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Climate Shocks, Finance and Green Practices among Nigerian Firms: Evidence from the 2025 World Bank Enterprise Survey

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Abstract
Nigeria has suffered severe flooding in recent years, and its climate commitments depend partly on private firms adopting cleaner and more efficient practices. Little firm-level evidence exists on how many Nigerian firms are directly hit by extreme weather, how they respond, or which firms adopt green practices. We use the green-economy questions of the World Bank Enterprise Survey Nigeria 2025 (N = 1,043). Survey-weighted logit and least-squares models relate damage from extreme weather and access to finance to three green practices (energy management measures, monitoring of CO2 emissions and on-site solar) and to real sales growth, employment continuity and fixed-asset investment, with stratified design-based and unweighted checks. Under the survey weights, 7.7 per cent of establishments reported asset damage from extreme weather, rising to 33.1 per cent in the North East (95% CI 14.6 to 51.6), and 53.4 per cent had adopted energy management measures or on-site solar. Having a loan or credit line is associated with a 24.6-point higher probability of adopting energy management measures ($p < 0.001$), and the association changes little when bank account, audited accounts and multi-establishment status are added (+22.0 points). Credit is not associated with solar use, which is associated instead with quality certification (+24.5 points). Weather damage is not associated with sales growth or employment continuity, but damaged establishments were 32.3 points more likely to have bought fixed assets in the last year. Damage is not robustly associated with green adoption. Weather damage among formal Nigerian firms is associated with higher fixed-asset investment but not with more green practices. Managerial green practices are concentrated among firms with bank credit, which suggests that banks may be a useful channel for promoting green practices, while solar adoption follows quality certification and firm scale.

Keywords: *Climate shocks; extreme weather; green practices; energy efficiency; solar; green finance; Nigeria; World Bank Enterprise Surveys* ***JEL classification:*** *Q54; Q56; G21; L25; O55.*

I. INTRODUCTION

Floods in Nigeria have become larger and more destructive. The 2022 floods killed more than 600 people and displaced over 1.4 million across most states, and in September 2024 the collapse of the Alau dam flooded much of Maiduguri, displacing over 400,000 people (National Emergency Management Agency [NEMA], as reported in 2022 and 2024). Households have received most of the research attention. Yet firms also lose buildings, machinery and stock to extreme weather, and the transition to a lower-carbon economy depends partly on whether private firms adopt more efficient and cleaner practices.

This paper uses the green-economy questions in the 2025 World Bank Enterprise Survey (WBES) for Nigeria to answer four questions. How many formal establishments were damaged by extreme weather, and where? How did damaged establishments fare in sales, employment and investment? Which establishments have adopted green practices: energy management measures, monitoring of CO2 emissions and on-site solar? And is access to finance associated with green adoption, as the green-finance literature suggests?

The paper contributes in three ways. It provides some of the first nationally representative estimates for formal Nigerian firms of direct damage from extreme weather and of green-practice adoption. It shows that energy management and solar adoption have different correlates: credit access for the first and quality certification and scale for the second. And it finds that damaged establishments invest more in fixed assets but do not adopt green practices more often. A companion paper (Apeh & Sani, 2026) studies how financial accounts help individuals in West Africa, including Nigeria, recover from natural disasters; the present paper turns to formal firms. Two other companion papers use the same 2025 Enterprise Survey: one on financing conditions (Sani & Apeh, 2026a) and one on generator dependence and firm performance (Sani & Apeh, 2026b). Neither analyses weather damage or green practices, and solar adoption is analysed only in this paper.

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The analysis is cross-sectional. Damage is self-reported, its timing is not recorded precisely, and green practices are measured by yes-or-no questions that do not capture their scale. All results are associations.

II. RELATED LITERATURE

Evidence on how disasters affect firms is mixed. In European firms, floods were followed by higher growth in assets and employment, consistent with reconstruction and capital replacement (Leiter, Oberhofer, & Raschky, 2009), while other studies find lasting losses for directly hit firms (Noth & Rehbein, 2019). Infrastructure disruption, including that caused by extreme weather, imposes substantial costs on firms in low- and middle-income countries (Hallegatte, Rentschler, & Rozenberg, 2019). For Nigeria, the World Bank's Country Climate and Development Report estimates that climate change could push an additional 5.1 million Nigerians into poverty by 2035 (World Bank, 2026). Firm-level evidence on how Nigerian businesses are exposed and respond is, however, largely missing.

On green adoption, management quality is a strong predictor of energy efficiency: better-managed manufacturing firms use less energy per unit of output (Bloom, Genakos, Martin, & Sadun, 2010). Using Enterprise Survey data for emerging Europe and Central Asia, De Haas, Martin, Muûls and Schweiger (2025) show that both credit constraints and weak green management slow green investment. Financial barriers also reduce environmental innovation among European manufacturers (Ghisetti, Mancinelli, Mazzanti, & Zoli, 2017). For Nigeria, the Central Bank's Sustainable Banking Principles of 2012 require banks to assess the environmental and social risks of their lending (Central Bank of Nigeria [CBN], 2012), so a bank relationship may bring both finance for green investment and pressure to adopt environmental practices.

Firm-level evidence from Sub-Saharan Africa on either question is scarce, and the WBES green-economy questions now make it possible to study both for Nigeria with a representative sample.

III. HYPOTHESES

- H1 (investment after damage): establishments damaged by extreme weather are more likely to have invested in fixed assets, without a detectable difference in sales growth or employment.
- H2 (green adoption after damage): damaged establishments are more likely to adopt the green practices measured here.
- H3 (finance): establishments with a loan or credit line are more likely to adopt green practices, and the association is stronger for capital-intensive practices such as solar.
- H4 (market pressure): exporters, foreign-owned establishments and those with international quality certification are more likely to adopt green practices.

We distinguish green practices from climate adaptation. Energy management, CO2 monitoring and solar reduce energy use or emissions, and solar can reduce dependence on the grid, but none of them directly protects a firm against floods or storms. The survey contains no question on flood protection, insurance or relocation, so H2 tests whether damage is followed by green adoption, not whether firms adapted to climate risk.

IV. DATA AND METHODS

The WBES Nigeria 2025 (World Bank, 2025) samples 1,043 formal private establishments with five or more employees in manufacturing, retail and other services, stratified by geopolitical zone, sector and size. Strict-eligibility weights are used throughout, and every variance is also re-estimated with Taylor linearisation within the 211 sampling strata.

Table 1. Variable definitions

Variable	Survey item	Definition
Weather damage	ge3	1 if the establishment experienced damage to physical assets due to extreme weather events
Damage as share of sales	ge3a, d2	Reported monetary value of damage / annual sales (damaged establishments)
Energy management	ge8d	1 if the establishment adopted energy management measures in the last three years
CO2 monitoring	ge7	1 if the establishment monitored its CO2 emissions in the last three years
On-site solar	c43	1 if the establishment used on-site solar panels in the last fiscal year

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Any green practice; count	ge7, ge8d, c43	At least one of the three; number adopted (0 to 3)
Has credit	k82a, k82b	1 if the establishment has a loan or line of credit
Credit constrained	k162a, k162b, k17, k20a1	Rejected, or did not apply for reasons other than having no need
Foreign-owned; quality certification	b2b; b8	10% or more foreign ownership; internationally recognised quality certification
Invested	k4	1 if the establishment purchased fixed assets in the last fiscal year
Real sales growth; employment continuity	d2, n3; l1, l2	FY2024 sales above FY2021 sales x 1.974; FY2024 permanent employment at least the FY2021 level
Variable	**Survey item**	**Definition**
Generator share	c10, c11	Share of electricity from own or shared generator

What the measures capture. Appendix Table A1 gives the item labels from the survey data file. The damage item asks only whether physical assets were damaged by extreme weather; the data do not record the type of event (flood, storm, heat or drought), its date or, for most damaged establishments, its value. Damage is self-reported, and reporting may be more complete among firms that later invested in repairs, which would inflate the association with investment. The green-practice items are yes-or-no and do not define "energy management measures", which could range from switching off equipment to a formal energy audit, so firms may interpret them differently. The CO2 monitoring item shows implausible variation across zones, and we do not rely on it. The public file identifies zones but not states, so damage cannot be mapped below the zone level.

Binary outcomes are estimated with survey-weighted logit models and reported as average marginal effects (AMEs) in percentage points; the count of green practices is estimated by weighted least squares. Adoption models control for weather damage, credit status, credit constraint, exporting, foreign ownership, quality certification, log employment, log age, log managerial experience, manufacturing, female ownership, a website, generator share and zone indicators. Outcome models control for log age, log employment three years earlier, manufacturing, female ownership, exporting, a website and zone indicators, and include credit status and its interaction with damage.

V. RESULTUS

5.1.Exposure to extreme weather and adoption of green practices

Table 2. Weather damage and green practices by group (weighted per cent)

Group	N	Weather damage	Energy management	CO2 monitoring	On-site solar	Any of the three
All	1,043	7.7	41.4	29.1	22.0	55.9
Manufacturing	485	7.2	41.1	35.1	20.5	53.2
Retail	127	8.1	42.5	25.4	22.3	51.1
Other services	431	7.8	41.4	27.6	22.4	57.8
Small (<20)	573	8.7	35.9	22.9	18.1	49.2
Medium/large (20+)	468	5.9	50.9	39.8	28.5	67.3
Exporter	79	12.4	53.4	61.2	54.1	80.7
Non-exporter	962	7.4	41.0	27.1	19.9	54.7
Has credit	209	7.6	61.7	54.2	26.5	77.2
No credit	828	7.7	35.9	22.3	20.7	50.3
Group	N	Weather damage	Energy management	CO2 monitoring	On-site solar	Any of the three
Lagos	229	5.4	37.8	28.9	13.8	44.3
South West excl. Lagos	115	7.6	53.6	35.2	35.5	68.4
South East	122	4.8	39.8	27.0	14.7	53.1
South South	150	6.9	35.5	12.6	9.0	43.5
North Central	164	9.4	57.1	55.6	22.9	72.8
North West	141	3.4	22.5	7.5	46.5	60.6
North East	122	33.1	37.1	17.2	15.9	50.2

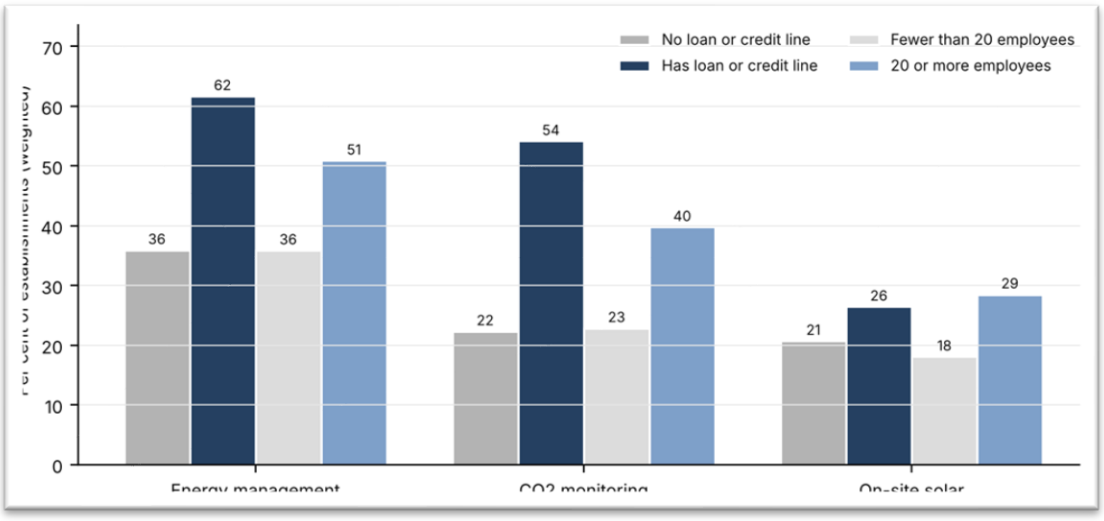
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Note: weighted shares; N is unweighted.

Under the survey weights, 7.7 per cent of formal establishments reported damage to physical assets from extreme weather. Exposure is concentrated in the North East, where 33.1 per cent were damaged under the weights (95% CI 14.6 to 51.6; 44 of 122 establishments, or 36.1 per cent unweighted), against 6.5 per cent in the rest of the country (71 of 921). The North East estimate is imprecise, but even its lower bound is about twice the national rate elsewhere, and zones range from 3.4 to 9.4 per cent outside the North East. This is consistent with the Maiduguri flood of September 2024, although the survey does not date the damage. For the 110 damaged establishments that reported a value, the median loss was 1.5 per cent of annual sales (interquartile range 0.4 to 5.1 per cent), and 16 per cent lost more than a tenth of annual sales. In a model of exposure (Appendix Table A2), no firm characteristic (size, sector, exporting, ownership or credit status) predicts damage at the 5 per cent level, which is what one would expect if exposure is driven mainly by location.

Most establishments report at least one of the three green practices: 41.4 per cent of establishments adopted energy management measures, 29.1 per cent report monitoring CO2 emissions and 22.0 per cent use on-site solar; 55.9 per cent do at least one of the three and 5.6 per cent do all three. Energy management and CO2 monitoring are strongly correlated ($r = 0.64$) and form a cluster of management practices; solar is only weakly correlated with either ($r = 0.16$ and 0.18). The very wide variation in reported CO2 monitoring across zones, from 7.5 per cent in the North West to 55.6 per cent in the North Central zone, suggests that respondents interpreted this question differently. We therefore report CO2 monitoring separately but do not rely on it for any conclusion: an index based only on energy management and solar ("energy management or solar", 53.4 per cent) gives the same results for credit (+29.1 points, $p < 0.001$) and for weather damage (-15.2 points weighted, -3.8 unweighted, neither significant at the 5 per cent level).

Figure 1. Green practices by credit status and firm size, 2025 (weighted per cent)



Source: authors' calculations from WBES Nigeria 2025.

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5.2.Who adopts green practices

Table 3. Correlates of green practices, 2025

	Energy management (AME)	CO2 monitoring (AME)	On-site solar (AME)	Any practice (AME)	Count 0-3 (OLS)
Weather damage	-18.9*** (7.0)	+0.3 (8.5)	+7.9 (8.0)	-2.1 (8.6)	-0.16 (0.15)
Has loan or credit line	+24.6*** (6.4)	+15.7*** (5.9)	+9.2 (6.4)	+28.5*** (5.4)	+0.51*** (0.12)
Credit constrained	+2.9 (5.1)	+2.6 (4.6)	+4.8 (4.3)	+7.5 (5.4)	+0.09 (0.10)
Exporter	+11.1 (12.3)	+9.9 (10.5)	+14.4* (8.5)	+9.6 (10.8)	+0.39 (0.24)
Foreign-owned (10%+)	+4.1 (12.4)	+13.9 (12.7)	-5.6 (6.7)	+8.4 (13.0)	+0.08 (0.27)
Quality certification	+0.0 (9.3)	+1.6 (8.4)	+24.5** (9.9)	+9.7 (9.5)	+0.30 (0.24)
Log employment	+9.2*** (3.2)	+9.0*** (2.9)	+4.2 (3.1)	+11.7*** (2.8)	+0.23*** (0.05)
Manufacturing	-2.2 (5.6)	+5.2 (5.1)	-7.5 (4.9)	-8.3 (6.1)	-0.04 (0.12)
Generator share	+5.2 (9.0)	+13.1* (7.9)	-27.2*** (7.4)	-11.1 (9.4)	-0.06 (0.18)
Weighted mean of outcome	41.6	28.5	21.4	55.8	0.92
Observations	973	973	973	973	973
AUC or R^2	0.718	0.777	0.761	0.726	0.207

Note: survey-weighted logit AMEs in percentage points and weighted least-squares coefficients for the count; robust standard errors in parentheses. Controls also include log age, log managerial experience, female ownership, a website and zone indicators. Stratified p-values for having credit: energy management < 0.001, CO2 monitoring 0.009, solar 0.157. *** p < 0.01, ** p < 0.05, * p < 0.10.

Credit access is the strongest correlate of energy management. Establishments with a loan or credit line are 24.6 points more likely to have adopted energy management measures, holding size, sector, location and market orientation constant. They are also 15.7 points more likely to report monitoring CO2 emissions, but because that item appears to have been interpreted inconsistently we treat this result as exploratory and do not base any conclusion on it. Being credit constrained is not associated with adoption. For solar, the credit association is smaller and not significant (+9.2 points, p = 0.154). Solar is associated instead with international quality certification (+24.5 points, p = 0.013) and is lower where generator shares are higher (-27.2 points for full generator dependence), which partly reflects substitution between the two sources of power. Larger establishments are more likely to adopt every practice.

The data are therefore in line with H3 for energy management but not for the capital-intensive practice, the opposite of what a pure financing-constraint account would predict. The association does not show that bank relationships finance green practices. One reading is that lenders transmit environmental expectations: under the Sustainable Banking Principles, banks are expected to screen borrowers' environmental and social risks, so borrowers may adopt or report management practices that lenders ask about. Another is that firms with bank relationships are better managed in ways the controls do not capture, consistent with the link between management quality and energy efficiency (Bloom et al., 2010). H4 receives limited support: quality certification is associated with solar, while exporting and foreign ownership have positive but imprecise associations in the weighted models.
Because firms with credit may differ in formality and management, we add three further controls: having a bank account, having externally audited accounts and belonging to a multi-establishment firm. The credit association with energy management is essentially unchanged (+22.0 points, p < 0.001), and so is the association with the energy-management-or-solar index (+27.9 points). Audited accounts are themselves strongly associated with energy management (+19.3 points), which is consistent with formality or management quality mattering alongside credit. Having a bank account is not informative, because 94.1 per cent of establishments have one. The survey has no measure of distance to bank branches or other plausible instrument, so we cannot separate the role of credit from selection into borrowing. The credit association is descriptive.

Solar use falls steeply with generator dependence: 44.5 per cent of establishments without a generator use solar, against 22.8 per cent of those drawing up to half their electricity from a generator, 14.5 per cent of those drawing 51 to 90 per cent and 0.3 per cent of those drawing more. Part of this is mechanical, because generator, solar and grid shares of electricity cannot exceed 100 per cent together; solar users obtain a median of 30 per cent of their electricity from solar. But it also reflects who these firms are. The most generator-dependent firms are smaller (71.2 per cent have fewer than 20 employees, against 55.6 per cent of firms without a generator) and far more likely to call electricity a major obstacle (88.9 against 24.8 per cent). Solar is thus most common among firms with the least need to replace generator power. The survey does not record energy needs or the capacity of solar installations, so whether solar and generators are substitutes for a given firm cannot be established from these data.

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Table 4. Sensitivity of the damage and credit associations

Outcome	Weather damage: weighted	Weather damage: unweighted	Has credit: weighted	Has credit: unweighted	Has credit: without constraint control
Energy management	-18.9*** (7.0)	-5.4 (4.9)	+24.6*** (6.4)	+19.4*** (4.0)	+24.0*** (6.4)
CO2 monitoring	+0.3 (8.5)	-5.0 (4.3)	+15.7*** (5.9)	+16.1*** (3.5)	+15.4*** (5.9)
On-site solar	+7.9 (8.0)	+1.4 (4.4)	+9.2 (6.4)	+6.8* (3.9)	+7.4 (6.6)
Any practice	-2.1 (8.6)	-1.4 (4.8)	+28.5*** (5.4)	+22.8*** (3.7)	+27.2*** (5.4)

Note: logit AMEs in percentage points (robust standard errors) from the specification of Table 3. *** p < 0.01, ** p < 0.05, * p < 0.10.

The data do not support H2. Damaged establishments are no more likely to adopt any green practice. In the weighted model they are 18.9 points less likely to have adopted energy management (p = 0.007), but the unweighted estimate is -5.4 points (p = 0.269), so this negative association is sensitive to the survey weights and should not be read as a finding. The credit associations, by contrast, are similar with and without weights and when the credit-constraint control is dropped. The null for damage is also imprecise: for any green practice the 95 per cent confidence interval runs from -19.1 to 14.8 points, so modest effects in either direction cannot be ruled out.

5.3.How damaged establishments fared

Table 5. Weather damage and firm outcomes, 2025

Outcome	Weather damage (AME)	Damage x credit (AME)	Excluding North East	Unweighted	Weighted mean (%)	N
Real sales growth	-0.1 (5.3)	-4.7 (8.2)	+2.0 (6.3)	+4.8 (4.1)	12.8	947
Employment continuity	-2.4 (7.2)	+7.5 (7.1)	-6.1 (8.1)	+2.5 (3.5)	85.8	987
Bought fixed assets in last FY	+32.3*** (8.8)	+12.0 (20.4)	+28.0*** (9.8)	+26.4*** (5.3)	31.7	983

Note: survey-weighted logit AMEs in percentage points (robust standard errors). All models control for credit status, log age, log employment three years earlier, manufacturing, female ownership, exporting, a website and zone indicators. Stratified p-value for damage and investment: < 0.001. *** p < 0.01, ** p < 0.05, * p < 0.10.

Damaged establishments were no less likely than others to raise real sales (-0.1 points) or to keep employment at its FY2021 level (-2.4 points). They were, however, 32.3 points more likely to have bought fixed assets in the last fiscal year (p < 0.001), against a weighted base rate of 31.7 per cent. The association holds without the North East and without weights. The data are consistent with H1, but the survey does not date either the damage or the purchases, so it cannot show that investment followed the damage or replaced damaged assets; firms that invest more may also report damage more readily. The pattern resembles the post-flood capital replacement documented for European firms (Leiter et al., 2009). Among damaged establishments, 85 per cent of those with credit invested against 62 per cent of those without, but with only 27 damaged credit holders the interaction is imprecise and not significant.

VI. DISCUSSION

Two findings stand out. First, weather damage is associated with higher fixed-asset investment but not with more green practices. This is consistent with firms replacing damaged capital, but the survey cannot establish the sequence, and because the green practices measured are not flood-resilience measures, it cannot tell whether damaged firms adapted to climate risk in other ways. Second, green practices among Nigerian firms divide into two groups. Energy management goes with bank relationships, while solar adoption follows quality certification, scale and lower generator dependence. Analyses that treat "green adoption" as a single outcome risk missing that difference.

The credit association has several possible explanations that the data cannot separate: lenders may finance green measures, may require them through environmental screening, or may lend to better-managed firms. Reverse causality is also possible, if firms that adopt good energy management are more creditworthy. What the evidence does show is that firms without a loan or credit line, roughly four in five formal establishments, are much less likely to have adopted energy management measures, so green-finance programmes that work only through existing bank borrowers will miss most firms.

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6.1.Limitations

- Cross-sectional associations only; the timing of damage relative to investment and adoption is not recorded.
- The credit association is descriptive; no instrument for credit access is available in the survey.
- Green practices are yes-or-no and self-reported; the CO2 monitoring question appears to have been interpreted inconsistently.
- Damage values are reported by only about 110 establishments, so severity cannot be modelled reliably.

The survey covers formal establishments with five or more employees; informal and micro-enterprises, which may be the most exposed, are excluded.

VII. POLICY IMPLICATIONS

The following are options to test, not effects shown by this analysis. They fall within the framework of Nigeria's Climate Change Act 2021, which provides for mainstreaming climate action across government, and of the national adaptation priorities set out in the Country Climate and Development Report (World Bank, 2026). First, because damaged firms appear to invest, post-disaster finance or grants for firms in flood-prone areas, particularly in the North East, could be evaluated as a way to encourage more resilient and efficient replacement capital. Second, because energy management is concentrated among bank borrowers, it would be worth testing whether green credit lines and technical assistance offered to firms outside existing lending relationships raise adoption among them. Third, solar adoption currently follows certification and scale; whether lease or pay-as-you-go arrangements reach smaller, uncertified firms is an open question for pilots.

VIII. CONCLUSION

About one in thirteen formal Nigerian establishments, and roughly one in three in the North East (with a wide confidence interval), reported asset damage from extreme weather. Damage is associated with higher fixed-asset investment but not with more green practices. More than half of all establishments (53.4 per cent) report energy management measures or on-site solar, a measure that does not rely on the less reliable CO2 monitoring item, and energy management is concentrated among firms with credit, an association that holds with additional controls for formality. These are cross-sectional associations. Panel data that follow firms through climate shocks, and survey questions that measure flood protection and the scale and cost of green investments, would allow them to be tested more directly.

APPENDIX

Table A1. Survey items used for the main measures (labels as in the WBES Nigeria 2025 data file)

Measure	Item	Label in the data file
Weather damage	ge3	Experience damage of physical assets due to extreme weather events?
Damage value	ge3a	Monetary damage of physical assets?
Measure	Item	Label in the data file
CO2 monitoring	ge7	Over the last 3 years, establishment monitor its CO2 emissions?
Energy management	ge8d	Over last 3 years, establishment adopt energy management measures?
On-site solar	c43	Over FY, did establishment use on-site solar panels?
Solar share	c44	Percentage of electricity from solar panels
Generator share	c11	% Electricity From Generator Owned/Shared By The Establishment In Last FY

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Note: labels are abbreviated versions of the questionnaire wording, reproduced as they appear in the data file.

Table A2. Correlates of weather damage, 2025

Variable	AME (points)
Log employment	-2.6* (1.5)
Manufacturing	-0.3 (3.0)
Retail	-0.3 (4.2)
Female owner	+2.8 (3.1)
Exporter	+7.3 (6.5)
Has loan or credit line	-0.2 (3.9)
North East	+18.9 (15.2)
North West	-5.1 (3.9)
South East	-3.2 (4.8)
South South	-2.0 (5.4)
South West	-2.6 (4.9)
Weighted share damaged	7.9
Observations	1013

Note: survey-weighted logit; reference zone North Central, reference sector other services; log age also included. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.10.

DECLARATIONS

Data availability. The WBES data are available from the World Bank Enterprise Surveys and Microdata Library after registration and are not redistributed by the authors. A replication package with code that rebuilds every table, figure and manuscript from the raw files, a variable-construction guide and the results files accompanies the submission.

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