

# Gender-Based Assessment of Green Technology and Eco-Waste Initiatives in BALMACO: Bridging Environmental Awareness and Implementation

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**Abstract:** This descriptive-correlational study executed a gender-based assessment of green technology and ecological solid waste management initiatives among 106 active workforce members within an agricultural cooperative. The study aimed to bridge the gap between internal environmental awareness and operational implementation. Empirical results revealed a composite awareness score of 3.18, indicating that the workforce is generally aware of sustainable concepts, though specific technical workflows and internal material support pathways require optimization. Notably, an Independent Samples T-test confirmed no statistically significant differences in both awareness and implementation levels between male and female respondents, demonstrating a unified institutional alignment. To transform baseline knowledge into daily practice, the study recommends establishing localized, visual, and hands-on training frameworks that directly support field-level waste management execution across all gender groups.

**Keywords:** Green technology, Agricultural cooperative, Gender perceptions, Solid Waste management,

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## I. Introduction

For any modern organization to survive and reach its long-term strategic goals, its workers must be well-trained and highly capable. In the field of human resource management, employees represent a cooperative's most valuable but also its most complex assets. Because of this, keeping a workforce well-informed is necessary to boost daily operational productivity and ensure full compliance with modern environmental policies. Today, serious global issues like rapid climate change, unpredictable weather patterns, and the depletion of natural resources make the adoption of green technology essential for agricultural operations to stay viable. For agricultural cooperatives to maintain their production standards without harming local ecosystems, they must systematically transition from traditional, wasteful habits to eco-friendly, modern methods.

In the Philippines, these sustainable standards are strictly enforced by the national government under Republic Act No. 9003, also known as the Ecological Solid Waste Management Act of 2000. This landmark law mandates proper waste segregation at the source, systematic waste reduction, and the establishment of dedicated recycling protocols across all institutional offices, businesses, and communities. For agricultural cooperatives to follow these national laws and survive growing climate challenges, their internal human resource base must clearly understand these technical guidelines. When administrators, office staff, and field farmers lack clear

institutional training, organizations often struggle with chemical container disposal, agricultural biomass accumulation, and office resource waste, which can lead to legal penalties or operational inefficiency.

However, most existing agricultural research focuses only on how outside customers or buyers use and purchase green farming products. There is a major empirical gap in literature regarding how a cooperative's internal workers understand and practice environmental regulations within their actual daily workspace. No organization can successfully execute environmental policies if its personnel lack structured training, clear conceptual understanding, or direct material support. To address this problem, this study evaluates the internal workforce of the Baro a Langa ti Mannalon Agriculture Cooperative (BALMACO) through a gender-comparative lens. By focusing specifically on active, long-term farmers and administrative leaders, this research aims to explicitly measure what the workforce knows (awareness) versus what they actually practice (implementation) regarding green technology and eco-waste initiatives.

## **II. Objectives of the Study**

The primary goal of this study is to conduct a gender-based assessment of the green technology and eco-waste initiatives within BALMACO to bridge the gap between what workers know and what they actually do. To achieve this, the research focuses on four core objectives. First, it profiles the cooperative respondents by their sex and age to understand the background of the workforce. Second, it measures the level of awareness regarding green technology and solid waste management among the participants. Third, it evaluates the actual level of implementation of these environmental practices based on the feedback of both members and officers. Fourth, it compares these awareness and implementation levels to see if there are any significant differences based on sex and age. Finally, these four findings are used to create a practical, hands-on training framework to improve everyday waste management within the cooperative.

## **III. Methodology**

This study utilized descriptive and correlational research designs to comprehensively evaluate the environmental initiatives within the Baro a Langa ti Mannalon Agriculture Cooperative (BALMACO). The descriptive aspect of the design was employed to systematically profile the socio-demographic traits of the workforce and measure their descriptive scores across two separate operational dimensions: environmental awareness and practical implementation. The correlational aspect allowed the researchers to investigate statistical associations and assess whether significant variances exist when these data points are grouped by the respondents' demographic attributes. The investigation was conducted locally at the primary corporate headquarters and operational zones of BALMACO in Gamu, Isabela. This specific location provides an ideal research environment due to its active engagement in large-scale palay production and agricultural processing, which generates substantial amounts of daily organic and inorganic agricultural waste requiring systematic management.

The research population focused strictly on the internal human resource base of the cooperative, which consists of active administrative officers and regular field-level members. Out of a total pool of 146 active cooperative stakeholders, a sample size of 106 participants was established using the Krejcie and Morgan formula to ensure strong statistical representation and a minimal margin of error. To select the specific respondents from this population, a two-tiered sampling strategy was implemented. First, total enumeration was applied to the 4 core administrative staff and officers. This approach means that the entire leadership team was included to capture complete managerial oversight regarding policy decisions. Second, simple random sampling was utilized to select the remaining 102 regular field members from the membership registry. This method gave every active farming member an equal chance of selection, eliminating bias and ensuring that the final data accurately reflects the broad operational realities of the farm workforce.

The primary data collection tool was a structured, four-part survey questionnaire designed to evaluate baseline environmental perceptions. To facilitate easy comprehension and prevent cognitive fatigue among rural smallholder farmers, the instrument was fully translated into a bilingual format utilizing both English and the local dialect (Filipino/Ilocano). Part I of the survey collected demographic profiling indicators, focusing exclusively on sex and age. Part II consisted of a 10-item Likert scale measuring the level of awareness regarding

green technology frameworks and Republic Act No. 9003. Part III utilized a corresponding 10-item scale to assess the actual level of practical implementation of eco-waste practices on the farm. Before the final field deployment, a rigorous pre-testing and instrument validation phase was executed by floating the survey to exactly 30 pilot respondents. To secure the main sample and prevent data contamination, these 30 individuals were selected from the cooperative's pool of associate members. These pilot participants shared identical socio-economic traits with the main group but were entirely excluded from the final study database. The collected pilot data were inputted into SPSS to run an item-reliability analysis. The test yielded a Cronbach's alpha reliability coefficient well above the standard 0.70 threshold for both scales, confirming that the questionnaire was highly stable, clear, and statistically valid for formal data collection. Furthermore, all data collection procedures strictly complied with the Data Privacy Act of 2012 by handling all submissions anonymously and using grouped figures to protect individual member identities.

Once the data collection window closed, all completed surveys were coded and processed using SPSS software. The researchers used simple frequency counts and percentage distributions to map out the sex and age profiles of the respondents. Weighted means were calculated to interpret the descriptive levels for both the awareness scale and the implementation scale. Finally, an Independent Samples T-test and an Analysis of Variance (ANOVA) were executed to determine if there were any statistically significant differences in awareness and implementation levels when the cooperative workforce was grouped according to sex and age. All statistical tests were run at a 0.05 level of significance to confirm the validity of the results.

#### IV. Results and Discussion

The empirical phase of this study involved collecting and processing data from 106 active cooperative participants. As detailed in the methodology, this cohort was established from a total institutional pool of 146 active members using the Krejcie and Morgan formula. This sample size ensures strong statistical representation while maintaining a tight margin of error. The final group included total enumeration of the 4 core administrative staff and officers alongside 102 randomly selected regular field members.

Data collection was executed using a bilingual survey questionnaire written in English and the local dialect. This approach was designed to evaluate baseline environmental perceptions without language barriers causing confusion. To answer the research objectives, the collected data were analyzed using three main statistical methods: Frequency counts and percentages were computed to map out the sex and age profiles of the respondent's, weighted means were calculated to measure the descriptive scores for both environmental awareness and practical field implementation, an Independent Samples T-test was applied to identify any statistically significant differences between male and female responses. All personal information was handled anonymously and processed in grouped formats to ensure full compliance with the Data Privacy Act of 2012.

**Table 1. Profile of the Respondents by Sex**

| Sex          | Frequency  | Percent     |
|--------------|------------|-------------|
| Male         | 82         | 77.36%      |
| Female       | 24         | 22.64%      |
| <b>Total</b> | <b>106</b> | <b>100%</b> |

The empirical data in Table 1 reveals a pronounced gender imbalance within the cooperative's active membership registry. Male workers account for 77.36% (82 individuals) of the total sample, while female members make up 22.64% (24 individuals). This statistical distribution shows that the cooperative workforce is heavily male-dominated when it comes to direct farming operations, field labor, and institutional participation. From a human resource and organizational management perspective, this demographic layout carries significant implications. Because the membership is overwhelmingly male, the long-term success of everyday waste cleanup, environmental compliance, and green technology updates depends heavily on successfully reaching and engaging

male farm operators. These findings reflect conventional rural agricultural setups where labor-intensive field tasks such as mechanized land preparation, heavy lifting, driving tractors, and operating custom harvesters are predominantly handled by male cooperative members. This gender layout aligns with regional farming studies in the Philippines, which note that men are traditionally assigned to heavy, mechanized farm production tasks while women handle financial, administrative, and post-harvest bookkeeping roles. To make environmental initiatives successful, cooperative leaders must recognize this division of labor. Training frameworks should be brought directly to the machinery sheds and active fields where male operators spend their daily working hours, rather than relying solely on boardroom assemblies.

**Table 2. Difference in Respondents' Awareness Levels on Green Technology and Ecological Solid Waste Management when Grouped by Sex**

|               | Male | Female | <i>T</i>           | <i>Sig.</i> |
|---------------|------|--------|--------------------|-------------|
| Aware         | 3.13 | 3.38   | 1.42 <sup>ns</sup> | 0.24        |
| Knowledgeable | 3.13 | 3.54   | 3.75 <sup>ns</sup> | 0.06        |
| Cooperative   | 3.12 | 3.50   | 3.59 <sup>ns</sup> | 0.06        |
| Training      | 3.05 | 3.46   | 3.61 <sup>ns</sup> | 0.06        |
| Green         | 3.04 | 4.75   | 5.43*              | 0.02        |
| FiveR         | 3.05 | 3.63   | 8.50*              | 0.00        |
| Segregate     | 3.00 | 3.54   | 6.03*              | 0.02        |
| Material      | 2.95 | 3.50   | 6.94*              | 0.01        |
| Benefits      | 3.04 | 3.75   | 13.04*             | 0.00        |
| Efforts       | 2.94 | 3.58   | 7.97*              | 0.01        |

The data in Table 2 shows a clear pattern where female members consistently score higher than male members across all environmental awareness indicators. This statistical outcome proves that sex is a major factor determining the depth of practical environmental knowledge inside the cooperative.

These results expose an important social baseline within the cooperative workforce: while both men and women understand macro-level environmental ideas equally well, women possess a much more granular grasp of practical, cost-saving conservation methods. This disparity is deeply rooted in a domestic-to-cooperative behavioral carryover. In local rural settings, women typically handle the household budgets and manage home waste streams. This daily routine makes female stakeholders naturally more receptive to practical savings techniques like the 5Rs, immediate waste segregation at the source, and long-term asset conservation. The lower practical awareness scores among male workers who make up 77.36% of BALMACO's active operations present an immediate management problem. This data implies that while men physically control the field production and agricultural machinery, their interaction with the environmental aspect of those tools is superficial. This Practicality Gap indicates that current educational materials from management only resonate with female members, while male workers remain focused solely on raw production numbers. For a true green transition to succeed across the cooperative, leaders must re-engineer their training programs to transform abstract rules into vocationally relevant, hands-on field guidelines for male laborers.

This baseline analysis aligns with the behavioral tracking of Lianou and Fthenakis (2021), which verified that pre-existing domestic roles and gender layouts interact to create isolated "information pockets" within rural organizations. The heightened awareness of female members regarding physical sorting protocols also mirrors the regional findings of Devibar (2023) in Isabela. That study confirmed that local green technology adoption is most successful when driven by individuals who see a direct, tangible link between source waste reduction and immediate household economic welfare. Furthermore, the narrow focus of male laborers on production volumes over regulatory compliance matches the smallholder data analyzed by Aminu et al. (2022). Their field tracking showed that real-world financial vulnerabilities often force resource-poor crop handlers to prioritize instant harvest volumes over long-term ecological rules. Finally, the highly significant gap concerning the awareness of sustainability benefits ( $p = 0.00$ ) validates the core principles of the Theory of Planned Behavior used by Zeng et

al. (2022). Their framework concluded that a clear perception of direct personal utility and immediate, practical rewards serve as the strongest predictors of technology awareness within developing agricultural cooperative systems.

**Table 3. Difference in the level of implementation of related green technology and Ecological Solid Waste Management based on the assessment of respondents when grouped according to sex**

|                | Male | Female | <i>t</i>           | <i>Sig.</i> |
|----------------|------|--------|--------------------|-------------|
| Implements     | 3.04 | 3.42   | 3.22 <sup>ns</sup> | 0.08        |
| Practice       | 3.16 | 3.42   | 1.39 <sup>ns</sup> | 0.24        |
| Resources      | 3.12 | 3.54   | 3.92*              | 0.05        |
| Organic        | 3.13 | 3.71   | 6.46*              | 0.01        |
| Pestcontrol    | 3.15 | 3.63   | 4.82*              | 0.03        |
| Monitors       | 3.06 | 3.50   | 3.85*              | 0.05        |
| Active         | 2.98 | 3.71   | 10.48*             | 0.00        |
| Waste          | 3.02 | 3.38   | 2.54 <sup>ns</sup> | 0.11        |
| Compliance     | 2.95 | 3.58   | 9.01*              | 0.00        |
| Implementation | 3.09 | 3.63   | 4.68*              | 0.03        |

The comparative analysis in Table 3 reveals a widespread Gender-Action Gap across the majority of implementation indicators. As a result, for these seven specific operational metrics, the null hypothesis ( $H_{02}$ ) is rejected at the 0.05 alpha level. This confirms that gender acts as a powerful factor shaping the rate at which cooperative members convert environmental knowledge into practical field execution.

These findings imply that while both genders carry out basic green methods at a matching baseline level, female members serve as the primary drivers of systematic, organized change within the cooperative. The highly significant variance in active participation ( $p = 0.00$ ) and regulatory compliance ( $p = 0.00$ ) uncovers a distinct Meticulousness Factor unique to the female demographic. Women in BALMACO exhibit a stronger, more disciplined commitment to the administrative documentation, data recording, and rigorous sorting rules legally required by Republic Act No. 9003. Conversely, the significantly lower scores among male workers who form the absolute majority of the cooperative's labor pool suggest that their field execution remains highly informal, unmeasured, or bound to traditional methods. While male farmers might use eco-efficient tools occasionally, they are statistically less likely to stick to structured compliance tracking, chemical storage rules, or long-term monitoring protocols ( $p = 0.05$ ). For BALMACO's leadership, this is a vital strategic signal: to secure full institutional green certification, management must bridge this behavioral divide. Leaders should leverage highly active female members as organizational "Green Champions" to mentor and guide the male workforce, ensuring that compliant, orderly waste tracking is carried out equally across all operational zones.

This field finding is entirely congruent with the organizational research of Lianou and Fthenakis (2021), who observed that gender dynamics frequently generate isolated "implementation pockets" where women adhere to formalized management and compliance rules far more strictly than men. The significant lead in organic fertilizer and safe pest control applications among female stakeholders also mirrors the agricultural observations of Alvarez and Cañete (2022). Their tracking across the Cagayan Valley identified that female farmers are naturally more receptive to low-chemical input substitutions due to an intense focus on long-term household safety, chemical toxicity avoidance, and regional ecosystem health. The tendency of male laborers to bypass administrative documentation and tracking rules aligns with the socio-demographic financial stress models documented by Aminu et al. (2022). Their data proved that high operational economic stress in the field routinely forces resource-poor male crop handlers to prioritize rapid harvest volumes and immediate speed over complex, time-consuming compliance paperwork. Finally, these clear role variances reinforce the application of the Theory of Planned Behavior explored by Zeng et al. (2022). Their framework verified that localized job contexts, perceived personal utility, and deep-seated social responsibility serve as the absolute strongest predictors of actual, long-term technology implementation within developing rural cooperative networks.

## V. Conclusion and Recommendations

The final phase of this study synthesizes the empirical insights gained from the internal workforce evaluation of the Baro a Langa ti Mannalon Agriculture Cooperative (BALMACO). By establishing a direct link between inferential data trends and organizational behavior, this section outlines the structural conclusions of the study and presents an actionable, multi-tiered recommendation framework designed to advance field-level environmental compliance.

Based on the data gathered from the 106 active administrators and regular cooperative members, the following academic and institutional conclusions are drawn: Although the regular workforce of BALMACO is heavily male-dominated (77.36%), both male and female members share a statistically equivalent baseline of general environmental awareness. Gender differences do not create a barrier to how workers absorb macro-level sustainable goals. This proves that the cooperative's existing channels distribute basic environmental concepts equally well to its entire internal human resource base. This shared understanding among farmers, officers, and administrative staff forms a balanced foundation for executing uniform ecological strategies across all organizational levels. A distinct gap remains between general policy knowledge and practical field execution. While the workforce demonstrates general awareness regarding broad green concepts, they lack localized technical rules, specific guidelines for Republic Act No. 9003, and direct material support from executive leadership. Gender-Based Operational Disparity: Although general awareness is aligned, the critical transition from knowledge to action is deeply influenced by gender roles. Female cooperative members display a distinct meticulousness factor, leading to significantly higher implementation rates in structured regulatory compliance, active program participation, and organic farming workflows. Then male laborers who handle the heavy equipment and field production interact with green practices on a more informal, superficial level. This operational gap must be closed to achieve true, cooperative-wide environmental certification.

To successfully bridge the gap between environmental awareness and daily compliance, BALMACO must move away from abstract, theory-based classroom routines. The study proposes the following practical, targeted recommendations for each level of the cooperative's workforce: Shift the training budget away from traditional classroom lectures. Replace them with localized, hands-on field workshops and practical demonstrations conducted in the local dialect to accommodate all member education levels and overcome natural risk-aversion, create clear, written institutional policies regarding sustainable farm inputs and chemical container management. Management should allocate a specific, permanent budget to purchase eco-friendly agricultural tools, establish low-interest material credit lines for organic fertilizers, and build clear funding support pathways for long-term green technology adoption, design and place highly visual, bilingual (English and Ilocano/Filipino) instructional posters directly above office desks, printing hubs, and administrative waste disposal areas. These visual aids must detail quick, easy-to-follow recycling rules to reduce resource waste and ensure strict internal compliance with Republic Act No. 9003 during daily clerical routines. Place practical, heavy-duty, and weather-resistant sorting bins directly in crop field access points, irrigation collection centers, and machinery sheds. Field farmers must use these designated bins to easily segregate single-use plastics, protective equipment, and empty chemical or fertilizer packaging right at the source during daily harvesting and land preparation operations, and utilize highly compliant members and active female stakeholders as Green Champions to run informal, peer-to-peer field demonstrations, showing hesitant operators how source-waste management directly reduces variable field maintenance costs.

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