# THE IMPACT OF SUSTAINABILITY PRACTICES ON FIRM-LEVEL INNOVATION: EVIDENCE FROM NEPALESE MANUFACTURING FIRMS

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Due to global development agendas pushing for more climate-responsive and inclusive approaches and global markets shifting toward the integration of sustainable practices, sustainability is not only ethical but also a competitive necessity. Theoretically, the relationship between sustainability and innovation is well-supported by Porter's Hypothesis, Resource-Based View, and Dynamic Capabilities Theory. Yet empirical evidence from developing countries remains limited. This study addresses that gap by examining whether the integration of sustainability practices affects firm-level innovation. 2023 firm-level data from the World Bank Enterprise Survey (WBES) in Nepal, focusing on 211 manufacturing firms, is used. Innovation is measured through product and process innovations. Nepal is selected as a proxy to represent the broader developing country context, including countries like Sri Lanka. Descriptive analysis indicated uneven adoption of environmental, social, and economic sustainability practices. Larger firms are more engaged, while smaller firms have limitations with financial and institutional constraints. Descriptive analysis of innovation by firm size, age, and region revealed that many firms were still building capacity but had not yet converted this into new products or processes. Innovation was more common in larger, older, and centrally located firms, highlighting structural barriers like limited access to finance, skilled labor, and institutional support faced by smaller, younger, and peripheral firms. The study employs a logit model with firm size, age, and region as control variables. Social sustainability indicators, female representation, and labor stability increased innovation probability by 12.1 and 17.7 percentage points, respectively, suggesting inclusive and adaptive labor structures stimulate innovation. Yet, environmental and economic sustainability did not show a significant relationship, suggesting sustainability is still treated as compliance rather than strategy in developing country manufacturing firms. A key limitation is the use of cross-sectional data and the exclusion of some relevant variables due to missing values. Findings offer valuable insights for similar economies like Sri Lanka, where aligning sustainability with firm innovation processes is essential. As policy recommendations, integrating industrial and environmental policies to align firm incentives with innovation goals, strengthening SME capacity through improved access to finance, technology, and global networks, and promoting inclusive labor structures, like gender-diverse leadership and workforce stability.

*Keywords*: developing countries, firm-level, innovation, sustainability

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## INTRODUCTION

As global markets shift toward the integration of sustainability practices, sustainability is not only an ethical imperative but also a competitive necessity. The United Nations' Sustainable Development Goals, including SDG 9 for industry, innovation, and SDG 12 for responsible consumption and production, highlight the growing pressure on firms to adopt sustainability practices. In this context, developing country firms face the challenge that they are expected to integrate sustainability into their core operations while still remaining competitive and innovative. Theoretically, the relationship between sustainability and innovation is well-supported by Porter's Hypothesis by Porter and Van Der Linde (1995), which suggests that strong environmental standards can drive innovation. The Resource-Based View (Barney et al., 2001), and the Dynamic Capabilities Theory (Teece et al., 1997) argue that internal capabilities like adaptability and innovation can help firms turn sustainability into a strategic advantage. Yet, in developing countries, firms face limited financial, technological, and institutional support. Therefore, it is still unclear whether sustainability is a driver or constraint to firm-level innovation in these contexts.

This study addresses that gap by examining whether the integration of sustainability practices affects firm-level innovation. It uses 2023 firm-level data from the World Bank Enterprise Survey (WBES) in Nepal, focusing on a sample of 211 manufacturing firms. Nepal is selected as a proxy to understand the broader developing country context, including countries like Sri Lanka. Understanding this link is crucial because if sustainability can stimulate innovation, it becomes a viable development strategy, not just an obligation for firms. This has direct implications for both firm strategy and public policy, especially in economies seeking sustainable industrial growth with limited resources.

The main objective of this study is to examine the relationship between the integration of sustainability practices and firm-level innovation. Innovation is measured through product and process innovations in firms within the manufacturing sector of developing countries, using firm-level survey data from the WBES. Specific objectives include,

1. Examine the level of sustainability adoption in the manufacturing sector within the developing country context.
2. Analyze the types of innovation adopted by manufacturing sector firms.
3. Analyze the relationship between sustainability and innovation in this context.

## METHODOLOGY

This study employed secondary data from the 2023 WBES, focusing on 211 manufacturing firms in Nepal. The WBES provides high-quality, stratified firm-level data, covering variables directly relevant to sustainability, innovation, and export performance. Data analysis was conducted using STATA software.

To examine the level of sustainability adoption, Energy management practices, CO2 monitoring, the cost of electricity, and water consumption to measure environmental sustainability, full-time employment, female representation, and employee dynamics to capture social sustainability, and sales, financial performance, and access to finance for economic sustainability were used as proxies. Composite indicators such as the Green Economy Index and Labor Stability Index were constructed following standard Econometric guidelines to increase explanatory power Handbook on Constructing Composite Indicators: Methodology and User Guide, 2008). Descriptive analysis was conducted to understand the variation of sustainability adaptation by firm size, age, and region.

To analyze innovation types of manufacturing firms, first, the innovation level with 0, 1and 2 being no innovation, innovation new to the firm, and new to market, respectively, was measured to reflect product novelty (Oslo Manual 2018, 2018). Innovative firms were defined as those that have introduced either a new or improved product, service, or process, captured through a combined variable. Innovation-active firms are firms involved in innovation-related activities. Descriptive analysis was used to examine the types of innovation by firm size, age, and region.

To analyze the relationship between sustainability and innovation, innovation was captured as a binary outcome, which captured either product or process innovation, as in the Oslo Manual 2018 (2018). The dependent variable is whether a firm is innovative or not, while the independent variables include firm characteristics like region, age, size, training, skilled labor, R&D spending, technology usage, and sustainability proxies. Variable selection was justified in the Resource-Based View, Endogenous Growth Theory by Romer (1990), and Demand-Pull Theory. Logarithmic transformations were applied to address skewness in sales and electricity costs. The logit model was estimated with Model 1, including firm characteristics, Model 2, adding variables that theoretically impact innovation in firms, and Model 3, adding sustainability indicators. Marginal effects were computed to interpret the probability changes. Model robustness was confirmed using the Likelihood Ratio test, the Variance Inflation Factor to check multicollinearity, and the Link Test for model specification.

Despite the strengths of the dataset, limitations remained as some theoretically relevant variables were excluded due to high missing data rates, and the cross-sectional nature of the data restricted causal inference.

## RESULTS AND DISCUSSION

The sample included 211 manufacturing sector firms, with 28% and 39% categorized as small and medium-sized, respectively. Over 50% were located in the Central region, with 79% categorized as mature.

Descriptive analysis related to the level of integration of sustainability practices showed that over half of the large firms have adopted environmental sustainability practices, while half of the small firms have not, suggesting a clear capacity and resource gap. Around 21% of firms report having female representation in ownership or management. Labor instability was most common in the Central region, highlighting the uneven adoption of social sustainability measures and broader institutional and capacity-based barriers that firms face. Related to economic sustainability, the data showed a sharp rise in median sales from small to large firms, highlighting the unequal financial capacity across sizes.

Descriptive analysis with types of innovation showed that 82% majority of firms had no product innovation, and only 6% had market-new product innovations, highlighting barriers to radical innovation (see Figure 1). Overall, 23% were innovative, while 64% were innovation-active. Among 136 innovative firms, 75% of firms being innovation-active showed strong alignment between active innovation efforts and outcomes. A 60% being innovation-active from 446 of non-innovative firms suggested many firms were still building capacity but had not yet converted this into new products or processes, as typically happens in the long run. Additionally, Innovation was more common in larger, older, and centrally located firms. This highlights structural barriers like limited access to finance, skilled labor, and institutional support faced by smaller, younger, and peripheral firms.

The Relationship between Sustainability and Innovation was examined using a logit model (see Table 1). The Model 1 results indicated that firm characteristics such as region, firm size, and firm age were control variables, and they alone were not statistically significant determinants of a firm being an innovative firm. In Model 2, training and being an innovation-active firm were statistically significant and positively related to innovation. Marginal values for model 3 showed that Social Sustainability Indicators (SSI), which are firms with female representation and firms with labor stability, had 12.1 and 17.7 percentage points higher probabilities of being innovative, respectively, compared to those without these characteristics. This suggests that inclusive and adaptive labor structures stimulate innovation. In contrast, environmental and economic sustainability variables showed no significant effect, indicating a lack of integration of sustainability practices into firms' strategic processes in developing countries. The likelihood ratio test ($\chi^2$ (19) = 39.09, p = 0.0043) confirmed the robustness of Model 3. The link test showed no model specification, and the mean VIF of 2.02 indicated no perfect multicollinearity.

**Table 1** Logit model results on the relationship between sustainability and innovation

| Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Region (Base category: Central) | | | |
| West | 0.251 | 0.321 | 0.323 |
| | (0.377) | (0.404) | (0.443) |
| East | -0.321 | -0.407 | -0.304 |
| | (0.399) | (0.435) | (0.484) |
| Firm Age (Base category: ≤5 years) | | | |
| Mid age (6–10 years) | -0.344 | -0.120 | -0.456 |
| | (0.670) | (0.701) | (0.767) |
| Mature (>10 years) | -0.390 | -0.446 | -0.842 |
| | (0.547) | (0.571) | (0.625) |
| Firm Size (Base category: Small) | | | |
| Medium | 0.517 | 0.749 | 0.531 |
| | (0.400) | (0.474) | (0.538) |
| Large | 0.588 | 0.878 | 0.526 |
| | (0.425) | (0.649) | (0.724) |
| Innovation Active | | 0.809* | 0.811* |
| | | (0.436) | (0.471) |
| Training Provided | | 1.051*** | 1.139*** |
| | | (0.383) | (0.419) |
| % Highly Skilled Employees | | 0.002 | 0.001 |
| | | (0.002) | (0.001) |
| ln Sales | | -0.176 | -0.175 |
| | | (0.122) | (0.160) |
| Female Representation | | | 0.714* |
| | | | (0.406) |
| Instability Index | | | 1.044** |
| | | | (0.460) |
| Green Economy Effect | | | 0.409 |
| | | | (0.404) |
| Log Cost of Electricity | | | -0.136 |
| | | | (0.152) |
| Log Water Consumption | | | 0.023 |
| | | | (0.125) |

| Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Access to Finance (Base category: No obstacle to finance) | | | |
| Minor Obstacle to Finance | | | -0.174 |
| | | | (0.605) |
| Moderate Obstacle to Finance | | | 0.628 |
| | | | (0.544) |
| Major Obstacle to Finance | | | -0.453 |
| | | | (0.626) |
| Very Severe Obstacle to Finance | | | -0.890 |
| | | | (0.958) |
| Constant | -0.926 | 1.308 | 2.908 |
| | (0.577) | (2.026) | (2.369) |
| Observations | 211 | 210 | 207 |
| Pseudo $R^2$ | 0.014 | 0.089 | 0.156 |
| $Chi^2$ | 3.59 | 22.57 | 39.09 |
| p-value | 0.732 | 0.012 | 0.004 |

*Note.* Standard errors are in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$.
Source:Author-generated.

## CONCLUSIONS/RECOMMENDATIONS

This study examined how the integration of sustainability practices influences firm-level innovation in Nepal's manufacturing sector, representing broader developing country contexts. This study contributes by giving firm-level evidence showing that social sustainability supports innovation. Yet other dimensions remain weakly linked, suggesting that sustainability is still treated as compliance rather than strategy in developing country manufacturing firms. This matters as sustainability should align with firm innovation to transform it into a long-term competitive tool rather than a cost. Based on the findings, three policy actions are critical: integrating industrial and environmental policies to align firm incentives with innovation goals, strengthening SME capacity through improved access to finance, technology, and global networks, and promoting inclusive labor structures, such as gender-diverse leadership and workforce stability, to increase innovation levels.

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