense, environmental performance improvements may be indirectly subsidised by labour precarity.

In Kerala, for example, door-to-door waste collection is frequently conducted by informal workers, often women, operating without stable wages, occupational safeguards, structured contracts, or social security coverage (Harakal, 2022). Such workers experience irregular income flows, exposure to hazardous materials, and limited social recognition. Despite their central role in enabling localised circularity, their labour remains structurally undervalued within prevailing sustainability narratives. This reflects a broader systemic pattern in which waste work, though essential for environmental performance, is positioned at the periphery of formal economic systems.

Social sustainability within supply chains must therefore extend beyond compliance based mechanisms to include fair and stable wages, occupational health and safety, skill development, inclusion of vulnerable populations, social protection integration, and dignity and recognition at work (Mani et al., 2016). Although Sustainable Supply Chain Management (SSCM) literature increasingly acknowledges these dimensions, their integration remains limited in practice, with social concerns often addressed through superficial compliance frameworks rather than embedded within core operational design (Pagell & Shevchenko, 2014). In informal sectors, formalisation becomes a central pathway toward social sustainability. Formalisation includes structured wage systems, integration into social security frameworks, skills training, occupational safety standards, and contractual clarity. Without such structural integration, social sustainability risks remaining rhetorical rather than operational.

Pal and Sandberg's (2017) conceptualisation of uncaptured value (VU) and value opportunities (VO) provides a critical theoretical lens for analysing this gap. Uncaptured value refers to economic, environmental, or social value that is lost, underutilised, or actively destroyed due to prevailing system design. In informal recycling systems, social value is frequently uncaptured: labour contributions are undervalued, workers lack institutional recognition, occupational risks remain unmanaged, and livelihood resilience is undermined by structural instability. These losses are not incidental; they are embedded within supply chain configurations that prioritise cost efficiency over welfare integration.

Value opportunities (VO), in contrast, represent strategic interventions through which organisations can transform uncaptured value into positive economic, environmental, and social outcomes (Pal & Sandberg, 2017). Within waste systems, such opportunities may include integrating workers into formal service delivery contracts, eliminating exploitative intermediaries, implementing transparent wage structures, embedding health and safety standards, and linking workers to social protection schemes. When labour welfare is embedded directly into operational models rather than treated as a peripheral corporate social responsibility (CSR) function, social value becomes systematically captured rather than incidentally generated.

However, empirical findings indicate that most VO strategies are pursued primarily to enhance economic competitiveness or environmental efficiency rather than to strengthen social protection or livelihood resilience (Pal & Sandberg, 2017). In post-consumer waste sectors, these dynamics are especially pronounced. Increasing volumes of low-value textile materials, fluctuating secondary material markets, and rising regulatory pressures intensify cost sensitivity and market development priorities. As a result, circular economy transitions risk reproducing structural inequalities unless labour welfare is deliberately embedded within system design.

The fragmentation of post-consumer textile value chains further exacerbates this vulnerability. Collection, sorting, aggregation, recycling, and resale are often dispersed across informal and semi-formal actors with limited coordination. Informal workers absorb price fluctuations, contamination risks, and demand volatility without institutional safeguards. While brands and manufacturers face regulatory scrutiny under Extended Producer Responsibility (EPR) frameworks and sustainability reporting mandates, labour conditions within downstream waste systems often remain insufficiently addressed.

Taken together, existing scholarship highlights a critical gap within sustainable supply chain and circular economy research:

- How do green enterprises internalise labour welfare within circular business models?
- Does enterprise-led formalisation improve income stability and access to social protection?
- How do dignity and social perception shift when waste work becomes formalised and institutionalised?

Addressing these questions requires moving beyond environmental efficiency metrics toward integrated assessments of livelihood transformation. It demands examining how green enterprises operationalise social objectives within environmental service delivery and how labour welfare can be treated as a core design principle rather than a CSR add-on.

This study responds to this gap by analysing Green Worms India as a case of green innovation with social depth. Unlike conventional recycling enterprises that prioritise material throughput and cost optimisation, this case foregrounds livelihood transformation as structurally linked to

circular waste management operations. By integrating structured wages, formal contracts, social security linkages, skill development, and occupational safeguards within its operational architecture, the enterprise demonstrates how uncaptured social value can be intentionally transformed into captured value opportunities.

By foregrounding income stability, social protection access, skill enhancement, and dignity as measurable sustainability outcomes, this research contributes to expanding Sustainable Supply Chain Management and circular economy scholarship beyond environmental efficiency. It advances a model in which social sustainability is not peripheral but embedded within the core operational logic of green enterprises. In doing so, it reframes circular economy transitions as not only material recovery processes but also as institutional redesign processes capable of transforming labour precarity into livelihood resilience.

Green Worms India: An Inclusive Circular Economy Enterprise

Green Worms India operates as a mission-driven waste management enterprise delivering decentralised, traceable, and circular waste solutions across rural and urban regions of India. The enterprise represents an integrated model of environmental service delivery and livelihood generation, positioning circularity not merely as a material recovery strategy but as a socio-economic intervention. Its innovation lies not only in improving segregation efficiency or traceability systems, but in redesigning the institutional architecture through which labour is organised, formalised, and protected within decentralised waste economies.

The enterprise functions through structured partnerships with Local Self Governments (LSGs), embedding operations within Kerala's decentralised governance framework. Central to this model is the integration of Haritha Karma Sena (HKS) members into decentralised waste collection, primary segregation, and scientific processing systems. The Haritha Karma Sena refers to organised groups of women engaged under the Kudumbashree poverty eradication mission of Kerala. These women are formally recognised as frontline sanitation workers responsible for door-to-door waste collection, user fee collection, and material handover to Material Recovery Facilities (MRFs).

At the MRF level, waste is further segregated, baled, and channelled into downstream recycling streams. These facilities are staffed largely by women from economically marginalised backgrounds. Given the physical strain, exposure to mixed waste, and health risks associated with manual segregation, the enterprise has deliberately prioritised workplace improvements. Investments have been directed toward protective equipment provision, ventilation systems, structured shifts, hygiene facilities, and safety protocols. Worker welfare is embedded as an operational cost rather than treated as an external compliance requirement.

The employment architecture spans three structured models:

- Payroll-based workers operating within Material Recovery Facilities under formal wage systems.

- Panchayat-linked micro-entrepreneurs engaged in decentralised door-to-door collection under user-fee-based revenue models.
- Community-facing waste educators and mobilisers, responsible for behaviour change communication, contamination reduction, and household awareness.

This diversified employment structure enables distributed circular operations while expanding inclusive green employment opportunities.

The workforce demographic profile reflects significant socio-economic vulnerability. A majority of workers are women, with an average age of 47 years, indicating mid-life economic participation often driven by household necessity. Approximately 95% of the workforce falls below the poverty line, and 22% of women workers serve as sole breadwinners within their households. The fact that 84% are married highlights the dual burden of unpaid domestic responsibilities alongside formal labour engagement.

Educational attainment levels further underline structural disadvantage. Approximately 43% have studied below the 10th grade, with an additional 10% having only lower primary education. While 34.4% completed 10th grade and 11.3% completed 12th grade, only 1.3% hold graduate degrees. Nearly half the workforce has not completed secondary education, and access to higher education remains limited. This educational profile underscores the model's inclusivity, as it provides structured green employment pathways to women who would otherwise face exclusion from formal labour markets.

Between 2021 and 2025, jobholders associated with Green Worms increased from 532 to 7,808. This exponential growth demonstrates scalability within local governance systems and indicates institutional acceptance of the decentralised circular model. Importantly, this scale expansion has occurred while retaining a labour-intensive, community-integrated structure, suggesting that circular economy enterprises can generate both environmental impact and inclusive livelihood growth when designed with embedded social objectives.

Methodology

Research Design

This study adopts a mixed-method case study approach to examine how a green enterprise operationalises labour welfare within a circular waste management model. A case study methodology is appropriate given the research objective: to understand how social sustainability is embedded within organisational design and operational processes in a real-world context. The study combines quantitative impact data with qualitative worker narratives to assess measurable livelihood transformation within a circular enterprise framework.

Rather than relying on a single cross-sectional dataset, the study synthesises findings from multiple independent impact assessments conducted between 2022 and 2025. The use of third-

party evaluations strengthens methodological reliability and reduces internal reporting bias. The longitudinal dimension allows for trend analysis across time, particularly in income stability, job satisfaction, and social protection indicators.

Data Sources

The study draws upon three primary independent assessments:

1. Upaya Social Ventures Baseline Impact Survey (2022)
2. 60 Decibels Social Impact Assessment (2024)
3. Upaya Social Ventures Midline Assessment (2025)

These studies were commissioned independently and implemented using structured survey instruments and field-based interviews.

Upaya Social Ventures Baseline (2022)

The 2022 baseline assessment surveyed 168 jobholders engaged through two employment models:

- Full-time payroll workers employed directly by the enterprise.
- Micro-entrepreneurs (Haritha Karma Sena – HKS workers) operating through panchayat-linked decentralised waste collection systems.

The baseline established pre-expansion metrics on income stability, skill acquisition, job satisfaction, and access to economic alternatives. Household income comparisons were conducted to assess relative improvement over previous employment conditions.

60 Decibels Social Impact Assessment (2024)

The 2024 independent assessment conducted by 60 Decibels surveyed 285 workers, including:

- 80 facility workers engaged in sorting and recovery operations.
- 205 HKS workers engaged in decentralised door-to-door collection systems.

The survey methodology included structured telephonic and in-person interviews using standardised impact measurement tools. 60 Decibels specialises in lean data methodologies, focusing on worker-reported outcomes and perception-based indicators. This assessment provided comparative benchmarking across similar employment cohorts within the broader waste management ecosystem.

Key areas assessed included:

- Income reliability and sufficiency.
- Perceived job stability.

- Occupational safety.
- Worker dignity and recognition.
- Access to alternative employment opportunities.

Upaya Social Ventures Midline Assessment (2025)

The 2025 midline assessment surveyed 198 jobholders, achieving a 95% confidence level with a 7% margin of error. Data collection was conducted through in-person interviews across Kozhikode and Malappuram districts, ensuring geographic representation across operational clusters.

The midline assessment enabled comparison with the 2022 baseline, facilitating evaluation of longitudinal shifts in:

- Income growth and volatility reduction.
- Skill deepening and role mobility.
- Social protection integration.
- Worker retention and satisfaction.
- Perceived improvement in household stability.

The use of consistent indicators across baseline and midline assessments enhances comparability and strengthens internal validity.

Sample Characteristics

Across all assessments, the combined dataset covers over 400 worker observations, including full-time employees and decentralised micro-entrepreneurs operating within local governance structures. A significant proportion of respondents are women, reflecting the gendered composition of door-to-door waste collection systems in Kerala.

The inclusion of both payroll employees and micro-entrepreneurial workers allows for analysis of differentiated formalisation pathways within the same circular enterprise model. This comparative lens is critical for evaluating how varying degrees of institutional integration influence livelihood outcomes.

Data Collection Methods

Data collection methods included:

- Structured quantitative surveys.
- Semi-structured interviews.
- Household income comparison exercises.
- Worker perception-based scoring.
- Qualitative testimonies documenting lived experiences.

Quantitative indicators were supplemented by narrative testimonies to capture non-monetary dimensions of social sustainability such as dignity, social recognition, and perceived occupational legitimacy. This triangulation enhances interpretive depth and reduces reliance on purely income-based metrics.

Analytical Framework

Indicators were analysed across five domains aligned with social sustainability literature and the uncaptured value (VU) framework proposed by Pal and Sandberg (2017):

- **Income and Financial Stability**
    - Monthly income levels.
    - Income volatility.
    - Ability to meet household expenses.
    - Savings behaviour.
    - Debt reduction trends.
- **Skill Development and Economic Mobility**
    - Technical training received.
    - Role expansion opportunities.
    - Entrepreneurial capability.
    - Self-reported confidence in job performance.
- **Job Quality and Occupational Safety**
    - Availability of protective equipment.
    - Injury incidence.
    - Perceived safety.
    - Structured work schedules.
    - Contractual clarity.
- **Social Perception and Dignity**
    - Community respect.
    - Reduction in stigma associated with waste work.
    - Worker's self-esteem.
    - Perceived recognition by local institutions.
- **Social Protection, Health, and Welfare**
    - Access to health insurance.
    - Social security integration.

- Pension enrollment.
- Emergency support systems.

The analysis examined both absolute improvements and directional consistency across independent assessments. Patterns were interpreted in relation to enterprise-led formalisation mechanisms, including wage structuring, safety provisioning, institutional partnerships, and governance integration.

Validity and Reliability

The study benefits from three methodological strengths:

1. **Third-Party Validation** : All datasets were collected by independent impact assessment organisations, reducing internal bias.

2. **Longitudinal Comparison** : Baseline-to-midline comparison enables tracking of change over time rather than static outcome reporting.

3. **Triangulation** : Combining quantitative metrics with qualitative testimonies strengthens interpretive robustness.

While the study does not include a counterfactual control group, the consistency of results across independent evaluators and timeframes strengthens confidence in observed patterns. The repeated emergence of positive livelihood indicators suggests structural rather than incidental impact.

Limitations

Despite its strengths, the study has limitations:

- Absence of a control group limits causal inference.
- Self-reported income and satisfaction data may contain response bias.
- The study is geographically concentrated in two districts of Kerala, limiting broader generalisability.
- Market-level fluctuations in waste pricing may influence income outcomes independently of enterprise design.

However, the convergence of findings across baseline, midline, and third-party assessments indicates a reliable pattern of livelihood enhancement linked to enterprise-led formalisation.

Ethical Considerations

All assessments were conducted through informed consent procedures. Worker confidentiality was maintained, and data were anonymised prior to analysis. Interviews were conducted in local languages to ensure comprehension and reduce response distortion.

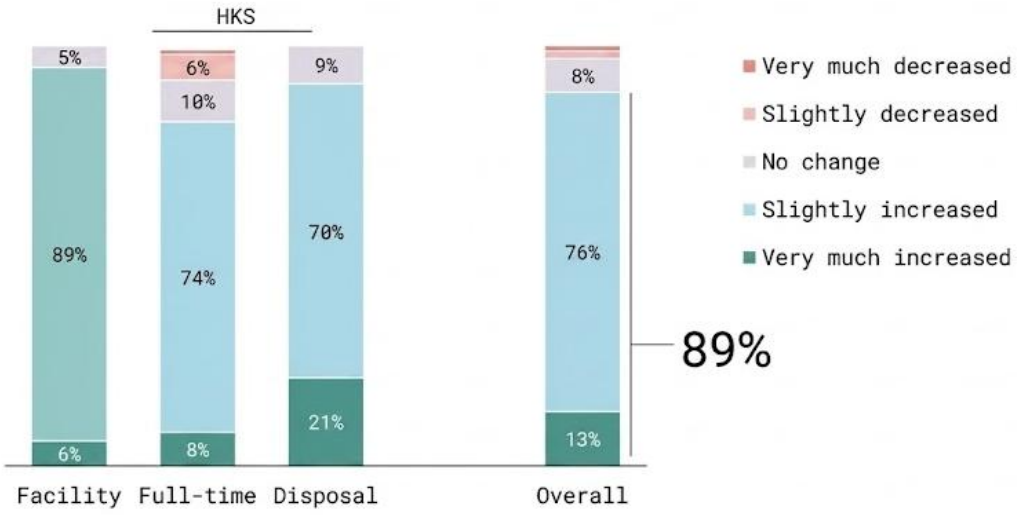
Results and Discussions

Income stability and financial security

Across studies, income stability emerges as the most significant livelihood outcome. 89% reported an increase in income because of Green Worms [60 Decibel]. The 2022 Upaya survey reported an average increase of 33% in household income after joining Green Worms. 95% facility workers reported their income is sufficient to meet household expenses whereas only 44-33% of HKS agree to that. A formal job with fixed working hours and fixed stable income could be driving this impact, compared to HKS where payment for some categories of workers is not fixed. Household level analysis shows that around 50% of total household income was derived from Green Worms employment. The 2025 midline assessment shows stronger income effects for first time earners. Average daily income increased from INR 57 to INR 380, a 580% rise, with 75% of workers having had no prior income. For previously employed workers income increased by 86%.

Question: Has your income changed because of working/ engaging with Green Worms?

(n = 284; Facility = 79, HKS Full-time = 85, HKS Disposal = 120)



67% of jobholders now consider their income as stable, compared to 14% at baseline. Even though average income declined between baseline and midline due to cohort difference and tenure shifts, perceived stability improved significantly. It is found that 18% of the jobholders

save from their income and 23% of the jobholders are currently paying a debt of INR 258,054 on average. Around 50% of jobholders pay debt through Green Worm's income. These findings suggest that structured green employment not only improves income level but also income consistency. This reliability allows workers to stop surviving and start investing in their families.

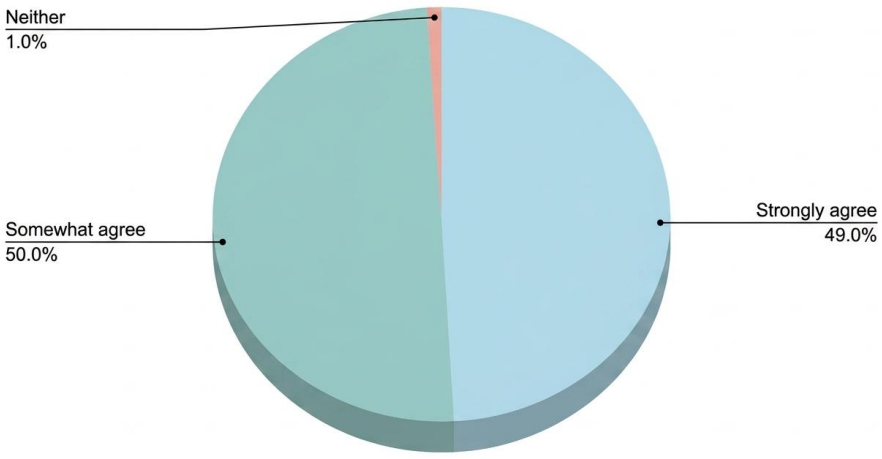
Skills Development and Employability

Skill acquisition represents a core mechanism of transformation. The Green Worms model generates significant human capital benefits. Employees have reported that they have gained relevant and transferable professional skills, enabling them to secure better employment in the future. At midline, 95% of jobholders reported acquiring new skills, compared to 34% at baseline. Workers reported improvement in technical skills like waste segregation and hygiene protocols, also soft skills such as communication skills, team work and community engagement. The sharp rise in reported skill gains (from 34% to 95%) between baseline and midline indicates that capacity building interventions, structured processes and machinery integration have strengthened professional identity and competence over time.

Around 31% workers reported significant improvement in their way of work after coming to Green Worms. The workers attribute this to improved work efficiency through usage of machinery for facility workers and systematic process for HKS workers. Availability and usage of protective gears also have enhanced the work efficiency. Nearly half of the facility workers strongly agreed that they have access to relevant tools and resources for their work.

Question for facility workers: To what extent do you agree or disagree with the following statement: "I have the tools and resources I need to do my work right."?

(n = 80)



This shift reflects the internalisation of labour upgrading within the circular model moving beyond waste handling towards skilled environmental service provision. Women jobholders reported increased confidence in community facing roles, contributing to enhanced employability and agency. These findings position green entrepreneurship as a site of skill formation, not merely low skilled service provision.

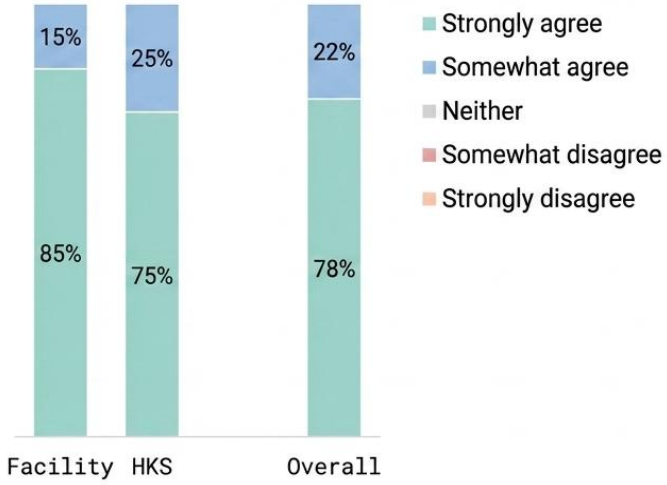
Dignity, Identity, and Social Recognition

Waste work in India is normally associated with stigma and informality. The data reveals a meaningful shift in both self perception and societal recognition among workers engaged with Green Worms. The 2025 assessment shows that 79% of jobholders reported positive changes in self perception, while 70% observed improved societal recognition after joining the organisation. Earlier data from 2022 indicated that 60% experienced improved dignity and respect from society, though 17% continued to experience stigma. Qualitative testimonies further highlight enhanced confidence, independence, and social status.

These shifts suggest that formalisation including uniforms, safety gear, fixed wages, and structured roles contributes to dignity restoration in historically marginalised occupations. Waste work, traditionally viewed as informal and stigmatised, is increasingly reframed as legitimate and professional green work. Workplace conditions reinforce this transition. 78% of workers strongly agree to being treated with respect at work and 44% strongly agree if feeling safe at work. About 69% of facility workers strongly agree that they have access to clean toilets and are allowed regular breaks. Together these indicators demonstrate that improvement in organisational structure and occupational safety are closely linked to enhanced dignity, recognition and professional identity within circular livelihoods.

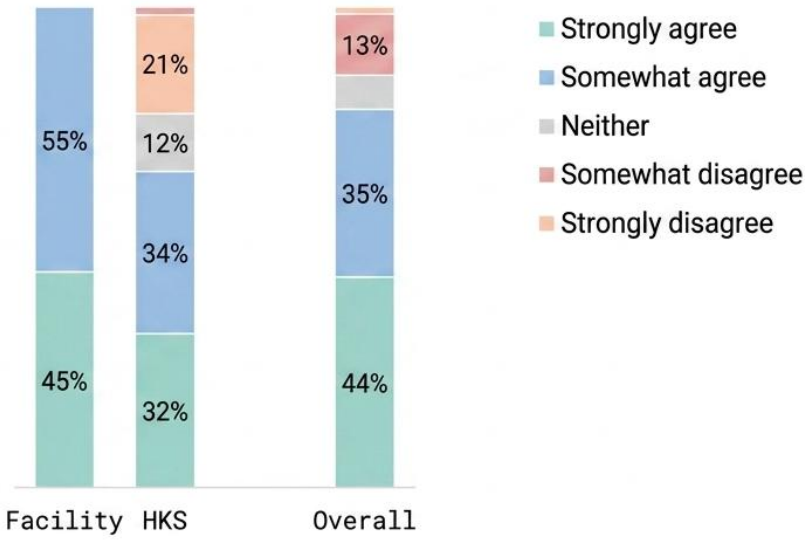
Question: To what extent do you agree or disagree with the following statement: "At work, I am treated with respect."?

(n = 285, Facility = 80, HKS Full-time = 85, HKS Disposal = 120)



Question: To what extent do you agree or disagree with the following statement: "I feel safe from threats, hazards, harassment and/or discrimination working here."?

(n = 285, Facility = 80, HKS Full-time = 85, HKS Disposal = 120)



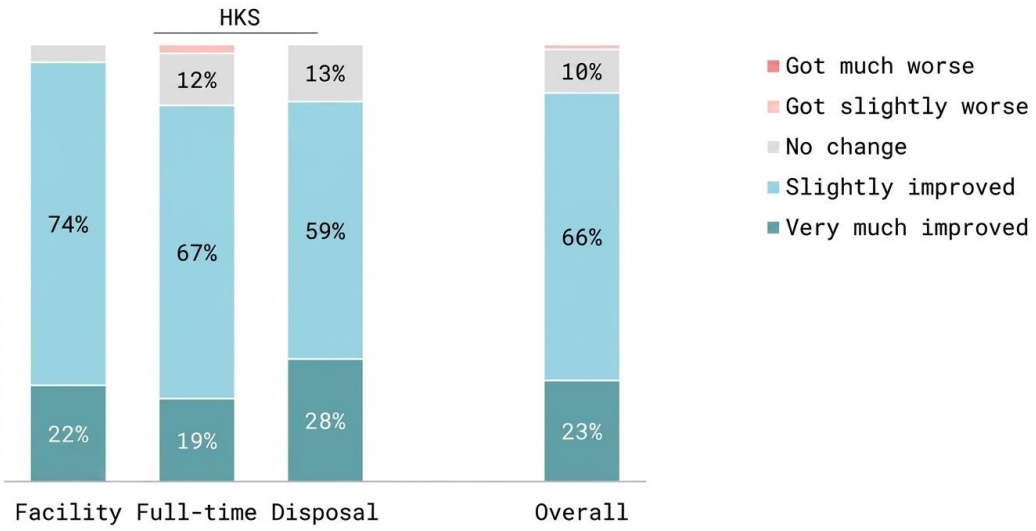
Job Satisfaction and Quality of Life

The findings indicate measurable improvements in household stability and overall quality of life among jobholders. 95% of jobholders live in their own homes, and 50% reported having made housing improvements financed through income earned from Green Worms. 71% of households possess life or health insurance, largely through group schemes linked to women's collectives, reflecting increased social protection coverage. Educational outcomes are also significant, with stable income supporting children's schooling and reducing reliance on informal labour within households.

4 in 5 workers reported improvement in their overall quality of life. Most workers report improved household expense management and income consistency as the reason that improved their quality of life. Job satisfaction levels remain consistently high across assessments. Predictable earnings eliminate the volatility that typically traps workers in debt cycles. By providing a stable financial foundation, the model empowers employees to manage their daily expenses with confidence and foresight.

Question: Has your quality of life changed because of working with Green Worms?

(n = 285, Facility = 80, HKS Full-time = 85, HKS Disposal = 120)



Question : How has your quality of life improved?

(n = 285, Facility = 80, HKS Full-time = 85, HKS Disposal = 120)

Top Outcomes	Facility	HKS Full time	HKS Disposal
Consistency in income	1%	46%	68%
Improved household expense management	74%	0%	0%
Ability to pay/access loans	18%	25%	16%
Educational support	19%	26%	13%
Increased family support	1%	24%	13%

Job satisfaction level remains consistently high across assessment periods. When the 2022 baseline assessment reported 64% job satisfaction, the 2025 report indicates that 87% of jobholders now experience high job satisfaction. This increase corresponds with improvements in timely wage payments, enhanced skill development, and structured supervision systems. It was reported that 80% of employees would recommend the job to friends or relatives, suggesting confidence in compensation and working conditions and organisational support. These findings indicate that structured green employment contributes not only to income gains but also to improved household security, social protection, and subjective well being.

Social Protection, Health, and Welfare as Green Job Quality Indicators

Green Worms integrates a range of social protection and welfare mechanisms that are uncommon in informal waste work. Payroll based workers are covered under statutory social security provisions such as the Employees State Insurance (ESI), and Employees Provident Fund(EPF), enabling access to healthcare, disability coverage and income protection. These

mechanisms significantly differentiate Green Worms model from informal waste systems where workers typically lack any formal safety net. The organisation conducts periodic health check ups, hepatitis B vaccination drives, occupational safety monitoring and training on fire safety and needle stick injury prevention. In addition to this workers also receive structured awareness programs including POSH (Prevention Of Sexual Harassment) training, women's self defence classes, menstrual hygiene sessions and refreshment or morale building activities such as organised tours. These interventions signal an institutional commitment to worker well being that extends beyond productivity concerns.

Access to ESI longer term intergenerational benefits. ESI linked reservations in admissions for medical and other professional courses expand higher education opportunities for worker's children, supporting access to better quality colleges that would otherwise remain structurally inaccessible. This introduces a longer term dimension to social mobility within a circular enterprise framework.

The enterprise further facilitates interest free emergency loans, welfare fund access, and financial assistance during medical or family crises. Evidence from the midline assessment shows that 59% of jobholders accessed additional benefits beyond wages, including emergency financial support and welfare assistance, contributing to higher job satisfaction and resilience. These measures partially offset healthcare related financial shocks, which remain a major source of vulnerability in informal labour markets, and illustrate how green enterprises can internalise elements of social protection typically absent in market led sustainability models.

In 2023 and 2024, Green Worms allocated INR 1,95,253 towards empowerment initiatives and INR 70,872 towards safety equipment such as gloves, masks and boots to strengthen occupational safety standards. The organisation also purchased recyclables worth INR 1,07,00,074 from HKS workers at an average rate of INR 10.2 per kilogram, the highest rate offered among comparable agencies, thereby enhancing income security. Average daily wage in partnered Local Self Governments increased from INR 300 to INR 455, reflecting improved earnings and strengthened collaboration toward full scale waste management systems.

The cumulative evidence suggests that Green Worms internalises labour welfare within its circular waste management design. Rather than treating social outcomes as peripheral CSR activities, the model integrates:

- Structured wage systems
- Statutory social security integration (ESI, EPF)
- PPE and occupational safety investments
- Skill training and process formalisation
- Higher purchase rates for recyclables
- Community engagement and dignity building initiatives

The steady growth in jobholders, up to 7,808 by 2025, indicates scalability of this socially embedded circular approach. This supports the theoretical proposition that "value opportunities" in circular systems can be intentionally directed toward labour formalisation and social protection, rather than solely economic competitiveness or material efficiency.

Environmental Performance

In addition to livelihood outcomes, the Green Worms model demonstrates strong environmental performance through large-scale material recovery and decentralised waste management systems. In 2024 alone, over 50,610 metric tons of waste were scientifically managed, marking a significant increase from 30,140 metric tonnes in 2023, reflecting the model's ability to scale environmental impact across geographies. Operations spanning 103 Local Self-Governments and 120 villages enable systematic diversion of waste from landfills and prevent environmental leakage into ecosystems. The material composition further highlights recovery efficiency, with a substantial proportion of waste being sorted, recyclable, or processed through appropriate channels. These outcomes demonstrate that decentralised circular economy systems can deliver measurable environmental benefits at scale. This performance is deeply interlinked with labour systems, where organised collection, segregation and processing by waste workers form the backbone of environmental efficiency, reinforcing the co-dependence between ecological outcomes and dignified work.

Implications

Implications for circular economy and green innovation scholarship

This study demonstrates that circular economy systems can be designed to generate *captured social value* alongside material recovery outcomes, challenging environmentally reductionist framings that treat labour as an externality. By evidencing improvements in income stability, skills, dignity, and social protection within a waste recovery enterprise, the paper supports a more socially embedded interpretation of circular transitions—one where labour welfare is not a downstream consequence but an upstream design variable. The findings strengthen the relevance of Pal and Sandberg's uncaptured value lens by showing that "value opportunities" in circular systems can be intentionally directed toward formalisation and worker wellbeing, not only toward economic efficiency or environmental performance (Pal & Sandberg, 2017).

Implications for policy and governance (Kerala and comparable contexts)

The model highlights the critical role of Local Self Governments (LSGs) as institutional anchors for inclusive circularity. In contexts where waste systems rely on informal labour, formalisation through panchayat-linked contracts, structured user fee systems, and predictable service delivery arrangements becomes a practical pathway for just transition outcomes. The demonstrated income stability improvements (e.g., perceived stability increasing from 14% to 67%) and welfare linkages (ESI/EPF) indicate that local governance structures can play a pivotal role in translating sustainability targets into livelihood gains (Upaya Social Ventures, 2022, 2025). For policymakers designing EPR and waste governance reforms, the implication is clear: waste diversion targets should be paired with worker welfare standards, including minimum service fees, safety protocols, and social security linkages, to avoid "green growth" being built on precarious labour.

Implications for enterprises, investors, and EPR-driven brand systems

For enterprises and investors funding circular infrastructure, the results provide evidence that embedding welfare into operations can improve retention, job satisfaction, and workforce stability—factors that directly influence service reliability and system scalability. High job satisfaction (87%) and willingness to recommend the job (80%) indicate organisational trust and reduce turnover risk, which is a major operational vulnerability in waste recovery systems (Upaya Social Ventures, 2022, 2025). For brands implementing EPR, the implication is that verified recovery should not be evaluated solely through tonnage metrics or recycling certificates; it should include social performance indicators that reflect job quality and labour dignity within downstream recovery chains.

Implications for gender inclusion and social equity

The case evidences a pathway for gendered inclusion in green jobs where women—many with low formal education and limited labour market mobility—gain structured income, skill development, and improved social recognition. In circular economy debates that often under-specify gender, the findings indicate that inclusive green enterprises can act as institutional mechanisms for women's economic agency and household resilience, especially among first-time earners (Upaya Social Ventures, 2022, 2025).

Limitations

This paper has several limitations that should be acknowledged. The study cannot establish strong causal attribution because it lacks a matched control group or quasi-experimental design. While triangulation across multiple independent assessments strengthens confidence in observed patterns, the results should be interpreted as evidence of consistent association rather than definitive causal proof. Several indicators (e.g., dignity, job satisfaction, perceived stability, social recognition) are self-reported and may be influenced by recall bias, social desirability bias, or interviewer effects. Nonetheless, these indicators are also essential for capturing non-income dimensions of social sustainability that cannot be fully measured through financial data alone. The baseline (2022) and midline (2025) samples represent different worker cohorts with different tenure levels, which may partly explain fluctuations in average income levels despite improvements in perceived stability. Additionally, broader economic changes (inflation, local wage shifts, changing household needs) may influence outcomes independently of enterprise design. Most evidence is concentrated in Kerala (notably Kozhikode and Malappuram), a state with relatively strong decentralised governance, Kudumbashree institutional capacity, and community-linked service systems. Replication in states with weaker local governance, different labour norms, or different waste compositions may not yield identical outcomes.Market volatility in recyclables and external policy dynamics income outcomes for HKS workers are partly influenced by market rates for recyclables and

LSG payment structures. Shifts in scrap pricing, procurement competition, or municipal policy changes could affect income stability and should be accounted for in longer-term evaluations.

Conclusion

This paper examined Green Worms India as a case of green innovation with social depth, analysing whether circular waste management operations can generate measurable livelihood transformation when labour welfare is embedded structurally within enterprise design. Across three independent assessments (Upaya baseline 2022, 60 Decibels 2024, Upaya midline 2025), findings indicate that the model produces multidimensional outcomes beyond waste diversion and material recovery.

First, Green Worms generates income gains and improved income predictability, particularly for first-time earners and payroll-based workers. Even where average income levels varied across cohorts, perceived stability increased substantially over time, indicating that predictability not only magnitude functions as a core livelihood outcome. Second, the enterprise demonstrates strong evidence of skills upgrading, with reported skill acquisition rising from 34% at baseline to 95% at midline, reflecting the professionalisation of waste work through structured processes, equipment use, and training. Third, the study documents a meaningful shift in dignity and social recognition, with improved self-perception and community respect indicating that formalisation mechanisms (uniforms, safety gear, structured roles, supervision) reshape the social meaning of waste work. Finally, the enterprise incorporates social protection and welfare mechanisms including statutory linkages such as ESI and EPF for payroll workers and additional welfare supports—that are uncommon in informal waste labour markets. These interventions contribute to household resilience through improved debt repayment capacity, increased insurance access, and better living conditions.

Collectively, the evidence supports the paper's central argument: circular economy models are more likely to generate inclusive outcomes when labour welfare is treated as a *core operational design principle* rather than a peripheral CSR activity. Green Worms illustrates how "value opportunities" in circular systems can be intentionally directed to capture uncaptured social value through formalisation, skill development, safety, and dignity-building institutional arrangements (Pal & Sandberg, 2017).

For sustainability scholarship, the study extends green transition evaluation beyond environmental metrics by positioning livelihood quality as a core performance matrix of green enterprises. For policy and practice, it offers actionable insight: waste management systems aimed at environmental outcomes should integrate minimum job quality standards, safety protocols, and social protection linkages to prevent circularity from reproducing labour precarity. The case demonstrates that environmental sustainability and labour dignity are not competing objectives; when designed structurally, they can be mutually reinforcing and scalable within local governance systems (Upaya Social Ventures, 2022, 2025).

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