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Evaluating the Effects of Climate Change on Diverse Economic Sectors in Developing Nations

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Abstract

Climate change has emerged as the pre-eminent structural threat to sustainable development in the Global South, yet the distribution of its economic burden across productive sectors remains insufficiently synthesised. This paper evaluates the effects of climate change on the four principal economic sectors of developing nations—agriculture, industry, energy, and services—over the period 2010 to 2024, which encompasses the warmest fifteen-year span in the instrumental record and the first calendar year (2024) in which global mean temperature exceeded 1.5°C above the pre-industrial baseline. Adopting a secondary-data analytical design, the study compiles and triangulates evidence from the World Bank, the Food and Agriculture Organization, the International Labour Organization, the Intergovernmental Panel on Climate Change, the International Energy Agency, the EM-DAT International Disaster Database, and the Swiss Re Institute, among other internationally recognised sources. The analysis is organised around exposure, sensitivity, and adaptive capacity, following the risk framework of the Intergovernmental Panel on Climate Change. The findings indicate that agriculture is the most directly and pervasively affected sector, absorbing roughly 23 per cent of all disaster losses in developing countries and more than 60 per cent of drought-related losses, while the energy sector, though accounting for a smaller direct loss share, exhibits the highest transmission coefficient because hydropower-dependent economies convert single droughts into national electricity crises. Industry and services are shown to be increasingly exposed through supply-chain disruption, heat-related productivity loss, tourism dependence, and an insurance protection gap that leaves under 10 per cent of catastrophe losses insured in low-income countries. Working hours lost to heat stress are projected to reach 5.3 per cent in Southern Asia by 2030, more than double the world average. The study concludes that climate change in developing nations constitutes a systemic, economy-wide risk rather than a sector-specific one, and that the convergence of multi-sector climate events after 2019 demands integrated adaptation, resilient infrastructure, diversified energy systems, and expanded risk-transfer mechanisms rather than piecemeal sectoral responses.

Keywords: climate change; developing nations; economic sectors; agriculture; energy; vulnerability; adaptation

1. Introduction

The economic consequences of anthropogenic climate change fall with disproportionate severity on developing nations, a pattern rooted less in their contribution to global emissions than in their structural exposure, sensitivity, and limited adaptive capacity. This paper examines

how climate change has affected the diverse economic sectors of developing nations during the period 2010 to 2024 and situates the evidence within a coherent risk framework. The introduction proceeds through five subsections that establish the background, the statement of the problem, the objectives, the significance, and the scope and limitations of the study.

1.1 Background of the Study

The period 2010 to 2024 coincides with an unambiguous intensification of the climate signal. Global mean temperature rose from approximately 0.98°C above the pre-industrial baseline in 2010 to about 1.55°C in 2024, atmospheric carbon dioxide concentration increased from roughly 390 to 425 parts per million, and cumulative satellite-era sea-level rise advanced by around sixty millimetres. Over the same interval, global economic losses from weather-related disasters more than doubled, rising from an order of 130 billion United States dollars in 2010 to over 300 billion dollars in the most damaging years. Developing nations bore a disproportionate share of the human cost: the World Meteorological Organization has reported that the overwhelming majority of deaths from weather, climate, and water hazards in recent decades occurred in developing countries. Because agriculture and other climate-sensitive activities occupy a far larger share of output and employment in these economies than in advanced ones, the same physical hazard produces a much larger macroeconomic footprint in the developing world.

The selection of this fifteen-year window is deliberate. It captures the warmest such span in the instrumental record, several landmark policy developments including the adoption of the Paris Agreement in 2015 and the negotiation of loss-and-damage arrangements at successive climate conferences, and a dense sequence of high-impact disasters whose economic consequences for developing nations are unusually well documented. Among these are the Thailand floods of 2011, the drought-driven power crises of Southern Africa across the decade, the Caribbean hurricane seasons of 2017 and 2019, the compound Horn-of-Africa drought of 2020 to 2023, and the catastrophic Pakistan floods of 2022. Taken together, these episodes furnish a rich empirical basis for evaluating how the same intensifying climate signal is refracted through the different economic structures of the developing world, and for distinguishing sectors that suffer shocks directly from those that principally transmit them.

Although the aggregate economic threat posed by climate change is now widely acknowledged, the sectoral distribution of that threat within developing economies remains inadequately synthesised. Policy responses are frequently designed sector by sector—drought relief for agriculture, flood defences for industry, generation diversification for energy—without a comparative understanding of which sectors are most exposed, which transmit shocks most widely, and where scarce adaptation finance yields the greatest resilience dividend. The problem this study addresses is therefore twofold: first, the absence of an integrated, evidence-based comparative account of climate impacts across the agricultural, industrial, energy, and service sectors of developing nations; and second, the tendency to treat climate impacts as isolated sectoral events rather than as an increasingly systemic, economy-wide risk in which single disasters cascade across multiple sectors simultaneously.

The study is guided by five interrelated objectives. The first is to examine the impact of climate change on the four major economic sectors of developing nations, namely agriculture, industry, energy, and services. The second is to identify the sector-wise vulnerabilities and risk factors associated with climate variability. The third is to analyse the economic consequences of climate change for productivity, employment, sectoral losses, and aggregate output. The fourth is to evaluate the effectiveness of existing adaptation and mitigation strategies across sectors. The fifth is to derive comparative, cross-sectoral policy insights capable of informing integrated resilience strategies for developing economies.

1.2 Significance of the Study

This study contributes to the literature and to policy in three respects. Analytically, it consolidates dispersed secondary evidence from more than a dozen authoritative international sources into a single comparative framework, enabling cross-sectoral judgements that individual data sources do not support in isolation. Methodologically, it demonstrates how triangulated secondary data spanning a fifteen-year window can be marshalled to characterise a slow-moving, compounding risk that resists conventional single-shock evaluation. For policy, the comparative matrix and vulnerability assessment it produces offer decision-makers in developing nations, and their development partners, a basis for prioritising adaptation investment, sequencing reforms, and designing risk-transfer mechanisms that reflect the true transmission structure of climate risk within their economies.

The study covers ten to fifteen representative developing nations across South Asia, Sub-Saharan Africa, Southeast Asia, and Latin America and the Caribbean, together with small island developing states, over the period 2010 to 2024. It relies exclusively on secondary data and does not generate primary survey evidence, which constrains the granularity of firm-level and household-level inference. Estimates drawn from different sources occasionally diverge; where they do, the study reports the range rather than a spurious point estimate. Attribution of specific losses to anthropogenic climate change, as distinct from natural variability, carries inherent uncertainty, and the study follows the conservative attribution conventions of the Intergovernmental Panel on Climate Change. These limitations notwithstanding, the breadth and authority of the assembled sources support robust comparative conclusions.

2. Literature Review

The scholarly and institutional literature on the economics of climate change in developing nations has expanded rapidly over the past decade. This review organises that literature under three themes: the aggregate macroeconomic impact of climate change, the sectoral transmission of climate shocks, and the vulnerability and adaptation frameworks that explain differential exposure.

2.1 Macroeconomic Impacts of Climate Change in Developing Economies

A substantial strand of research establishes that warming reduces aggregate output and that the losses are concentrated in hotter, poorer countries. Burke, Hsiang, and Miguel (2015) demonstrated a non-linear relationship between temperature and economic productivity, with output peaking at moderate annual temperatures and declining sharply beyond them, implying disproportionate losses for tropical developing economies. Kahn et al. (2021) extended this

evidence to persistent per-capita growth effects, finding that deviations from historical climate norms lower long-run income across a wide sample of countries. Dell, Jones, and Olken (2014), in an influential survey, synthesised the emerging 'climate–economy' literature and cautioned that damage estimates are sensitive to model specification and adaptation assumptions. Diffenbaugh and Burke (2019) further argued that warming has already widened the gap between rich and poor countries, a finding of direct relevance to the developing-nation focus of the present study. Collectively, these contributions establish that climate change is not merely an environmental externality but a first-order determinant of the growth trajectories of developing economies.

2.2 Sectoral Transmission of Climate Shocks

A second body of work traces how climate shocks propagate through specific sectors. On agriculture, Ortiz-Bobea et al. (2021) estimated that anthropogenic climate change has reduced global agricultural total factor productivity growth by roughly 21 per cent since 1961, with the largest losses in warmer regions, corroborating the sector-level findings later consolidated in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (2022). On labour and industry, the International Labour Organization (2019) projected that heat stress would erode 2.2 per cent of global working hours by 2030, equivalent to eighty million full-time jobs, concentrated overwhelmingly in agriculture and construction in developing regions. On energy, the International Energy Agency (2021) documented the exposure of hydropower- and thermal-dependent systems to drought and heat, while research by the Food and Agriculture Organization (2021) on disasters and agriculture quantified the sector's outsized absorption of disaster losses. This literature is unified by the recognition that sectors differ not only in the magnitude of the shocks they suffer but in the extent to which they transmit those shocks to the wider economy.

2.3 Vulnerability, Adaptation, and the Risk Framework

A third theme concerns the conceptual apparatus used to explain why identical hazards produce divergent outcomes. The risk framework articulated by the Intergovernmental Panel on Climate Change decomposes climate risk into hazard, exposure, and vulnerability, the last comprising sensitivity and adaptive capacity. Hallegatte et al. (2016), in the World Bank's Shock Waves report, demonstrated that climate change could push more than one hundred million people into poverty by 2030 absent rapid, inclusive development, foregrounding the role of poverty as a vulnerability multiplier. Noble et al. (2014) and subsequent adaptation scholarship emphasised the limits of autonomous adaptation and the necessity of planned, financed, and institutionally supported measures. The University of Notre Dame Global Adaptation Initiative operationalised these ideas in the ND-GAIN index, which pairs vulnerability with readiness and consistently ranks Sahelian and Horn-of-Africa states as both most exposed and least prepared. This literature motivates the analytical structure adopted here, in which impacts are interpreted through the interaction of exposure, sensitivity, and adaptive capacity rather than through hazard magnitude alone.

3. Research Methodology

This study adopts a descriptive and analytical research design based entirely on secondary data. The choice of a secondary-data design is dictated by the nature of the research problem: characterising a slow-moving, multi-decadal, multi-country phenomenon requires longitudinal and cross-national coverage that primary data collection by a single researcher cannot feasibly attain, whereas authoritative international agencies already compile the requisite indicators to consistent standards.

The data span the period 2010 to 2024 and were drawn from internationally recognised sources, including the World Bank World Development Indicators, the Food and Agriculture Organization and FAOSTAT, the International Labour Organization, the Assessment Reports of the Intergovernmental Panel on Climate Change, the International Energy Agency, the International Renewable Energy Agency, the United Nations Environment Programme, the United Nations Conference on Trade and Development, the EM-DAT International Disaster Database, the Swiss Re Institute sigma reports, the Germanwatch Climate Risk Index, the World Meteorological Organization State of the Global Climate reports, and peer-reviewed academic literature. The sample comprises a purposive selection of developing nations chosen to represent the major developing regions and the principal climate-exposed economic structures, including agriculture-dependent low-income economies, manufacturing-oriented middle-income economies, hydropower-dependent energy systems, and tourism-dependent small island developing states.

Data were extracted, tabulated, and triangulated across sources to improve reliability. Where estimates diverged, the range was reported and the divergence discussed rather than concealed within a single figure. The analytical strategy combined three techniques: descriptive trend analysis of quantitative indicators such as cereal yields, temperature anomalies, and disaster losses; comparative sectoral analysis using a qualitative impact matrix derived from the frequency and magnitude of documented events; and vulnerability analysis structured by the exposure–sensitivity–adaptive-capacity framework of the Intergovernmental Panel on Climate Change, supplemented by the ND-GAIN composite index. All monetary values are reported in United States dollars as given in the source, and all tables indicate the source from which the data were compiled. The study is bounded by the limitations inherent in secondary data, including source heterogeneity and attribution uncertainty, which were mitigated through triangulation and conservative interpretation.

4. Results

This section presents the empirical results of the study in six tables. The results are organised to move from the structural and climatic context of developing economies, through the sectoral impacts on agriculture, energy, and services, to the comparative synthesis of cross-sectoral impacts and the productivity consequences of heat stress. Each table is followed by a concise interpretation of the evidence it contains.

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Table 1. Sectoral Composition of GDP in Selected Developing Nations, 2010 and 2023 (per cent of GDP)

Country	Agri. 2010	Agri. 2023	Ind. 2010	Ind. 2023	Serv. 2010	Serv. 2023
India	17.0	16.4	30.7	25.7	45.2	49.6
Bangladesh	17.0	11.0	25.5	34.6	52.6	51.1
Nigeria	23.9	23.7	25.3	30.8	50.8	43.8
Ethiopia	41.5	35.8	9.9	23.2	39.1	36.5
Kenya	24.8	21.3	19.0	17.0	47.6	54.4
Pakistan	24.3	22.9	19.6	18.8	52.1	52.0
Vietnam	18.4	12.0	32.1	37.1	40.6	42.5
Brazil	4.8	6.5	27.4	23.5	59.7	58.9
Indonesia	13.9	12.5	42.8	40.2	43.3	44.4

Source: Compiled by the researcher from World Bank, World Development Indicators (2024).

Table 1 establishes the structural context of the analysis. Agriculture remains a substantially larger share of output in developing nations than in advanced economies, exceeding one-third of gross domestic product in Ethiopia and one-fifth in Nigeria and Pakistan as late as 2023. Although a gradual shift towards services is visible in most countries, the transformation is slow and uneven, so that climate shocks transmitted through agriculture continue to carry economy-wide consequences. The employment picture is more skewed still, since agriculture employs a far greater share of the workforce than its output share implies, magnifying the social exposure of these economies to agricultural climate risk.

Table 2. Key Global Climate Change Indicators, 2010–2024

Indicator	2010	2015	2020	2024	Change
Global mean temperature anomaly (°C)	0.98	1.15	1.27	1.55	+0.57
Atmospheric CO_2 concentration (ppm)	389.9	400.8	414.2	424.6	+34.7
Cumulative sea-level rise (mm)	51	70	91	111	+60
Climate-related disasters (no. per year)	385	376	389	399	+14
Economic losses from disasters (US$ bn)	132	103	210	320	+188

Source: Compiled by the researcher from WMO State of the Global Climate Reports (2011–2023), NOAA, EM-DAT, and Swiss Re Institute sigma reports.

Table 2 confirms that the study period coincides with a pronounced intensification of the climate signal. The year 2024 was the warmest on record and the first calendar year in which global mean temperature exceeded 1.5°C above the pre-industrial baseline. Economic losses

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from weather-related disasters more than doubled between 2010 and 2024, and a disproportionate share of the human cost of these losses was borne by developing nations, providing the empirical backdrop against which the sectoral results that follow must be read.

Table 3. Cereal Yield Trends in Selected Developing Nations, 2010–2023 (kg per hectare)

Country	2010	2015	2020	2023	CAGR (%)
India	2,538	2,720	3,289	3,551	2.6
Bangladesh	4,157	4,418	4,809	5,050	1.5
Nigeria	1,530	1,441	1,447	1,502	−0.1
Ethiopia	1,749	2,354	2,769	2,913	4.0
Kenya	1,571	1,635	1,410	1,662	0.4
Pakistan	2,752	2,905	3,059	3,266	1.3
Vietnam	5,183	5,585	5,752	5,921	1.0
Sub-Saharan Africa (avg.)	1,349	1,432	1,489	1,521	0.9

Source: Compiled by the researcher from FAOSTAT and World Bank, World Development Indicators (2024).

Table 3 shows that although absolute yields rose in most countries owing to improved seeds, fertiliser use, and irrigation, growth rates were modest and highly uneven. Nigeria recorded essentially zero yield growth over fourteen years, and Kenya experienced pronounced collapses in drought years such as 2017 and 2021–2022, when consecutive failed rainy seasons produced the worst Horn-of-Africa drought in four decades. The evidence is consistent with estimates that climate change has already slowed agricultural productivity growth substantially, with the largest losses in Africa, so that observed yields lie well below the counterfactual yields that would have prevailed without anthropogenic warming.

Table 4. Climate-Induced Hydropower Disruptions in Selected Developing Nations, 2010–2024

Country	Hydro share (%)	Drought episodes	Observed impact
Zambia	83	2015–16, 2019, 2024	Load-shedding up to 12–21 hrs/day; GDP growth cut 1–2 pp
Zimbabwe	~50	2015–16, 2019, 2024	Kariba at record lows; 18-hour daily power cuts
Brazil	~60	2014–15, 2021	Worst drought in 91 years; thermal backup cost >US$10 bn
Ghana	~38	2013–15 (Dumsor)	Prolonged rationing; loss of 1.8–2% of GDP per year

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Country	Hydro share (%)	Drought episodes	Observed impact
Ecuador	~75	2023–24	Nationwide blackouts up to 14 hrs/day in 2024
Vietnam	~30	2023	Northern shortfall idled industrial parks; ~US$1.4 bn lost

Source: Compiled by the researcher from IEA country reports, World Bank, IHA Hydropower Status Reports, and national utility publications.

Table 4 shows that hydropower-dependent developing nations experienced repeated, macroeconomically significant electricity crises directly linked to climate variability. Because electricity is an input to every other sector, these disruptions transmitted climate shocks from the energy sector to industry, services, and households. The evidence identifies generation-mix concentration—particularly hydropower dependence above fifty per cent—as the decisive energy vulnerability, capable of converting a single multi-year drought into a national economic crisis.

The industrial dimension of these energy shocks deserves emphasis. In Zambia, whose mines consume more than half of national electricity, drought-induced load-shedding repeatedly curtailed copper output, the country's principal export earner, illustrating how a hydrological hazard propagates from reservoirs to the balance of payments. In Vietnam, the northern hydropower shortfall of 2023 idled industrial parks hosting export manufacturers, while in China the 2022 Sichuan drought forced the temporary closure of factories supplying global electronics and automotive firms. These cases show that the energy sector's modest direct share of disaster losses conceals its outsized role as a conduit through which climate variability reaches the manufacturing base. The same mechanism, operating through cooling-water scarcity at thermal plants and heat-driven surges in peak demand, produced rolling blackouts across South Asia during the heatwaves of 2022 to 2024, simultaneously constraining industrial production and straining public finances through elevated fuel-import bills.

Table 5. Climate-Related Impacts on Tourism in Selected Developing Economies, 2010–2024

Event / period	Country / region	Tourism dependence (% GDP)	Documented impact
Hurricanes Irma & Maria (2017)	Caribbean	30–60	~US$741 m tourism losses; Dominica damages 226% of GDP
Hurricane Dorian (2019)	The Bahamas	~43	Damages US$3.4 bn (~one-quarter of GDP)

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Event / period	Country / region	Tourism dependence (% GDP)	Documented impact
Coral bleaching (2016–24)	Maldives, Indonesia	10–40	Reef degradation; 2024 event most extensive on record
Cyclone Pam (2015)	Vanuatu	~20	Damages 64% of GDP; arrivals fell sharply
Kerala floods (2018)	India	~10 (state)	Arrivals fell; total flood losses ~US$4.3 bn

Source: Compiled by the researcher from UNWTO, World Travel and Tourism Council, IMF and World Bank post-disaster assessments, and ECLAC damage evaluations.

Table 5 demonstrates that the service sector, often assumed to be climate-insulated, is in fact substantially exposed, particularly through tourism in small island developing states whose asset base, infrastructure, and visitor demand are all climate-sensitive. Dominica's loss of 226 per cent of gross domestic product to Hurricane Maria in 2017 illustrates the compounded vulnerability of tourism-dependent economies. The near-absence of insurance—under ten per cent of catastrophe losses are insured in low-income countries—converts such asset losses into permanent balance-sheet destruction for households and small firms.

Table 6. Working Hours Lost to Heat Stress, by Region (per cent of working hours and FTE jobs)

Region	Hours lost 1995 (%)	Hours lost 2030 proj. (%)	FTE jobs lost 2030 (millions)
Southern Asia	3.9	5.3	43.0
Western Africa	2.9	4.6	9.0
South-Eastern Asia	2.9	3.7	16.0
Central Africa	1.8	2.5	2.0
Latin America and Caribbean	0.6	0.9	2.5
World	1.4	2.2	80.4

Source: Compiled by the researcher from ILO, Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work (2019).

Table 6 shows that heat-related productivity losses are overwhelmingly a developing-nation phenomenon. Southern Asia and Western Africa are projected to lose 5.3 and 4.6 per cent of working hours respectively by 2030, against a world average of 2.2 per cent, with agriculture and construction together accounting for the large majority of projected global losses. Because these projections were built on a conservative pathway that observed warming has already

reached, realised losses are likely to fall at the upper end of the estimates, underscoring the productivity dimension of climate risk in the developing world.

Read together, the six tables support three comparative findings. First, agriculture is the most directly and pervasively affected sector on nearly every dimension, reflecting its rain-fed dependence, smallholder structure, and dominant employment share. Second, the energy sector, despite a smaller direct loss share, has the highest transmission coefficient, since a single climate-induced electricity crisis imposes losses on all other sectors simultaneously. Third, impacts are converging over time: whereas the early study period was dominated by agricultural drought, the later period exhibits simultaneous multi-sector events, such as the 2022 Pakistan floods, which damaged agriculture, industry, energy infrastructure, and services in a single episode valued at over thirty billion dollars, or roughly nine per cent of national output. This convergence supports the characterisation of climate change in developing nations as a systemic, economy-wide risk.

The productivity results in Table 6 add a further dimension that the sectoral loss tables do not capture. Whereas disaster losses are episodic and visible, heat-related productivity erosion is chronic and largely invisible in conventional disaster accounting, yet its cumulative magnitude is substantial: the projected loss of eighty million full-time-equivalent jobs worldwide by 2030 is concentrated in exactly the regions and sectors—agriculture and construction in Southern Asia and Western Africa—that this study identifies as most exposed. When the chronic productivity drag is combined with the episodic disaster losses documented in Tables 3 through 5, the total economic burden of climate change on developing nations is considerably larger than any single indicator suggests. This layering of chronic and acute impacts, falling most heavily on the countries with the least adaptive capacity, is the defining economic feature of climate change in the developing world during the study period.

5. Discussion

The results confirm and extend the macroeconomic literature reviewed in Section 2. The finding that agriculture absorbs the largest share of disaster losses aligns with the productivity estimates of Ortiz-Bobea et al. (2021) and the sectoral conclusions of the Intergovernmental Panel on Climate Change (2022), while the pronounced concentration of heat-related working-hour losses in Southern Asia and Western Africa reflects the projections of the International Labour Organization (2019). The energy results illustrate a mechanism under-emphasised in output-focused studies: transmission. Because electricity is a universal input, hydropower and thermal vulnerability convert a climatic hazard into an economy-wide productivity shock, as the Zambian, Ghanaian, and Ecuadorian episodes demonstrate. The service-sector evidence, particularly the insurance protection gap, corroborates the vulnerability framework of Hallegatte et al. (2016), in which the absence of risk-transfer mechanisms transforms recoverable shocks into permanent wealth destruction and pushes the burden onto sovereign balance sheets.

Interpreted through the exposure–sensitivity–adaptive-capacity framework, the results reveal an inverse relationship between exposure and capacity: the countries most vulnerable to climate disruption, concentrated in the Sahel and Horn of Africa, are simultaneously the least ready to

finance and govern adaptation, as the ND-GAIN scores indicate. Three structural multipliers cut across all sectors—poverty, which suppresses autonomous adaptation; weak public finances, which delay reconstruction; and institutional capacity gaps, which limit early warning and the enforcement of land-use and building regulations. These multipliers explain why physically similar hazards produce systematically larger economic losses in developing nations than in advanced economies, and why sectoral policy responses that ignore the shared underlying vulnerabilities are likely to underperform.

6. Conclusion

This study set out to evaluate the effects of climate change on the diverse economic sectors of developing nations over the period 2010 to 2024, using a triangulated secondary-data design anchored in authoritative international sources. The evidence assembled across six tables and four sectors supports a clear central conclusion: climate change in developing nations is not a series of discrete sectoral problems but a systemic, economy-wide risk whose burden is distributed unevenly across sectors and, crucially, transmitted between them.

Agriculture emerges as the most directly and pervasively affected sector, owing to its dependence on rain-fed cultivation, its smallholder structure, and its dominant employment share, and it therefore warrants priority in vulnerability-reduction strategies. The energy sector, though accounting for a smaller direct loss share, carries the highest transmission risk, since generation-mix concentration—above all hydropower dependence—allows a single drought to incapacitate entire economies; diversification of generation and strengthening of grids are consequently first-order resilience measures. Industry and services share a common vulnerability rooted in unplanned urbanisation, informality, and uninsured assets, implying that urban resilience policy and the expansion of risk-transfer markets can address both sectors at once. Across all sectors, poverty, constrained public finances, and institutional weakness act as risk multipliers that widen the gap between hazard and outcome.

The convergence of multi-sector climate events after 2019 is the study's most consequential finding. Episodes such as the 2022 Pakistan floods, which struck agriculture, industry, energy, and services simultaneously, demonstrate that piecemeal, sector-by-sector responses are increasingly inadequate. The study therefore recommends an integrated adaptation agenda that combines climate-resilient agriculture, diversified and hardened energy systems, resilient urban and industrial infrastructure, and greatly expanded insurance and risk-transfer mechanisms, supported by adequate and predictable adaptation finance. Future research would benefit from complementing this secondary-data foundation with primary, firm-level, and household-level evidence, and from developing sector-linked models capable of quantifying the cross-sectoral transmission that this study has identified qualitatively. Addressing climate risk in developing nations, the analysis concludes, requires treating the economy as an interconnected system rather than as a collection of independently exposed sectors.

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