An Exploratory Report on

CLIMATE STRESS TESTING

For the Banking Sector of Bangladesh

April 2025

Financial Stability Department

Bangladesh Bank

(The Central Bank of Bangladesh)

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Disclaimer

The information presented in this report is based on data and projections available at the time of analysis. For clarity, some numerical figures have been rounded, which may result in minor discrepancies.

While reasonable efforts have been made to ensure the accuracy of the report, any inadvertent errors or omissions, typos, and misinterpretations are subject to correction. This report is intended to provide a risk assessment based on climate scenarios and should not be interpreted as a definitive prediction of future outcomes.

This report is released in April 2025 and
prepared based on data available as of 31 March 2024.
Feedback on this report may be sent to gm.fsd@bb.org.bd

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ACRONYMS

B2	Below 2°C Scenario
B2_HCPD	Below 2°C with High Chronic Physical Risk Damage
B2_MCPD	Below 2°C with Medium Chronic Physical Risk Damage
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BRPD	Banking Regulation and Policy Department
CP	Current Policies Scenario
CP_HCPD	Current Policies with High Chronic Physical Risk Damage
CP_MCPD	Current Policies with Medium Chronic Physical Risk Damage
CST	Climate Stress Testing
DFIM	Department of Financial Institutions and Markets
DT	Delayed Transition Scenario
DT_HCPD	Delayed Transition with High Chronic Physical Risk Damage
DT_MCPD	Delayed Transition with Medium Chronic Physical Risk Damage
EAD	Exposure at Default
EAD NPE	Exposure at Default of Non-Performing Exposures
EAD PE	Exposure at Default of Performing Exposures
EL	Expected Loss
EL NPE	Expected (Credit) Loss against Non-Performing Exposures
EL PE	Expected (Credit) Loss against Performing Exposures
ETC	et cetera
FIs	Financial Institutions
FSD	Financial Stability Department
fxr	Foreign Exchange Rate Movements (USD period average)
GCAM	Global Change Analysis Model
GCC Economies	Gulf Cooperation Council Economies
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
GPR	General Provision Rate
HCPD	High Chronic Physical Risk Damage
inf	12-Month Average General Inflation
LGD	Loss Given Default
LLR	Loan Loss Reserve
lr	Lending Rate (all Banks)
lty	Long-term Yield of 02-Years Government Bond
MCPD	Medium Chronic Physical Risk Damage
MS Excel	Microsoft Excel Application
NDC_HCPD	Nationally Determined Contributions with High Chronic Physical Risk Damage
NDC_MCPD	Nationally Determined Contributions with Medium Chronic Physical Risk Damage
NDC	Nationally Determined Contribution
NGFS	Network for Greening the Financial System
NPL	Non-Performing Loan
NPLIR	Non-Performing Loan Inflow Ratio
nplir_lt	Logit transformation of Non-Performing Loan Inflow Ratio
PD	Probability of Default
PPP	Purchasing Power Parity
t	Current Period
t-1	Lag of One Period of the Current Period
TL	Total Loan Outstanding
w/o_D	Without Damage

EXECUTIVE SUMMARY

The financial system of Bangladesh may face significant challenges from climate-induced GDP slowdown in the coming years. To address this, the Financial Stability Department of Bangladesh Bank (BB) developed a forward-looking climate stress testing framework and conducted comprehensive scenario-based stress testing on the banking sector of Bangladesh.

The study adopted a top-down climate stress testing exercise considering a macro approach based on data as of March 2024. The results presented in this report explore the plausible impact of climate change on loan losses for some sample banks, which may represent the overall banking sector of Bangladesh. In the first step, the study estimates the association between the GDP growth rate and credit risk of banks applying econometric-based satellite models. Then, by analyzing projected GDP under various climate scenarios, the impacts of plausible climate risk on banks' balance sheets were assessed using tailored capital engines. Instead of immediately imposing stricter capital requirements for banks based on this climate stress testing, this report aims to raise stakeholders' awareness on climate risks. Finally, based on the findings, the report offers several recommendations for the banks and supervisors to address the plausible risks associated with climate change.

The study finds that higher damage scenarios would consistently lead to greater loan loss, indicating significant vulnerability to climate-induced GDP shocks. Notably, the study finds that immediate climate action is essential to minimize any plausible loss.

The analysis highlights the need for banks to integrate the aspect of climate change and associated risks into their strategies, adopt robust provisioning practices, and implement bank-specific climate risk management frameworks. The study also emphasizes the importance of climate risk-related reliable data collection and reporting mechanisms. Despite limitations arising from the use of hypothetical climate scenarios, static balance sheet assumptions, and a relatively short projection horizon, this report provides a vital foundation for further improvements.

This report presents the technical aspects, methodology, results, and findings of the first-ever climate stress test based on scenario analysis conducted by BB for banks. This initiative aims to foster a more resilient and climate-conscious financial system in Bangladesh. BB has updated its stress testing guidelines for banks to incorporate climate change considerations, and initiatives have been taken to introduce a bottom-up climate stress testing model.

Furthermore, BB has already received technical assistance from the International Monetary Fund (IMF) for climate risk analysis. BB may introduce a robust climate stress testing methodology by incorporating advanced hazard projections, damage estimation models, and exposure assessments with the assistance from IMF. This would minimize the shortcomings of scenario-based climate stress testing portrayed in this report.

CHAPTER 1 : INTRODUCTION

This report portrays the scenario-based climate stress testing study that Bangladesh Bank conducted on the banking sector of Bangladesh based on data available as of 31 March 2024. To identify and measure the plausible risks to financial stability arising from the adverse impact of climate change, Bangladesh Bank developed a framework and performed a scenario-based climate stress testing study considering a macro approach. The study tried to estimate the losses for the banks due to climate change-induced GDP shock under different plausible scenarios. The study uses GDP projection data under various climate scenarios published by the Network for Greening the Financial System (NGFS)[1], a consortium of central banks, wherein Bangladesh Bank is a member[2]. A top-down exercise is adopted in the study, where a satellite model are developed to derive the association between macro variables and the credit risk of banks. To calculate the estimated loss, sample bank-specific capital engines are developed to estimate the loan loss reserves in different climate scenarios considering the climate-induced GDP projections. The study results reveal valuable insights into the current state of the financial system, particularly regarding how banks perceive the overarching impact of climate change. The developed framework can be used as a policy tool to improve the readiness of the banks to manage the risks associated with climate change.

1.1 BACKGROUND

Bangladesh is considered as one of the most vulnerable countries to the adverse impacts of climate change[3]. It is important to evaluate how climate-related risks, when transmitted through their adverse effects on the macroeconomy, can negatively affect the financial system of Bangladesh.

The climate risk may put the financial system at substantial risk in the form of physical risk and transition risk. The frequent natural disasters resulting from climate change cause substantial physical risk and have a significant impact on the population, economy, and society of the country. These physical risks could also pose a significant threat to financial stability arising from the possibility of affecting banks' exposure in disaster-prone areas. The physical risk may arise when climate-related shocks and stresses, such as floods, cyclones, etc., cause considerable damage to the physical assets of firms and individuals where the banks have exposures. On the other hand, the transition risk could arise from the loss of businesses in the process of economic transition from high-carbon emissions to low-carbon.

Bangladesh Bank, in collaboration with the Government, can play a pivotal role by assessing the climate risk for the financial system and taking decisive actions to mitigate the identified risks, thus keeping the financial system stable and resilient. The roles of the central bank can be extended but not limited to assessing climate risk for the financial system on a forward-looking basis by adopting an appropriate climate stress testing framework, integrating the assessed risks in climate mitigation and adaptation plans by appropriate policy initiatives; formulating an effective and efficient national climate transition plan keeping into account the changing reality; accommodating the key opportunities and challenges of climate risks in the institutional framework; and identifying the potential financing needs for priority sectors.

Aligning with global best practices[4], Bangladesh Bank, the central bank of Bangladesh, took the initiative to conduct Climate Stress Testing (CST) to address the risks associated with climate change

[1] https://www.ngfs.net/en
[2] https://www.ngfs.net/en/about-us/membership (Accessed on 07 January 2025)
[3] https://www.worldbank.org/en/news/feature/2022/10/31/key-highlights-country-climate-and-development-report-for-bangladesh (Accessed on 19 December 2024)

on the banking sector as a further endeavor to ensure financial stability. Climate Stress Testing provides data-driven insights to assess the magnitude of any plausible climate-induced GDP shock on the financial system. Along with helping banks adopt climate stress testing frameworks, CST would help fill up the requirement for tools vital to formulate appropriate policy designs to adapt and mitigate the risks associated with climate change.

1.2 ORGANIZATION OF THE REPORT

This paper is divided into seven chapters for the convenience of the readers. Chapter 1 is the introductory part, which discusses the background and theoretical understanding behind climate risks, the conceptual framework for conducting climate stress testing, the scope, the objective, and the research question of the study. Chapter 2 provides details on the methodology and describes how the framework of climate stress testing considering macro-approach is developed. Chapter 3 deals with the satellite models for climate stress testing and estimates the average extent to which a bank's credit risk can be associated with the GDP growth rate in Bangladesh. Chapter 4 elaborates on how climate stress testing and the analysis were conducted, whereas, Chapter 5 discusses the results of the analysis. Chapter 6 includes the discussion, recommendations for the stakeholders, and way-forward remarks, and finally, Chapter 7 concludes the report.

1.3 RISKS ASSOCIATED WITH CLIMATE CHANGE

The risks associated with climate change refer to the vulnerabilities or shock or plausible adverse impact of climate change on the financial system that may originate from multifaceted sources depending on the geographical setting and physical environment of a country or various climate initiatives. In Bangladesh, the sources of climate risk could be broadly discussed from physical and transition risk perspectives. Some of the sources of physical and transition risks due to climate change in the context of Bangladesh are summarized in Table 1.1 from the financial stability standpoint.

TABLE 1.1: THE SOURCES OF RISKS ASSOCIATED WITH CLIMATE CHANGE

Risk Type	Sources	Example
Physical risk	Domestic physical hazards from extreme events (e.g., river and coastal flood, cyclone, drought, extreme temperature changes) and from gradual changes in climate (e.g., decline in agricultural yields or water availability, sea-level rise, heating and cooling requirements); These events have implications on several areas including: • Real estate and infrastructure, business continuity, people, and food systems; • International trade channels (e.g., import/export of food, supply chains); • Adaptation measures (e.g., shift in crop types, water regulations, coastal protection measures). These impacted areas eventually become sources of physical risk.	Natural disasters arising from climate change could result in slow GDP growth, which eventually could increase the Probability of Default (PD) of a bank's investment. An increase in PD could erode the bank's capital and may thereby pose a system-wide threat to the financial system if the bank is systemically important one; Moreover, the physical climate risks (e.g., river and coastal floods) could affect the exposures (including physical assets, and collaterals) of banks in disaster-prone areas;

[4]https://www.bis.org/bcbs/publ/d573.pdf

Risk Type	Sources	Example
Transition risk	Type of government policies are being considered/implemented (e.g., carbon tax, direct regulation, subsidies); Type of technological changes could play a key role in the coming decades (e.g., renewable energy, carbon capture and storage, electrification of motor vehicles); Significant changes in consumer preference (e.g., transport demand, diets, energy-efficient housing, energy-efficient appliances); The economic sectors that are particularly at risk of policy or technological disruption (e.g., energy sector, agriculture, construction, industry, mobility, and freight transport).	By 2030, Bangladesh would reduce emissions by 5 percent across three pivotal sectors: power, transport, and industry[5]; The Government of Bangladesh envisions that 40% of its energy generation capacity will come from renewable sources by 2041[6]; Various climate actions taken by Governments and Financial Institutions translate into transition risk for corporations and borrowers to whom the financial institutions have exposure. Thus, financial institutions may incur loan losses due to the impairment of the borrowers' loan servicing capacity.

Source: FSD's compilation.

1.4 APPROACHES OF CLIMATE STRESS TESTING (CST)

Depending on data granularity, climate stress testing could be developed under the following alternative approaches (Table 1.2):

TABLE 1.2: APPROACHES OF CLIMATE STRESS TESTING BASED ON DATA GRANULARITY

		Economic Resolution	Geographical Resolution	Approaches
Level of granularity	Low	Macroeconomy	Global to Country	Macro approach
	Medium	Sectoral level	Regional	2nd best Micro approach
	High	Firm /Household level	Postcode down to individual property location	1st best Micro approach

Source: Adopted from Technical document, NGFS[7], and IMF; compiled by FSD, BB.

The first best micro approach could be developed based on data with the value and location of physical assets of firms and households to which banks have exposures. The second best micro approach could be developed based on the bank exposure data, aggregated at the smaller geographical area like the upazila level[8], whereas the macro approach could be based on the country-level GDP and exposure data.

1.5 CONCEPTUAL FRAMEWORK TO CONDUCT THE CST STUDY

Climate shock would slow down the GDP growth through physical and transition risks. Banks may face elevated credit risk due to a slowdown in economic activities as businesses and households are

[5]http://mof.portal.gov.bd/sites/default/files/files/mof.portal.gov.bd/page/b1a52827_25d9_4854_8d82_a6f61921cfc2/Climate_English-Final-%2805-06-2024%29-compressed.pdf (Accessed on 17 March 2024)

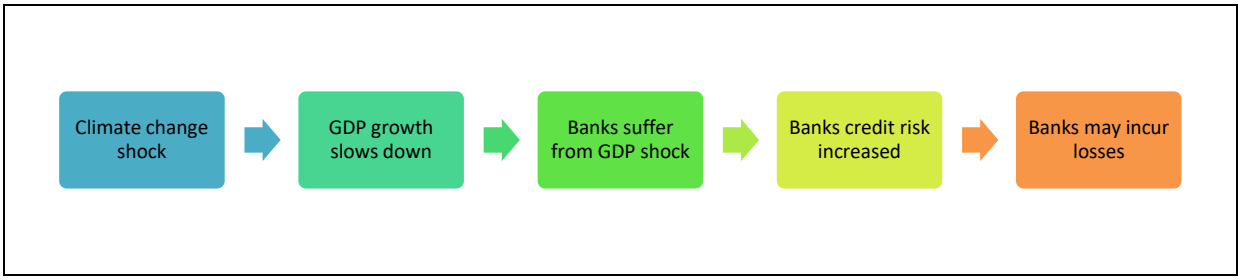
[6]https://ieefa.org/articles/bangladesh-needs-us171-billion-annually-until-2041-40-renewable-energy-capacity (Accessed on 20 December 2024)

[7]Network for Greening the Financial System Guide to Climate Scenario Analysis for Climate Scenario Analysis central banks and Supervisors (June 2020); https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_scenario_analysis_final.pdf (Accessed on 21 December 2024)

[8]In the context of Bangladesh, the third-order administrative level is named upazila, first-order are divisions, and second-order districts

exposed to macroeconomic shock. Ultimately, banks would incur higher loan losses due to heightened credit risk (Figure 1.1).

FIGURE 1.1: CONCEPTUAL FRAMEWORK OF CLIMATE STRESS TESTING



Source: FSD's design, FSD, BB.

1.6 SCOPE OF THE STUDY

The scope of this report is confined to analyzing the estimated loan losses of banks resulting from climate-induced GDP shocks and their potential impacts on the balance sheets of these banks. It focuses on quantifying credit risk under various hypothetical climate scenarios by leveraging econometric satellite models and bank-specific capital engines. By assessing the resilience of the banking sector, the study intends to raise stakeholders' awareness and build preparedness against risks associated with climate change. The study would finally recommend some specific suggestions to banks that might be helpful in better managing the risk related to climate events and climate initiatives.

1.7 GOAL AND OBJECTIVES OF THE STUDY

The primary goal of the study is to develop a climate stress testing framework and assess the impact of various hypothetical climate scenarios on the banking sector of Bangladesh. The intention of preparing and publishing the climate stress testing result as a report is to create awareness among the stakeholders regarding the risks associated with climate change to the financial system. The study thus focuses on determining how climate change can adversely affect the banks in Bangladesh through climate-induced macroeconomic shocks. To achieve the goal of the study, the following objectives are considered:

a. Identify the impact of macroeconomic variables, particularly GDP, on the credit risk of banks.

b. Explore how different hypothetical GDP projections in various climate scenarios may adversely affect banks' loan loss.

1.8 RESEARCH QUESTION

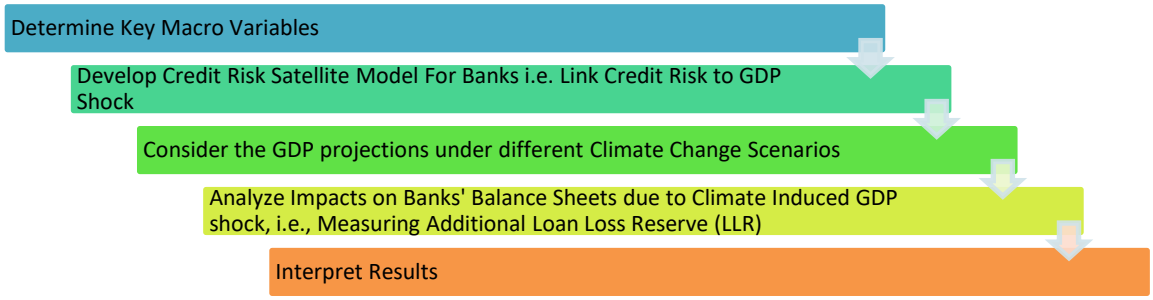
Considering the objectives of the study, the research question of this climate stress testing study is as follows:

"To what extent climate risks could affect the overall banking sector of Bangladesh under various plausible climate scenarios?"

CHAPTER 2 : METHODOLOGY

The study involves a systematic approach to conduct Climate Stress Testing through several steps, as depicted in Figure 2.1.

FIGURE 2.1: STEPS FOLLOWED TO CONDUCT CLIMATE STRESS TESTING



Source: FSD's design, FSD, BB.

At first, key macroeconomic variables are determined, which serve as the foundation for understanding how broader economic factors influence the credit risk of a bank. The GDP growth rate is chosen as the anchor variable for developing the model, with other macro variables as the control variables, which is discussed in Chapter 3.

Next, the study models credit risk in banks by linking GDP shocks to credit risk. Satellite models based on econometric analysis, are developed, where credit risk is measured by the Non-Performing Loan Inflow Ratio (NPLIR) as the proxy of Probability of Default (PD). This step quantifies the relationship between climate-related economic downturns and Banks' credit risk exposure. The output of this analysis would help develop a framework to estimate potential loan loss under various climate scenarios.

Following this, GDP projections under various climate scenarios are considered as outlined in the NGFS climate scenarios, e.g., Delayed Transition or Current Policies scenario with high or medium chronic physical damage, and so on. These growth rates of projected GDP serve as inputs to extrapolate the PD of each bank for future periods, enabling an assessment of how climate-induced economic changes may alter the credit risk level of that bank. To assess this, bank-specific capital engines are developed to calculate PD under various climate scenarios. This approach provides insights into the probable credit risks that a bank might face due to climate-related hypothetical events within the projected time horizon.

Finally, the analysis measures the expected loan loss as a Loan Loss Reserve (LLR). The estimated LLR is calculated by aggregating loan loss reserves against each bank's non-performing and performing exposures utilizing tailored capital engines. Here, the PD is associated with the expected credit loss against a bank's non-performing exposures by Equation 2.1, whereas, for performing exposures, loan loss would be calculated by Equation 2.2.

$$\text{EL NPE}_{t1} = (\text{EAD NPE}_{t0} + \text{PD}_{t1} \times \text{EAD PE}_{t0}) \times \text{LGD} \qquad \textit{Equation 2.1}$$

$$\text{EL PE} = \text{EAD PE} \times \text{GPR} \qquad \textit{Equation 2.2}$$

Here,

EL NPE : Expected Loan Loss against Non-Performing Exposures, i.e. the anticipated loss on a non-performing loan or portfolio at a particular time;

EL PE : Expected Loan Loss against Performing Exposures, i.e. the anticipated loss on a

performing loan or portfolio at a particular time;

EAD NPE : Exposure at Default of Non-Performing Exposures, i.e. the amount of non-performing exposure at the time of default;

EAD PE : Exposure at Default of Performing Exposures, i.e. the amount of performing exposure at the time of default;

PD : Probability of Default, i.e. the likelihood of a loan default;

LGD : Loss Given Default, i.e. the proportion of the exposure that is not recovered after a default;

GPR : General Provision Rate, i.e. the proportion of maintained LLR to EAD PE;

t0 : Current period;

t1 : Next period;

2.1 ADDRESSING THE RESEARCH GAP

The NGFS data provides projections of macroeconomic variables, such as GDP, under various hypothetical climate scenarios. However, a significant research gap exists in assessing the impact of climate-induced GDP growth rate on banks' expected losses in the context of Bangladesh. This study aims to bridge this gap by employing a scenario-based climate stress testing framework (Figure 1.1). Specifically, the study developed satellite models and used tailored capital engine tools to assess how hypothetical climate-induced GDP projections would affect banks' credit risk.

2.1.1 Satellite Model

In this study, the satellite model is a statistical model that estimates the relationship between macroeconomic variables (e.g., GDP growth) and credit risk (e.g., probability of default) using historical data by conducting econometric analysis. Thus, macroeconomic stress scenarios can be linked to banks' financial statements. The detailed methodology for developing the satellite model is described in Chapter 3.

2.1.2 Capital Engine

Capital engines are analytical tools used to extrapolate the credit risk matrices of each bank using the coefficients obtained from the satellite models and to estimate banks' loan loss reserves under specific climate scenarios. This study designed several customized MS Excel-based capital engines tailored to the individual bank. Eventually, specific capital engines for each sample bank are developed. The GDP data of NGFS is used to estimate the projected growth rate of GDP under various climate scenarios. The capital engine tool utilizes the projected GDP growth rates as input and provides estimated bank-specific loan loss reserves as the output. The details of the analysis and the results are described in Chapter 4 and Chapter 5.

2.2 APPROACH AND BALANCE SHEET ASSUMPTIONS

Considering the data availability for developing a CST framework and conducting scenario-based climate stress testing, this study adopted a top-down macro approach using quarterly data. The study assumes a static balance sheet for the banks, and projections are limited to the year 2035, considering 2025, 2030, and 2035 as short-term, medium-term, and long-term respectively.

2.3 COVERAGE AND PARTICIPANTS

Climate scenario analysis was conducted on a sample of five banks, which are assumed to represent the banking sector of Bangladesh. The selected banks hold approximately thirty percent of the total banking sector assets[9].

[9] Source: Department of Off-Site Supervision, Compiled by FSD, BB.

2.4 DATA COLLECTION

Two types of data were required for conducting climate stress testing using the developed framework: financial or macroeconomic data and climate scenario-specific GDP projections. Bank-specific and financial system-specific data were collected to develop satellite models and capital engine tools. Accordingly, unbalanced panel data from 61 banks and related macroeconomic data are utilized for the satellite model. Except for the bank-specific credit risk data, i.e., NPLIR, all data used in this study are collected from publicly available secondary sources (Annexure I).

CHAPTER 3 : SATELLITE MODELS FOR CLIMATE STRESS TESTING

3.1 INTRODUCTION

It is essential to determine how macroeconomic variables affect the credit risk of banks so that the estimated parameter can be used in conducting climate stress testing. This chapter describes a study undertaken to explore the association of the Non-performing Loan Inflow Ratio (NPLIR) as a proxy of Probability of Default (PD), i.e., credit risk, and real Gross Domestic Product (GDP) as a key macro variable using a panel data analysis. Several econometric models helped to derive the association between NPLIR and GDP. The study employs both fixed effects models and Generalized Method of Moments (GMM) techniques to provide robust insights.

3.2 THEORETICAL UNDERPINNING

Probability of Default (PD) is the probability of a banking book asset to default over a period which represents the credit risk for a bank. To explore the satellite model of this study, PD would be represented by the NPLIR of a bank, which is derived as per the following formula as expressed in Equation 3.1:

$$NPLIR_t = \frac{New\ NPL\ Inflow_t}{TL_{t-1} - NPL_{t-1}}$$

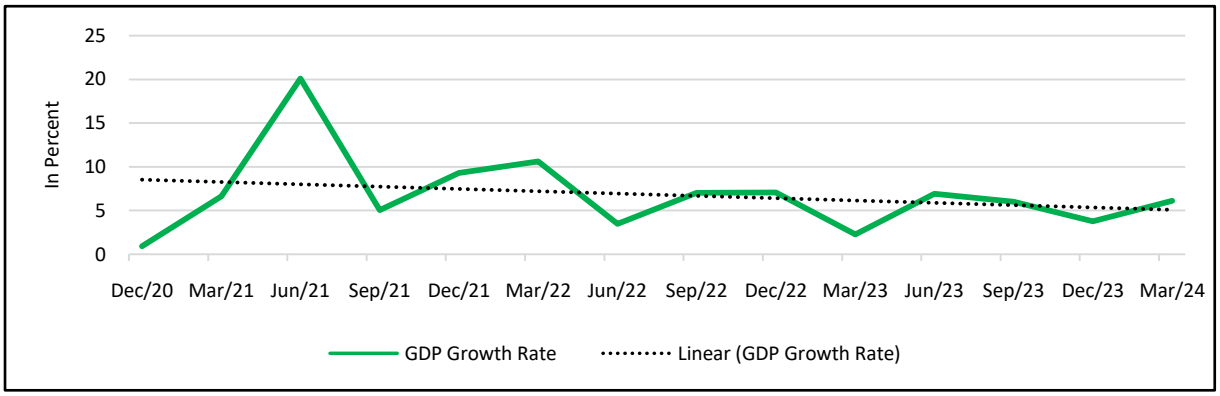
Equation 3.1

Here,

NPL	:	Non-Performing Loan;
TL	:	Total Loan Outstanding;
NPLIR	:	Non-Performing Loan Inflow Ratio;
t	:	Current Period;
t-1	:	Lag of one period of the current period.

The study explores satellite models to detect any association between macroeconomic variables and banks' credit risk. The quarterly GDP growth rate and NPLIR of the banking sector[10] are plotted for a visual inspection for any association between these variables.

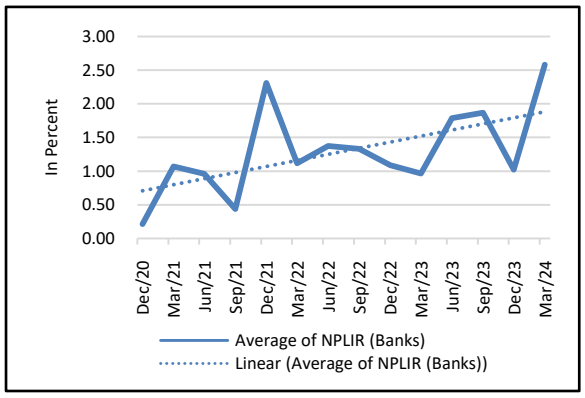
FIGURE 3.1: QUARTERLY GDP GROWTH RATE



Source: BBS[11] and MET, Compiled by FSD, BB.

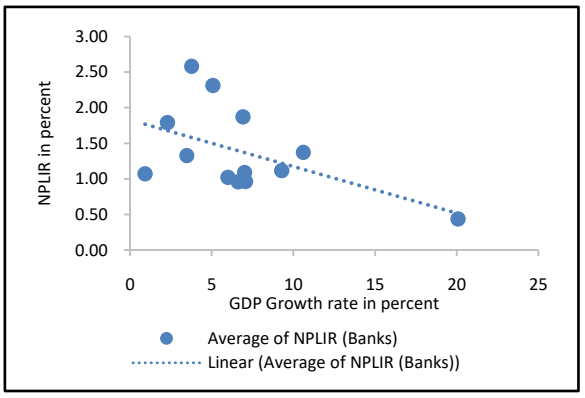
[10]All the 61 banks of the banking sector are considered to develop satettile model
[11]https://bbs.gov.bd/site/page/b588b454-0f88-4679-bf20-90e06dc1d10b/ (website accessed on 29 December 2024)

FIGURE 3.2: BANKING SECTOR'S AVERAGE NPLIR



Source: BRPD-2, BB, Compiled by FSD, BB.

FIGURE 3.3: BANKING SECTOR'S AVERAGE NPLIR AGAINST GDP GROWTH RATE



Source: BBS; BRPD-2, BB; Compiled by FSD, BB.

From Dec/20 to the end of Mar/24, the quarterly GDP growth rate exhibited a declining trend (Figure 3.1). Conversely, the average NPLIR for the banking sector showed an increasing trend over the same period (Figure 3.2). This overall inverse relationship indicates a negative association between the GDP growth rate and NPLIR for the banking sector. This negative association is also evident in the scatter plots of the average NPLIR for banks (Figure 3.3) against one lag period of the GDP growth rate. These findings are supported by the theoretical understanding that higher GDP growth, driven by increased economic activity, leads to improved debt servicing by the borrowers and consequently lowers credit risk, whereas low GDP growth would indicate reduced economic activity, leading to poor loan performance.

3.2.1 Research Question to Explore Satellite Model for CST

The research question to explore the satellite model is as follows:

"To what extent do macroeconomic variables affect the credit risk of a bank?"

3.2.2 Objectives of the study on satellite model

The objective of the satellite model is to find out the estimated parameters by which banks' credit risk is associated with macro variables, especially GDP, as these coefficients will be used to conduct climate stress testing.

3.2.3 Literature review on the impact of macro variables on credit risk

Credit risk metrics, such as the probability of default (PD), are strongly influenced by macroeconomic factors like GDP growth, unemployment, and interest rates. These relationships are often dynamic, with lagged effects and feedback loops impacting the outcomes (Stéphane Dees, 2017)[12]. Specifically, Abdelbaki (2019)[13] investigated the macroeconomic determinants of Non-Performing Loans (NPLs) in Gulf Cooperation Council (GCC) economies and found that non-oil GDP growth, domestic private sector credit-to-GDP ratio, and inflation could have a negative impact on NPLs. In contrast, interest rates and financial crises could have a positive effect. Szarowska (2018)[14] also investigates the

[12]Stéphane Dees, J. H. (2017, February). Stress-Test Analytics for Macroprudential Purposes in the euro area. STAMP€:. Germany.
[13]Abdelbaki, H.H. (2019). Macroeconomic determinants of non-performing loans in GCC economies: does the global financial crisis matter?. International Journal of Economics and Business Research, 17(4), 433–447.
[14]Szarowska, I. (2018). Effect of macroeconomic determinants on non-performing loans in central and eastern European countries. International Journal of Monetary Economics and Finance, 11(1), 20– 35.

influence of macroeconomic factors on non-performing loans in Central and Eastern European countries from 1999 to 2015 and discovers a negative relationship between GDP growth, inflation, and the Nominal Effective Exchange Rate with NPLs. Furthermore, the author believes unemployment and lending interest rates positively impact NPLs.

3.3 METHODOLOGY TO EXPLORE SATELLITE MODEL

The methodology includes the design of the study, data collection method, econometric model formation, and analytical software used to explore satellite models. Econometric modeling, such as conventional dynamic panel data analysis, is performed to understand the association between dependent (credit risk) and explanatory variables (GDP growth rate as the anchor variable and other control variables), and the Generalized Method of Moment (GMM) approach is chosen finally.

As the study considers GDP as the anchor variable to conduct the climate stress testing, some other related macroeconomic variables are primarily considered as the control variables[15], and quarterly data ranging from the end of December 2020 to the end of March 2024 is collected. An unbalanced panel data is prepared, comprising all the 61 scheduled banks to conduct the panel data regression analysis. Data on all the explanatory variables has been collected from secondary sources except NPLIR. The NPLIR data is collected from the Banking Regulation and Policy Department of Bangladesh Bank. The sources of collected data and the considered variables are mentioned in Annexure I.

The dependent variable NPLIR is converted to a logit transformation (nplir_lt) by the following rule (Equation 3.2):

$$nplir\_lt = ln\frac{nplir}{(1 - nplir)}$$

Equation 3.2

Specification of the Model for Banks (Equation 3.3):

$$nplir\_lt = f(gdp, inf, lr, fxr, lty)$$

Equation 3.3

In the Equation 3.2 and 3.3,

nplir_lt	:	Logit transformation of Non-Performing Loan Inflow Ratio;
ln	:	Natural logarithm function;
gdp	:	GDP growth rate at Constant Price;
inf	:	12-month average General Inflation;
fxr	:	Foreign exchange rate Movements (USD period average[16]);
lty	:	Long-term Yield of 02-Years Government Bond;
lr	:	Lending rate (all Banks);

3.3.1 Analytical software used

Microsoft Excel is used to collect and prepare the panel data. R-Studio is used to prepare the lag of variables and to estimate the satellite models.

[15]Control variables are chosen based on the evidence from the literature review, in-house correlation matrix study among macroeconomic variables, and expert judgment.
[16]Monthly Average was used

3.3.2 Results and Coefficients of Satellite Models

Oneway (individual) effect Two-step model System GMM is ultimately chosen for final estimation for banks. The analysis reveals a significant negative association between the lagged GDP growth rate (gdp_lag1) and the logistically transformed non-performing loan inflow ratio (nplir_lt) for banks. Specifically, a percentage point increase in the GDP growth rate is estimated to decrease the nplir_lt of banks by 0.09383 percentage point on average, assuming other variables remain constant. This finding supports the theoretical expectation that economic growth enhances overall financial activity, thereby reducing the possibility of loan defaults.

3.3.3 Limitations to Explore the Satellite Model

Bank-specific variables could not be included in the model, as the primary objective was to derive coefficients representing the relationship between credit risk and macroeconomic variables, particularly GDP growth. Thus, the satellite models also assume that any time-variant characteristics of banks would not significantly influence the results.

3.3.4 Concluding Remark on Satellite Model Exploration

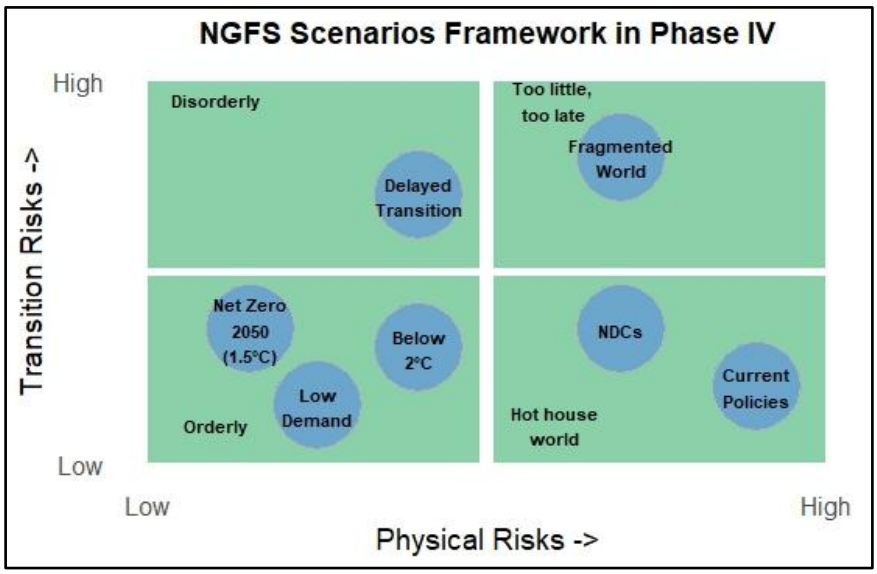
The study identifies a significant negative relationship between banks' credit risk and GDP growth in Bangladesh. The models would be used as satellite models, and the coefficients obtained from the analysis would be utilized in conducting climate stress testing to estimate banks' loan loss reserves under various hypothetical climate change scenarios in this report.

CHAPTER 4 : SCENARIO-BASED CLIMATE STRESS TESTING

4.1 SCENARIOS OF CLIMATE STRESS TESTING

NGFS illustrates[17] projections of Gross Domestic Product (GDP) at purchasing power parity (PPP) under a range of climate and policy scenarios for Bangladesh using the downscaling Global Change Analysis Model (GCAM)[18] up to the year 2100. GDP projections under various climate scenarios are instrumental in understanding how economic growth is expected to evolve in response to different hypothetical climate scenarios.

FIGURE 4.1: NGFS SCENARIOS



Note: Positioning of scenarios is approximate.
Source: Reproduced from NGFS Climate scenarios for central banks and supervisors (phase iv)[19]; Compiled by FSD, BB.

4.2 APPLIED SCENARIOS AND CONDITIONS

The NGFS scenarios[20] (phase iv) explore a set of seven scenario drivers under four broad climate scenarios, namely, Orderly, Disorderly, Hot House World, and Too-little-too-late scenarios as depicted in Figure 4.1. The climate stress testing is conducted considering the relevant subset of NGFS climate scenarios. Avoiding the extreme scenarios, i.e., the Too-little-too-late scenario at this stage, from the other three broad climate scenarios, the 'Current Policies,' 'Nationally Determined Contributions,' 'Delayed Transition,' and 'Below 2^0C' scenarios are considered in the study. These scenarios evaluate how climate policies and physical risks influence economic growth. The study considers projected GDP up to 2035 for Bangladesh under the scenarios considered in 'Without Damage,' 'Medium Chronic Physical Risk Damage,' and 'High Chronic Physical Risk Damage' conditions as published by NGFS. The considered scenarios with different conditions along with their notation are listed in Table 4.1.

[17]https://www.ngfs.net/sites/default/files/media/2024/01/16/ngfs_scenarios_technical_documentation_phase_iv_2023.pdf (accessed on 03 December 2024)
[18][GCAM 6.0 NGFS]; https://jgcri.github.io/gcam-doc/v6.0/overview.html; (Accessed on 19 December 2024)
[19]https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_phase_iv.pdf (Accessed on 19 December 2024)
[20]Annexure II: Explanation of NGFS scenarios

TABLE 4.1: SCENARIOS AND CONDITIONS APPLIED IN THE STUDY

	Notation	Elaboration
Scenarios	DT	Delayed Transition
	CP	Current Policies
	NDC	Nationally Determined Contributions
	B2	Below 2°C
Conditions	w/o_D	Without Damage
	HCPD	High Chronic Physical Risk Damage
	MCPD	Medium Chronic Physical Risk Damage
Scenarios in Various Conditions	w/o_D	Without Damage*
	DT_HCPD	Delayed Transition with High Chronic Physical Risk Damage
	DT_MCPD	Delayed Transition with Medium Chronic Physical Risk Damage
	CP_HCPD	Current Policies with High Chronic Physical Risk Damage
	CP_MCPD	Current Policies with Medium Chronic Physical Risk Damage
	NDC_HCPD	Nationally Determined Contributions with High Chronic Physical Risk Damage
	NDC_MCPD	Nationally Determined Contributions with Medium Chronic Physical Risk Damage
	B2_HCPD	Below 2°C with High Chronic Physical Risk Damage
	B2_MCPD	Below 2°C with Medium Chronic Physical Risk Damage

*Note: * irrespective of any climate scenario.*
Source: NGFS Scenarios as represented in the report; Compiled by FSD, BB.

4.3 METHODOLOGY OF SCENARIO ANALYSIS

After getting the satellite models and developing the tailored capital engines of banks, the next step is to use the GDP projections under various climate scenarios with various conditions[21] in the capital engines. The bank-specific extrapolation of credit risk, i.e., NPLIR (as a proxy of PD), is conducted by leveraging the tailored capital engine using the coefficients of satellite models.

To estimate the loan loss of banks, PD is obtained from the reverse transformation of predicted nplir_lt with the following equation (Equation 4.1) where "e" denotes the Euler's number:

$$\widehat{nplir} = \frac{1}{1 + e^{-nplir\_lt}}$$

Equation 4.1

4.4 PROJECTION HORIZON AND FREQUENCY

This climate stress testing framework considers the macro approach, using 2020's GDP as the base period for calculating the GDP growth rate. It evaluates the impact of projected GDP till 2035 with five-year intervals (i.e., for the years 2025, 2030, and 2035) on the banking sector's LLR. The five-year interval from 2025 is chosen to reflect the gradual nature of climate-related changes and the slow economic impacts that may manifest from adopting climate actions.

4.5 ASSUMPTIONS ON SCENARIO ANALYSIS

Across the climate scenarios, projected GDP growth rates exhibit a gradual decline from 2025 to 2035. It is assumed that, during the projected period, the country's economy would grow slowly since economies at higher stages of development may experience slower growth rates. Thus, to extricate the climate-induced loan losses, loan loss reserves under various climate scenarios are compared with those in the 'Without Damage' condition for each bank and the banking sector.

The study assumes that the GDP growth rates obtained from the NGFS projections would manifest as the actual GDP growth rates over the projected horizon, and these can be used in capital engines to assess banks' loan losses. Furthermore, other explanatory variables are held constant throughout the projection horizon to isolate the relationship between climate-induced projected GDP growth and

[21] Annexure III: NGFS Data For Bangladesh.

credit risk. This approach ensures that the analysis focuses solely on the association between GDP growth and credit risk in various climate scenarios.

Lastly, a static balance sheet assumption is applied to keep the analysis simple and easily interpretable. Consequently, the projection horizon is intentionally kept relatively short, up to 2035, to maintain the robustness of the results under this static balance sheet assumption.

4.6 TWO-FOLD APPROACH OF INTERPRETING THE CST RESULT

In all climate scenarios considering without damage condition, the Loan Loss Reserves (LLR) are estimated based on the assumption that the economy will continue to grow in 2025, 2030, and 2035, but at a slower pace as implied by the GDP growth rate derived from the NGFS projections. Nevertheless, the without damage condition would act as a baseline for the analysis irrespective of any climate scenarios.

By comparing the estimated LLR under different climate scenarios with high or medium chronic physical damage conditions for the projected periods against those of without damage conditions, the study estimates the additional LLR required for banks due to climate-induced GDP shock. Hence, the findings of this comparison would evaluate the impact of different climate events on the credit risk of banks.

Thus, the interpretation of the results is carried out in two steps. First, the LLR position for each bank for the projected years 2025, 2030, and 2035 are compared to their respective LLRs in 2024 (here, 2024 would be the base period) to identify the movement and pattern of the banks' provisioning requirements over the projection horizon. These estimated LLRs under without damage scenario would reflect a bank's loan loss without any climate impact due to the economy's slowdown. In contrast, the LLRs under other damage conditions in various climate scenarios would capture both the climate impact and the economy's slowdown. Thus, estimated LLR over the projected horizon can be used as a baseline scenario for further analysis.

Second, additional LLR for each bank due to climate shock is estimated by comparing the LLR required for high and medium chronic damage conditions of different climate scenarios against the without damage conditions (baseline scenario) in the various climate scenarios for the projection years (See Equation 4.2).

$$Additional\ LLR\ = Projected\ LLR\ in\ a\ scenario\ - Projected\ LLR\ under\ w/o\_D$$

Equation 4.2

Here,
Additional LLR = Estimated Additional LLR due to risks associated with climate change for a particular scenario
Projected LLR in a scenario = Projected LLR in a scenario with HCPD or MCPD condition
Projected LLR under w/o_D = Projected LLR under without damage condition

Chapter 5 interprets climate stress testing results using a two-fold analytical approach, enabling a structured assessment of estimated LLR for considered banks and the overall banking sector across various scenarios in projection years. Projected LLRs for 2025, 2030, and 2035 under HCPD, MCPD, and w/o_D will be expressed as percentages of a bank's actual LLR for 2024, whereas additional LLRs will be shown in percentage points[22].

[22]Numbers will be the approximate estimates due to rounding in two decimal points.

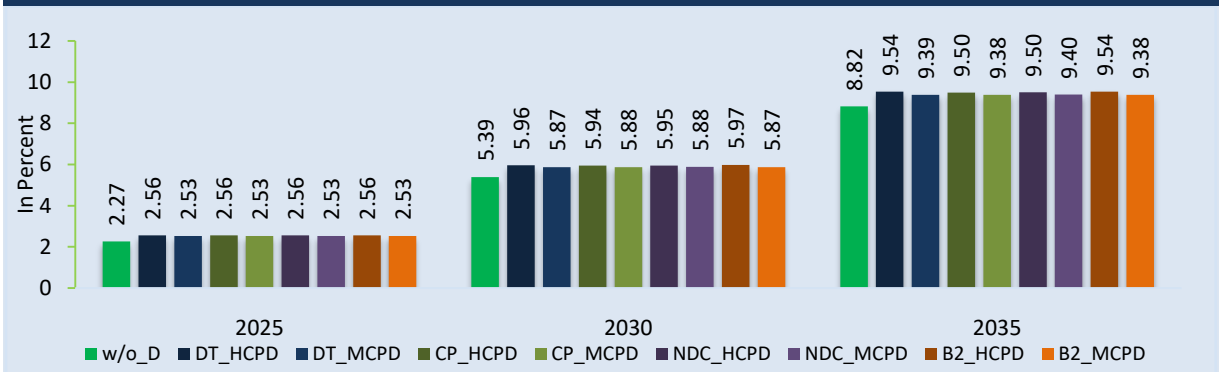
CHAPTER 5 : RESULTS OF CLIMATE STRESS TESTING

5.1 CLIMATE SCENARIO ANALYSIS OF THE BANKING SECTOR

5.1.1 Climate Scenario Analysis of Bank-1

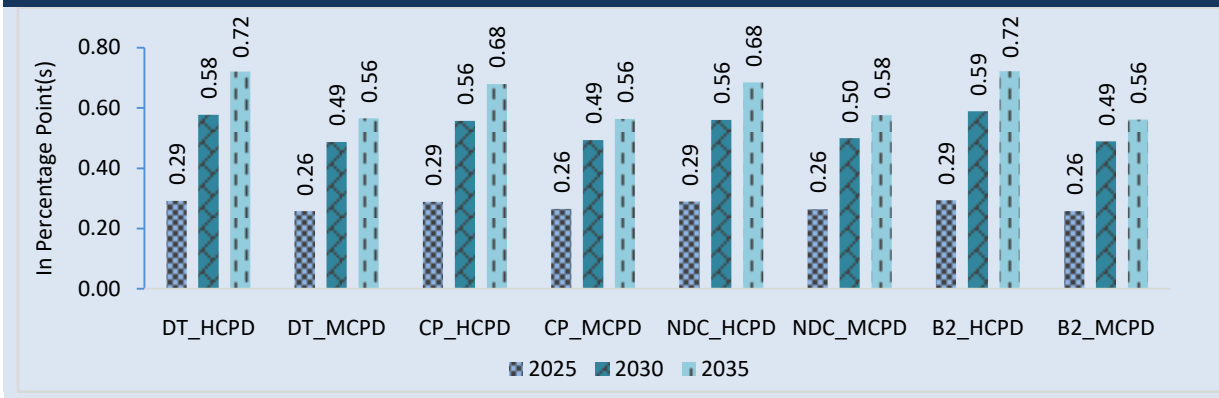
Bank-1 would incur more loss over the projected period as compared to the base period in various climate scenarios. As illustrated in Chart 5.1, the estimated LLRs for Bank-1 under all the climate scenarios and conditions are consistently higher than the actual LLR recorded in 2024 for the projected years 2025, 2030, and 2035. Furthermore, the estimated additional LLRs for Bank-1 due to climate shock follow an upward trend over the projected periods, as illustrated in Chart 5.2.

CHART 5.1: ESTIMATED LLR OF BANK-1 IN VARIOUS CLIMATE SCENARIOS



Source: FSD's calculation, BB.

CHART 5.2: ESTIMATED ADDITIONAL LLR FOR BANK-1 DUE TO CLIMATE SHOCK



Source: FSD's calculation, BB.

For Bank-1, the estimated LLRs under without damage condition are projected to increase by 2.27 percent in 2025, 5.39 percent in 2030, and 8.82 percent in 2035 compared to the actual LLR in 2024, providing a baseline scenario for estimating the additional loan loss due to various climate scenarios in high or medium chronic physical damage conditions.

In the Delayed Transition scenario with high chronic physical risk damage condition, the LLR would likely go up by 2.56 percent in 2025, 5.96 percent in 2030, and 9.54 percent in 2035 compared to the LLR in 2024, which is approximately 0.29, 0.58, and 0.72 percentage point higher than those of without damage conditions respectively. Under the Delayed Transition with medium chronic physical risk damage, the increase is expected to be 2.53 percent in 2025, 5.87 percent in 2030, and 9.39 percent in 2035 compared to the LLR in 2024, indicating up growth of 0.26, 0.49, and 0.56 percentage point as compared to those of without damage conditions in the respective projected years.

Similarly, for the Current Policies scenario, under high chronic physical risk damage, the LLR might rise by 2.56 percent in 2025, 5.94 percent in 2030, and 9.50 percent in 2035, which is 0.29, 0.56, and 0.68 percentage point higher than those of without damage condition respectively. Under medium chronic physical risk damage, the values are expected to increase by 2.53 percent in 2025, 5.88 percent in 2030, and 9.38 percent in 2035. These growth against the baseline scenario would be 0.26, 0.49, and 0.56 percentage point higher than those of the condition where no chronic physical damage would occur.

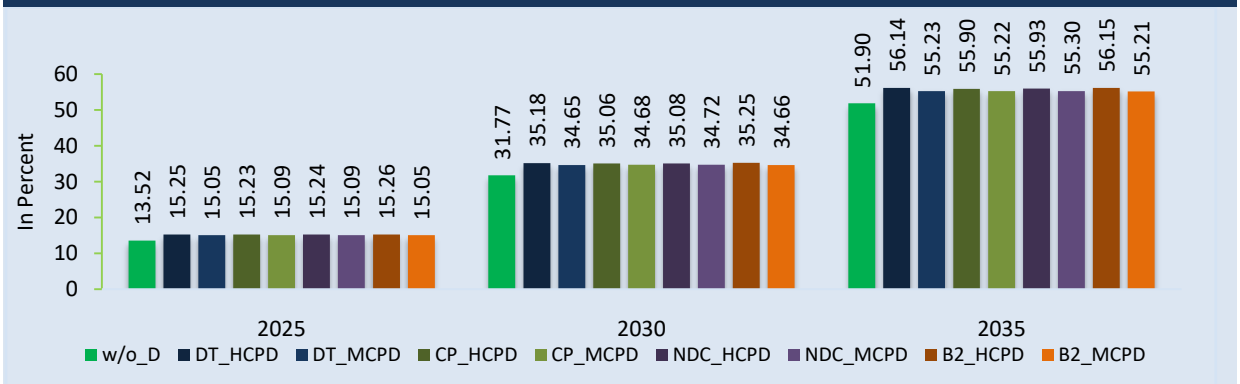
Accordingly, in the Nationally Determined Contributions with high chronic physical risk damage scenario, the LLR may increase by 2.56 percent in 2025, 5.95 percent in 2030, and 9.50 percent in 2035, exhibiting 0.29, 0.56, and 0.68 percentage point higher growth, respectively, than the baseline scenario. For medium chronic physical risk damage, the LLR would rise by 2.53 percent in 2025, 5.88 percent in 2030, and 9.40 percent in 2035, which is 0.26, 0.50, and 0.58 percentage point up from those of without damage condition respectively.

Likewise, under the Below 2°C scenario with high chronic physical risk damage, the LLR is expected to increase by 2.56 percent in 2025, 5.97 percent in 2030, and 9.54 percent in 2035, which indicates 0.29, 0.59, and 0.72 percentage point up respectively from the baseline scenario. In the medium chronic physical risk damage scenario, the LLR may rise by 2.53 percent in 2025, 5.87 percent in 2030, and 9.38 percent in 2035, which is 0.26, 0.49, and 0.56 percentage point higher respectively than the scenario where no climate damage would occur.

5.1.2 Climate Scenario Analysis of Bank-2

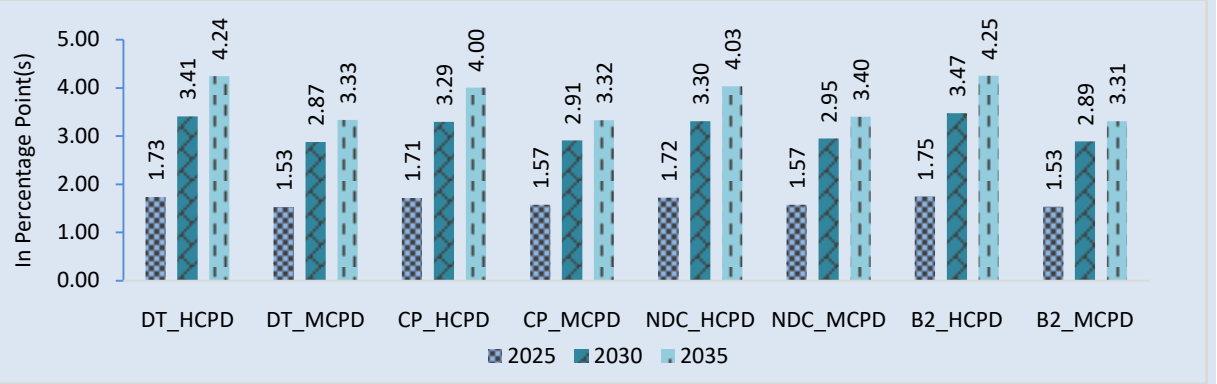
Bank-2 would incur more loss over the projected period as compared to the base period in various climate scenarios. As illustrated in Chart 5.3, the estimated LLRs for Bank-2 under all climate scenarios and conditions are consistently higher than the actual LLR recorded in 2024 for the projected years of 2025, 2030, and 2035. Along with that, the estimated additional LLRs for Bank-2 due to climate shock follow an upward trend over the projected periods, as illustrated in Chart 5.4.

CHART 5.3: ESTIMATED LLR OF BANK-2 IN VARIOUS CLIMATE SCENARIOS



Source: FSD's calculation, BB.

CHART 5.4: ESTIMATED ADDITIONAL LLR FOR BANK-2 DUE TO CLIMATE SHOCK



Source: FSD's calculation, BB.

For Bank-2, the estimated LLRs under without damage condition are projected to increase by 13.52 percent in 2025, 31.77 percent in 2030, and 51.90 percent in 2035 compared to the LLR in 2024, providing a baseline scenario for estimating the additional loan loss due to various climate scenarios in high or medium chronic physical damage conditions.

In the Delayed Transition with high chronic physical risk damage scenario, the LLR may rise by 15.25 percent in 2025, 35.18 percent in 2030, and 56.14 percent in 2035, indicating 1.73, 3.41, and 4.24 percentage points higher than those without damage conditions respectively. Under the Delayed Transition with medium chronic physical risk damage, the LLR would likely increase by 15.05 percent in 2025, 34.65 percent in 2030, and 55.23 percent in 2035, which is 1.53, 2.87, and 3.33 percentage points up as compared to without damage conditions in the respective projected years.

Similarly, for the Current Policies scenario, under high chronic physical risk damage, the LLR might rise by 15.23 percent in 2025, 35.06 percent in 2030, and 55.90 percent in 2035, exhibiting 1.71, 3.29, and 4.00 percentage points higher than those of without damage condition respectively. Under medium chronic physical risk damage, the values are expected to increase by 15.09 percent in 2025, 34.68 percent in 2030, and 55.22 percent in 2035, which is 1.57, 2.91, and 3.32 percentage points up from those of without damage condition respectively.

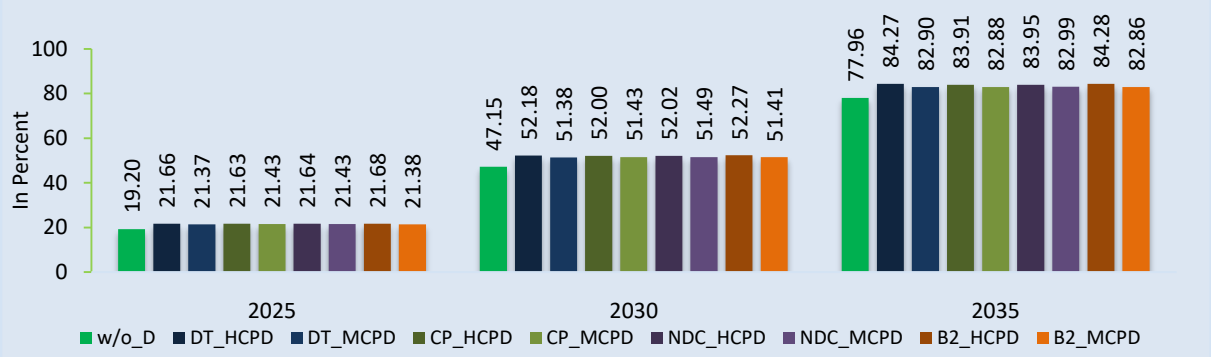
Accordingly, in the Nationally Determined Contributions scenario with high chronic physical risk damage condition, the LLR would likely rise by 15.24 percent in 2025, 35.08 percent in 2030, and 55.93 percent in 2035, exhibiting 1.72, 3.30, and 4.03 percentage points higher growth respectively than the baseline scenario. For medium chronic physical risk damage, the LLR is expected to increase by 15.09 percent in 2025, 34.72 percent in 2030, and 55.30 percent in 2035, which is 1.57, 2.95, and 3.40 percentage points up from those of without damage condition respectively.

Likewise, under the Below 2°C scenario with high chronic physical risk damage condition, the LLR may rise by 15.26 percent in 2025, 35.25 percent in 2030, and 56.15 percent in 2035, representing 1.75, 3.47, and 4.25 percentage points up respectively from those of the baseline scenario. In the medium chronic physical risk damage scenario, the LLR would likely increase by 15.05 percent in 2025, 34.66 percent in 2030, and 55.21 percent in 2035, which are 1.53, 2.89, and 3.31 percentage points higher respectively than the scenario where no climate damage would occur.

5.1.3 Climate Scenario Analysis of Bank-3

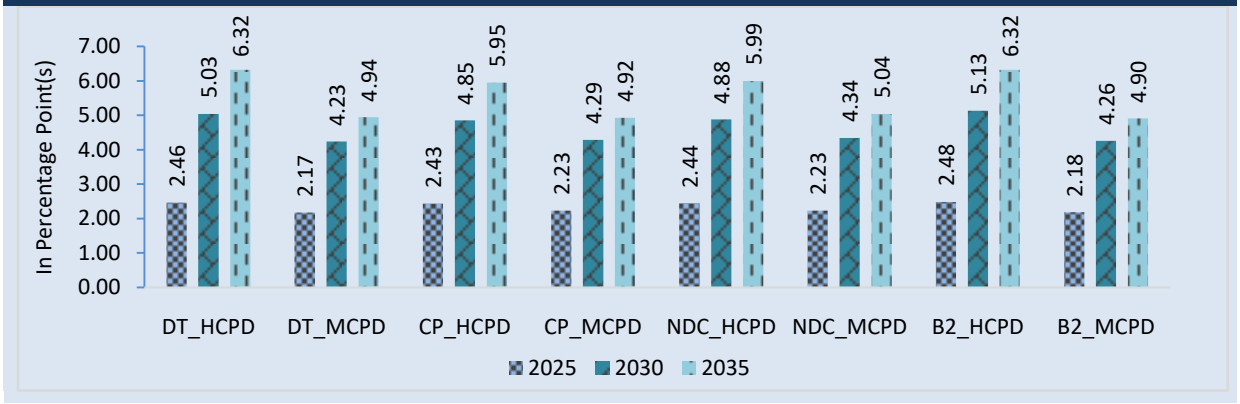
Bank-3 would incur more loss over the projected period as compared to the base period in various climate scenarios. As illustrated in Chart 5.5, the estimated LLRs for Bank-3 under all climate scenarios and conditions are consistently higher than the actual LLR recorded in 2024 for the projected years of 2025, 2030, and 2035. Furthermore, the estimated additional LLRs for Bank-3 due to climate shock follow an upward trend over the projected periods, as illustrated in Chart 5.6.

CHART 5.5: ESTIMATED LLR OF BANK-3 IN VARIOUS CLIMATE SCENARIOS



Source: FSD's calculation, BB.

CHART 5.6: ESTIMATED ADDITIONAL LLR FOR BANK-3 DUE TO CLIMATE SHOCK



Source: FSD's calculation, BB.

For Bank-3, the estimated LLRs under without damage condition are projected to increase by 19.20 percent in 2025, 47.15 percent in 2030, and 77.96 percent in 2035 compared to the LLR in 2024. This provides a baseline scenario for estimating the additional loan loss due to various climate scenarios in high or medium chronic physical damage conditions.

In the Delayed Transition with high chronic physical risk damage scenario, the LLR might rise by 21.66 percent in 2025, 52.18 percent in 2030, and 84.27 percent in 2035, demonstrating 2.46, 5.03, and 6.32 percentage points higher than those of without damage conditions respectively. Under the Delayed Transition with medium chronic physical risk damage, the LLR is expected to increase by 21.37 percent in 2025, 51.38 percent in 2030, and 82.90 percent in 2035, that is 2.17, 4.23, and 4.94 percentage points up as compared to those of without damage conditions in the respective projection years.

Similarly, for the Current Policies scenario, under high chronic physical risk damage, the LLR may rise by 21.63 percent in 2025, 52.00 percent in 2030, and 83.91 percent in 2035, which indicates 2.43,

4.85, and 5.95 percentage points higher growth than those of without damage condition respectively. Under medium chronic physical risk damage, the values would likely increase by 21.43 percent in 2025, 51.43 percent in 2030, and 82.88 percent in 2035, which is 2.23, 4.29, and 4.92 percentage points up from those of without damage condition respectively.

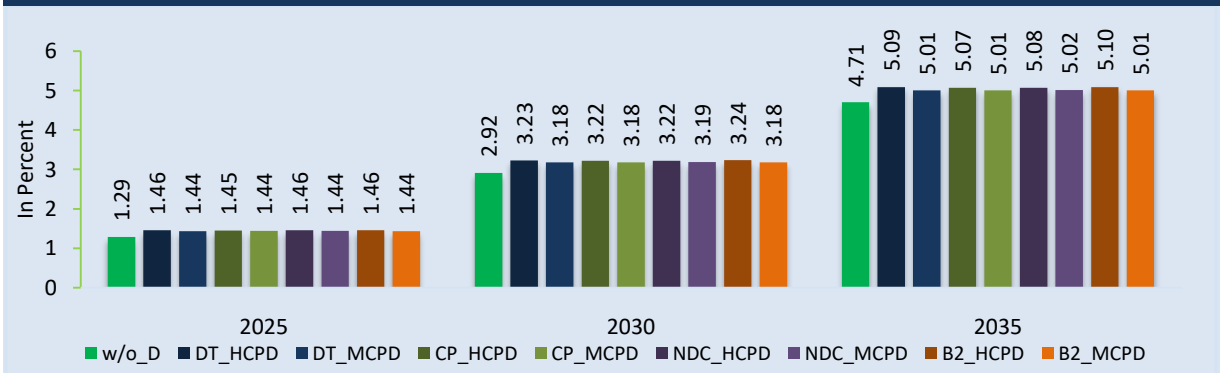
Accordingly, in the Nationally Determined Contributions with high chronic physical risk damage scenario, the LLR is projected to increase by 21.64 percent in 2025, 52.02 percent in 2030, and 83.95 percent in 2035, showing 2.44, 4.88, and 5.99 percentage points higher respectively than the baseline scenario. For medium chronic physical risk damage, the LLR might rise by 21.43 percent in 2025, 51.49 percent in 2030, and 82.99 percent in 2035, which is respectively 2.23, 4.34, and 5.04 percentage points higher than the scenario if no climate damage would occur.

Likewise, under the Below 2°C scenario with high chronic physical risk damage, the LLR is expected to increase by 21.68 percent in 2025, 52.27 percent in 2030, and 84.28 percent in 2035, displaying 2.48, 5.13, and 6.32 percentage points up respectively from the baseline scenario. In the medium chronic physical risk damage scenario, the LLR would likely rise by 21.38 percent in 2025, 51.41 percent in 2030, and 82.86 percent in 2035. These growth rates are 2.18, 4.26, and 4.90 percentage points up from those of without damage condition, respectively.

5.1.4 Climate Scenario Analysis of Bank-4

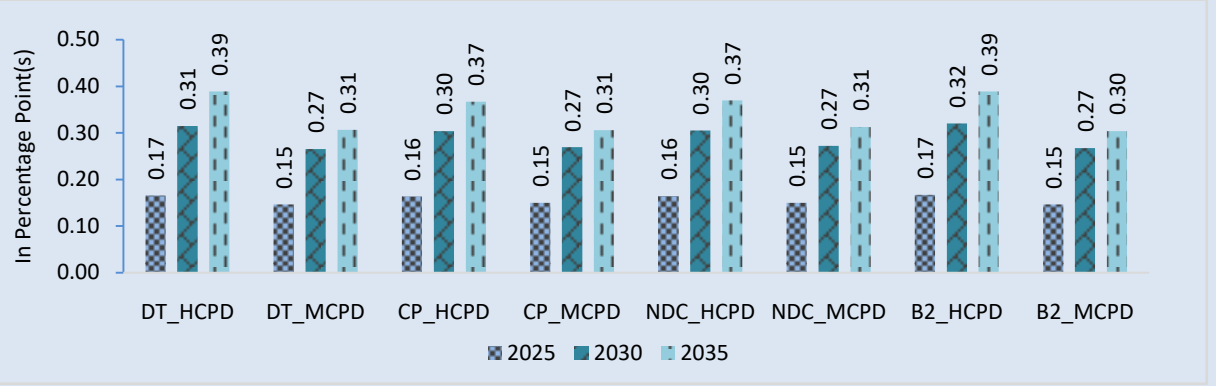
Bank-4 would incur more loss over the projected period as compared to the base period in various climate scenarios. As illustrated in Chart 5.7, the estimated LLRs for Bank-4 under all climate scenarios and conditions are consistently higher than the actual LLR recorded in 2024 for the projected years of 2025, 2030, and 2035. Furthermore, the estimated additional LLRs for Bank-4 due to climate shock follow an upward trend over the projected periods, as illustrated in Chart 5.8.

CHART 5.7: ESTIMATED LLR OF BANK-4 IN VARIOUS CLIMATE SCENARIOS



Source: FSD's calculation, BB.

CHART 5.8: ESTIMATED ADDITIONAL LLR FOR BANK-4 DUE TO CLIMATE SHOCK



Source: FSD's calculation, BB.

For Bank-4, the estimated LLRs under without damage condition are projected to increase by 1.29 percent in 2025, 2.92 percent in 2030, and 4.71 percent in 2035 compared to the LLR in 2024, providing a baseline scenario for estimating the additional loan loss due to various climate scenarios in high or medium chronic physical damage conditions.

In the Delayed Transition with high chronic physical risk damage scenario, the LLR might rise by 1.46 percent in 2025, 3.23 percent in 2030, and 5.09 percent in 2035, showing 0.17, 0.31, and 0.39 percentage point higher growth than those of without damage conditions respectively. Under the Delayed Transition with medium chronic physical risk damage, the LLR is expected to increase by 1.44 percent in 2025, 3.18 percent in 2030, and 5.01 percent in 2035. These growths against the baseline scenario would be 0.15, 0.27, and 0.31 percentage point higher respectively than those of the condition if no chronic physical damage occurs.

Similarly, for the Current Policies scenario, under high chronic physical risk damage, the LLR may rise by 1.45 percent in 2025, 3.22 percent in 2030, and 5.07 percent in 2035, which is respectively 0.16, 0.30, and 0.37 percentage point higher than those of without damage condition. Under medium chronic physical risk damage, the values would likely increase by 1.44 percent in 2025, 3.18 percent in 2030, and 5.01 percent in 2035, which is 0.15, 0.27, and 0.31 percentage point up as compared to without damage conditions in the respective projected years.

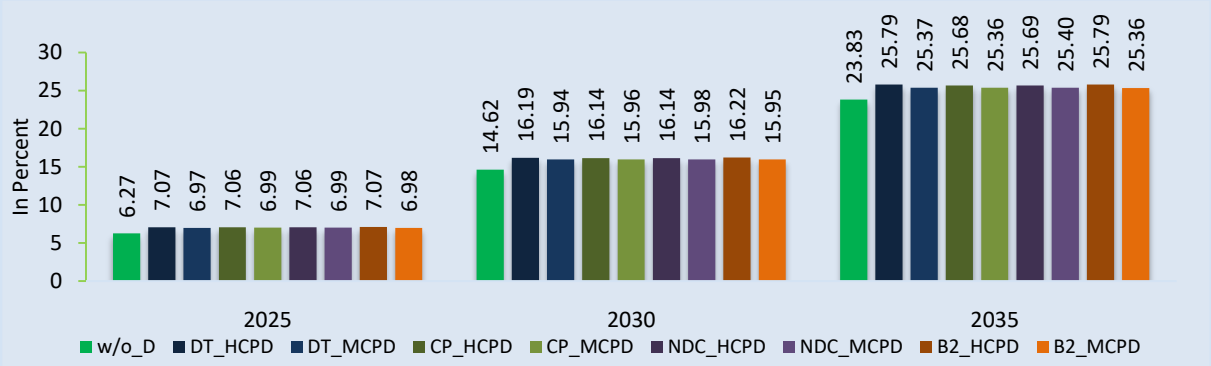
Likewise, in the Nationally Determined Contributions with high chronic physical risk damage scenario, the LLR is projected to increase by 1.46 percent in 2025, 3.22 percent in 2030, and 5.08 percent in 2035, indicating 0.16, 0.30, and 0.37 percentage point higher rise than those of the condition if no chronic physical damage occurs. For medium chronic physical risk damage, the LLR might rise by 1.44 percent in 2025, 3.19 percent in 2030, and 5.02 percent in 2035, which is respectively 0.15, 0.27, and 0.31 percentage point up from those of without damage condition.

Similarly, under the Below 2°C scenario with high chronic physical risk damage, the LLR is expected to increase by 1.46 percent in 2025, 3.24 percent in 2030, and 5.10 percent in 2035, displaying 0.17, 0.32, and 0.39 percentage points up growth respectively from the baseline scenario. In the medium chronic physical risk damage scenario, the LLR would likely rise by 1.44 percent in 2025, 3.18 percent in 2030, and 5.01 percent in 2035, which is 0.15, 0.27, and 0.30 percentage points higher than those of without damage condition respectively.

5.1.5 Climate Scenario Analysis of Bank-5

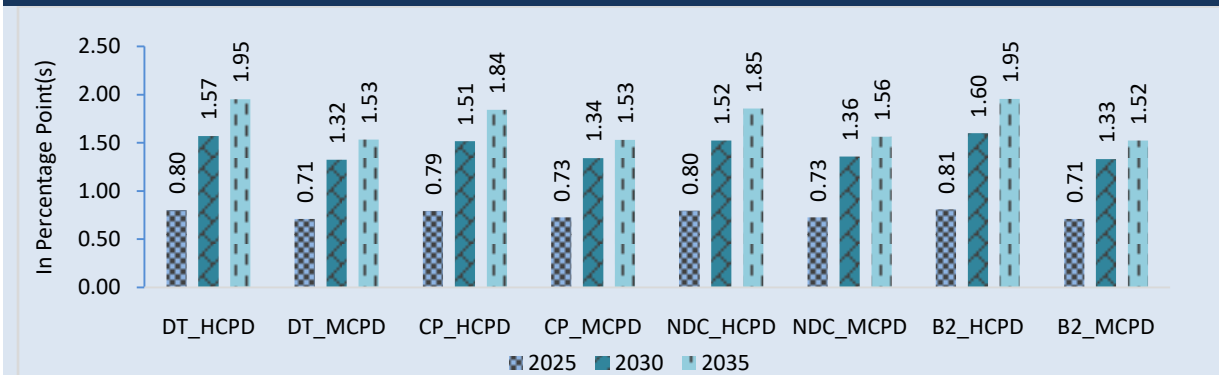
Bank-5 would incur more loss over the projected period as compared to the base period in various climate scenarios. As illustrated in Chart 5.9, the estimated LLRs for Bank-5 under all climate scenarios and conditions are consistently higher than the actual LLR recorded in 2024 for the projected years of 2025, 2030, and 2035. Furthermore, the estimated additional LLRs for Bank-5 due to climate shock follow an upward trend over the projected periods, as illustrated in Chart 5.10.

CHART 5.9: ESTIMATED LLR OF BANK-5 IN VARIOUS CLIMATE SCENARIOS



Source: FSD's calculation, BB.

CHART 5.10: ESTIMATED ADDITIONAL LLR FOR BANK-5 DUE TO CLIMATE SHOCK



Source: FSD's calculation, BB.

For Bank-5, the estimated LLRs under without damage condition are projected to increase by 6.27 percent in 2025, 14.62 percent in 2030, and 23.83 percent in 2035 compared to the LLR in 2024, providing a baseline scenario for estimating the additional loan loss due to various climate scenarios in high or medium chronic physical damage conditions.

In the Delayed Transition scenario, with high chronic physical risk damage, the LLR might rise by 7.07 percent in 2025, 16.19 percent in 2030, and 25.79 percent in 2035, indicating 0.80, 1.57, and 1.95 percentage points higher growth than those of without damage conditions respectively. Under medium chronic physical risk damage, the LLR is expected to increase by 6.97 percent in 2025, 15.94 percent in 2030, and 25.37 percent in 2035, which is 0.71, 1.32, and 1.53 percentage points higher than those of without damage conditions respectively.

Similarly, for the Current Policies scenario, with high chronic physical risk damage, the LLR may rise by 7.06 percent in 2025, 16.14 percent in 2030, and 25.68 percent in 2035, which is respectively 0.79, 1.51, and 1.84 percentage points up from those of without damage condition. Under medium chronic

physical risk damage, the values would likely increase by 6.99 percent in 2025, 15.96 percent in 2030, and 25.36 percent in 2035, which against the baseline scenario would be 0.73, 1.34, and 1.53 percentage points higher in the respective projection period.

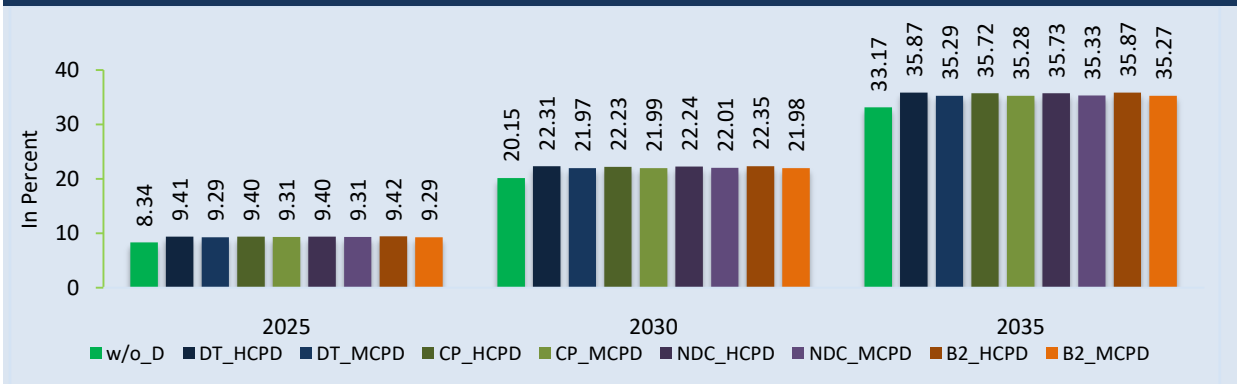
Accordingly, in the Nationally Determined Contributions scenario, with high chronic physical risk damage, the LLR is projected to increase by 7.06 percent in 2025, 16.14 percent in 2030, and 25.69 percent in 2035, which is respectively 0.80, 1.52, and 1.85 percentage points up from those of without damage condition. For medium chronic physical risk damage, the LLR might rise by 6.99 percent in 2025, 15.98 percent in 2030, and 25.40 percent in 2035, showing 0.73, 1.36, and 1.56 percentage points higher growth respectively, from the baseline scenario.

Likewise, under the Below 2°C scenario with high chronic physical risk damage, the LLR is expected to increase by 7.07 percent in 2025, 16.22 percent in 2030, and 25.79 percent in 2035, which is 0.81, 1.60, and 1.95 percentage points up respectively from the baseline scenario. In the medium chronic physical risk damage scenario, the LLR would likely rise by 6.98 percent in 2025, 15.95 percent in 2030, and 25.36 percent in 2035. These growths against the baseline scenario would be 0.71, 1.33, and 1.52 percentage points higher in the respective projection period.

5.1.6 Climate Scenario Analysis for the Overall Banking Sector

Overall banking sector[23] would incur more loss over the projected period as compared to the base period in various climate scenarios. As illustrated in Chart 5.11, the estimated LLRs for the overall banking sector under all the climate scenarios and conditions are consistently higher than the actual LLR recorded in 2024 for the projected years of 2025, 2030, and 2035. Furthermore, the estimated additional LLRs for the overall banking sector due to climate shock follow an upward trend over the projected periods, as illustrated in Chart 5.12.

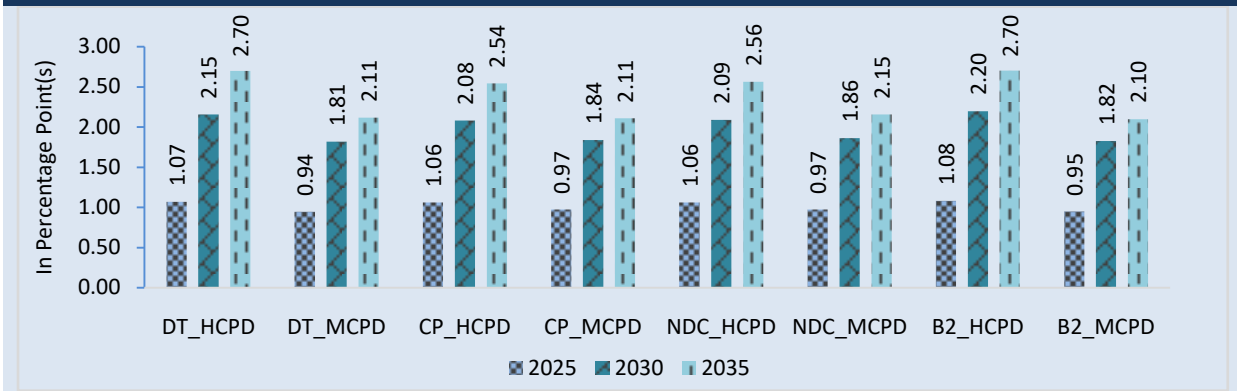
CHART 5.11: ESTIMATED LLR OF THE BANKING SECTOR IN VARIOUS CLIMATE SCENARIOS



Source: FSD's calculation, BB.

[23]aggregates of all sample banks.

CHART 5.12: ESTIMATED ADDITIONAL LLR FOR THE BANKING SECTOR DUE TO CLIMATE SHOCK



Source: FSD's calculation, BB.

For the overall banking sector, the estimated LLRs under without damage condition are projected to increase by 8.34 percent in 2025, 20.15 percent in 2030, and 33.17 percent in 2035 compared to the actual LLR in 2024. This provides a baseline scenario for estimating the additional loan loss due to various climate scenarios in high or medium chronic physical damage conditions.

In the Delayed Transition scenario, with high chronic physical risk damage, the LLR is expected to rise by 9.41 percent in 2025, 22.31 percent in 2030, and 35.87 percent in 2035, indicating 1.07, 2.15, and 2.70 percentage points higher than baseline scenario in the respective projection years. For medium chronic physical risk damage, the values are likely to go up by 9.29 percent in 2025, 21.97 percent in 2030, and 35.29 percent in 2035, which is 0.94, 1.81, and 2.11 percentage points higher than those of without damage conditions, respectively.

Similarly, under the Current Policies scenario, with high chronic physical risk damage, the LLR might increase by 9.40 percent in 2025, 22.23 percent in 2030, and 35.72 percent in 2035, exhibiting 1.06, 2.08 and 2.54 percentage points higher growth than those of without damage condition respectively. In medium chronic physical risk damage, the LLR is projected to rise by 9.31 percent in 2025, 21.99 percent in 2030, and 35.28 percent in 2035, which is 0.97, 1.84, and 2.11 percentage points up as compared to without damage conditions in the respective projection years.

Likewise, for the Nationally Determined Contributions scenario, with high chronic physical risk damage, the LLR is likely to grow to 9.40 percent in 2025, 22.24 percent in 2030, and 35.73 percent in 2035, which is 1.06, to 2.09, and 2.56 percentage points higher respectively from those of without damage condition. With medium chronic physical risk damage, the values are expected to increase by 9.31 percent in 2025, 22.01 percent in 2030, and 35.33 percent in 2035. These growths against the baseline scenario would be 0.97, 1.86, and 2.15 percentage points higher in the respective projection period.

In the Below 2°C scenario, with high chronic physical risk damage, the LLR might increase by 9.42 percent in 2025, 22.35 percent in 2030, and 35.87 percent in 2035 compared to the LLR in 2024, indicating higher growth of 1.08, 2.20, and 2.70 percentage points than those of without damage condition respectively. Under medium chronic physical risk damage, the values may rise by 9.29 percent in 2025, 21.98 percent in 2030, and 35.27 percent in 2035, which is 0.95, 1.82, and 2.10 percentage points higher than those without damage condition respectively.

CHAPTER 6 : DISCUSSION AND RECOMMENDATION

6.1 LLR GROWTH IN "WITHOUT DAMAGE" CONDITION

The projected Loan Loss Reserves (LLR) for the banking sector under the "without damage" condition is expected to grow significantly over the projection years, highlighting the escalating financial risks in the future. This upward trend in LLR suggests a potential strain on the banking sector, irrespective of specific climate change events. Stakeholders should address this issue collaboratively and proactively to prepare for the challenges ahead.

6.2 IMPACT OF CLIMATE SHOCK ON LLR OF THE SAMPLE BANKS

The study results show several crucial findings on the multifaceted impact of hypothetical climate scenarios on the banking sector. The projection reveals the magnitude of risks associated with climate change over the projection years, identifying which scenarios are likely to have the most adverse effects, suitable climate actions, and optimal timing for implementing climate actions.

For all the sample banks, the estimated LLR growth with respect to the LLR of 2024 in high or medium damage conditions under all the considered climate scenarios would be higher than those of the without damage condition for all the projection years. The higher estimated LLRs under various climate scenarios emphasize the need for robust provisioning strategies to effectively manage potential climate-driven impacts for the banking sector.

The impact of physical climate risks on LLR under high chronic physical damage conditions would be comparatively higher than the impact under medium chronic physical damage conditions. Among the climate scenarios, the high-ambition scenario, i.e., the Below 2°C scenario with high chronic physical damage condition, leads to the most significant increases in the loan loss reserve in the long term (2035).

The analysis indicates that the banking sector of Bangladesh would experience increasingly significant impacts from climate-related risks as time progresses for all the considered scenarios. While the increases in LLR are relatively small in the short-term (2025), these effects would become more pronounced in the medium (2030) and long-term (2035). These results underscore the importance of managing long-term risks while preparing for short-term challenges in the financial sector that may arise from the adverse effects of climate change.

The study also finds that under high chronic physical damage conditions, all the sample banks would require to maintain slightly higher LLR in the Nationally Determined Contributions (NDC) scenario compared to the Current Policies scenario during the projection period. However, for the overall banking sector, there would be almost no increase in estimated LLR in 2025, a 0.01 percentage point increase in 2030, and a 0.02 percentage point increase in 2035 for high chronic physical damage conditions. This finding indicates that the banking sector as a whole would not likely to face significantly increased loss due to the adaptation of NDC over Current Policies. Moreover, under high chronic physical damage condition, all the sample banks are exposed to greater loss in the Delayed Transition than the current policies over the projection periods. This finding indicates prompt climate initiatives would be helpful to mitigate probable future loss due to delayed transition.

6.3 SCOPE OF FURTHER STUDY ON THIS CST FRAMEWORK

As the projected horizon gets longer, the rate of increase in estimated LLR in various climate scenarios, in comparison to the without damage condition, eventually slows down, indicating that the initial exposure to climate risk may have a long-lasting impact on the banking sector. However, further study on this topic with a large sample over a longer projection period would be required to

infer any statistical significance in this assumption. Nevertheless, the accumulation of LLR over time indicates increasing credit risk, albeit at a decreasing rate. This does not necessarily imply the banking sector is getting more resilient over time, as further data is required to draw such a conclusion.

6.4 LIMITATIONS OF CST FOR THE BANKING SECTOR OF BANGLADESH

This study adopted a simple yet effective methodology for scenario-based climate stress testing for banks in Bangladesh. However, several limitations made the study even more challenging. Hence, some assumptions were made to keep the study simple. The limitations and assumptions made for the study are mentioned below:

a) The satellite model estimates credit risk associated with macroeconomic variables, with limited historical data; more historical data would have improved the robustness of the study;

b) In the case of climate-related financial risk assessments, data availability is also a critical issue. If banks' exposure data and climate hazard data (country-specific damage function for specific hazards, e.g., flood, drought, river erosion, cyclone, etc.) were available, the study could have identifed hazard-specific risks for banks effectively;

c) Scenario analysis was limited to a handful number of banks. It was assumed that the aggregates of the findings would represent the whole banking sector. A larger sample would better represent the overall banking sector;

d) Climate data is scarce, and financial data is not only scarce but also treated as confidential often. Climate-induced GDP projection data under without damage conditions were annualized based on the key assumption that the GDP growth rate remains constant over the interim periods of 2021 to 2025, 2026 to 2030, and 2031 to 2035. This annualized projected GDP growth rate was then applied to the capital engine for loss estimation. Thus, another key assumption is that the satellite models' coefficients are applicable to the annualized GDP growth rate. Furthermore, bank-specific credit risk data is confidential in nature and not publicly available;

e) This study did not create customized scenarios that are specific to Bangladesh's financial system and climate. Developing and utilizing a scenario that incorporates historical climate events and significant financial sector events in Bangladesh would have enhanced the robustness of the study. The study relied solely on the NGFS data;

f) The NGFS data for the projected periods are not forecasts. Therefore, the loan loss reserves for various banks over the projected periods estimated in this study are not forecasts. Moreover, hazard-specific prediction was not possible with the NGFS climate data that was available for Bangladesh.

g) The lack of historical climate data and the short projection horizon prevented this study from performing statistical tests to determine the significance of the additional LLR required relative to the without damage condition. Although additional LLR growth is present over the projected years for different climate scenarios, it is uncertain whether this increase is statistically significant in the context of comparatively large LLR growth already projected in the without damage condition.

Despite the aforementioned challenges encountered during the analysis, the study successfully developed a forward-looking climate stress testing framework, bridging the gap between financial risk and climate-induced macroeconomic shocks. This framework creates a foundation for future research to assess the stability threats that may emerge from risks associated with climate change.

6.5 KEY INSIGHTS AND IMPLICATIONS

The findings of the conducted climate stress testing underscore a critical need for timely climate action alongside the implementation of robust financial risk management practices. The integration of climate change considerations into strategic planning by all relevant stakeholders is essential. Immediate climate action should be taken, with particular attention given to the longer-term outlook where climate-related risks are projected to become most pronounced. This proactive and concerted approach would reduce the potential adverse impacts of climate change on financial stability.

Financial risks that emerge due to climate change may manifest over a variety of periods, some of which may exceed a bank's conventional capital planning horizon. As evidenced by the trends in LLR growth across various banks in this study, banks require an institution-specific framework for managing climate risk. Banks need to incorporate climate risk considerations into their long-term financial strategies and be prepared to manage the risks attached to chronic physical damages as the projected LLR rises over time.

6.6 RECOMMENDATIONS FOR BANKS

Banks should consider the potential effects of climate-related risk factors when formulating and executing their business strategies. This includes evaluating the resilience of their business models to significant climate-related financial risks across different time frames leveraging climate stress testing. Primarily banks are suggested to adopt the following recommendations along-with related other directives circulated from time to time by Bangladesh Bank:

1. **Integration of Climate-Related Risks into Banks' Strategic Planning**

   Banks should incorporate climate-related risk concerns in both short and long-term strategic planning. This may involve but is not limited to plans for conducting climate stress testing to evaluate how resilient their business models are to climate-related physical and transition risks in various scenarios and projected time frames.

2. **Improving Climate Risk Data and Reporting**

   Banks should strengthen their ability to collect and analyze data related to climate risks. Regular and transparent disclosures on climate-vulnerable exposures, as directed by Bangladesh Bank from time to time, can be accompanied by scenario-based loan loss reserve projections, for the time being.

3. **Development of Climate Risk Management Frameworks**

   Banks should establish comprehensive climate risk management frameworks, preferably considering the findings from at least scenario-based climate stress testing analyses conducted by themselves. In addition to stress testing, strong climate risk governance and developing a climate risk management strategy are necessary, and the framework should include proper management action plans if climate stress testing results indicate significant vulnerabilities.

6.7 SUGGESTIONS FOR SUPERVISORY MEASURES

Based on the findings of this report, some supervisory measures are highlighted accordingly. At this stage, instead of imposing additional capital requirements on banks, Bangladesh Bank could prioritize building awareness within the financial system regarding the risks associated with climate change.

To achieve this, BB could actively support the banks in the following ways:

- **Data Collection:** Assist in collecting relevant climate data.
- **Capacity Building for Banks:** Facilitate the development of a knowledge base for banks on climate risk assessment and climate stress testing methodologies.
- **Continuously collaborate with development partners:** BB could approach international development partners for assistance on capacity building, infrastructure development for climate risk analysis, and technical assistance for a more granular approach to climate stress testing considering the Bangladesh-specific climate context.

6.8 WAY FORWARD

To strengthen resilience of the Bangladesh financial system against climate risks, Bangladesh Bank may take proactive steps to implement a robust methodology for climate risk assessment and adopt an updated climate stress testing framework. Dedicated resources could be allocated to conduct climate stress testing regularly for the entire banking sector, ensuring a systematic and data-driven approach to identifying vulnerabilities. Moreover, as the financial regulator, BB could establish stringent climate risk analysis guidelines for banks, encompassing methodology, risk management, reporting, and disclosure frameworks.

Effective climate risk assessment requires both inter-agency and intra-agency collaboration to enhance data collection, integrate expert insights, and maintain analytical consistency. Such collaboration is essential for ensuring the credibility and comparability of climate risk assessments across the banking sector.

Bangladesh Bank has already received technical assistance from the International Monetary Fund (IMF) to enhance its capacity to evaluate climate-related risks, particularly given Bangladesh's vulnerability to climate disasters such as riverine flooding. Moving forward, Bangladesh Bank may refine its climate stress testing methodology by incorporating advanced hazard projections, damage estimation models, and exposure assessments. To mitigate the shortcomings of scenario-based climate stress testing portrayed in this report, in the future, more refined scenarios and more robust credit satellite models can be considered to estimate credit risk based on a flood shock scenario. These enhancements would largely address existing limitations in the current climate stress testing framework and strengthen the financial sector's preparedness for climate-induced risks.

Bangladesh Bank could also take initiatives to conduct climate risk analysis for Finance Companies of the financial system in the long-term. Such initiatives would improve the assessment of climate risk for the overall financial system.

CHAPTER 7 : CONCLUSION

This report anticipates how climate risks may adversely affect the banking sector of Bangladesh by conducting scenario-based climate stress testing. The adopted approach is simple yet robust enough to provide valuable insights into the long-term impact of climate risk actions on the banks that traditional stress tests may overlook. The analysis discloses that the banks in Bangladesh are likely to incur more losses in the long run if climate initiatives are not taken into account in time. The findings also indicate that, even over the long-term, there would be nearly no significant impediments in banks' performance if Bangladesh adopts Nationally Determined Contributions instead of its Current Policies.

Bangladesh Bank incorporated the aspects of climate change into the stress testing model for the banks as per the Stress Testing Guidelines, 2024[24]. A reporting template has already been provided to the banks. The Climate Vulnerability Index (CVI)[25] is used to estimate climate-vulnerable assets for that purpose. Banks are instructed to report the findings to BB regularly as a regulatory requirement. Given the current stage of climate risk management in Bangladesh's financial sector, BB could primarily focus on building awareness regarding the adverse impact of climate events and actions on the financial system rather than imposing additional capital requirements based on this climate stress testing result displayed in this report at this stage.

The banks can be benefited from this report if they plan to implement the scenario-based climate stress testing framework. More specifically, the methodology adopted in this study would play an instrumental role in developing climate stress testing models using a macro-approach for banks' internal use.

This study is the very first attempt of BB to conduct scenario-based climate stress testing for banks of Bangladesh, making the foundation of further research on this topic. The study also attempts to provide some recommendations for the banks as well as for supervisory authorities.

While the conducted climate stress testing results provide valuable insights into the potential impacts of climate-related risks on the banking sector, there is scope for further improvement. Thus, keeping the limitations of this study in account, it is necessary to apply qualitative judgment also to assess the climate change-induced financial risk in the context of Bangladesh.

Bangladesh Bank may introduce a more robust climate stress testing framework by integrating advanced hazard projections, damage estimation models, and exposure assessments. Notably, Bangladesh Bank has already benefited from technical assistance provided by IMF in this regard. To address the limitations identified in the current scenario-based climate stress testing approach, future efforts need to focus on developing more sophisticated scenario based models and credit satellite models. These refinements will enable more precise credit risk estimation under hazard-specific scenarios, which would strengthen the resilience of the banking sector against climate-related financial risks.

[24]https://www.bb.org.bd/mediaroom/circulars/fsd/dec302024fsd01e.pdf (Accessed on 05 January 2025)
[25]https://www.undp.org/sites/g/files/zskgke326/files/2023-03/Climate%20Vulnerability%20Index%20Book.pdf (Accessed on 25 December 2024)

ANNEXURES

ANNEXURE I: VARIABLES USED AND DATA SOURCES FOR SATELLITE MODELS FOR CST

Sl. No.	Variable	Details	Data source	Web Address/Specific source
1	bankid	Bank identification number	-	-
2	period	Period	-	-
3	nplir	NPLIR	BRPD-2, task force section, BB	-
4	gdp	GDP growth rate in Constant Price (Real) (Point to Point) (Q1/2022 to Q1/2023)	BBS website	https://bbs.gov.bd/site/page/b588b454-0f88-4679-bf20-90e06dc1d10b/; As cited in Monthly Economic Trends, Table IXC, published by the Statistics Department of BB; available at website: https://www.bb.org.bd/en/index.php/publication/publictn/3/10
5	inf	Gen_Inflation_12MAv	BB Quarterly[26]	Table II.1: Trend in Inflation
6	fxr	Foreign exchange rate Movements, (USD period average)	BB Quarterly	Table V. 8: Exchange Rate Movements
8	lty	Long-term_Yield_2yr_Bonds	BB Quarterly	Table III.3: Interest Rates Developments
9	lr	Lending rate (All Banks)	BB Quarterly	Table III.3: Interest Rates Developments OR https://www.bb.org.bd/en/index.php/econdata/intrate

[26]Different issues of BB quarterly is available in https://www.bb.org.bd/en/index.php/publication/publictn/2/7 (Accessed on 21 December 2024)

ANNEXURE II: EXPLANATION OF NGFS SCENARIOS

Broad Climate Scenario Category	Scenario Drivers
Orderly Transition Scenarios	These scenarios assume that climate policies would be taken early and would become stricter over time. It would maintain the physical and transition risk in limit.
Net Zero 2050	Assumes strict climate policies and innovations that limit global warming to 1.5°C and by 2050, the global net-zero CO_2 emissions would be achieved.
Below 2°C	Assumes gradual increase in the intensity of climate policies giving a 67 percent chance of limiting global warming to below 2°C.
Low Demand	This scenario presumes substantial shifts in behavior toward reduced energy consumption, alongside (shadow) carbon pricing and technological solutions. Thus global net-zero CO_2 emissions would be achieved by roughly 2050 with easing pressure on the economic system.
Disorderly Transition Scenarios	These scenarios focus on higher transition risks arising from delays in implementing climate policies or inconsistent policies across different countries and sectors.
Delayed Transition	Assumes that annual emissions will not decrease before the year 2030, necessitating forceful policies to ensure global warming remains below 2°C, while negative emissions are limited.
Hot House World Scenarios	These scenarios depict situations where some climate policies are implemented in certain areas, but overall global efforts are insufficient to prevent substantial global warming. This may lead to severe physical risks, including irreversible effects such as rising sea levels.
Nationally Determined Contributions (NDCs)	All climate targets that countries have pledged, even if these targets are not currently supported by fully implemented effective policies.
Current Policies	Only currently implemented policies are preserved, leading to high physical risks.
Too-Little-Too-Late Scenarios	These scenarios assume that the implications of a late and poorly coordinated transition would not effectively contain the physical risks.
Fragmented World	Assumes a delayed and divergent climate policy response among countries globally, leading to high physical and transition risks. Countries with net zero targets achieve them only partially (80% of the target), while the other countries follow Current Policies.

Source: NGFS's Scenarios for central banks and supervisors (November 2023). https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_phase_iv.pdf (Accessed on 24 December 2024), The concept is compiled by FSD, BB.

ANNEXURE III: NGFS DATA FOR BANGLADESH

Table 1

Scenario	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
DT_WD	453.94					663.38				
CP_WD	453.94					663.38				
NDC_WD	453.94					663.38				
NZ_WD	453.94					663.38				
B2_WD	453.94					663.38				
DT_HCPD	453.94	491.42	532.36	574.67	615.85	653.89	687.48	716.45	741.27	763.65
DT_MCPD	453.94	492.27	534.27	577.78	620.50	660.25	695.34	726.15	753.29	777.65
CP_HCPD	453.94	491.86	533.16	575.41	616.76	655.19	689.04	718.21	743.61	766.56
CP_MCPD	453.94	492.41	534.54	577.95	620.41	659.94	694.82	725.51	752.68	777.04
NDC_HCPD	453.94	491.84	533.13	575.36	616.67	655.04	688.83	717.94	743.31	766.19
NDC_MCPD	453.94	492.23	534.19	577.56	619.99	659.36	694.11	724.50	751.27	775.45
NZ_HCPD	453.94	491.35	532.17	574.32	615.34	653.21	686.39	714.90	739.50	761.37
NZ_MCPD	453.94	492.24	534.20	577.66	620.33	659.99	695.03	725.80	752.83	777.07
B2_HCPD	453.94	491.37	532.22	574.40	615.46	653.39	686.67	715.23	739.93	762.00
B2_MCPD	453.94	492.24	534.22	577.67	620.36	660.06	695.10	725.88	752.95	777.23

Table 2

Scenario	2030	2031	2032	2033	2034	2035
DT_WD	806.77					919.40
CP_WD	806.77					919.40
NDC_WD	806.77					919.40
NZ_WD	806.77					919.40
B2_WD	806.77					919.40
DT_HCPD	784.59	804.75	824.03	842.66	861.07	879.82
DT_MCPD	800.31	821.89	842.99	864.01	885.08	906.50
CP_HCPD	787.55	807.34	826.65	846.00	865.17	884.50
CP_MCPD	799.90	822.02	843.52	864.62	886.00	907.78
NDC_HCPD	787.12	806.87	826.11	845.36	864.45	883.65
NDC_MCPD	798.06	819.99	841.38	862.44	883.49	904.98
NZ_HCPD	781.92	802.28	821.83	840.80	859.81	879.41
NZ_MCPD	799.71	821.37	842.65	863.90	885.32	907.06
B2_HCPD	782.60	802.87	822.65	841.62	860.30	879.64
B2_MCPD	799.86	821.49	842.74	863.94	885.25	906.89

Note For Both Tables 1 and 2:

Model	Downscaling [GCAM 6.0 NGFS]
Scenario	Delayed transition
Region	BGD
Variable	GDP|PPP|Counterfactual without damage; High chronic physical risk damage estimate; Medium chronic physical risk damage estimate
Unit	billion US$2010/yr

Sources:

https://www.ngfs.net/ngfs-scenarios-portal/data-resources-phase-4
https://www.ngfs.net/en/ngfs-climate-scenarios-phase-iv-november-2023
https://data.ene.iiasa.ac.at/ngfs
https://www.ngfs.net/sites/default/files/media/2023/11/07/ngfs_user_guide_for_ngfs_scenarios_data_access.pdf
(All the sources are available as of 04 December 2024)

-The End-