

MITIGATING CLIMATE CHANGE THROUGH GREEN FINANCE IN GREEN
BUILDINGS – A COMPARATIVE STUDY ON THE EUROPEAN UNION, INDIA
AND CAMBODIA

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Sailesh Patnaik. B Arch & PGPCM

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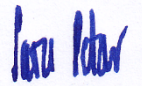
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APPROVED BY



Prof.dr.sc. Saša Petar, Ph.D., Dissertation chair

RECEIVED/APPROVED BY:



Admissions Director

Dedication

This thesis is dedicated with most profound love and gratitude to my mother, Late Dr Snigdha Mohapatra—a distinguished poet and scholar of the Odia language and the most enduring, guiding presence in my life.

Her wisdom, strength, and boundless love continue to inspire every step of my journey. This thesis is a tribute to your enduring legacy, built not only through your academic accomplishments but also through your boundless compassion, wisdom, and quiet resilience. As a scholar, you dedicated your life to preserving and celebrating the richness of the Odia language, nurturing in your students and in me a love for words, meaning, and identity. As a mother, you offered unwavering support, gentle guidance, and an unshakable belief in my potential, even in moments when I doubted myself.

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I have so often longed for you to be here to witness this moment, to see this dream come to life, and to hear me whisper through tears and pride, “I did it, Maa.” But even in your absence, you are with me in every heartbeat of courage, in every silent strength I've drawn, in every word I write.

This achievement is more yours than it is mine. I dedicate it to you not only in memory, but in reverence for the quiet sacrifices you have always made, the depth of your love, and the soul-deep wisdom you left behind. Your presence still guides me, quietly, gently — a constant light even from afar. I carry you with me in all that I do, and I shall always will. May this work, in its own small way, honour your memory, reflect your life's passion, and offer a tribute to the quiet strength and love you gave so freely to everyone who knew you. I hope I made you proud today, Maa!

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To each one of you — Thank you for being an integral part of this milestone.

ABSTRACT

MITIGATING CLIMATE CHANGE THROUGH GREEN FINANCE IN GREEN BUILDINGS – A COMPARATIVE STUDY ON THE EUROPEAN UNION, INDIA AND CAMBODIA

Sailesh Patnaik
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The current climate scenario has created an alarming situation around the world. Climate change has been building an inhabitable environment, affecting everyone physically and economically. The unpredictable nature of the climate scenario has been affecting many businesses. The earth's temperature has been increasing gradually because of greenhouse gases. To control the earth's temperature, every sector has to reduce its emission levels responsibly. To achieve this target, the Paris Agreement was formulated in 2015.

Among all sectors contributing to GHG emissions, the construction sector alone contributes 37% of the total GHG emissions globally (UNEP Global Status Report on Building and Construction 2022). The development of green buildings and retrofits, as well as switching from traditional construction methods to green and energy-efficient construction technologies, can help reduce GHG emissions significantly. Green finance has the potential to act as a strong driving force in the development of green buildings.

This dissertation investigates the role of green finance mechanisms in promoting sustainable building practices, focusing on identifying deficiencies, analysing practical implications, uncovering barriers and enablers, and evaluating the effectiveness of these financial tools in the construction industry. The study compares three regions—the European Union (EU), India, and Cambodia—each representing different levels of institutional, economic, and regulatory maturity in green finance adoption. A quantitative research approach was used, with data collected through surveys from stakeholders in green finance, including financial institutions, construction firms, developers, and policymakers.

The findings reveal significant gaps in awareness, clarity, and effectiveness of current green finance mechanisms in the construction sector. A majority of respondents expressed dissatisfaction with the existing financial tools, highlighting a disconnect between the available mechanisms and the industry's specific needs. Key barriers identified include regulatory complexities, high upfront costs, long payback periods, and perceptions of green finance as high-risk. However, the study also identifies key catalysts, such as government incentives, subsidies, and stakeholder collaboration, that could improve the adoption and implementation of green finance tools.

The research further explores the practical implications of green finance, showing that while these mechanisms offer both environmental and economic benefits, inadequate support and guidance hinder their practical application. The study also emphasises the need for a tailored green finance framework to address the shortcomings of existing mechanisms and align financial instruments with global and local sustainability goals.

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CHAPTER I: INTRODUCTION

1.1 Background and Global Climate Imperative

1.1.1 Rising Global Temperatures and Climate Risks

The Earth's climate system has undergone an unprecedented transformation over the past 50 years, primarily due to the emission of greenhouse gases (GHGs) into the atmosphere. These emissions—mostly anthropogenic—are caused by human activities such as industrial processes, fossil fuel combustion, deforestation, and land-use changes. In line with these predictions, the Intergovernmental Panel on Climate Change's Sixth Assessment Report concludes, with high confidence, that human influence has been the primary cause of observed global warming since the mid-twentieth century (Mansour and Chenguel, 2023). As a result, the global average surface temperature has increased by approximately 0.89°C compared to the pre-industrial baseline of 1880–1900. However, this warming is not uniform across all regions; some areas, such as the Arctic, are experiencing temperatures rising at nearly three times the global average. This unequal warming leads to a rapid loss of ice cover, permafrost thaw, and rising sea levels. The World Meteorological Organisation (WMO) warns that without more urgent mitigation efforts, global temperatures could temporarily exceed 1.5°C above pre-industrial levels as soon as the early 2030s. The rising nature of temperature is directly related to an increase in the frequency, intensity and duration of extreme abnormalities of the weather everywhere in the world. For example:

Wildfires closer to home in Southern Europe, California and Australia have covered millions of hectares of forests and caused respiratory health crises.

Flooding incidences like the ones in Pakistan in 2022 and Germany in 2021 have reached millions of people and claimed billions in economic loss.

The heatwaves are stronger and longer than before and the latest cases in India, the Middle East, and Europe have seen both high rates of deaths and high temperatures.

The loss of biodiversity is accelerating, brought on by deforestation, ocean acidification and the shifting of ecological boundaries meaning they are threatening ecosystems and food supplies.

In addition, the economic impacts of global warming are becoming increasingly apparent. The insurance industry has seen a rise in claims related to weather-driven calamities, resulting in a greater need for reinsurance and shifts in capital allocation. The latest IPCC synthesis report shows that with an increase of each unit of global temperature, risks to ecosystems, human health, infrastructure, and livelihoods also rise. In urban areas, this leads to higher energy consumption for cooling, reduced productivity due to heat, and increased vulnerabilities within existing infrastructure. Notably, the built environment—which includes residential, commercial, and industrial buildings as well as other structures—plays a dual role as both a major source of pollution and a key opportunity for low-carbon transformation. Acting on climate issues is no longer a matter of debate but a scientific imperative with significant socio-economic consequences. This section outlines why decarbonising the building industry, supported by green finance, is not only a prudent

choice but a necessity to limit global warming, strengthen resilience, and meet the Paris Agreement targets.

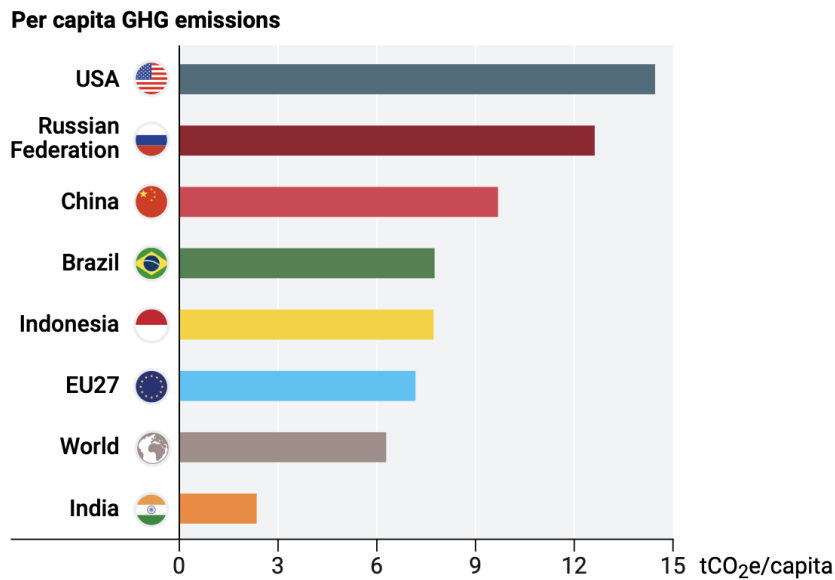
1.1.2 The Paris Agreement and Financial Mobilisation

To combat global warming and climate change, 196 countries convened at the UN climate change conference in Paris, France, on December 12, 2015. The "Paris Agreement" represents the first legally binding international treaty on climate change under the UNFCCC. According to Article 2.1. (a) of the Paris Agreement, the primary goal of this agreement is “Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change”. Further according to Article 9.3 of the Paris Agreement, to achieve these targets, the agreement further states that “As part of a Global effort, developed country Parties should continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies and taking into account the needs and priorities of developing country Parties. Such mobilization of climate finance should represent a progression beyond previous efforts”.

According to the (UNEP's emission gap report 2022), there are significant differences in per capita emissions among countries (refer to Figure 0). The average global per capita greenhouse gas (GHG) emissions, including land use, land-use change, and forestry

(LULUCF), were 6.3 tons of CO₂ equivalent (tCO₂e). On average, the least developed countries emit 2.3 tCO₂e per capita annually.

Figure - 0



Source: UNEP emission gap report, 2022

The document also indicates that as part of the Paris Agreement's five-year cycle to increase ambition, countries were asked to present new or revised NDCs in time for COP 26. The Glasgow Climate Pact, which was adopted in 2021 at COP 26, additionally urged countries to review and enhance their 2030 mitigation goals to correspond with the temperature objective of the Paris Agreement. By September 2022, 166 parties, representing approximately 91% of global GHG emissions, had submitted new or updated NDCs (UNEP emissions gap report, 2022)

According to the definition of the Standing Committee on Finance of the UNFCCC (2021), climate finance is local, national, or transnational financing resources of public, private, and alternative nature, which are aimed at financing mitigation and adaptation measures to address climate change. The wide definitional scope leaves room for the embracing of not only concessional finance, covered by e.g. grants or soft loans provided through development banks, but also market-based finance via, e.g., green bonds, blended finance or carbon funds: green building financial support. From 2015, there has been an increase in global climate financing. However, the scale is still not sufficient to reach the estimated capital deployment of at least 4.5-5 trillion dollars annually until 2030 as needed to address the aims of the climate agenda.

The Paris Agreement has been incorporated into the European Climate Law of the European Union (EU), which sets a legal target for achieving net-zero emissions by 2050 (Bruhl, 2022). EU-funded financial instruments such as Next Generation EU, Invest EU, and the EU Green Bond Standard align fully with the EU's commitments under the Paris Agreement. Although India is not legally required to decarbonize, it has voluntarily committed to achieving net-zero emissions by 2070, a goal supported by green finance and reflected in India's Long-Term Low Emissions Development Strategy (LT-LEDS). Cambodia, classified as a Least Developed Country (LDC), underscores the importance of Article 9 financing within the Paris Agreement, which calls for developed countries to mobilize financial resources to assist developing nations, especially those most vulnerable to climate change. Article 9 specifically obliges developed countries to contribute \$100 billion annually to support mitigation and adaptation efforts in developing countries. In the

new NDCs, there are also conditions regarding international finance building-sector adaptation goals, in the form of the structure of the Paris Agreement.

In addition, Article 2.1(c) of the Paris Agreement is a paradigm shift in financial alignment and countries are being asked to align their finance flows towards a pathway of low greenhouse gas emissions and climate-resilient development. This provision includes climate finance not only in the form of aid but also in a wide-ranging definition that includes mainstream investment realignment, corporate reporting, sustainable banking standards, and green capital markets.

By this token, the Paris Agreement doesn't purely set international ground temperature goals, but additionally establishes a financial governance agenda for the green transition, where the mobilisation and the channelling and customisation of finance are becoming a fundamental facilitator.

1.2 Emissions from the Building Sector

1.2.1 Sectoral Contribution to Global Emissions

The four key sectors contributing most to global CO₂ emissions are electricity supply, industry, transportation, and buildings. According to the UNEP Global Status Report on Building and Construction 2022 and Debrah et al. (2021), buildings accounted for approximately 37% of global CO₂ emissions in 2021. It further highlights that the building and construction sector is one of the world's most significant sources of energy-related CO₂ emissions. These emissions are categorised into two primary types:

operational emissions and embodied emissions. This statistic underscores the critical need to prioritise the sector in global decarbonization efforts.

Operational Emissions

Operational emissions can be defined as the emissions of greenhouse gases associated with the utilisation of buildings, mainly due to heating and cooling systems, ventilation systems, lighting, water heating, and the operation of appliances located within the buildings. The International Energy Agency (IEA, 2022) estimated that operational energy used in buildings accounts for 26 per cent of energy-related emissions of CO₂. 26 % of the emissions were due to the energy efficiency of electricity, which was based on the use of fossil fuels and energy efficiency of the building systems. These emissions are not equal across regions. Operational emissions in the European Union are continuously falling thanks to restrictive energy-efficiency laws and the increased use of renewable energy sources. Urbanisation and rising demand for cooling are increasing electricity consumption in urban buildings across the residential and commercial sectors in India. In Cambodia, the per capita operational energy mix is relatively low but rapidly increasing, driven by growing demand for electrification and air conditioning. The environmental impact of the expected growth in floor space, predicted to double by 2060 (Global status report of buildings and construction, 2020), will worsen emissions if energy performance is not improved in time. Otherwise, there is a risk that the building sector will lock into high-carbon emissions and provide pathways of action over decades, mainly in developing and least developed economies, where new building construction prevails.

Embodied Emissions

Upfront carbon or embodied emissions are associated with how building materials are extracted, manufactured, transported, installed, maintained, and disposed. The main contributors are cement, steel, aluminium and glass, as well as insulation materials, many of which are energy and carbon-intensive. The emission of cement production is about 7-8 per cent of total global CO₂ emissions (IEA, 2023); a large part of this portion can be explained as a result of the calcination process, but also the use of high-temperature kilns. Embodied emissions are highly relevant to a new construction project, potentially accounting for close to 50% of the total life-cycle emissions in a given construction. These emissions are not included in the national accounting regime and are not subjected to any control in the developing world, most of the time. The lack of standard procedures for measuring and reporting on embodied carbon compounds does add to the problem.

Indirect And Life Cycle Emissions

Apart from the operational and embodied carbon emissions, the building industry produces indirect emissions throughout the construction life cycle. These include emissions related to water use, waste, and refrigerant emissions (particularly those with a high Global Warming Potential, such as hydrofluorocarbons), as well as the value chain of the entire services that support new building/retrofit operations. There is a shortage of complete life-cycle carbon accounting (LCCA), with little organisation across the processes of design, construction and operations.

Energy Intensity and Carbon Lock-In

Buildings are durable. The poor quality building design and construction may lock in high-emitting products for decades, or a century, as scholars call it, and it is called carbon lock-in. This is especially inappropriate for developing and emerging economies such as India and Cambodia, where most construction is urbanised, and capital constraints to investments in effective materials or systems limit the development of the built environment. The production analysis by the World Resources Institute (WRI) and IEA found that retrofitting buildings is 2-3 times more expensive than low-carbon building design in the initial years of construction. This creates an economic and climate need to act swiftly, especially in urbanising countries.

The concentration or the increasing volume of building-related emissions and their rapid growth, as well as the long life span of buildings, make it the centre of focus of any proper climate action agenda. However, there is a discrepancy between the value of working in the building industry over other mitigation activities and the amount of climate finance allocated to it.

1.2.2 The Role of Green Buildings

Green buildings represent a paradigm shift toward solving climate, environmental, and resource problems in the built environment. Green buildings are designed to incorporate sustainable building, construction and operating procedures over the life cycle of the asset to minimise its environmental impact and maximise the social and economic returns, according to the definition provided by the World Green Building Council (WGBC), a green building is defined as a building that is one which in its design,

construction or operation minimises or eliminates negative impacts and may produce positive ones on our climate and natural environment.

Green buildings have significant reductions in energy and water use, GHG emissions, and waste production. As an example, green-certified buildings (e.g. LEED, BREEAM, IGBC) are often expected to:

- Use 25-50 per cent less energy than standard counterparts (USGBC, 2021)
- Conserve up to 40 per cent less water with low-flow fixtures, greywater recycling, and drought-tolerant landscaping.
- Demonstrate improved indoor air quality (IAQ) by material selection, ventilation and filtration, with a direct health and productivity impact on occupants.
- Stimulate resource efficiency through measures such as the use of low-carbon and recycled building materials, with Life Cycle Assessment (LCA) tools applied at the design stage.

Additionally, green buildings have lower operational expenditure (OPEX) over their lifetimes, which aligns with long-term assets such as pension funds, real estate investment trusts (REITs), and institutional investments.

Green buildings are also part of national and global climate action plans. The IEA (2023) reported that upgrades in the building sector and improvements in energy efficiency may play a significant role, accounting for nearly 20% of the total emission mitigation needed by 2030 on a Net-Zero basis. Green buildings are a useful lever for decarbonization

due to their integrated characteristics, such as passive cooling, on-roof solar, high-efficiency appliances, and building automation systems (BAS).

In India, 70% of buildings required by 2030 have not yet been constructed, and there is significant potential to incorporate green building strategies at the pre-construction stage.

In the EU, given the 'renewal wave', retrofitting of the existing stock accounts for the most significant part of emissions reductions, with a 55% reduction in total emissions by 2030.

In Cambodia, NDC has included sustainable buildings as one of the priority mitigation sectors under the conditions of international finance and capacity building.

Green buildings not only minimise climate change, but they also result in greater social, economic and population well-being. Better indoor air quality, contributed to by the use of nontoxic materials and an adequate ventilation system, would lead to fewer people becoming ill, less absenteeism, and lower healthcare costs. The aspects of daylighting, glare, and acoustic optimisation help improve the occupants' comfort, satisfaction, and productivity, particularly in commercial buildings and learning institutions. Furthermore, the resiliency of an urban area is enhanced with the help of green infrastructure, through stormwater control using permeable materials, passive design (providing heat wave thermal comfort), and structural integrity against seismic risks (in seismic-prone areas). Developmentally, the green building value chain is viewed as fostering a more inclusive form of economic development by generating green employment opportunities in

sustainable architecture and green engineering, including architecture, civil and environmental engineering, energy auditing, materials innovation, and building performance evaluation.

As impressive as these (multi-dimensional) benefits are, the actual adoption of green buildings worldwide remains modest. By 2022, fewer than one in five new building projects worldwide had been certified under recognised and reputable Green rating systems, with even fewer in least-developed countries (LDCs) and those on the informal or peri-urban outskirts. There are several mutually tethered obstacles to mainstreaming. To begin with, there are real financial risks: Developers tend to believe that green buildings imply 5-10% increases in initial costs, which, in a market where the cost of capital is not readily available, is a turn-off. Secondly, among such impediments, the lack of green finance tools specifically relevant to the building sector. There are no specific green home loans, concessional finance windows, or performance-linked mortgages, which severely limit the bankability of green construction (particularly for small-scale/first-time developers). Third, there is still a lack of integration between the policy and regulatory programmes; green building codes are not mandatory in most countries, are poorly applied in those that do have them, or are only weakly integrated into national climate strategies. Lastly, but not least, there is a second-hand gap in awareness and technical ability amongst the major stakeholder groups, including developers, architects, municipal authorities and financiers, who end up underestimating the long-term financial and non-financial returns of green buildings.

Such difficulties are even more profound in developing economies such as Cambodia, where institutional support for sustainable building is still in its early stages, and where the story of urbanisation is essentially one of informal housing. In India, although there is a growing effort in the green building sector in the high-end commercial segment, a huge backlog is still there in the residential and affordable housing sector, which is caused primarily by the limited access to credit options, illiteracy among the consumers, and the reluctance of the developers to adopt green building systems. These forces illustrate the importance of both demand and supply side approaches through financial innovation and the need to align the actions of the private and public sectors.

The diffusion of green building is therefore not only about policy requirements or technological solutions, but far more about the availability of enabling funds or mechanisms that complement the economics of a building asset's sustainable life. They include green mortgages and home loans to lure buyers, sustainable-linked funds, real estate finance, and green construction bonds to bring institutional investors and credit-affirmative actions to assuage the perceived risks to the lenders. In most emerging and frontier markets, though, such instruments are either underdeveloped, do not meet industry needs, or are not available to industry players. It is hence the kernel of the research question: how green finance can be structured, personalised, and scaled to accelerate the uptake of green buildings. The comparative prospect of the European Union, India, and Cambodia study, in determining the findings and trajectories of policies to be contextualised in light of the stipulation of Paris Agreement Article 2.1(c), and in linking financial flows to ensure the sustenance of construction works.

1.3 Introduction to Green Finance

Green finance, as a conceptual and policy area, is an innovation that has emerged at the nexus of financial-sector innovation and environmental sustainability. It is a loose definition of financial flows (including debt, equity, insurance instruments, guarantees, grants, and even blended capital) channelled to projects and activities that result in positive environmental outcomes. These are, but not limited to, climate change mitigation, adaptation, biodiversity conservation, pollution reduction, sustainable land and water utilization, and energy transition. Green finance is not just applied to public capital; green finance is also defined by the United Nations Environment Programme (UNEP progress report, 2017) as a type of finance that funds investments with environmental benefits in the broader context of environmentally sustainable development. This statement makes green finance not an instrumental aspect of sustainable economic growth but a marginal one. It is clear that the financial systems, comprising banking, capital markets, insurance and public finance, need to transform to incorporate the risks and opportunities that exist in the environment in their decision-making processes, asset valuation and capital deployment.

Unlike conventional finance, green finance has the traits of intentionality and conditionality as well: the desire to have an environmental impact must be expressed purposefully and frequently verified or certified. This is what makes green finance different from more inclusive sustainable finance, which includes investments related to social and governance issues. In the context of climate change issues, green finance may be confused with climate finance, which has the particular objective of mitigation and adaptation

projects. However, green finance has a broader environmental impact and encompasses sustainable practices, such as water efficiency, biodiversity protection, and circular economic processes. The theoretical underpinnings of green finance saw a significant change in the early 2000s. It was initially the instrument in niches like green bonds, but has since diversified into a wide range of instruments, including, but not limited to, green mortgages, green credit lines, green securitisation, and even green insurance products. Moreover, green finance has become an integral part of credit analysis, due diligence, and portfolio structuring, as environmental, social, and governance (ESG) risk considerations have been mainstreamed into lending. The Network for Greening the Financial System (NGFS) has also seen regulatory authorities and central banks adopt green finance as a tool to manage climate-related financial risks and maintain macroeconomic stability.

Green finance is backed by governance frameworks as well as taxonomies with respect to eligible activities, such as the EU Taxonomy for Sustainable Activities, Climate Bonds Initiative (CBI) criteria, national green finance guidelines (Reserve Bank of India and Constan Mug and the Cambodian Ministry of Environment, to name but a few), and still emerging regulatory and voluntary frameworks trying to generate compatibility in terminology, transparency and trust for investors by (Bullier and Millin, 2013).

For the research, green finance is both a lever and a lens: a lever for scaling up the transition of the building sector to low-carbon pathways, and a lens for assessing policy readiness, institutional voids, and financial innovation. As the world economy shifts to sustainable infrastructure and obligations, green finance will cease to be a sidelight to the

principal economies, but rather a strategic imperative by governments, financial backers and property designers.

1.3.1 Components and Instruments

Green finance includes financial systems, instruments and actors in various sectors of finance such as retail finance, corporate and investment finance, asset management and insurance. Each of these elements has an essential function in orienting capital toward specific directions and environmentally beneficial outcomes, pursuant to different rules, incentive structures, and regulations. The diversity of instruments reflects the increasing complexity of the associated climate and environmental challenges, as well as the requirement for sustainable and financial innovation to match green finance objectives and sustainability more broadly with capital stack goals.

At the retail level, within green finance are tools designed for consumers, such as green mortgages and green home loans. These instruments usually include improved terms, such as lower interest rates, longer reimbursement periods, or up-front subsidies, for the purchase or construction of buildings based on specified environmental performance criteria. Green mortgages could be associated with accredited properties in schemes such as the US LEED, UK BREEAM, EDGE or local equivalents. Building performance measures, including energy utilisation or carbon intensity, are becoming eligibility filters for such loans by financial institutions. These products may then alter the borrowing cost of sustainable housing, ultimately potentially influence consumer choices and stimulate demand for certified green buildings, especially in the residential sector, a sector of green finance that tends to have lower penetration of sustainability.

In the corporate and investment finance community, there have been two main types of instruments - green bonds and ESG-linked loans. Green bonds are fixed-income securities whose proceeds are intended for the specific expenses of green projects, including energy-efficient buildings, renewable energy projects, sustainable transportation, water-use efficiency, and infrastructure. Green bonds flourished, outpacing USD 500 billion in global issuance in 2022, following a surge in investor demand and favourable regulations. ESG-linked loans, on the other hand, do not have to ringfence the proceeds, as they are designed so that the loan price is determined by the borrower's performance against certain ESG or sustainability-related metrics. Both instruments offer financial incentives for companies, including real estate developers, to incorporate sustainability goals. For both green bonds and ESG-linked loans, third-party verification and performance reporting will be expected more than ever to minimise greenwashing and build market confidence.

In asset management, green finance is embodied in green mutual funds, sustainability-related exchange-traded funds (ETFs), and green real estate investment trusts (REITs). Green funds seek to invest in environmentally responsible assets using pooled capital from individual and institutional investors. Green REITs, for example, provide investors with portfolios of high-performing sustainable buildings, which allow them direct exposure to the real estate market while incorporating ESG principles.

While not frequently highlighted in broader dialogue on green finance, the insurance sector has an important role to play in supporting the green movement by pricing risks linked to climate and environmental issues. To this point, climate risk underwriting has grown beyond the mere approach of insuring ecological risks (extreme weather event,

natural catastrophes, and business interruption types of environmental hazards) to the development of novel insurance products that enable energy efficiency retrofits and the installation of renewable energy, by de-risking their performance and effectiveness in managing environmental risks. New insurance products include, for instance, performance guarantees (e.g., solar photovoltaic (PV) systems) or building energy savings insurance (e.g., Energy Efficiency Retrofits) that can unleash what is referred to as "bankability" for sustainable green building developments. These projects are arguably complicated to fund in risk-and-return markets (Cambodia) and/or in unregulated urban areas in India. Additionally, insurers are establishing ESG products by using ESG-focused strategies that incorporate ESG criteria into their institutional investment portfolios, the "green insurer," and, as such, create impacts on capital flows on both their liability-side and asset-side balance sheets.

These instruments are the implementation landscape of green finance. For these instruments to be effectively utilised, there needs to be supportive policy measures and robust green taxonomies, access to high-quality environmental data and institutional capacity across the financial system. In many developing and emerging markets, such as India and Cambodia, these instruments are still scarce, often available only in pilot or demonstration programs, which means that the bulk of the construction and real estate sectors remain outside the sights of green capital. The cure for this financing imbalance, in light of the decarbonization potential across various sectors, remains at the heart of the research question. Subsequent sections will outline how these instruments can be adjusted,

scaled up, and brought into the national policy apparatus and capital markets, with the goal of rapidly accelerating the transition of the building sector towards net-zero pathways.

1.4 Relevance of Green Finance to Green Buildings

1.4.1 Current Investment Landscape

The investor underpinnings supporting investment in green buildings remain underdeveloped; the importance and contribution of the built environment to climate mitigation are, however, being recognised more widely. According to Debrah et al. (2021), in 2019, only 2.6% of the total investment in the buildings sector went into green buildings, which is disproportionate to most climate finance decisions, in which the amount of capital to clean or renewable energy generation and clean transportation is much larger than the share going into buildings. The money has gone to large, concentrated sectors that have historically surrounded fixed infrastructure with accountability to the investor world, offering clear revenue streams, lower risk, and shorter return timeframes for existential investment. On the other hand, the building sector, particularly in developing economies, remains relatively poorly served by green construction, which is often perceived as a niche or risky business, or as one that can only be profitable to a limited extent.

When traditional real estate investment processes and finances can restrict growth in sustainability considerations due to the lack of incentives for community progress and a general focus on short-term turnover, asset structural arrangements focused on high turnovers, and some form of debt-equity that is considered normal, overall, provide little to no incentive to do otherwise. Although green bonds and ESG-linked loans have grown

in structure and use globally, real estate's uptake compared to other industry sectors is progressing very slowly as real estate financing for small and mid-sized developers is also developing at a slow pace. Other hurdles in real estate include the fact that the market is fragmented and there are thousands of discrete actors and informal practices, and the relative paucity of institutions that participate in lending or historical investments in green buildings and real estate developments.

1.4.2 Mismatch of Instruments and Sector Needs

Most financiers use traditional underwriting criteria - land value, developer. The lack of use of green finance in the building sector is not only a matter of volume, but it is also a matter of design issues. Most current financial products are not adequately tailored to the specific characteristics of buildings for investment purposes. One of the biggest challenges is mental payback for green building investments. Unlike renewable energy projects, which generate predictable cash flow through power purchase agreements (PPAs), buildings produce savings over time throughout their lifetimes. This makes them less attractive to short-horizon investors, and without credit enhancements or guarantees of performance, it is difficult for commercial lenders to lend against. A second obstacle is the division of incentives, especially in rental or commercial situations, where the developer or landlord pays the capital cost of the green features. At the same time, the benefits are shared by tenants or occupants (utility savings, etc.). In this arena, there is a disincentive to developers installing energy-efficient or low-carbon technologies that are most productive unless the investments are incentivised through targeted subsidies or regulatory mandates. Additionally, there is currently a lack of awareness and capacity among financial

institutions, especially in emerging markets, to understand and price the risks and benefits associated with green buildings.

In summary, there is a continued disconnect between the available green financing tools and the investment profile, operational model, and market characteristics of the building value chain. Addressing this disconnect will require the development of products adapted to the sector, effective data and certification systems, and policies that remove barriers and incentivise sustainable building.

1.5 Policy and Market Maturity by Region

1.5.1 The European Union

The European Union (EU) has built a global reputation for its green finance and for decarbonising the built environment. The EU has set an explicit and coherent policy framework developed through the EU Green Deal, together with explicit regulatory tools on climate finance for the built environment. One essential example is the EU Taxonomy Regulation, which provides a framework for classifying environmentally sustainable economic activities. This offers clear direction to investors on identifying green building assets in line with net-zero ambitions. Another notable example is the EU Green Bond Standard, which aims to increase the transparency and integrity of the market, including through standardised reporting and use-of-proceeds requirements for green-labelled instruments. Another critical area of focus is the Renovation Wave Strategy, created in 2020, which aims to increase the number of residential and non-residential buildings that

undertake energy renovations to 3 or 4 million annually by 2030, with a total of 35 million buildings considered across the entire Union.

Notwithstanding these structural advances, there are also practical bottlenecks, especially in small-scale, decentralised building projects, in municipal-level retrofits, and in low-income housing segments. Many local governments and housing cooperatives do not have the technical capacity or initial capital to prepare bankable green building projects, so EU-backed funding lines have been little taken up to date. Additionally, with regulatory and institutional investors being activated through blended finance and mandates for ESG investing, despite increasing mobilisation of the CSF, unfavourable risk-return characteristics define projects for sub-sovereign or retrofitting, which limits the private sector's capital injection. This requires improved financial aggregation tools, opportunities to enhance credit, and improved policy design for green finance, which could offer India, and Cambodia frameworks for improvement.

1.5.2 India

India presents a fascinating mix of opportunities and challenges when considering the linkages between green finance and the transformation of the building sector. India's construction industry is experiencing rapid growth due to urbanisation, population pressure, and infrastructure expansion. Consequently, India is scheduled to add more than 70% of its building stock for 2030 by the end of this decade. Though India has made strides in renewable energy financing (with installed capacity above 175 GW and attracting

investments worth Billions in clean energy), green buildings are relatively underfinanced. According to Khanna et al. (2022), the building sector has the largest gap between its mitigation potential and investment levels, currently at 75%.

While several green building rating systems exist (e.g., IGBC, GRIHA, etc.), the building sector has not yet fully integrated with mainstream finance. Most of the human head investment in green building is relegated to premium commercial or institutional buildings. In contrast, residential and affordable housing development have been left out of the green finance discourse due to perceived price and credit constraints. However, some policy motion is gaining ground. The Reserve Bank of India is considering avenues for green finance frameworks, and green housing credit is also being considered as part of priority sector lending. SEBI's ESG disclosure requirements for listed companies will raise investor awareness and encourage real estate developers to pursue investments aligned with sustainability standards.

1.5.3 Cambodia

Like other Least Developed Countries (LDCs), Cambodia faces a distinct set of green finance challenges, as it is characterised by high economic and institutional structural constraints characterise it. Moreover, there is no availability of domestic capital to finance longer-term infrastructure projects, and the overall financial market is shallow in domestically raised capital. However, Cambodia has stated its aspirational intent through its updated Nationally Determined Contributions (NDCs), prioritising green buildings as a

mitigation measure. In particular, the built environment is an integral part of national climate policy, a testament to the emissions and resilience implications it entails.

Cambodia also made progress in developing green economy roadmaps in cooperation with international agencies and donors. These roadmaps have moved towards a focus on sustainable urbanisation, energy efficiency, building codes and standards, and labelling systems. Still, many green finance activities in Cambodia are donor-driven and supported by the Multilateral Development Banks, bilateral support, and technical support. Accordingly, the institutional capacity to implement building codes and to certify and develop a viable localised green finance instrument is limited. Financial inclusion of developers and homeowners is also weak, as traditional banking systems have not fully integrated the greening process into construction finance, leading to low take-up of green mortgages or construction finance.

1.6 Key Barriers to Green Building Finance

The transformation towards sustainable buildings is effectively being held back by a series of obstacles, including structural, regulatory and behavioural challenges, that limit the flow of finance into green buildings. Although there is growing awareness of the sustainability of the built environment, the investment ecosystem has not yet adjusted to the requirements and practices of green construction. These barriers take the form of economic-financial, policy-regulatory, and institutional-behavioural, and negatively affect

the scale and speed of green building adoption in both advanced and developing economies.

1.6.1 Economic and Financial Challenges

Economic and financial hurdles are the first to occur and are linked to the costs of green buildings as it is perceived as well as it is put into practice. The one mentioned most, however, is the additional first cost of energy-efficient materials, intelligent systems and sustainable design. Although green building tend to generate lifecycle cost savings due to reduced utility and maintenance expenses, the benefits are received over time but the capital obligation is immediate; thus, for developers (especially the small-to-mid tier), of which many green projects have little to no access to financial products, the delay in benefits makes the first cost difficult to justify. Further, due to limited access to soft loans, concessional funding, and green credit lines, the economic viability of a project is further constrained. Standard banking products are also primarily risk-averse and emphasise short-term repayment horizons (none of which align with the longer repayment cycles of green buildings). In many markets, developers also face difficulty securing a credit rating, partly because of their informal operations and partly because they lack a history of green projects, which makes it difficult for them to tap into commercial finance at a reasonable level. Another technical barrier is the unavailability of standardised valuation methodologies to adequately demonstrate the environmental, social and financial benefits of green buildings.

1.6.2 Policy and Regulatory Issues

The existing policy and regulatory environment also forms a combined hurdle to the successful uptake of green building finance. In many countries, especially in emerging and frontier markets, there are no comprehensive, national green building codes or taxonomies. This results from ad hoc policy and developers and financiers' inability to know what they are doing. Even when codes exist, a lack of consistency or perceived stability in green building incentives can be a severe obstacle to long-term planning by investors: time-limited subsidies, limited tax abatements, or uncoordinated municipal plans, for instance. Often, these incentives are not adjusted for inflation or regional cost.

The plethora of and ambiguity around environmental certification systems also leads to confusion in the market. In the absence of a standardised approach, for many developers and lenders, the certifications are unclear about which ones are credible, which environmental performance measures can be relied on, or how they can measure compliance. Regulatory vagueness prevents the structuring of green finance products and the setting of underwriting criteria or performance-based incentives. However, in some cases, a lack of legally binding requirements for implementing green buildings creates the models for voluntary uptake, and that is not enough to spur change in the system.

1.6.3 Behavioural/ Institutional Challenges

In addition to economic and regulatory issues, behavioural and institutional factors continue to hinder the adoption of green building finance. A critical concern of investors is long ROI cycles. This is not attractive to private equity investors, commercial banks, venture capital funds, and other types of investors who prefer shorter payback periods,

including hard cash, and investment outlays that are readily convertible to cash. Furthermore, and to the detriment of mitigation or risk modelling, corporate equity and environmental performance indicators are not taken into account in the risk model considered in both cost-benefit and net present value analyses, leading to underpricing or neglect of greening assets.

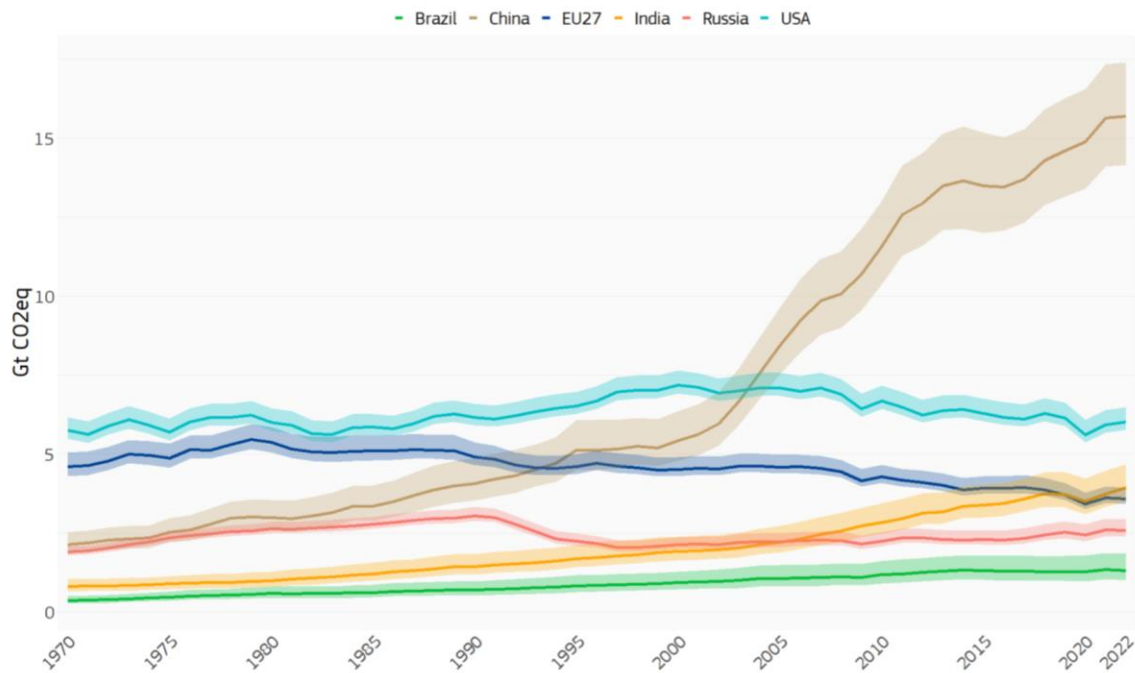
At the same time, the financial literacy of developers, homebuyers, and construction professionals remains low, particularly in developing markets such as South and Southeast Asia. Addressing stakeholders' awareness of the benefits of green building, available finance, and the project structuring for biased actors is mutually exclusive knowledge. This knowledge is further handicapped by the lack of viable pilot projects and demonstration cases which can be replicated or scaled. Financiers won't invest in things without proof of concept. Developers won't develop without a project to latch on to. Policymakers lack the evidence and data to design robust interventions.

Together, these barriers represent a complex, multi-layered problem that is not amenable to solution through one-off interventions. When developing an enabling environment for green building finance, capital markets, policy instruments, behavioural incentives, and technical structures must be aligned. In the following chapters of this study, we will investigate to what extent such an ecosystem has emerged in the European Union and what lessons could be transferable to countries such as India and Cambodia, where the need for financial innovation and institutional capacity building is urgently felt.

1.7 Research Problem

Global development is advancing at a rapid pace, leading to higher levels of GHGs. The graph in Figure 1 shows the annual GHG emissions of the EU 27 and the top five emissions nations in the world (China, the United States, India, Russia, and Brazil) from 1970 to 2022 (Crippa et. al, 2023)

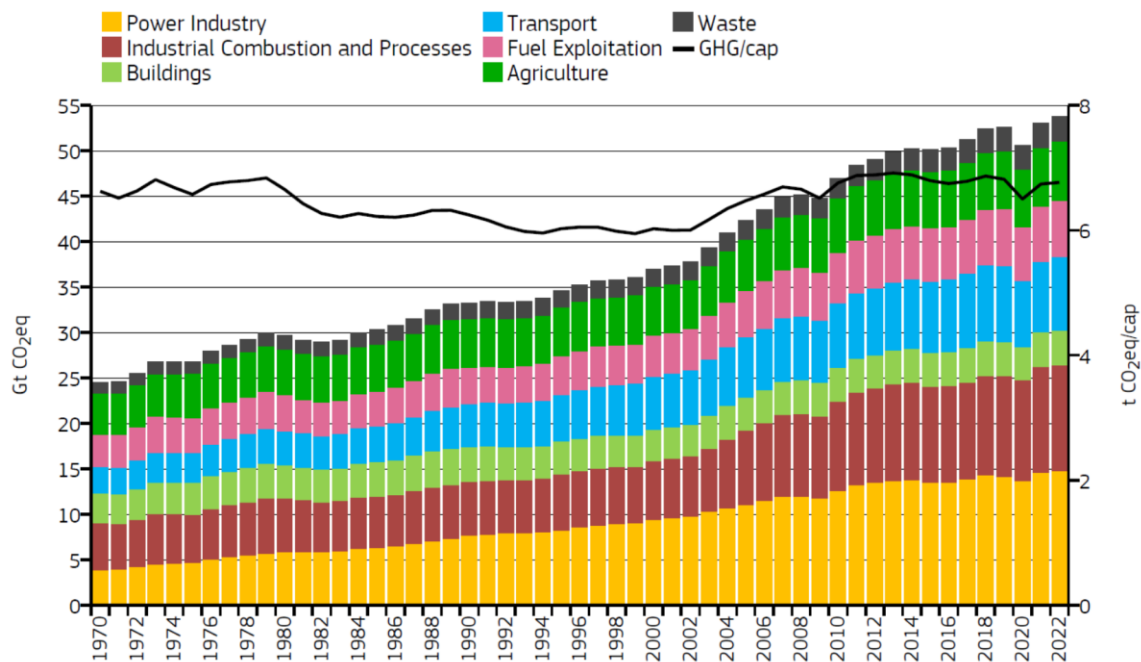
Figure 1 GHG Emission of Various Countries



Source: European Commission, JRC science for policy report, GHG emissions of all countries of the world, 2023

Growth across various sectors drives the development of countries. The contribution of greenhouse gas (GHG) emissions across multiple sectors has increased. Emissions trends by key activity sectors, including the Power Industry, Agriculture, Waste, and Fuel Exploration, along with their emissions trends from 1970 to 2022, are presented in Figure 2 (Crippa et al., 2023).

Figure 2 GHG Emissions of Various Countries (By Sector), 2023



Source: European Commission, JRC science for policy report, GHG emissions of all countries of the world, 2023

According to the UNEP's Global Status Report for Buildings and Construction 2023, CO₂ emissions from buildings and construction operations reached record levels in 2022. CO₂ emissions from building operations and construction (including emissions from the production of materials) accounted for 37% of total global CO₂ emissions of just under 10 gigatons (GtCO₂). Carbon emissions from the buildings and construction sector have substantially increased over the past few years. Given the significant contribution of the buildings and construction sector to GHG emissions, it can be a substantial contributor to aggregate reductions in GHG emissions from a broader group of emission sources. Green buildings and green construction practices are critical pathways that can facilitate

reductions in greenhouse gas emissions. Green construction techniques have been readily available for many years, yet an adaptation of these technologies persists. Green finance may offer solutions to the challenges of funding green building projects. Green finance has been a part of our financial system for many years and continues to evolve. Still, the lack of specific financial instruments designed to finance the sector has limited its ability to provide financial support to the green construction sector.

The growth of the green construction sector may be pivotal in the battle against climate change. Green finance, in theory, can support these efforts, but the lack of industry-specific green finance mechanisms should be a matter of urgency.

1.8 Purpose of Research

The primary objective of this study is to investigate how green finance can be leveraged to expedite the transition to sustainable buildings within the construction industry. There remains a gap between access to green finance instruments and their use in green construction, particularly in developing and emerging economies, despite the building sector being a major contributor to global greenhouse gas emissions. This study aims to identify and examine the shortcomings of current green finance mechanisms, assess their practical outcomes, and evaluate the barriers and enablers affecting the current use of green finance. To identify contextual details that can guide the development of scalable

and adaptable financial solutions, this study will examine three different economic and regulatory environments: the European Union, India, and Cambodia. By adopting this approach, this study will develop a conceptual framework that links green finance instruments to the distinct needs of the sustainable building industry. The framework will serve as a mechanism to enable the effective deployment of green funds, limit emissions, and facilitate climate-resilient urban development in line with the Paris Agreement, for the use of relevant organisations, including governments, financial institutions, and construction industry stakeholders.

1.9 Significance of the Study

This research study is extremely valuable, given the increasing necessities of climate change, urbanisation and sustainable development. The building and construction sector contributes around 37% of global CO₂ emissions, and this area is one of the most important sectors to reduce greenhouse gas Emissions. Although green buildings can help reduce emissions and improve environmental performance, the sector remains underfinanced, especially in developing and emerging market economies.

This study fills a significant gap by analysing how green finance mechanisms, such as green bonds, green mortgages and ESG-linked loans, can be designed, customised and implemented to support the transition of the sustainable built environment. It will provide a better understanding of the current financial landscape, including its challenges and opportunities, and introduce a conceptual framework for directing investments in green construction projects.

By researching the varied contexts of the European Union, India and Cambodia, this research will offer valuable, context-driven insights for policymakers, financial service providers, developers, and sustainability champions. It will also identify how financial innovation can help bridge the implementation gap between climate policy ambitions and infrastructure delivery. The results of the study will contribute to the growing body of literature on green finance, support the implementation of national climate strategies consistent with the Paris Agreement (Article 2.1(c)), and inform future green building programs. This can influence financial reform, promote inclusive green growth, and assist with the global transition to resilient, low-carbon cities.

1.10 Research Purpose and Questions

Construction is among the largest emitters of greenhouse gases in the world, contributing approximately 37% of the total carbon dioxide emissions. Although the effectiveness of green buildings in curbing emissions and advancing sustainability has been established, significant limitations remain in applying this approach to building construction, particularly in developing economies, due to financial, institutional, and policy challenges. This study aims to investigate ways to create, modify, and expand green finance instruments to facilitate a transformation towards sustainable buildings. The research will examine the primary financial tools to be used, including green bonds, green mortgages, and ESG-linked loans, specifically assessing their accessibility and

functionality in various regional settings, as well as their impact on these settings. The study will compare the policies, regulatory frameworks, and market environments of the European Union, India, and Cambodia, thereby identifying the gaps in green finance and evaluating the consequences of available instruments on stakeholders in the construction industry.

The primary objective of this research is to develop a conceptual framework that integrates green finance tools with the operational and developmental needs of the sustainable building industry. This involves identifying the obstacles and drivers to the adoption of green finance and assessing the level of development that various financial ecosystems promote or hinder in green construction activities. Through qualitative analysis and a comparative case study, the proposed research will provide policymakers, financial institutions, and construction industry stakeholders with actionable information. This will fill the gap between climate finance intentions and practice, contributing to Article 2.1(c) of the Paris Agreement by guiding capital flows toward climate resilience and low-carbon building practices.

Research Questions:

1. What are the existing gaps in green finance mechanisms in the construction industry regarding sustainable buildings?
2. How do existing green finance instruments function in practice, and what are their implications for construction sector participants?

3. What are the significant barriers and enablers of green finance for sustainable buildings in various economic and regulatory contexts?
4. What conceptual framework can be developed to align green finance instruments with the sustainable building industry's needs and development?

CHAPTER II: REVIEW OF LITERATURE

2.1 Introduction

The correlation between green buildings and green finance is one of the two sides of the coin, representing the overlap between climate action and economic sustainability. Internationally, it is estimated that around 37% of total energy-related carbon dioxide (CO₂) emissions are attributable to the built environment, i.e., residential, commercial, and industrial infrastructure. The sources of these emissions are the use of energy in the operations, as well as the embodied carbon found in building materials (Debrah, Darko, and Chan, 2022). Targeting this sector is thus critical to realising the climate ambitions of the Paris Agreement and the Sustainable Development Goals (SDGs).

Green finance is a key factor in enabling this move. At its broadest definition, green finance describes a method of funding investments with environmental benefits in the context of sustainable development and offering solutions to finance green infrastructure, using tools such as green bonds, concessional loans, guarantees, and blended finance (Xu and Chen, 2024). Nevertheless, while global climate finance is gaining momentum, especially in areas such as renewable energy and sustainable transport, the use of green finance in the construction sector remains relatively low, especially in developing and least developed countries.

This literature review critically examines the conceptual base, theoretical frameworks, policy plans, and empirical findings at the intersection of green buildings and green

finance. It explores why green finance mechanisms have not yet been mainstreamed in the building sector to the necessary extent, how this is reflected in the activities of stakeholders and institutions, and the roles played by developed and developing countries.

Due to the broad scope of the research, the study has been limited geographically to three specific countries. These countries were selected based on two main criteria. The first criterion was to choose one country from each of the developed, developing, and least developed categories, based on the GDP data released by the World Bank. The second criterion involved selecting countries that have included green building and green construction in their updated NDCs. According to these criteria, the European Union (developed), India (developing), and Cambodia (least developed) were identified as the focus countries for this research.

To provide a solid analytical foundation, this review draws on knowledge from environmental economics, behavioural science, and development sociology.

2.2 Theoretical Framework

The theoretical framework underpinning this research is designed to capture the multi-dimensional nature of green finance adoption in the building sector. A purely economic analysis does not sufficiently capture the behavioural, institutional, and cultural barriers that hinder implementation. Therefore, this study draws from both classical economic theory and emerging behavioural and sociological frameworks to provide a well-rounded analytical lens.

2.2.1 Foundations of Climate Finance Theory

At its core, climate finance theory is based on the principle of internalising negative environmental externalities. The earlier work laid the foundation by arguing that market failures—such as pollution—can be corrected through fiscal tools, such as taxes and subsidies (Hawkins, 2020). The economic logic of early and decisive investment in climate mitigation is to avoid far greater costs in the future.

This school of thought advocates for the use of public finance mechanisms to mitigate the risk associated with private investment in green infrastructure. It promotes blended finance structures that combine concessional capital with private equity or debt, creating financially viable investment propositions. Climate finance theory also advocates aligning capital flows with long-term climate goals through tools such as taxonomies, carbon pricing, and mandatory climate-related financial disclosures. However, most practical applications of climate finance have focused on renewable energy, with the building sector receiving a relatively minor share of attention and funding.

2.2.2 Behavioural Economics and Sustainability Finance

In contrast to neoclassical economics, behavioural economics recognises that real-world decision-making often deviates from purely rational models. The concept of "nudging" illustrates how people can be guided toward better choices without restricting freedom of choice (Kemper and Wichardt, 2024). This approach is highly relevant to understanding investment behaviour in the context of green buildings.

For instance, developers may hesitate to adopt green construction methods due to present bias (overvaluing immediate costs vs. future benefits), loss aversion (fearing performance risk or uncertain returns), or social proof (waiting for others to act first).

Financial institutions may lack the internal expertise to evaluate the long-term risk-adjusted returns of green buildings, especially in the absence of standardised metrics. Consumers, too, may undervalue energy-efficient housing due to a lack of information or misaligned incentives.

Behavioural economics suggests that targeted interventions—such as performance guarantees, simplified green certifications, and public recognition—can help overcome these biases. However, these principles are still underutilised in the design of green finance instruments for the building sector, especially in low-income and emerging markets.

Figure 3 Theoretical Framework for Green Building Finance

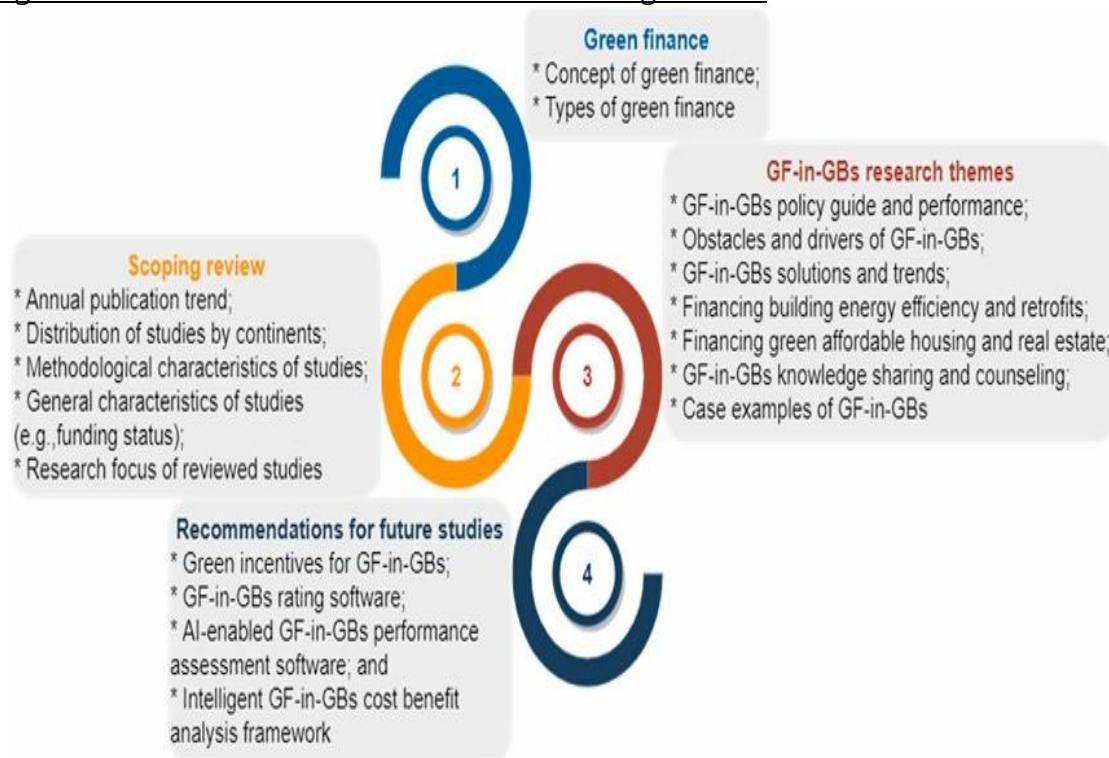


Image Source: (Debrah, Chan and Darko, 2021)

2.3 Theory of Reasoned Action

2.3.1 Origin and Conceptual Overview

The Theory of Reasoned Action (TRA) is a widely used psychological model that explains and predicts human behaviour. TRA posits that an individual's behaviour is determined by their behavioural intention, which is, in turn, influenced by two primary factors: their attitude toward the behaviour and their subjective norms (Ng, 2024). Attitudes are shaped by beliefs about outcomes and evaluations of those outcomes, while subjective norms arise from perceived social pressure to perform or not perform the behaviour.

The key assumption behind TRA is that individuals are rational actors who systematically use available information to make decisions. This makes it especially relevant in policy contexts where individuals are expected to act based on incentives, information, or regulations. TRA has been widely applied in environmental psychology, including studies on recycling behaviour, energy conservation, and pro-environmental purchasing decisions.

2.3.2 Application to Green Building Investment Behaviour

TRA offers a valuable framework for analysing the behaviour of key stakeholders in green building finance (Karamoozian and Zhang, 2023). For example, a real estate developer's decision to invest in a certified green building may depend on:

Attitude: Belief that green buildings will result in cost savings, brand differentiation, or regulatory benefits

Subjective Norms: Industry norms favouring green buildings, client demand, or peer behaviour within the developer community

Similarly, a bank's willingness to offer green loans may depend on internal alignment with sustainable finance policies and perceived market readiness. Global commitments, peer benchmarking, and expectations from civil society may also influence policymakers and government bodies.

By identifying these motivational drivers, TRA can help design more effective green finance interventions, which may include capacity-building for financial institutions, public campaigns to influence consumer preferences, or regulatory mandates to alter industry norms.

2.3.3 Criticism and Limitations

Despite its wide application, TRA has limitations. It assumes that individuals have complete control over their actions and are not constrained by environmental or structural barriers (Liang et al., 2024). In reality, stakeholders in green building finance often face multiple constraints:

- Developers may lack access to concessional capital
- Regulatory capital requirements may restrict banks
- Consumers may be unable to afford or evaluate green homes

TRA also does not account for habitual behaviours, emotional responses, or cognitive overload—factors that are increasingly recognised as influential in environmental decision-making processes. These limitations suggest that TRA should be used in conjunction with other frameworks, such as the Theory of Planned Behaviour,

institutional theory, or socio-technical systems theory, to provide a more comprehensive understanding of the barriers to the adoption of green finance.

In this research, TRA serves as a foundational behavioural model, helping to frame stakeholder motivation and intention. Its integration with other theories provides a multidimensional understanding of how financial, psychological, and social variables interact in the green building context.

2.4 Human Society Theory

2.4.1 Sociological Underpinning

Human society theory, influenced by the structural functionalism of Emile Durkheim and further shaped by modernization and systems theories, explains how social institutions develop, interact, maintain stability, and adjust to change. Durkheim emphasized the functions of institutions such as government, economy, religion, and education in supporting social integration and meeting collective needs. (Puttamanjaiah and Thangamuthu, 2025). In the context of green finance and green buildings, the theory helps explain how institutional arrangements, norms, and cultural practices influence society's response to climate change.

The theory views societies as structured wholes, in which different subsystems (economic, political, environmental) operate in relative harmony to maintain equilibrium. When confronted with disruptions - such as climate change or resource depletion - societies react by reorganising their institutions, their values and norms. From this perspective, the change of the sustainable finance mechanisms and the environmentally responsible

construction practices may be perceived as part of a broader socio-technical change imposed by the need to ensure social cohesion and ecological harmony.

2.4.2 Implications for policy and practice

Applying Human Society Theory to green finance has shown us that it is not simply technical capacity or financial innovation that matters, but also institutional readiness or the role of cultural values. In high-capacity societies such as the EU, sustainability norms are firmly embedded in the political mandates, legal frameworks, and citizen expectations of the EU (Borie and Bracking, 2024). This has enabled the development of integrated financial mechanisms (the EU Taxonomy and the Renovation Wave Strategy).

By contrast, green finance and green buildings are new concepts in countries such as Cambodia. Institutions may be insufficient in authority, capacity or often public trust to enact complex environmental policies. The theory implies that adequate adoption of green finance in such contexts demands more than the adoption of financial instruments used in the Global North; there needs to be intentional, culturally appropriate institution-building and grassroots participation.

The theory also throws light on the need for adaptive policy frameworks that can change with the evolving values of society. For example, in India, in real estate, while the narrative of sustainability has caught on in urban markets, it has not yet developed in rural and peri-urban spaces. Bridging this gap requires engagement not only among financial actors, but also among local governance structures, social networks and community leaders.

2.4.3 Relevance in Multinational Comparative Perspective

A major contribution of Human Society Theory is that it contextualises the concept of green finance within various political economies. In Europe, for instance, the culture of regulatory compliance, institutional trust, and citizen engagement drives the adoption of green finance policies (Tran, Van, and Thi, 2025). Social acceptance of paying a higher tax price or buying energy insurance is relatively high, allowing social investments in green retrofits and the public green build-up.

The situation is more complicated in India. In metropolises, there is a growing demand for green-certified buildings driven by market incentives and a need for debranding. However, in secondary cities and rural districts, adoption is limited by concerns about affordability, weak enforcement of building codes, and poor institutional coordination. The way green finance functions in society in such environments is yet to mature.

Cambodia is a least-developed country, so it is heavily dependent on external aid and development finance. Here, the concept of green building is being filtered through donor priorities and international standards rather than locally embedded practices. Human Society Theory promotes the acknowledgement of this dependency from the outside and highlights the value of creating institutional legitimacy and localised capacities through participative governance and trust-building.

Overall, this theoretical lens affirms the fact that green finance for green buildings must be understood in other terms, not that it is economically efficient nor technically efficient, but as a societal process, which is marked by institutions, values, and trajectories of historical developments. Effective strategies cannot only be underpinned by economic

data but also be sociologically informed and mindful of local realities to ensure long-term sustainability and equity in climate action capabilities.

2.5 Sectoral Literature Review

2.5.1 Built Environment and Climate Change

Building and construction has become known as among the energy consuming sectors in the world. The United Nations Environment Programme (UNEP) found that the building sector's total energy- and process-based CO₂ emissions were approximately 37% in 2021 (Yaqoob et al., 2024). There are two types of emissions: operational energy consumption (heating, cooling, lighting, and appliance use) and embodied carbon (emissions resulting from the extraction, manufacture, and construction of materials). According to the Sixth Assessment Report, released in 2022 by the IPCC (Intergovernmental Panel on Climate Change), the efficiency of buildings, as one of the low-hanging fruits in global emission-reduction efforts, is estimated to reduce greenhouse gas emissions significantly. Technical interventions, such as building envelope insulation, improved heating, ventilation, and air-conditioning systems/have the potential to provide between 30 and 50% mitigation for urban mitigation, according to the report (Zhang and Li, 2022). Although such technological remedies are not a secret, the pace of implementation of such measures with respect to the level of knowledge is grossly out of proportion due to system-related issues such as the rate of financial expenditures, institutional resistance and decentralisation of policy.

2.5.2 Green Buildings: terminologies and magnitude

Green buildings are generally defined as environmentally responsible and resource-efficient throughout their life cycle, from design, construction, and operation to maintenance, renovation, and demolition (Verma et al., 2020). The World Green Building Council (WGBC) describes green buildings as "Green buildings are buildings that reduce harmful impacts on the environment, improve the health and wellbeing of occupants, and are more economically beneficial."

Certification systems are central towards the definition and legitimisation of green buildings. The largest certifications entail:

LEED (USA): it puts focus on the development of sustainable sites, water efficiency, energy performance, materials and indoor air quality.

BREEAM (UK): Incorporating environmental impacts in ten categories, this is one of the oldest ones.

GRIHA (India): Intended for the Indian climatic and regulatory environment; focuses on passive architecture and local technologies;

EDGE (Global, IFC): promotes the use of cost-efficient certifications in data-MFI to implement the use of accreditation in the developing economy

These systems may promote transparency and comparability; however, their use in the market is generally limited to large developers in urban markets.

2.5.3 Economic Barricades towards Adoption of Green Building

Some perceived and real economic challenges are significant inhibitors to the adoption of green buildings (Rajendra and Mohanasundaram, 2024). There are four obstacles to maintenance finances:

- I. Expensive capital in green technologies, as well as design consultancy
- II. Small liquidity volumes and limitations of concessional finance
- III. The long payback periods to keep off short-term investors
- IV. Failure to measure and rate the Green construction risk by the banks,

The other significant problem is the so-called split-incentive dilemma, in which landlords make decisions about whether to invest in energy-efficiency renovations. Yet the tenants benefit from the utility cost reduction. This has deterred any investment in rented and commercial premises. Moreover, the inability of buildings to generate a certain market premium due to the energy savings that they will have in the future, as a consequence of valuation mechanisms that do not take them into account in the appraisals of properties, has increased the risk that green buildings fail to achieve premium prices.

2.5.4 Development of Green Finance Instruments

UNEP defines green finance as "the financing of investments that provide environmental benefits in the broader context of environmentally sustainable development" (UNEP Progress Report, 2017). It further notes that green finance was included in the G20 agenda for the first time during China's presidency in 2016, with the creation of the Green Finance Study Group (GFSG), and was advanced during Germany's presidency in 2017. The primary aim of green finance is to allocate financial resources to projects that minimize environmental harm while offering favorable investment returns. As ecological civilization and sustainable economic growth accelerate, green finance has emerged as a new direction in financial development and a key pathway toward achieving carbon neutrality (Zhang and Li, 2022).

The history of green finance dates back to the past 20 years, when green finance developed in response to the demand for climate finance across different sectors. In the construction industry, there are now a number of financial products:

Green Bonds: Bond securities to finance Clean projects. Although in some major markets, for example, the EU and China, they are proven, the use of real estate are still small and generally an institutional use.

ESG-Linked Loans: Loans given to corporations that are conditional on meeting sustainability key performance indicators. This is becoming increasingly popular amongst listed real estate investment trusts (REITs).

Green Mortgages: Home loans for certified green homes are incentivised with lower interest rates or extended loan terms.

Concessional Blended Finance: Risk-sharing route between the government and the business sector with the purpose of affordable green housing.

The Climate Bonds Initiative (2022) suggests that, despite the total issuance of green bonds reaching USD 2 trillion by 2021, the portion set aside for buildings amounted to only around 7%. This brings to light the fact that this sector has the least representation in spite of its super extensive potential in terms of mitigation. Multiple factors have prevented mainstream adoption at scale such as institutional bottlenecks, regulatory ambiguity, and data asymmetry.

2.5.5 EU, India, Cambodia Case Analysis

European Union (EU): The EU is leading in sustainability in its financial structuring. The region seeks the possibility for transparent reporting and incentives for

building retrofits, e.g. through the so-called Renovation Wave Strategy and the Sustainable Finance Disclosure Regulation (SFDR). Deep energy renovations are supported by public financing mechanisms, such as the EU Green Deal, InvestEU, and national renovation grants (Cremasco and Boni, 2022). Nonetheless, there is a particular difficulty in mobilising into the social housing segment from the side of privately held capital and issues associated with complicated ownership structures in multi-family housing.

India: There is a model of a hybrid state which has the characteristics of central guidance and decentralised implementation at the state level in India. A strategic trend to energy efficiency could be witnessed in the Energy Conservation Building Code (ECBC), Perform Achieve Trade (PAT) scheme and urban missions (e.g. Smart Cities, AMRUT). Nevertheless, green finance in the building sector remains a niche (Dwivedi and Soni, 2022). The majority of lending is spent on renewable energy, and financing for the building sector is hampered by transaction costs, a lack of green loan lines, and underdeveloped investor education.

Cambodia: Cambodia is leading the way in developing a green finance ecosystem. In its revised NDCs, green buildings have been identified, though implementation depends on donors (mainly through GCF projects and UNESCAP sustainable financial systems). National building codes did not require or encourage sustainability (Scartozzi, 2023). There are pilot programs which are not scaled. Urban development, which mainly comprises the informal housing sector, has yet to be substantially affected by green finance programmes.

Synthesis: Three cases identify the variable institutional preparedness, regulatory structures and market maturity. The EU has proved to be policy coherent and substantive.

India is a new market with aspirations to regulate, but the execution is poor at the ground level. Cambodia is in the process of developing its capacity. To succeed and be scalable, green finance approaches need to be adapted to such contexts.

2.6 Institutional Frameworks

2.6.1 International Conventions and Norms

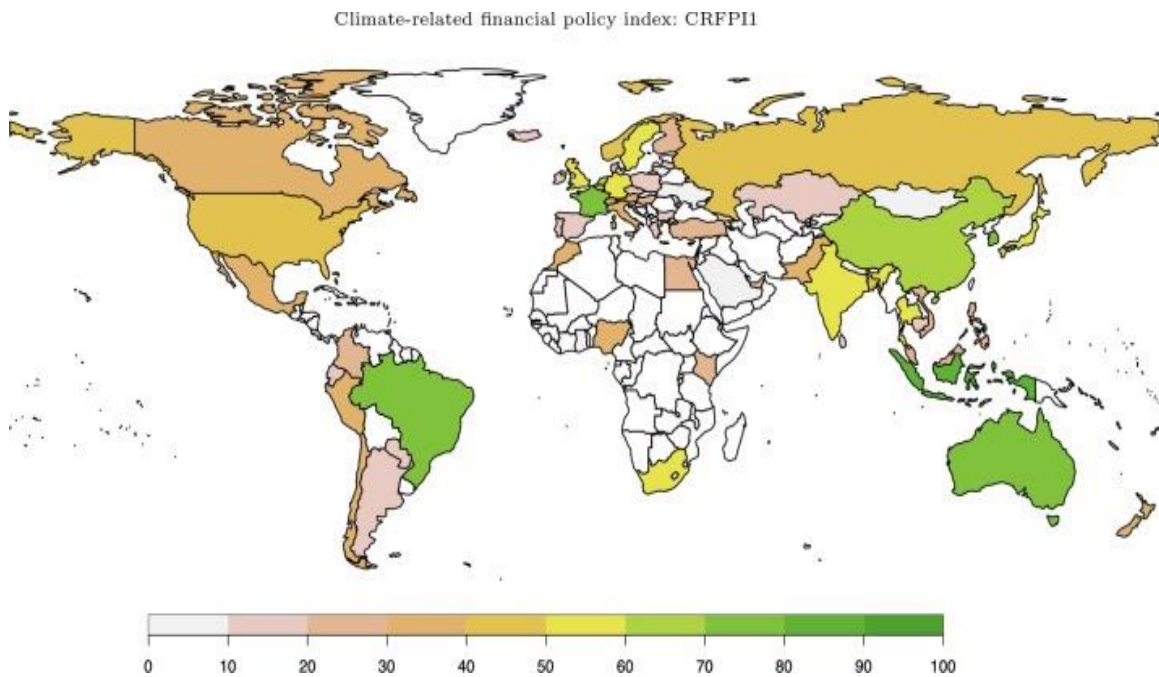
The development of climate-related international agreements has significantly influenced the green finance agenda. Articles 2 and 9 of the Paris Agreement (2015) are of particular importance, as they bind countries to continue pursuing low-emission development strategies and enable developed nations to activate financial flows to support mitigation and adaptation in developing countries (Raiser, Çalı, and Flachsland, 2022). These principles have informed national and institutional efforts to create regulatory frameworks that are favourable to green finance.

This is also evident in the context of the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action), where the need for safe building practices and the mechanisms to fund them are addressed. Common principles of transparency, reporting, and eligibility for green finance projects (including those in the built environment) are also outlined in international frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD), the EU Taxonomy of Sustainable Activities, and the International Capital Markets Association (ICMA) Green Bond Principles.

2.6.2 Favourable National Policies on Green Finance

European Union: The European Union's initiatives, including the European Green Deal, the European Sustainable Finance Taxonomy, and the Renovation Wave Initiative, have made significant strides in regulating green finance within the EU. These frameworks establish a classification structure for sustainable economic activities, comprising buildings and provide legal clarity for investors. Through the Energy Performance of Buildings Directive (EPBD), the nearly zero-energy building (nZEB) requirements and renovation targets for both public and private stock are mandatory (Jenkins et al., 2024). Other financial market participants in the EU are also covered by the Sustainable Finance Disclosure Regulation (SFDR), which increases the disclosure of ESG risks in investment portfolios (Vuola et al., 2020).

Figure 4 Countries-Wise Performance under the Climate-Related Financial



Policy Index 1 (CRFP1) for 2020 and Sub-Index from 2000-2020

Image Source: (D'Orazio and Thole, 2022)

India: India's strategy has been a combination of regulatory nudges and development-based policy frameworks. Green buildings can be scaled through the Energy Conservation Building Code (ECBC), the National Mission on Sustainable Habitat and the urban policies under the Smart Cities Mission. The Reserve Bank of India (RBI) has prioritised most lending norms for financial services, such as renewable energy and the housing sector (Anand and Ansari 2022). Nevertheless, it lacks a compulsory disclosure system, such as the EU taxonomy, or a clear definition of green finance, which is vague and variable. The Securities and Exchange Board of India (SEBI) has also released guidelines on the issuance of green bonds; however, uptake has been limited outside the renewable energy sector.

Cambodia: The regulatory environment of Cambodia remains at a nascent level, where donor-funded projects and the UN bodies externally direct the majority of green finance policies. Infrastructure and urban development are featured in the country's updated NDCs as one of the most vital sectors for climate mitigation. National-level codification of green building standards is currently absent. Nonetheless, the efforts of the National Bank of Cambodia and its cooperation with UNESCAP are indicative of an increasing commitment to sustainability in financial planning. A conceptual step exists in the development of a local taxonomy and MRV system.

Figure 5 Green Finance and Investment Ranking of Selected Countries

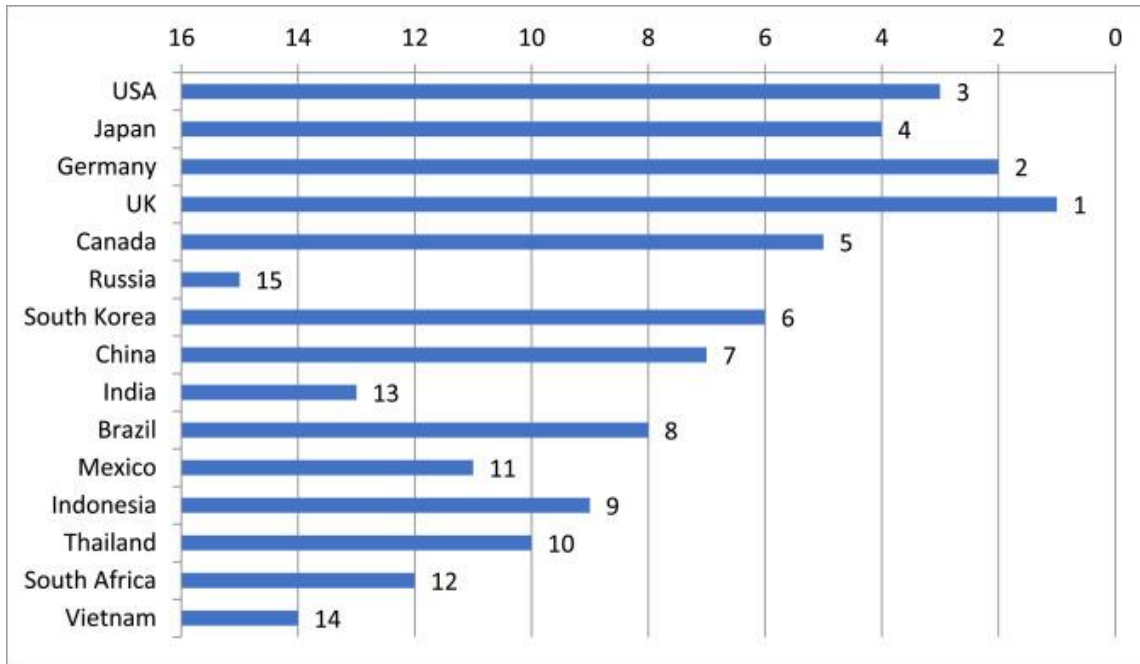


Image Source: (Bhatnagar, Sharma and Bundel, 2024)

Comparative Insight: Although it is evident that the EU is at the higher end of integrating climate finance into financial systems/ legal commitments, India falls in the middle and has an emerging policy/ partially enforced. Cambodia exemplifies the lowest level of institutional development, where external frameworks and capacity-building support are highly significant. The most successful green finance ecosystems rely on consistent policies, strong disclosure, and aligned incentives, which, to varying degrees, are found in the three regions examined.

2.7 Stakeholder Perspectives in Literature

A variety of stakeholders in green finance associated with green buildings face different incentives, constraints, and areas of influence. (Abraham and Gundimeda, 2018)

argue that, although green buildings have the potential to create mutually beneficial outcomes and are being developed globally, various barriers hinder their widespread adoption. These obstacles arise from the building sector's inherent complexity and the conflicting interests of its many stakeholders. The authors conclude that high initial investment costs, limited financial resources, and budget constraints are major hindrances to adopting green buildings. Additional challenges include the lack of soft loans, long payback periods, and difficulties in quantifying the benefits. High capital costs, extended payback times, and the perceived risk by banks and financial institutions—due to uncertain returns—further complicate investment. There are also split incentives in the sector, with those investing often differing from those who benefit, which poses another barrier.

The literature review has highlighted the importance of stakeholder convergence in addressing the implementation barrier to scale. There are three major forces in academic discussions: financial institutions, developers and builders, and final users.

2.7.1 Banking

The primary gatekeepers of capital for green building projects are financial sources, including banks, institutional investors, and multilateral organisations. Perceived credit risk and policy clarity are crucial factors, while fund availability, as measured by performance, is of great significance in determining these institutions' readiness to fund green initiatives.

A study by Frimpong et al. (2022) list several deterrents:

- Absence of uniform risk assessment measures of green buildings

- Lack of previous performance history of energy saving and operating efficiency
- Little knowledge of the assessment of green building certifications

Furthermore, regulatory frameworks such as Basel III tend to treat green and conventional projects comparably when calculating capital requirements, thereby rendering green loans unattractive unless accompanied by guarantees or concessions.

There is some development seen in markets such as the EU, where the launch of the EU Taxonomy and green bond frameworks has promoted institutional confidence. Financial institutions, however, are risk-averse in developing and least-developed countries and would rather allocate capital to projects they are more certain about, such as infrastructure or energy.

2.7.2 Builders and Developers

The key players in the shift to green buildings are the developers (Abdel-Hamid, Abdelhaleem, and Abd El-Razek Fathy, 2025). The availability of green finance, regulatory incentives, and market demand will drive their choices. Debrah et al. (2021) lists the following barriers to developers:

- Costly up-front payments with no visible access to concessional equities
- Delays in green certifications due to bureaucracy
- Inadequate or no knowledge of financial arms related to green building

There are green real estate developers in metropolitan areas such as Delhi, Mumbai, and the Bangalore region in India who have adopted a green approach, driven by consumer

pressure and exposure to international markets. Cities in tiers 2 and 3, however, face disadvantages due to low institutional support and awareness.

The green building industry in Cambodia is still in its early stages of development, and the majority of builders operate in informal or semi-formal markets. Small pilot projects, funded by multilateral donors, are just starting to implement best practices, but they are constrained by capacity and funding.

2.7.3 Tenants And End-users

The market demand is driven by consumers of green buildings, including homeowners, tenants, and corporate lessees. There is a literary indication of an increasing interest in environmentally sustainable housing, particularly among young and urban citizens (Anthony Jr., 2021).

To enhance consumer awareness, educational campaigns, public benchmarking tools, and disclosure regulations have been introduced. In the EU, transparency has improved through the introduction of the Energy Performance Certificate (EPC) rating and compulsory disclosure regulations. Consumer illiteracy and a disclosure standard have become a progress retarding in India and Cambodia.

Synthesis:

Alignment of stakeholder incentives is a common theme in the studies. Financial institutions are interested in risk-adjusted returns and the benefits of standards' transparency; developers want the availability of tailor-made finance and the predictability of regulatory approvals; consumers want the best prices and transparency. Effective green building finance environments are likely to have:

- Expansion of risk-sharing tools, guarantees and green credit lines
- Regulatory transparency of codes, taxonomies and performance measures
- Sensitisation and empowerment of all stakeholders

Consideration of these factors is crucial in developing effective policies and financial designs for regions and development.

2.8 Empirical Studies and Methodologies Used

It is essential that there is an understanding of the empirical foundation of green finance research on green buildings to determine which data are informed and can inform policymaking frameworks. A literature review shows a range of methodologies used in past research, which represents the multidisciplinary nature of the topic. These methodologies differ from quantitative econometric studies to qualitative case studies and mixed methodologies, which suggest different benefits for measuring the financial, institutional, behavioural, and technological dimensions.

2.8.1 Quantitative Survey

The empirical research is mostly conducted through quantitative techniques, especially while examining financial return, market value and environmental impact factor of the green buildings (Miraj, Berawi, and Utami, 2021). Important methods of survey are:

Regression Analysis: Frequently used to calculate the association of the green certification with property values or the rental premium of property. Eichholtz et al. (2013) indicated statistically significant price differentials between LEED and IGBC certified buildings, which demonstrates that there can be investor interest.

Time-Series Forecasting: Forecasts based on time series are used in determination of the trend of energy consumption before and after retrofit in buildings and facilitating forecasting of the trajectory of energy savings and carbon reduction.

Simulation on Carbon Accounting: LCA, Energy Simulation Models (e.g. Energyplus) and EC Embodied Carbon Tracking (e.g. EC3 tool) are utilised to measure the degree of reduction in emission due to green construction at various stages.

Such tools are becoming increasingly common amongst developers, banks and regulators in India and EU to develop evidence bases in support of tax incentives or subsidies or concessional lending. In Cambodia, limited data means that empirical modelling can only be done as demonstration projects or pilot evaluations which are often supported by donors (Krushelnytska 2017).

2.8.2 Using Mixed and Qualitative Methods

Qualitative research is extremely important in finding behavioural norms, policy design mechanisms and contextual enablers/barriers (Simpeh et al., 2021). Popular methods are:

Stakeholder Interviews: Considered as one of the most widely used methods to obtain views of the developers, financiers, regulators and occupants. Such approaches were adopted by Frimpong E. (2018) in African and Asian contexts in develop regionally localised Green Finance models.

Policy and Document Analysis: It provides an overview of how national policies, building codes, and climate finance roadmaps do or do not align with sustainable construction objectives.

Case Studies: Contextual studies, e.g., EU Renovation Wave, implementation of ECBC in India or Urban NDC Pilots Campbell Configurations in Cambodia, enable discussion on success factors and policy barriers.

2.8.3 Cross Methodologies and Comparisons

This is coupled with an increasing adoption of mixed-methodology, especially in the Global South, where complex data tends to be fragmentary. For example, stakeholder mapping can be combined with financial modelling via regression analysis, or with institutional policy reviews via LCA (Umair et al., 2024). The triangulation provided helps strengthen the research's robustness and is policy-driven.

Comparative Methodological Insights:

The European Union: In the EU, because of a well-developed data infrastructure, econometric work, panel estimation and sectoral input-output analysis can be performed.

India: In India, the research combines statistical and qualitative methods to capture the complexity of federal governance and heterogeneous real estate markets.

Cambodia: At present, research in Cambodia is mainly donor-driven. It draws heavily on grey literature, program evaluations, and feasibility studies, which often take the form of pilots funded by UNESCAP, the GGGI, and the GCF.

The integration of such empirical approaches results in a limited, yet growing knowledge base that feeds into policy learning, improvement of investment frameworks and tracking of the level of green finance penetration in the realm of the built environment.

2.9 Identified Gaps in Existing Literature

Despite the fact that green finance and green buildings are now a developing field of scholarship, several significant gaps at the interface between research and practice hinder their successful practice and study. These vulnerabilities are expressions of conceptual uncertainties and operational difficulties in policy, funding, and stakeholder involvement.

2.9.1 Finance: There are Specialized Finance Tools in the Sector

One common deficit in the literature is the lack of specific financial instruments in the field of green buildings. Besides the existence of green bonds and ESG-linked loans, the most important thing is to have huge project investments in infrastructure or green energy (Chiu, 2023).

Green building initiatives do not include innovative financing instruments such as on-bill financing, pay-as-you-save models or outcome-based green building grants; this is one of the major challenges in mainstreaming green financing.

2.9.2 Implementation Models (Country Specific)

Literature is biased towards research on developed nations, particularly the US and the EU. Although there are emerging studies in India, the least developed countries, such as Cambodia, receive hardly any empirical attention. Strategies adopted to implement regions concerning governance capacity, institutional maturity and socio-cultural behaviour are few (Leiringer et al. 2022). There is a requirement for:

- Surveys of enabling environments of green finance
- Policy transferring between countries which have the same level of development

- Evidence-based localisation of green finance taxonomies

2.9.3 Psychological and Behavioural Barriers

In most research, the main barriers are taken to be financial access and policy clarity. Behavioural economics, however, holds that factors such as thought processes, risk judgements, and distrust also significantly contribute to decision-making (Nurick and Thatcher, 2021). Important gaps are:

- Low levels of infusion of behavioural theories, such as the Theory of Planned Behaviour or Prospect Theory, in the green finance literature.
- Lack of concern about what makes individual investors and developers tick and what scares individual investors and developers.
- Little research has been done on consumer-side views, particularly in the low-income housing sector.

2.9.4 MRV Gaps

Reliability in green finance is based on strong MRVs (Sinaga et al., 2024). Most literature, however, criticises the lack of a standardised and enforced framework to:

- Quantifying the reductions in emissions
- Monitor the progress of the green building investments promptly
- Give a third-party assurance and validation on the results of environmental outcomes

Although international initiatives like the TCFD and the EU Taxonomy are constructive, country-specific MRV instruments in developing economies, such as those

in India and Cambodia, often lack development or fail to meet international standards. This lack of development decreases investor trust and inhibits the scalability of green finance.

Synthesis:

The attempt to close these gaps requires an interdisciplinary, cross-regional research agenda that combines the financial sphere, behavioural science, architecture, and governance. It further necessitates the co-design of tools and policies that are partly inclusive, scalable, and flexible to diverse development circumstances. These shortcomings must be addressed directly through a strong conceptualisation, as proposed in this study.

Green finance and green building literature developed in the late decades of the past century, but its unevenness, conceptual confusion, and the rarity of regional settings characterise its literature. The main points that this extensive review has identified are the following:

1. **The Importance of Buildings in Climate Mitigation:** Buildings presently cause more than a third of global GHG emissions. The literature continues to support the premise that green buildings can achieve high impact and cost-effectiveness in emission reduction through the implementation of the correct financing mechanism.

2. **Green Finance as an Enabler:** An essential element in the faster development of green construction is green finance. Nevertheless, at present, the financial fluxes are concentrated on such spheres as energy and transport, and a mere fraction of it is oriented to buildings. Committed sector instruments have not been developed.

3. Underutilization of Theoretical and Behavioural Foundations: Other practical frameworks, e.g., the Theory of Reasoned Action and Human Society Theory, offer a view of adoption-related behaviour but are rarely employed in empirical studies. Behavioural economics and its integration with sociological insights remain in their infancy.

4. Cross-Country Policy and Institutional Decoupling: In the EU, the regulatory environment exhibits the existence of binding sustainability disclosures and green taxonomies. India represents a transitional status, where progress occurs in a scattered manner among the various states. In contrast, Cambodia is characterised by its initial level of development, which has heavy donor engagement without much institutionalisation at the domestic level.

5. Misaligned Incentives Motivate Stakeholders: Stakeholders, such as developers, financiers, and end-users, do not always work under aligned incentives, as indicated in the literature. There is a lack of strong risk assessment models in financial institutions for green buildings. Developers often lack easy access to inexpensive upfront costs, and consumers may not always be willing to pay high prices due to a lack of awareness.

6. Empirical Rigour and Geographic Representation: Low-income and least developed countries lack numerous peer-reviewed, data-driven research works. The MRV systems are weak or absent in various regions, which lowers credibility and investor confidence.

7. Demand for Contextualised, Scalable Frameworks: A 'one-size-fits-all' attitude towards green finance will not work. The key to success lies in the design of local policies, the development of close-fitting instruments, and the integration of stakeholder proposal models. The literature provides a framework for developing a conceptual model that can be adapted to various national capabilities and levels of financial market maturity.

Altogether, the literature supports the validity and timeliness of the proposed research, highlighting the need for a sophisticated deliverable framework to address the green building finance gap in general and, specifically, in developing and least-developed countries in Asia, which face high climate risks but have underdeveloped financial ecosystems.

2.10 Summary of Key Insights

Research on green buildings, as well as green finance, has been maturing over the last two decades, but remains disjointedly covered, conceptually unclear, and lacking representative representation of contexts, such as regional situations. The most important results of the present detailed review address the following:

1. **Buildings and Their Critical Role in Climate Mitigation** Buildings are responsible for producing greater than one-third of the world's GHG emissions. The literature has repeatedly confirmed the opinion that green buildings provide cost-effective, high-impact opportunities for emissions reduction, provided that favourable financing mechanisms are adopted.

2. Green Finance as an enabler Green finance is a critical enabler to the rapid development of green construction. Nonetheless, the flow of finance remains concentrated mainly on industries such as energy and transportation, while investment in buildings is relatively insignificant. The sector-specific instruments to be used are relatively backward.

3. Theory/Behavioural Roots are underutilised: Many theories can be applied to adoption behaviour studies, for example, the Theory of Reasoned Action or the Human Society Theory; both theories can have relevant lenses as a foundation for other research work. Unfortunately, they are very poorly employed in empirical research. Combining behavioural economics and sociology is still in its first stages.

4. Divergence of Institution and Policy between Countries The EU has developed a high regulatory ecosystem in terms of binding sustainability reporting and green taxonomies. India is a transitional case, with mixed development and progress across states. In contrast, Cambodia is at the first stage of development, with donors being more involved and local institutions less institutionalised.

5. Misaligned Stakeholders can still be a Hurdle: It has been pointed out in the literature that it is common for developers, financiers and end-users to work under misaligned incentives. Banks do not have strong models for risk analyses in green buildings because building them is expensive, and consumers may or may not be willing to pay a premium or be aware of it.

6. Lacunae of Empirical Strength and Geographical Coverage: Low-income countries and least developed countries are underrepresented in terms of the number of

research studies supported by peers and/or data-driven. Some of these areas exist with weak or no MRV systems, thus decreasing the credibility and confidence they get from investors.

7. Demand for Contextualised, Scalable Frameworks: A Universal strategy for green finance doesn't work. Specific tools, domestication of formal policy frameworks and universal stakeholder models are essential. The theory used in the literature applies to the conceptual model, which can be modified to account for different national capacities and the financial market's level of development.

Overall, there is confirmation - through the literature, the topicality and relevance of the proposed research - as the researcher recommends a formulation of a nuanced, practical mechanism to narrow down the gap between green financing in the building sector, particularly in developing and least-developed nations where a high degree of climate-related risk exposure has existed, but financial ecosystems are immature.

CHAPTER III: METHODOLOGY

3.1 Introduction

This chapter describes the methodology followed for the purpose of analysing the role of green finance mechanisms in the promotion of sustainable building practices in three countries: the European Union (EU), India and Cambodia. The research takes a quantitative approach to measure the contribution of financial instruments, including green bonds, green mortgages and ESG-linked loans, in the development of green buildings in these diverse regions.

The methodology aims to deliver empirical evidence on the research questions regarding the barriers, enablers, and effectiveness of green finance mechanisms. The research design, data collection techniques, and data analysis techniques applied to assess the research results are outlined in this chapter. A key focus is laid on making the data collected provide actionable insights into how green finance has been operating in the construction sector.

Additionally, this section has the support of the evidence of the data collecting process, such as the questionnaire used, how the participants were chosen, and the results of the analysis in terms of presentation of the results in form of a number or a visual. Ethical issues are also discussed to ensure that the research is conducted in compliance with academic standards and the limitations of the study are acknowledged to maintain transparency in the research process.

3.2 Research Design

This study is a quantitative, cross-sectional study with positivist paradigm which focuses on objective measurement, statistical analysis and empirical testing. The design is appropriate as the purpose of the research undertaken is to generate evidence based insights about the contribution of green finance mechanisms to sustainable building practices across three regions - European Union (EU), India and Cambodia. From a managerial point of view this approach offers measurable data in the support of strategic, investment and policy decisions in the green finance and construction sectors.

The research specifically assesses the adoption, effectiveness and barriers that relate to green finance tools such as green bonds, green mortgages and ESG linked loans, specifically relating to the application of these tools in relation to green building projects. The quantitative method was chosen due to the capability to collect similar, quantitative data from a wide range of stakeholders in order to provide objective assessment and statistical generalisation. Quantitative research is also useful in terms of replicability, as this ensures that the research findings are able to be applied or used for the testing of other markets and organization contexts - an umbrella that makes business decision-making dependable.

The research design is based on a survey methodology, which is effective for collecting standardized data from various stakeholder groups such as financial institutions, real estate developers, policymakers, and sustainability experts. These respondents are the most important managerial and operational actors of green finance adoption. The survey enables the study to capture their perception, attitude, experience, which reflect the

decision-making process generating the sustainable finance implementation in building sector.

In accordance with the research objectives the survey instrument is structured to measure:

Adoption of green finance tools by regions.

Effectiveness of these tools in the support of green building projects & sustainability outcomes.

Barriers and enablers to the adoption of green finance in the construction sector.

Financial performance aspect such as cost savings, efficiency of operation, and return on investment (ROI) in green buildings.

The survey is a five-point Likert scale survey and the respondents may choose in which manner they agree or disagree with a statement related to the practice of green finance. This quantitative structure is useful for statistical testing, so that results can be analysed to establish relationships, pattern and significant predictors of adoption and effectiveness.

Justification of the Research Design

The quantitative, cross-sectional study is both warrantable on an academic as well as managerial basis.

From an academic perspective, this design is in line with the positivist paradigm and supports the variables of objectivity, replicability and generalisability. It enables that statistical methods are used for testing the relations between variables such as financial

awareness, regulatory readiness, perceived ROI - which will generate credible, empirical evidence supporting other's effort of scholarly understanding about sustainable finance.

From the business and managerial point of view, this design produces knowledge which is vital for strategic management. Quantitative evidence enables business leaders or policy makers to:

- Identify the specific financial instruments that are most effective in achieving sustainability outcomes;

- Evaluate the influence of regulatory and institutional readiness to investment success;

- Benchmark performance between different regions and markets; and

- Develop specific ways to overcome barriers to adoption

The design therefore aids evidence-based management through a process of translating stakeholder information into actionable recommendations for policy, investment and operational improvement. It provides a data-driven basis for management actions, allowing managers to optimize their resource allocation, manage financial risk and enhance green finance structures in construction and the real estate industries.

By gathering similar information from the EU, India and Cambodia, this research design also enables a comparison across countries, which is expected to inform decision-makers on the impact of differing policy, market maturity and institutional capacity on the scale and success of green finance efforts. This comparative approach makes the study more strategic and managerial, and thus its results can inform the planning of both local and international sustainability.

3.3 Population and Sample

The population of this study consists of following key stakeholders who deal with green finance mechanism and sustainable building practices in three regions: the European Union (EU), India and Cambodia. These regions were selected by deliberate choice as they represent different stages of institutional, economic and regulatory maturity. The EU has an evolved and organized green finance regime, India is a quickly growing market that will see more policy intervention, and Cambodia is an emerging economy that has yet to see institutional readiness develop. This comparative population enables the study to produce regionally differentiated managerial insights regarding the role of financial maturity, governance structures and business environment on the adoption of green finance in the building sector.

The population has a wide range of stakeholders that are key to the operation of green finance and sustainable construction outcomes. These include:

Financial institutions, banks, investment companies, and insurance companies, which offer and facilitate important financial instruments such as green bonds, green mortgages, and ESG-linked loans. Their inclusion helps to ensure that the research captures the supply-side managerial perspective, in particular as it relates to investment risk assessment, financial product innovation and market development.

Real estate developers and construction firms, which are responsible for the implementation of green building projects. Their participation provides information about managerial decision-making at the project execution level, especially related to cost-benefit analysis, adoption behaviour and reaction to financial incentives.

Policymakers and regulatory bodies, such as government ministries, environmental agencies, and public finance institutions. Their input is critical to understand the role that policy frameworks and institutional incentives play in creating the green finance landscape from a managerial governance perspective.

End-users and building occupants (homeowners, tenants and commercial lessees) having the demand-side perspective (affecting the viability of the market through their consumer behavior, their willingness to pay and sustainability preferences)

Together, these groups constitute the entire value chain of managerial decisions in green finance - from investment to policy formulation to project implementation and adoption by end users. This thorough inclusion is for the sake of making sure that findings are relevant for both strategic as well as operational business decisions.

Sampling Approach & Justification

A random sampling approach was adopted within each stakeholder group to minimise any bias and to reflect the diversity of views within each stakeholder category. Random sampling contributes to the external validity of the findings and makes it sure that the results are representative of a larger managerial ecosystem related to green finance and sustainable construction.

From a managerial perspective, this approach enables the study to include both macro-level decision-makers (e.g. policy and institutional leaders) and micro-level implementers (e.g. project managers and developers), which enables a holistic perspective to be taken on the challenges and enablers across the financial and operational spectrum. This multi-level representation is critical to identifying shortcomings in the difference

between policy intention and market implementation - a critical issue in sustainable business management.

A total of 201 valid responses was collected among the three regions, which was statistically sufficient sample for conducting descriptive and inferential analyses, including regression and anova. The sample includes people working in financial institutions, real estate development companies, policy-making and end-user groups. Such diversity provides for an equilibrium understanding by management of both the supply and demand mechanisms for green finance.

From a business perspective, a sample of this size is adequate to ensure the data reliability to benchmark stakeholder attitude and behavior across regions. It gives a base to evidence-based strategic recommendations so that industry leaders and policymakers can see which managerial practices, financial tools or regulating mechanisms are most effective for driving the adoption of green finance in sustainable building initiatives.

Justification for Sample Size

The sample size of 201 respondents was chosen taking into consideration both statistical validity and managerial relevance. Statistically, this sample provides enough power to conduct quantitative analyses, including, for example, descriptive statistics, regression, and ANOVA, so that the results are robust and generalizable.

From a managerial justification, representation of a wide range of significant business and policy actors affecting the green finance success is ensured through the sample. By involving a cross-section of institutional and operational stakeholders, the study

produces insights that are not only suitable for academic reasoning but can also be implied to address business strategies, investment eighties and policy implementation.

The variety of respondents in the study guarantees that supply side of the analysis (from the side of the financiers and developers) and demand side (from the side of the policymakers and end-users) are represented, thus allowing for a comparative analysis based on management. This is to help identify region-specific and globally transferable best practices for the sustainable finance management.

3.4 Participant Selection

The method of choosing participants for this study was through a process of random sampling, which was done in order to ensure that the sample represented the general population of people and stakeholders engaged in green finance and green building practices. Random sampling was chosen so as to avoid selection bias and for an unbiased selection of the participants in a different sector in order to be generalized for three regions, namely, European Union (EU), India, and Cambodia.

Participants were selected from key stakeholder communities, including financial institutions, real estate developers, policymakers, and end-users of green buildings. Financial institutions have been selected because of their role in accommodating green finance tools, and on the other hand, real estate developers have been selected for their role in implementing and adopting green building projects. Policymakers were chosen as they shape the regulatory environment and end-users were invited to get the perspectives of demand sides.

This random sampling approach ensures that a diverse and representative sample of responses is collected to provide a full picture of the barriers, opportunities, and effectiveness of green finance in facilitating sustainable building practices in the selected regions.

3.5 Instrumentation

The primary data collection tool employed in this research was the structured questionnaire, administered via Google Forms. The objective of this questionnaire was to gather the quantitative data regarding the green finance mechanisms and the sustainable building practices. It was divided into 5 sections; demographic information, awareness of green finance mechanisms; efficiency of green finance tools; barriers and opportunities; and, finally, the future outlook of green finance and sustainable buildings.

The first part was with questions for simple demographic information such as sector, region and years of experience to get to know the background of the respondents. The second of part was used to perceive the awareness of green finance mechanisms such as green bond, green mortgage and ESG-linked loan by the respondents. The third and final section was to focus on how effective these financial tools were at encouraging sustainable building practices. The fourth section addressed barriers and opportunities in adoption of Green Finance, including the particular issues of high up-front costs as well as regulation. The last part was the aggregation of some observations about the future face of green finance in the building sector.

The questionnaire consisted predominantly of closed-ended questions which were based on Likert-scale, multiple choice questions and binary (yes/no) questions with regards to agreements with statements. A few open-ended questions were included to solicit more insights e.g. challenges in implementation of green finance or suggestions for improvement.

Before the complete distribution, the questionnaire was also pre-tested with a small group of respondents to make sure that it is clear and relevant. The data were collected through the use of Google forms which provided real time response tracking as well as easy data management. Ethical considerations were prioritized where informed consent was taken from all the participants in order to assure confidentiality and anonymity of the responses.

3.6 Data Collection Procedures

The data collection for this study was done through an online survey using an online survey system form through Google Forms, and this was selected for its efficiency and accessibility across geographical locations. The primary objective of the survey was to collect quantitative information about green finance mechanism and sustainable building practice from various stakeholders like financial institutions, real estate developers, policy makers and ultimate users of green buildings. Respondents were drawn from three different areas, the European Union (EU), India, and Cambodia, to have a variety of different perspectives from various institutional and economic contexts.

The survey has been designed with five sections as follows: demographic information, awareness of green finance mechanisms, perceived effectiveness of green finance tools, barriers and opportunities towards green finance adoption, and future outlook for green finance in sustainable buildings. Each section was designed to collect information (in the form of Likert scale and multiple choice questions) in order to obtain a comprehensive view of the thoughts of stakeholders related to green finance and sustainable construction.

The participants were selected using a random sampling approach to ensure that there are no biases in the selection of the stakeholders from different sectors that are involved in green finance and sustainable building practices. This approach allowed a set of individuals to be included here to present a more generalizable set of responses. The Survey link was distributed using email invitations, professional networks/social media to reach out to professionals in the selected regions. During the data collection period, several reminder emails were sent to encourage participation to improve the response rate.

The responses were automatically collected and stored using Google Forms, which presented the data in a structured way, so that the results of the survey could be monitored and managed easily. Once data collection was complete, the responses were carefully examined for completeness, and invalid responses were not considered. The cleaned data were stored securely to maintain participant confidentiality and anonymity.

Ethical considerations were strictly followed. Participants were fully informed as to the purpose of the study and their voluntary participation. Informed consent was sought from all respondents before the commencement of the survey, and all data was anonymised

to preserve privacy. The data obtained was only used for this study, ensuring the integrity and confidentiality of the answers.

Figure 6 Evidence of Data Collected

Timestamp	Email Address	What is your age group?	What is your Gender?	What is your highest level of education?	What is your current employment status?	Which sector do you primarily work in?
11/25/2024 7:39:56	juhd.gh.com	35-44	Male	High School	Part-time	Academia/Research
11/25/2024 13:47:06	jjena2010@gmail.com	35-44	Male	Master's Degree	Full-time	Finance/Banking
11/25/2024 22:07:08	chaudhuryalok31@gmail	25-34	Male	Bachelor's Degree	Self-Employed	Construction/Real estate
11/25/2024 22:15:12	shrutray25@gmail.com	25-34	Female	Master's Degree	Full-time	Government/Policy
11/25/2024 22:41:52	vikash.agarwal123@gm	35-44	Male	Master's Degree	Full-time	Oil
11/26/2024 9:11:34	deepak.igit2005@gmail.	35-44	Male	Bachelor's Degree	Full-time	Government/Policy
11/26/2024 9:19:55	nishthaessentials@gma	25-34	Female	Bachelor's Degree	Self-Employed	Construction/Real estate
11/26/2024 9:49:23	shilpika2004@gmail.cor	35-44	Female	Bachelor's Degree	Full-time	Construction/Real estate
11/28/2024 21:22:32	neeladri.neo@gmail.com	35-44	Male	Master's Degree	Full-time	Consulting
11/29/2024 1:15:03	pruthesh29@gmail.com	35-44	Male	Master's Degree	Full-time	Product management
11/29/2024 12:09:27	omahead@gmail.com	35-44	Male	Bachelor's Degree	Full-time	IT
12/1/2024 20:47:55	ar.abhishashsingh.09@g	35-44	Female	Master's Degree	Full-time	Academia/Research
12/2/2024 11:34:49	aroop.sundarray@gmail	45-54	Male	Master's Degree	Full-time	Finance/Banking
12/2/2024 20:29:25	prempsc@gmail.com	55 and above	Male	Bachelor's Degree	Full-time	Academia/Research
12/2/2024 20:41:57	praveen.rath@gmail.cor	35-44	Male	Master's Degree	Self-Employed	Construction/Real estate
12/2/2024 21:00:00	ankitdixit030@gmail.cor	35-44	Male	Master's Degree	Full-time	Government/Policy
12/2/2024 21:34:59	indraban111@gmail.cor	45-54	Male	MBA	Full-time	Media analytics
12/2/2024 21:35:36	archvalue@gmail.com	35-44	Male	Bachelor's Degree	Self-Employed	Construction/Real estate
12/2/2024 21:54:09	sahoo.bikram1991@gm	35-44	Male	Master's Degree	Full-time	Construction/Real estate

(Source: Google form)

3.7 Data Analysis

The data analysis for this study was done using the Python programming language, which was used to conduct the required statistical tests and generate visual representations of study findings. The analysis process was designed to resolve the research questions on how effective barriers and opportunities of the green finance mechanism are to promote

sustainable building practices. This was done using data cleaning, descriptive statistics, inferential statistics, and graphical representations.

The first step in the data analysis process was to clean the data. After the data collection, the raw responses were imported into a Python environment - the data set was then checked for incomplete, invalid or outlier' responses. Missing or inconsistent data were resolved by eliminating incomplete data in order to ensure the integrity of the analysis. This helped to ensure that only valid responses were included in the final dataset and that any potential biases in the results were minimised.

Once the data was cleaned, descriptive statistics were then applied in order to summarise and present the data in a meaningful way. Python libraries such as Pandas and NumPy were used to calculate relevant statistics, including the mean, median, mode, and standard deviation, for Likert-scale responses and multiple-choice questions. This initial analysis supported the determination of trends and central tendencies in the responses, such as agreement or disagreement with statements on green finance mechanisms and sustainable building practices as a whole. The descriptive analysis provided an overview of the participant's perception of the green finance tool and its effectiveness.

After doing the descriptive analysis, inferential statistics were used to explore the relationships between different variables. Python's SciPy library was used to perform tests, such as those based on the Chi-square test, to see if perceptions of green finance mechanisms varied on parameters such as region, sector or years of experience, etc. For example, the Chi-square test was then applied in case there existed a significant difference in responses between the respondents residing in the European Union, India and Cambodia,

based on their industry background (financial institution, developer, policy maker, etc.) differences.

Correlation analysis using Python's Pandas library to find out any significant relationship that shall exist between any of the perceived barriers (ex, High costs, constraints of regulations), and the willingness to adopt green finance mechanisms. This helped to identify key drivers that can contribute to and/or impede the uptake of green finance in the building sector.

Regression analysis was also performed to determine the impact of the green finance tools (eg green bonds, green mortgages) on the adaptation of sustainable building practices. The Python library Statsmodels was used to engage in linear regression to understand how strong and in which way the relationship between the financial instruments and the promotion of sustainable building practices. This analysis had paid dividends in getting insights on the way green finance mechanisms had had the most significant impact in overcoming challenges of green building projects.

In addition to the statistical tests, the graphical representation of the data was also done using the Python language. Visualisations such as bar charts, pie charts and scatter plots were plotted with the help of Matplotlib and Seaborn libraries. These visualisations helped in the clear presentation of the key results, such as the distribution of the responses related to the effectiveness of the green finance tools, barriers to adoption and demographic breakdown of the respondents. Graphs were beneficial at finding trends and patterns in the data making complex finding easier to access and interpret.

3.8 Research Design Limitations

While the quantitative research design used in this study provides valuable insights into the role that green finance mechanisms play in sustainable building practices, there are a number of limitations that should be recognised.

First, the cross-sectional design implies that data have been gathered at a single point in time. As a result, the study does not reflect changes or trends over time, which could provide more insight into how perceptions and practices related to green finance are evolving.

Second, a random sampling method was used in the selection of the sample, which reduces the possibility of bias but does not guarantee the representation of all the relevant subgroups in the population. While the study's approach to improve generalizability through sampling is good, the conclusions may not adequately reflect the specific characteristics or experiences of particular stakeholder groups, especially in emerging green finance markets, such as Cambodia.

Additionally, although survey methodology is a helpful and efficient way to collect data, it is plagued by the fact that responses are self-reported. Participants may have given socially desirable responses or have been affected by their own biases or perceptions in considering the effectiveness of green finance mechanisms, and the reliability of the data provided may be affected.

Another limitation to this is the scope of study. The research is focusing on as many as three areas only (EU, India, and Cambodia), on which we may not have a complete idea of what the experiences of stakeholders in other regions with different regulatory,

economic, and institutional setups are. Whilst this comparative approach is valuable, the findings may not be fully relevant to other countries and/or regions with different green finance ecosystems.

Finally, the study is based on survey data, which is a valuable source of information, but it may not capture the depth and nuance of stakeholder experiences and challenges. The absence of qualitative information does, therefore, mean that the complexity of some of the barriers, such as cultural or contextual, may not be fully explored.

3.9 Conclusion

This chapter presented the methodology of quantitative research that was employed to study the role of green finance mechanisms for sustainable building practices in three regions: the European Union (EU), India, and Cambodia. Using a survey-based methodology, the study aimed to collect empirical data from key stakeholders, including financial institutions, real estate developers, policy-makers, and end-users, to examine the adoption, implementation, and barriers to the adoption of green finance tools (i.e., green bonds, green mortgages, and ESG-linked loans).

The research design was set to include measurable, statistical evidence that would provide actionable insight into the workings of green finance in the construction sector. The application of random sampling meant that a representative sample was obtained, and a sample that can be generalised to other parts of the region regarding the adoption of green finance can be inferred.

While the methodology was planned meticulously to provide answers to research questions, there were some limitations, as noted, e.g., the cross-sectional nature of the study, possible biases in self-reported information and focused on three regions. Despite these limitations, the methodology provides a rigorous approach to understanding the current landscape of green finance in the building sector, and the results will make valuable contributions to both policy development and industry practice.

Overall, this chapter has laid the foundation for the empirical analysis that follows to ensure that the collected data are reliable and capable of answering the key research questions concerning the barriers, enablers, and effectiveness of green finance in promoting sustainable building practices.

CHAPTER IV:

RESULTS

4.1 Demographic Details

4.1.1 Survey Graphs

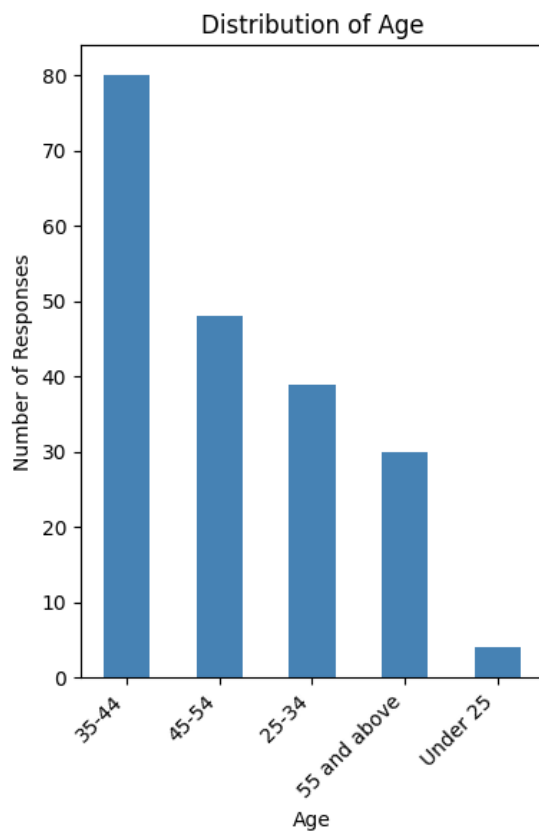


Figure 7 Distribution of Age

(Source: Author)

The graph titled "Distribution of Age" shows the number of responses across various age groups. The majority of the responses fall within the 35-44 age group, with

over 80 responses. The 45-54 age group follows with around 50 responses, while the 25-34 and 55 and above groups have roughly 30 and 20 responses, respectively. The "Under 25" age group has the least number of responses, with fewer than 10.

Interpretation:

The age distribution highlights that the survey responses are predominantly from individuals in the middle-aged demographic, with a significant representation from the 35-44 and 45-54 age groups. This suggests that individuals with more career experience or responsibilities in green finance and construction-related fields are engaging with the subject matter. The relatively low representation from younger respondents (Under 25) indicates a potential gap in involvement from early-career professionals or students, which could be an area for further research or targeted outreach in future studies. The data could indicate that green finance and sustainability issues are being taken up more by those in mid to late career stages who might have more decision-making power or greater exposure to these topics.

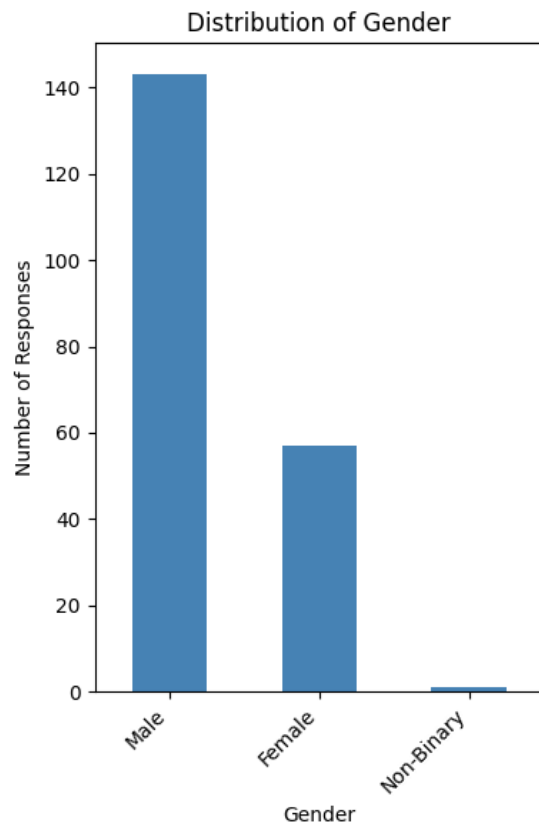


Figure 8 Distribution of Gender

(Source: Author)

The graph titled "Distribution of Gender" shows that the majority of the responses come from male participants, with over 140 responses. Female participants contribute fewer than 70 responses, while non-binary respondents are minimal, with less than 10 responses.

Interpretation:

The gender distribution reveals a clear imbalance, with a dominant representation from male respondents. This could suggest a gender gap in the involvement or engagement with green finance and sustainability topics, possibly reflecting broader trends in the

construction and finance industries where men may be more represented. The relatively low response from female and non-binary individuals indicates that these groups might be underrepresented in the field or the survey's respondent pool. It may be beneficial to explore ways to engage more diverse participants in future studies to ensure a more inclusive representation of views on green finance.

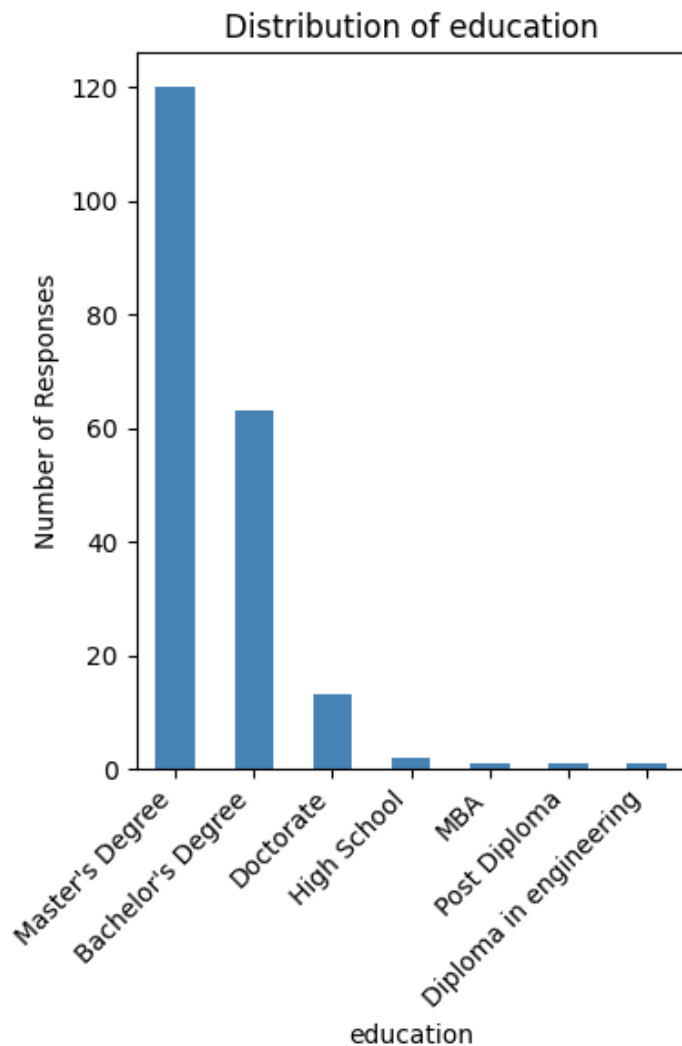


Figure 9 Distribution of Education

(Source: Author)

The graph titled "Distribution of Education" shows that the majority of responses come from individuals with a Master's Degree, with more than 120 responses. The next highest category is Bachelor's Degree, with around 70 responses. A smaller proportion of respondents hold a Doctorate, with fewer than 30 responses. Other categories such as High School, MBA, Post-Diploma, and Diploma in Engineering have minimal representation, each with fewer than 10 responses.

Interpretation:

The education distribution reveals a highly educated respondent pool, with a dominant representation of individuals holding Master's Degrees. This suggests that the survey is drawing from a group with significant academic qualifications, likely professionals or experts in their respective fields. The relative scarcity of respondents with High School diplomas or lower educational qualifications may indicate that the topics of green finance and sustainability are primarily of interest to individuals with higher education levels. The presence of some Doctorate-level responses shows that the subject is attracting experts or those with specialized knowledge in the field. This trend may reflect the complexity and technical nature of green finance and construction, which typically requires advanced education. However, the low representation of other educational backgrounds highlights a potential gap in involving a more diverse range of educational experiences in the research.

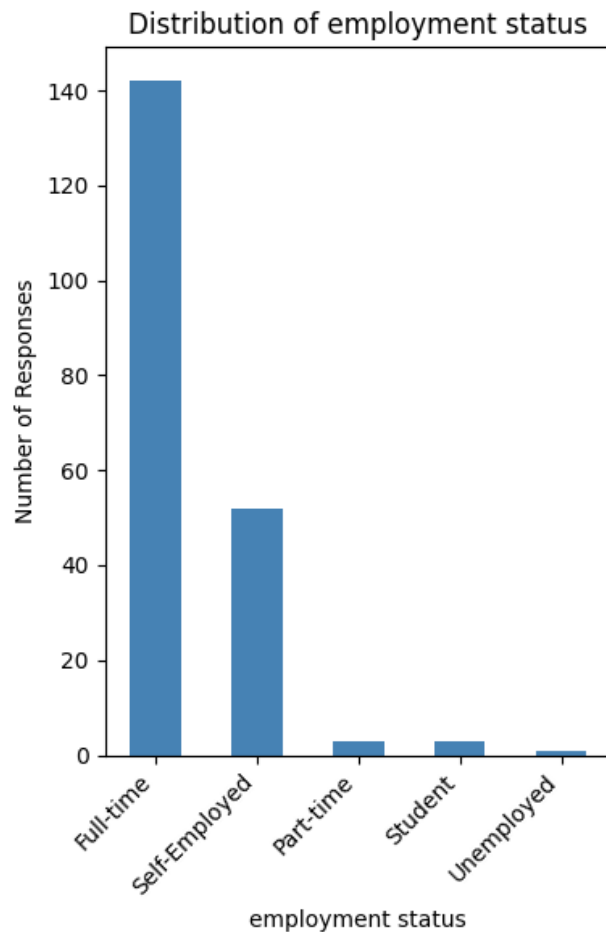


Figure 10 Distribution of Education Status

(Source: Author)

The graph titled "Distribution of Employment Status" shows that the majority of responses come from individuals employed full-time, with over 140 responses. The second largest group is self-employed, with around 60 responses. Part-time employees, students, and unemployed individuals each have very few responses, with numbers below 10.

Interpretation:

The employment status distribution reveals that the survey is predominantly represented by individuals in full-time employment, indicating that professionals engaged

in green finance and construction are the primary participants. This suggests that green finance and sustainability are topics of interest to those with stable career positions, likely in decision-making or policy roles. The presence of self-employed respondents also indicates some entrepreneurial involvement, particularly in fields related to sustainability or consulting. The minimal representation of part-time workers, students, and unemployed individuals suggests that these groups are less engaged with the subject matter, potentially due to limited exposure to these sectors or a lower level of professional involvement. The data may imply that more targeted outreach is needed to engage a broader range of employment statuses in future research.

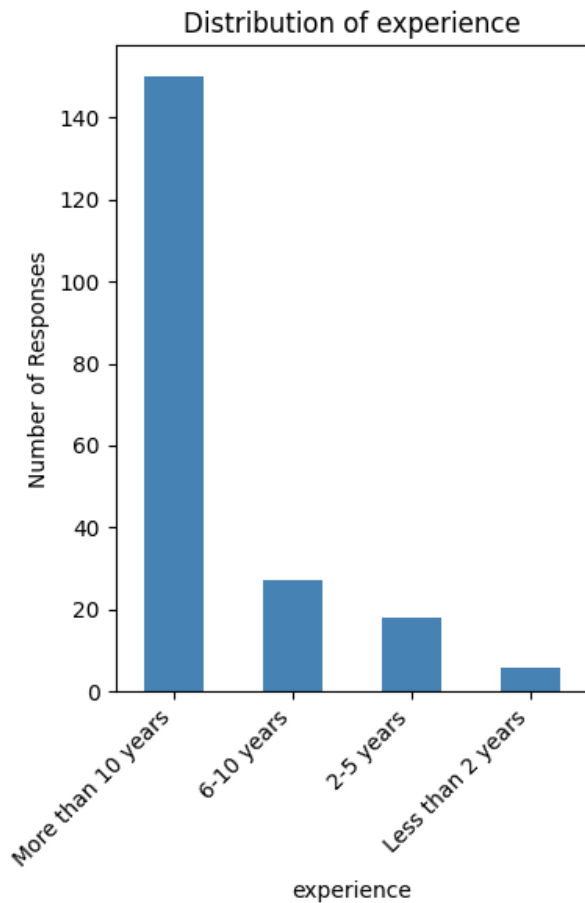


Figure 11 Distribution of Experience

(Source: Author)

The graph titled "Distribution of Experience" shows that the majority of responses come from individuals with more than 10 years of experience, with over 140 responses. The second largest group includes individuals with 6-10 years of experience, followed by those with 2-5 years of experience, and a very small number of respondents with less than 2 years of experience.

Interpretation:

The experience distribution highlights that the survey primarily captures responses from individuals with significant professional experience, particularly those with over 10

years in their respective fields. This indicates that the topics of green finance and sustainability attract more seasoned professionals, likely those who hold leadership or decision-making roles. The relatively smaller representation of respondents with 6-10 years and 2-5 years of experience suggests that mid-career professionals are somewhat engaged but not as extensively. The minimal response from individuals with less than 2 years of experience points to the fact that newcomers to the field are underrepresented, potentially due to limited exposure or involvement with green finance. This demographic gap could be addressed in future research to capture a more diverse range of experience levels.

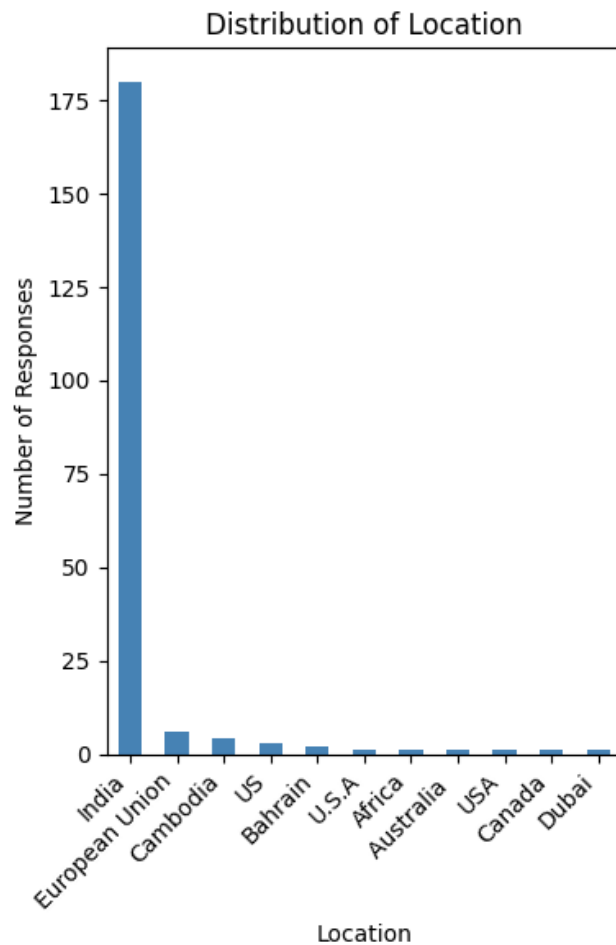


Figure 12 Distribution of Location

(Source: Author)

The graph titled "Distribution of Location" shows that the overwhelming majority of respondents are located in India, with over 175 responses. Cambodia follows with a much smaller number of responses, and other locations, such as the European Union, the U.S., Bahrain, Africa, Australia, Canada, and Dubai, each have minimal representation, with fewer than 20 responses from each location.

Interpretation:

The location distribution indicates a strong regional bias, with India representing the vast majority of the responses. This could reflect the geographic focus of the survey or the level of awareness and engagement with green finance in India, suggesting that the topic is of particular relevance or interest in that region. The underrepresentation of other regions, like the European Union and the U.S., might be due to fewer participants from these areas or a lack of targeted outreach in these regions. This imbalance suggests the potential to expand the survey's reach in future studies to include a more diverse set of global respondents, especially from regions actively engaged in green finance policies and practices.

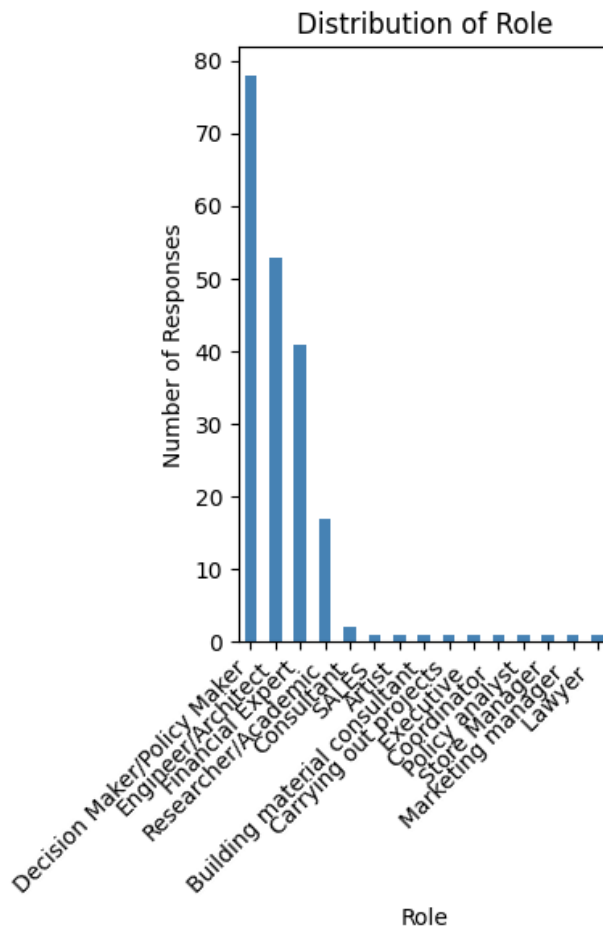


Figure 13 Distribution of Role

(Source: Author)

The graph titled "Distribution of Role" shows that the majority of responses are from individuals in decision-making or policy-making roles, with over 70 responses. The next highest groups include engineers/architects, researchers/consultants, and financial experts, each with around 30 to 40 responses. Other roles, such as building material consultants, project managers, and marketing managers, have minimal representation, with fewer than 10 responses in each.

Interpretation:

The role distribution suggests that green finance and sustainability in construction are primarily being addressed by professionals in leadership and decision-making positions, such as policy makers and senior consultants. This aligns with the importance of strategic thinking in green finance adoption. The presence of respondents from engineering and architectural roles indicates a technical interest in the implementation of green building practices. The low representation from project managers, marketing professionals, and others suggests that there is less engagement from the operational or promotional sides of the industry. This might highlight a gap in the engagement of certain roles, which could be important in facilitating broader adoption of green building practices in the future.

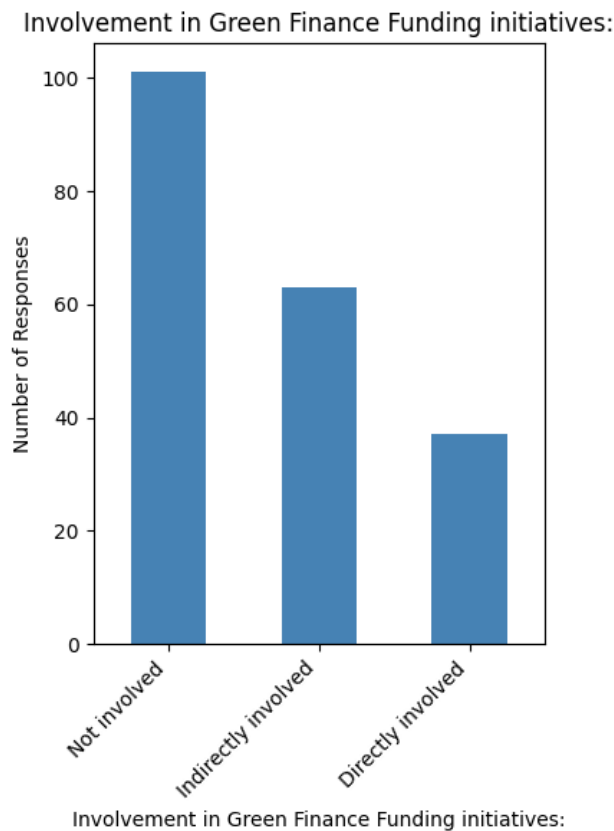


Figure 14 Distribution of Involvement in Green Funding Initiatives

(Source: Author)

The graph titled "Involvement in Green Finance Funding Initiatives" shows that the majority of respondents (over 100) are not involved in green finance funding initiatives. A smaller group (around 70) reports being indirectly involved, while fewer than 50 respondents are directly involved in such initiatives.

Interpretation:

The data suggests that while green finance is an area of interest, most respondents are not directly involved in green finance funding initiatives. This could reflect the early stage of engagement with green finance or indicate that many professionals work in areas related to the industry but not within the funding or investment arms. The significant number of respondents who are "indirectly involved" suggests that while they may not directly manage funding, they might still influence or support these initiatives through advisory roles, policy-making, or other forms of indirect involvement. The relatively low number of direct participants highlights an opportunity for increased engagement in green finance funding activities, which could help accelerate the development and adoption of green building solutions.

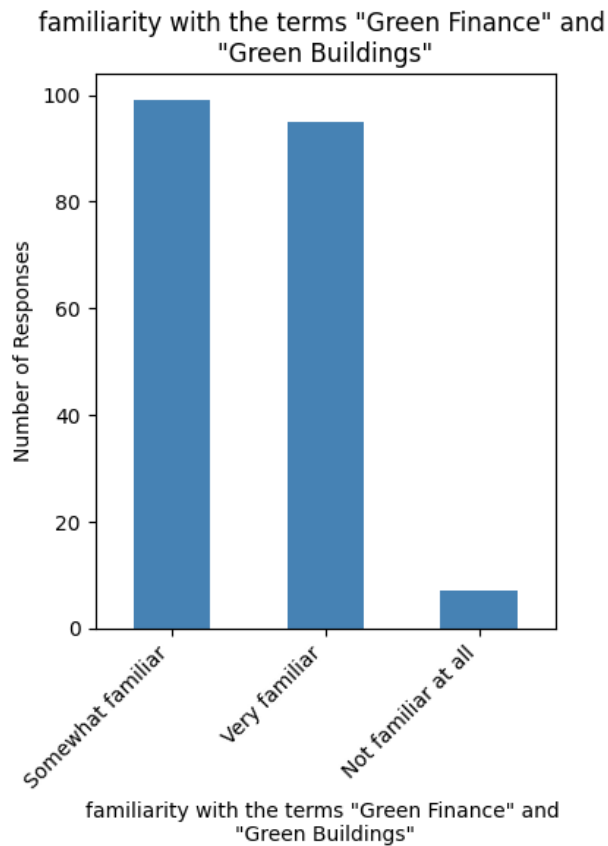


Figure 15 Distribution of Familiarity with the Terms “Green Finance and Buildings”

(Source: Author)

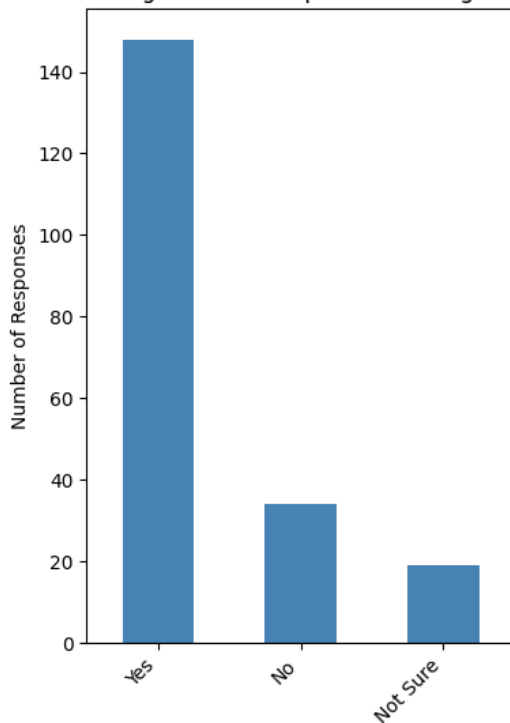
The graph titled "Familiarity with the terms 'Green Finance' and 'Green Buildings'" indicates that the majority of respondents are either "Very familiar" or "Somewhat familiar" with these terms, with more than 80 responses in each of these categories. Only a small number of respondents (fewer than 10) are "Not familiar at all."

Interpretation:

The high level of familiarity with the terms "Green Finance" and "Green Buildings" suggests that the survey respondents have a solid understanding or exposure to these concepts. This could indicate that the participants are likely professionals or individuals

involved in sustainability, construction, or finance, where these terms are commonly discussed. The small number of respondents who are "Not familiar at all" shows that the terms have gained significant traction within the relevant sectors, making this a promising foundation for further research or initiatives in green finance and sustainable construction. The data suggests that awareness and knowledge of these terms are already widespread among the respondents, which could facilitate deeper discussions and insights into green building practices and financing mechanisms.

Investment in green finance products and green building



Investment in green finance products and green building

Figure 16 Distribution of Investment in Green Finance Products and Green Building

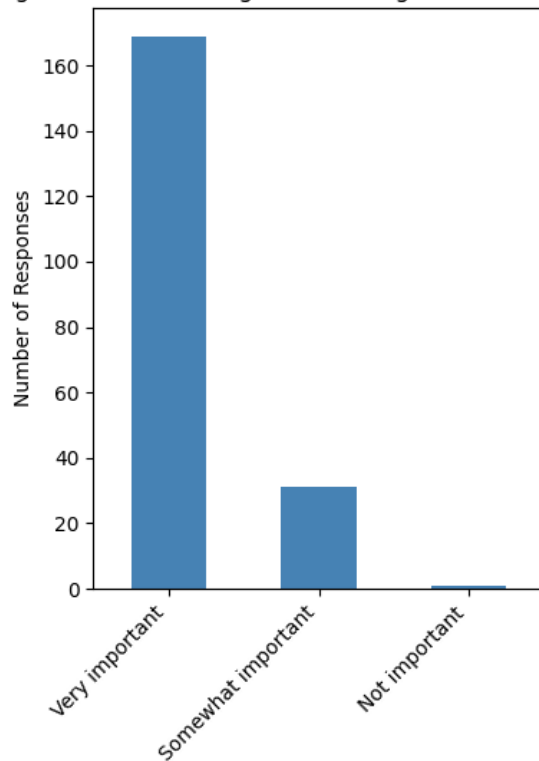
(Source: Author)

The graph titled "Investment in Green Finance Products and Green Building" shows that a large majority of respondents (over 140) indicate they are invested in green finance products and green buildings. A smaller group (around 40) say they are not invested, while fewer than 20 respondents are unsure about their investment status.

Interpretation:

The significant number of respondents indicating investment in green finance products and green buildings suggests a strong commitment to sustainability in the surveyed population. This could reflect an increasing interest in environmentally responsible investment, especially within industries related to construction and finance. The relatively small number of individuals reporting no investment may point to a growing trend towards integrating green finance into business or personal portfolios. The few respondents who are unsure might benefit from more education or clarity about green finance products and green building investments. Overall, this data reflects a positive inclination towards sustainable financial practices and investment in green technologies.

Importance of green finance and green building for environmental sustainability



Importance of green finance and green building for environmental sustainability

Figure 17 Distribution of Importance of Green Finance and Building for Environmental Sustainability

(Source: Author)

The graph titled "Importance of Green Finance and Green Building for Environmental Sustainability" indicates that the majority of respondents (over 160) consider green finance and green buildings to be "Very important" for environmental sustainability. A smaller group (around 50) believes they are "Somewhat important," while only a few (fewer than 10) think they are "Not important."

Interpretation:

The overwhelming perception that green finance and green buildings are "Very important" underscores the widespread recognition of their role in promoting

environmental sustainability. This highlights that a majority of respondents understand the critical need for sustainable practices in the finance and construction sectors to combat climate change and support eco-friendly development. The smaller number of those who view them as "Somewhat important" may reflect varying levels of involvement or understanding. However, the minimal representation of those who deem them "Not important" suggests a consensus within the surveyed group about the significant environmental impact of green finance and buildings. This data points to a strong alignment with sustainability goals and the increasing importance of these topics in global discussions.

Summary of Demographic section

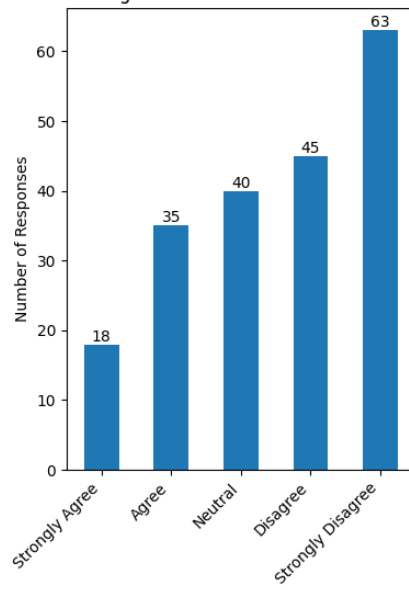
The demographic section of the survey reveals that the majority of respondents are from the 35-44 age group, with a predominant male representation and a high level of education, particularly Master's degrees. Most respondents are employed full-time and have over 10 years of experience in their respective fields, with a strong concentration in decision-making or policy-making roles. Geographically, India has the highest number of respondents, followed by Cambodia, with minimal representation from other regions. Additionally, the survey participants show high familiarity with the terms "Green Finance" and "Green Buildings," with a significant number indicating their involvement in these areas. The overwhelming majority also views green finance and green buildings as very important for environmental sustainability. However, while many respondents are invested

in green finance products, most are not directly involved in funding initiatives but are indirectly engaged.

4.2 Identifying Deficiencies in Green Finance Mechanisms

4.2.1 Survey Graphs

Distribution of Responses for I am aware of the green finance mechanisms available for sustainable construction projects.



I am aware of the green finance mechanisms available for sustainable construction projects.

Figure 18 Distribution of Responses for Awareness of Green Finance Mechanisms for Sustainable Construction Projects

(Source: Author)

Table 1 Distribution of Responses for Awareness of Green Finance Mechanisms for Sustainable Construction Projects

Response	Count
Strongly Disagree	63
Disagree	45
Neutral	40
Agree	35
Strongly Agree	18

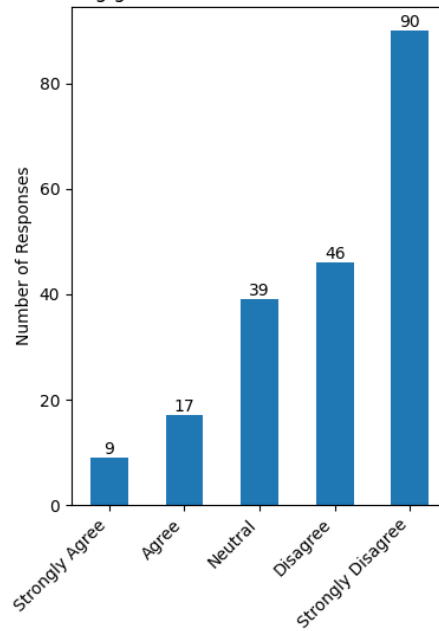
(Source: Author)

The graph titled "Distribution of Responses for Awareness of Green Finance Mechanisms for Sustainable Construction Projects" shows that the majority of respondents (63) strongly disagree with being aware of green finance mechanisms. The next largest group (45) disagree, followed by 40 respondents who are neutral. A smaller group (35) agree, and only 18 respondents strongly agree that they are aware of these mechanisms.

Interpretation:

The data indicates a lack of awareness of green finance mechanisms for sustainable construction projects among the majority of respondents. With a substantial number of individuals strongly disagreeing or disagreeing with the statement, it suggests that knowledge about the available financial tools and resources for green construction is limited within the surveyed group. Although some respondents are neutral or agree, the overall trend points to a need for further education, outreach, and development of green finance awareness initiatives. Increasing familiarity with these mechanisms could encourage greater adoption and investment in sustainable construction practices.

Distribution of Responses for The existing green finance mechanisms meet the needs of the construction industry.



The existing green finance mechanisms meet the needs of the construction industry.

Figure 19 Distribution of Responses for The Existing Green Finance Mechanisms Meeting the Needs of the Construction Industry

(Source: Author)

Table 2 Distribution of Responses for The Existing Green Finance Mechanisms Meeting the Needs of the Construction Industry

Response	Count
Strongly Disagree	90
Disagree	46
Neutral	39
Agree	17
Strongly Agree	9

(Source: Author)

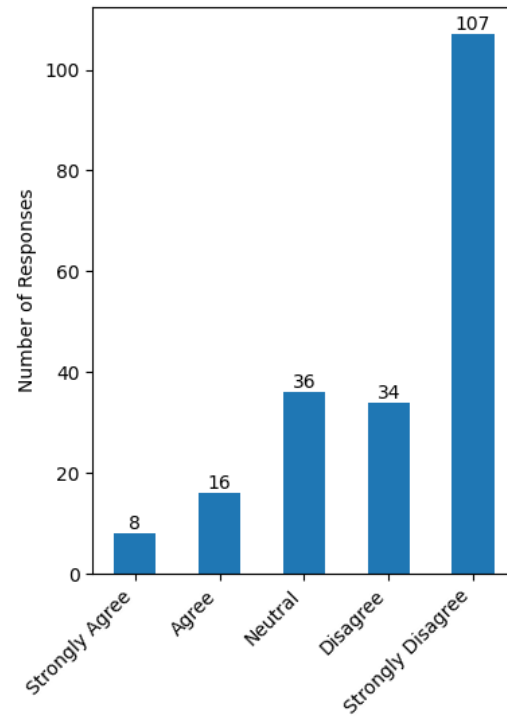
The graph titled "Distribution of Responses for The Existing Green Finance Mechanisms Meeting the Needs of the Construction Industry" shows that the majority of respondents (90) strongly disagree with the statement. The second largest group (46) disagree, while 39 respondents are neutral. Fewer individuals agree (17) and only 9

strongly agree that the existing green finance mechanisms meet the needs of the construction industry.

Interpretation:

The data reveals a significant dissatisfaction with the current green finance mechanisms in meeting the specific needs of the construction industry. The overwhelming number of respondents who strongly disagree or disagree suggests that existing financial tools and resources may not be adequate or well-suited for the industry's requirements. While a few respondents are neutral or agree, the general consensus points to a gap in the alignment between green finance offerings and the practical needs of construction projects. This highlights the need for more targeted, accessible, and effective green finance solutions tailored to the construction sector's demands to foster sustainable growth in the industry.

Distribution of Responses for Green finance mechanisms are clear and transparent for stakeholders.



Green finance mechanisms are clear and transparent for stakeholders.

Figure 20 Distribution of Responses for Green Finance Mechanisms Being Clear and Transparent for Stakeholders

(Source: Author)

Table 3 Distribution of Responses for Green Finance Mechanisms Being Clear and Transparent for Stakeholders

Response	Count
Strongly Disagree	107
Neutral	36
Disagree	34
Agree	16
Strongly Agree	8

(Source: Author)

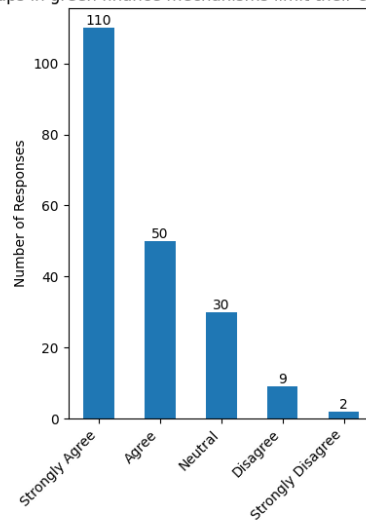
The graph titled "Distribution of Responses for Green Finance Mechanisms Being Clear and Transparent for Stakeholders" shows that the majority of respondents (107) strongly disagree that green finance mechanisms are clear and transparent for stakeholders.

The second largest group (36) disagrees, followed by 16 who agree and 8 who strongly agree. A moderate number of respondents (36) remain neutral.

Interpretation:

The data suggests that most respondents feel that the existing green finance mechanisms lack clarity and transparency for stakeholders. The overwhelming number of individuals who strongly disagree or disagree indicates significant concerns about the accessibility and comprehensibility of these financial mechanisms. This points to a need for better communication, clearer guidelines, and more transparent processes to help stakeholders, particularly those in the construction and finance sectors, fully understand and engage with green finance. The relatively small number of respondents who agree or strongly agree suggests that the current state of transparency is not sufficiently addressing the needs of the majority.

Distribution of Responses for Significant gaps in green finance mechanisms limit their effectiveness in supporting sustainable construction.



Significant gaps in green finance mechanisms limit their effectiveness in supporting sustainable construction.

Figure 21 Distribution of Responses for Significant Gaps in Green Finance Mechanisms Limiting Their Effectiveness in Supporting Sustainable Construction

(Source: Author)

Table 4 Distribution of Responses for Significant Gaps in Green Finance Mechanisms Limiting Their Effectiveness in Supporting Sustainable Construction

Response	Count
Strongly Agree	110
Agree	50
Neutral	30
Disagree	9
Strongly Disagree	2

(Source: Author)

The graph titled "Distribution of Responses for Significant Gaps in Green Finance Mechanisms Limiting Their Effectiveness in Supporting Sustainable Construction" shows that the majority of respondents (110) strongly agree that gaps in green finance mechanisms limit their effectiveness. Another 50 respondents agree with this statement. The remaining responses are more evenly distributed, with 30 respondents neutral, 9 disagreeing, and only 2 strongly disagreeing.

Interpretation:

The data indicates a strong consensus among respondents that gaps in the existing green finance mechanisms significantly hinder their ability to support sustainable construction effectively. The overwhelming majority who strongly agree or agree suggests that the current mechanisms may not be fully developed or aligned with the needs of the construction sector, posing a barrier to the widespread adoption of sustainable building practices. The smaller number of neutral, disagreeing, and strongly disagreeing responses implies that while some may not see these gaps as limiting, the general sentiment strongly leans toward the need for improvement in green finance mechanisms to better support

sustainability in construction. This points to a clear opportunity for refinement and better-targeted solutions in the sector.

Summary of all bar graphs of Objective 1

Objective 1 reveals that while a significant number of respondents are familiar with green finance mechanisms and their role in sustainable construction, there is a clear perception that existing mechanisms are insufficient. Most respondents indicate limited awareness of available green finance mechanisms and express dissatisfaction with their effectiveness in meeting the needs of the construction industry. Many believe that gaps in these mechanisms hinder their ability to support sustainable construction, with concerns about their clarity and transparency. The survey highlights a strong consensus on the need for improvement in green finance initiatives to better address the challenges of the construction sector, suggesting a demand for more comprehensive and accessible financial solutions to promote sustainability.

4.2.2 Test 1: Descriptive Statistics

Result:

Question	Mean	S.D	Min	Max	25th Per	50th
Per (Median)						
I am aware of the green finance mechanisms						

available for sustainable construction projects	2.50	1.33	1 (SD) 5 (SA)	1.0
	2.0	4.0		

The existing green finance mechanisms meet

the needs of the construction industry	2.05	1.18	1 (SD) 5 (SA)	1.0
	2.0	3.0		

Green finance mechanisms are clear and

transparent for stakeholders	1.93	1.18	1 (SD) 5 (SA)	1.0
	1.0	3.0		

Significant gaps in green finance mechanisms

limit their effectiveness in supporting

sustainable construction	4.28	0.94	1 (SD) 5 (SA)	4.0
	5.0	5.0		

Interpretation:

Awareness of Green Finance Mechanisms: The mean score of 2.50 suggests that respondents generally fall between Neutral and Agree regarding their awareness of available green finance mechanisms. A significant number of respondents (63) strongly disagree with this statement, indicating that many stakeholders might not be fully aware of the mechanisms available for sustainable construction.

Effectiveness of Green Finance Mechanisms: The mean score of 2.05 suggests that respondents perceive the existing mechanisms as not very effective. This aligns with the

large number of respondents (90) strongly disagreeing with the statement that these mechanisms meet the needs of the construction industry. This suggests that a gap exists in the alignment of green finance mechanisms with industry needs.

Clarity and Transparency: The low mean score (1.93) and the high frequency of Strongly Disagree responses (107) indicate that respondents perceive green finance mechanisms as lacking clarity and transparency, which could be a barrier to adoption.

Perceived Gaps in Green Finance Mechanisms: The mean score of 4.28 indicates that respondents overwhelmingly believe that significant gaps in green finance mechanisms limit their effectiveness. The majority of respondents (110) Strongly Agree with this statement, indicating a strong consensus that green finance mechanisms are not fully effective due to these gaps.

Conclusion:

The descriptive statistics suggest that while respondents acknowledge the existence of green finance mechanisms, there are substantial concerns regarding their effectiveness, clarity, and alignment with industry needs. Particularly, gaps in green finance mechanisms are perceived as a significant barrier to their adoption, with most respondents strongly agreeing that these gaps limit their effectiveness.

These findings emphasize the need for improving awareness, enhancing transparency, and addressing the gaps in green finance mechanisms to better support sustainable construction.

4.2.3 Test 2: ANOVA

Result

(1.300788322000314, 0.2325254496653376, 4.307870066903681, 0.005720975398219074)

One-Way ANOVA Results:

Comparison of Green Finance Awareness Across Different Regions (EU, India, Cambodia):

F-statistic: 1.30

p-value: 0.2325

Interpretation:

The p-value (0.2325) is greater than 0.05, indicating that there is no statistically significant difference in green finance awareness across the regions (EU, India, Cambodia). This suggests that the region in which an individual is located does not play a significant role in determining their level of awareness of green finance mechanisms.

Comparison of Green Finance Awareness Across Different Experience Levels:

F-statistic: 4.31

p-value: 0.0057

Interpretation:

The p-value (0.0057) is less than 0.05, indicating a statistically significant difference in green finance awareness across different experience levels. This suggests that individuals

with different levels of experience (e.g., less than 2 years, 2–5 years, etc.) have significantly different perceptions of their awareness of green finance mechanisms.

Conclusion:

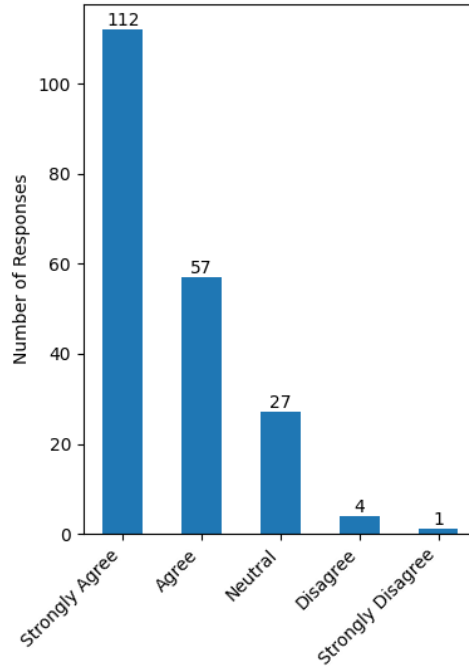
Region does not seem to be a significant factor influencing awareness of green finance mechanisms.

Experience level is a significant factor, with respondents from different experience levels showing differing levels of awareness.

4.3 Analyzing Practical Implications of Green Finance Tools

4.3.1 Survey Graphs

Distribution of Responses for Green finance instruments effectively promote sustainable building practices.



Green finance instruments effectively promote sustainable building practices.

Figure 22 Distribution of Responses for Green Finance Instruments Effectively Promote Sustainable Building Practices

(Source: Author)

Table 5 Distribution of Responses for Green Finance Instruments Effectively Promote Sustainable Building Practices

Response	Count
Strongly Agree	112
Agree	57
Neutral	27
Disagree	4
Strongly Disagree	1

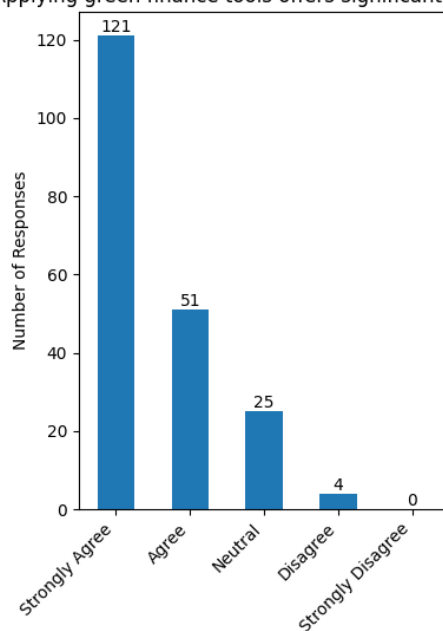
(Source: Author)

The graph titled "Distribution of Responses for Green Finance Instruments Effectively Promote Sustainable Building Practices" shows that the majority of respondents (112) strongly agree that green finance instruments effectively promote sustainable building practices. An additional 57 respondents agree with the statement. Fewer individuals (27) are neutral, while very few (4) disagree, and only 1 strongly disagrees.

Interpretation:

The data reflects a positive outlook on the role of green finance instruments in promoting sustainable building practices. A large majority of respondents strongly agree or agree, indicating that these financial tools are seen as effective in advancing sustainability within the construction industry. The relatively small number of neutral or negative responses suggests that the majority of stakeholders have confidence in the potential of green finance to drive change. However, the minimal disagreement or strong disagreement indicates that while the general sentiment is positive, there may still be some concerns or barriers preventing full support or implementation, possibly due to gaps in awareness or the practical application of these instruments.

Distribution of Responses for Applying green finance tools offers significant economic and environmental benefits.



Applying green finance tools offers significant economic and environmental benefits.

Figure 23 Distribution of Responses for Applying Green Finance Tools Offers Significant Economic and Environmental Benefits

(Source: Author)

Table 6 Distribution of Responses for Applying Green Finance Tools Offers Significant Economic and Environmental Benefits

Response	Count
Strongly Agree	121
Agree	51
Neutral	25
Disagree	4

(Source: Author)

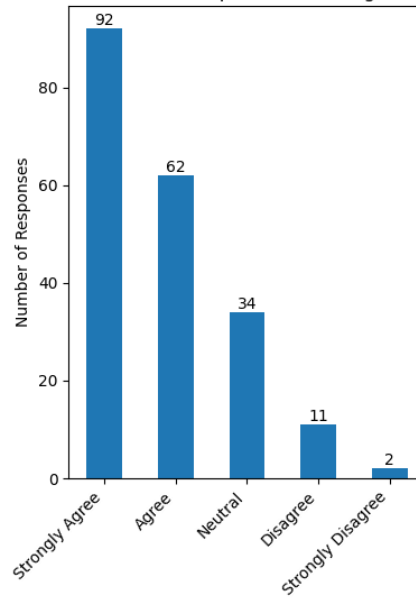
The graph titled "Distribution of Responses for Applying Green Finance Tools Offers Significant Economic and Environmental Benefits" shows that the majority of respondents (121) strongly agree that applying green finance tools offers significant

economic and environmental benefits. A significant number (51) agree with the statement. Fewer individuals (25) are neutral, while 4 disagree, and no respondents strongly disagree.

Interpretation:

The data strongly supports the notion that respondents perceive green finance tools as offering both economic and environmental benefits. The overwhelming majority who strongly agree suggests that these tools are seen as valuable in driving sustainability while also delivering tangible financial advantages. The smaller number of neutral and negative responses indicates broad support, though there may still be some who are uncertain or less convinced of the full impact. The consensus points to a growing recognition of the dual value that green finance can bring, especially in terms of promoting environmental sustainability alongside financial gains, but further efforts to clarify and expand these tools could further strengthen their adoption.

Distribution of Responses for Green finance tools are adaptable to the regulatory and economic conditions in my region.



Green finance tools are adaptable to the regulatory and economic conditions in my region.

Figure 24 Distribution of Responses for Green Finance Tools Are Adaptable to the Regulatory and Economic Conditions in My Region

(Source: Author)

Table 7 Distribution of Responses for Green Finance Tools Are Adaptable to the Regulatory and Economic Conditions in My Region

Response	Count
Strongly Agree	92
Agree	62
Neutral	34
Disagree	11
Strongly Disagree	2

(Source: Author)

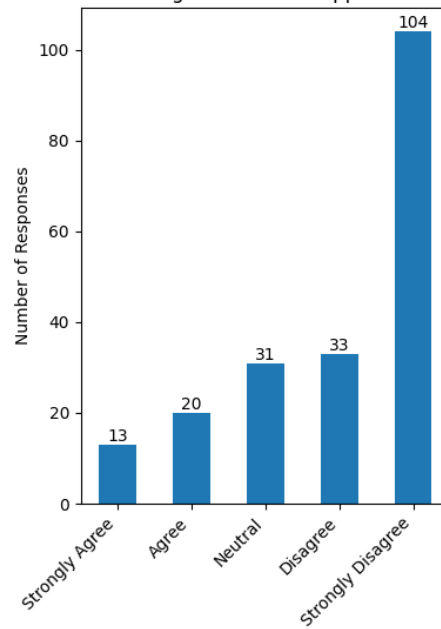
The graph titled "Distribution of Responses for Green Finance Tools Are Adaptable to the Regulatory and Economic Conditions in My Region" shows that the majority of respondents (92) strongly agree that green finance tools are adaptable to the regulatory and economic conditions in their region. An additional 62 respondents agree with the statement.

A smaller group (34) are neutral, and even fewer (11) disagree, with only 2 strongly disagreeing.

Interpretation:

The data indicates that most respondents believe that green finance tools can be effectively adapted to fit the regulatory and economic conditions of their regions. This strong consensus suggests that respondents are confident in the flexibility and applicability of these tools across different regulatory environments and economic climates. While a small number of respondents are neutral or disagree, the overall sentiment points to a positive outlook regarding the scalability and adaptability of green finance tools, reinforcing their potential for broader regional implementation in sustainable projects. However, efforts to address the concerns of the small group of skeptics could further enhance the adoption of these tools.

Distribution of Responses for There is sufficient guidance and support for using green finance tools in construction.



There is sufficient guidance and support for using green finance tools in construction.

Figure 25 Distribution of Responses for There Is Sufficient Guidance and Support for Using Green Finance Tools in Construction

(Source: Author)

Table 8 Distribution of Responses for There Is Sufficient Guidance and Support for Using Green Finance Tools in Construction

Response	Count
Strongly Disagree	104
Disagree	33
Neutral	31
Agree	20
Strongly Agree	13

(Source: Author)

The graph titled "Distribution of Responses for There Is Sufficient Guidance and Support for Using Green Finance Tools in Construction" shows that the majority of respondents (104) strongly disagree that there is sufficient guidance and support for using green finance tools in construction. The second largest group (33) disagree, followed by

31 who are neutral. Smaller groups of respondents agree (20) or strongly agree (13) that there is sufficient support and guidance.

Interpretation:

The data indicates a significant concern among respondents regarding the lack of adequate guidance and support for using green finance tools in construction. The overwhelming number of individuals who strongly disagree and disagree suggests that stakeholders in the construction industry may be struggling with the accessibility, clarity, or availability of resources needed to effectively implement these tools. The relatively small number of respondents who agree or strongly agree points to a gap in the support systems for green finance in construction. This highlights the need for more comprehensive educational resources, clearer guidelines, and practical support mechanisms to help stakeholders effectively engage with green finance initiatives.

Summary of all bar graphs of Objective 2

Objective 2 indicates a positive outlook on the role of green finance tools in promoting sustainable construction practices, with most respondents strongly agreeing that these tools are effective in offering economic and environmental benefits. However, there are concerns regarding the adequacy of guidance and support for their use within the construction industry. While many respondents believe green finance tools are adaptable to regional regulatory and economic conditions, a significant gap remains in terms of clear communication and accessible support. This suggests that while green finance has

potential, there is a pressing need for greater clarity, resources, and regional alignment to ensure these tools can be fully leveraged in the construction sector.

4.3.2 Test 1: Regression Analysis

Result:
OLS Regression Results

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Dep. Variable:	obj2_avg	R-squared:	0.056
Model:	OLS	Adj. R-squared:	0.026
Method:	Least Squares	F-statistic:	1.901
Date:	Tue, 06 May 2025	Prob (F-statistic):	0.0825
Time:	03:16:41	Log-Likelihood:	-178.44
No. Observations:	201	AIC:	370.9
Df Residuals:	194	BIC:	394.0
Df Model:	6		
Covariance Type:	nonrobust		

=====

=====

	coef	std err	t	P> t	[0.025
					0.975]

const		3.2788	0.398	8.232	0.000
2.493	4.064				
Which sector do you primarily work in?			-0.0017	0.012	-
0.140	0.888	-0.026	0.022		
How many years of experience do you have in your field?			-0.0102	0.043	
-0.239	0.812	-0.095	0.074		
Where are you located?			0.0392	0.041	0.955
0.341	-0.042	0.120			
What is your role in your organisation?			0.0313	0.020	1.563
0.120	-0.008	0.071			
Involvement in Green Finance Funding initiatives:			-0.0824	0.076	-
1.079	0.282	-0.233	0.068		
How familiar are you with the terms " Green Finance" and "Green Buildings" ?				0.0972	
0.102	0.953	0.342	-0.104	0.299	
=====					
=====					
Omnibus:	9.431	Durbin-Watson:	1.725		
Prob(Omnibus):	0.009	Jarque-Bera (JB):	11.141		
Skew:	-0.373	Prob(JB):	0.00381		
Kurtosis:	3.880	Cond. No.	116.		

Key Outputs:

R-squared: 0.056 — Only 5.6% of the variance in perceptions about green finance tools' practical value is explained by the model.

F-statistic ($p = 0.0825$) — The model is not statistically significant at the 5% level, indicating weak explanatory power overall.

Coefficient Highlights:

Variable	Coef.	p-value	Interpretation
Familiarity with Green Finance	0.097	0.342	Not significant
Involvement in Green Finance Initiatives	-0.082	0.282	Not significant
Role in Organization	0.031	0.120	Not significant
Location	0.039	0.341	Not significant
Years of Experience	-0.010	0.812	Not significant
Sector	-0.002	0.888	Not significant

Interpretation:

None of the independent variables significantly predict the perceived effectiveness or benefits of green finance tools.

While familiarity and involvement were hypothesized to be strong drivers, their p-values (> 0.05) suggest weak influence in this model.

Regression Model Results with other variables

Dependent Variable: Average agreement on the practical implications of green finance tools

Independent Variables: Awareness, perceived gaps, barriers, and policy-related statements

OLS Regression Results

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Dep. Variable:	obj2_avg	R-squared:	0.336
Model:	OLS	Adj. R-squared:	0.315
Method:	Least Squares	F-statistic:	16.34
Date:	Tue, 06 May 2025	Prob (F-statistic):	3.33e-15
Time:	03:27:12	Log-Likelihood:	-143.07
No. Observations:	201	AIC:	300.1
Df Residuals:	194	BIC:	323.3
Df Model:	6		
Covariance Type:	nonrobust		

=====

=====

				coef	std err
t	P> t	[0.025	0.975]		

const 1.6369 0.261

6.271 0.000 1.122 2.152

I am aware of the green finance mechanisms available for sustainable construction projects.

0.0694 0.028 2.478 0.014 0.014 0.125

Significant gaps in green finance mechanisms limit their effectiveness in supporting sustainable construction. 0.1969 0.050 3.943 0.000 0.098 0.295

Regulations and policies make it difficult to adopt green finance for construction projects.

-0.0402 0.059 -0.676 0.500 -0.158 0.077

High costs and long payback periods are barriers to using green finance.

0.0738 0.066 1.120 0.264 -0.056 0.204

Government incentives and subsidies adequately support green finance adoption.

0.1362 0.049 2.795 0.006 0.040 0.232

Collaboration among developers, financial institutions, and policymakers improves the adoption of green finance. 0.0819 0.074 1.103 0.272 -0.065 0.229

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Omnibus: 12.219 Durbin-Watson: 1.961

Prob(Omnibus): 0.002 Jarque-Bera (JB): 29.895

Skew: 0.088 Prob(JB): 3.22e-07

Kurtosis: 4.881 Cond. No. 75.8

Key Outcomes

R-squared: 0.336 — The model now explains 33.6% of the variance in perceived effectiveness of green finance tools, a significant improvement.

F-statistic: 16.34 ($p < 0.001$) — The model is statistically significant.

Coefficient Summary

Variable	Coef.	p-value	Interpretation
Awareness of green finance mechanisms	0.069	0.014	Significant positive impact
Gaps in green finance mechanisms gaps perceived, higher (possibly indicating awareness of need)	0.197	0.000	Highly significant — stronger avg. score
Regulations/policies as barriers	-0.040	0.500	Not significant
High costs & long payback periods	0.074	0.264	Not significant
Government incentives and subsidies support, higher value	0.136	0.006	Significant — more perceived perceived
Collaboration among stakeholders	0.082	0.272	Not significant

Interpretation

Perceived gaps and government support are key drivers for shaping positive opinions about green finance tools.

Awareness also plays a meaningful role in shaping perceptions.

Policy, cost, and collaboration perceptions, while relevant, did not show strong statistical significance here.

Interpretation of Regression Results

The multiple regression analysis on Objective 2 (green finance tools' effectiveness in promoting sustainable building practices) reveals important insights based on various independent variables:

Awareness of Green Finance Mechanisms

Coefficient: 0.069 ($p = 0.014$)

Awareness of green finance mechanisms positively influences perceptions of their effectiveness in promoting sustainable building practices. Respondents who are more aware of the available mechanisms tend to rate the effectiveness of these tools higher. This highlights the importance of education and outreach in improving stakeholder engagement with green finance initiatives.

Perceived Gaps in Green Finance Mechanisms

Coefficient: 0.197 ($p < 0.001$)

The existence of significant gaps in green finance mechanisms is the most influential factor in shaping respondents' perceptions of the effectiveness of green finance tools. Those who perceive substantial gaps in the current mechanisms tend to view green

finance tools as more effective, likely due to the recognition of unmet needs that green finance can address. This result suggests that improving or addressing these gaps could enhance the perceived utility and effectiveness of green finance.

Regulations and Policies as Barriers

Coefficient: -0.040 ($p = 0.500$)

Regulations and policies that make it difficult to adopt green finance do not have a statistically significant impact on perceptions of green finance effectiveness. This suggests that while regulatory barriers are acknowledged, they may not be the primary factors influencing respondents' views on the practical impact of green finance tools in sustainable construction. Other factors, such as awareness and the identification of gaps, might overshadow regulatory challenges in shaping these perceptions.

High Costs and Long Payback Periods as Barriers

Coefficient: 0.074 ($p = 0.264$)

Perceptions of high costs and long payback periods are also not statistically significant in influencing respondents' evaluations of green finance tools. Despite concerns around financial viability, this does not appear to be a major determinant in shaping how respondents assess the effectiveness of green finance tools for promoting sustainable building practices.

Government Incentives and Subsidies

Coefficient: 0.136 ($p = 0.006$)

Government incentives and subsidies are found to significantly support the adoption and perception of green finance tools. Respondents who perceive government

support in the form of incentives and subsidies are more likely to view green finance tools as effective in promoting sustainable building practices. This underscores the importance of financial support and policy interventions to encourage the widespread adoption of green finance.

Collaboration Among Stakeholders

Coefficient: 0.082 ($p = 0.272$)

Collaboration between developers, financial institutions, and policymakers does not have a statistically significant impact on perceptions of green finance tools. While collaboration is likely an important factor in practice, it may not have a direct or strong influence on respondents' views regarding the effectiveness of green finance tools in this context.

Key Insights:

Awareness and the perception of gaps in green finance mechanisms are the most influential factors shaping how effective respondents believe green finance tools are.

Government incentives play a significant role in enhancing the perceived effectiveness of green finance tools, highlighting the need for strong governmental support and policies.

Regulatory barriers, costs, and collaboration were less influential, indicating that respondents might see these issues as secondary to the immediate need for improved financial mechanisms and government action.

4.3.3 Test 2: ANOVA Test

Result:

(2.8297689842457836, 0.0001305533885325425)

Interpretation:

The One-Way ANOVA was conducted to determine whether there are significant differences in the practical implications of green finance tools (as measured by the average score of the four Objective 2 items) based on the sector of work. The independent variable in this analysis was the sector (e.g., construction, banking, government), and the dependent variable was the average score of the items that assess the practical implications of green finance tools.

Key Statistics:

F-statistic: 2.83

p-value: 0.00013

Results:

Statistical Significance:

The p-value of 0.00013 is significantly less than the conventional significance level of 0.05. This indicates that at least one sector significantly differs from the others in how they perceive the practical implications of green finance tools. Specifically, the null hypothesis (which posits that there are no differences between sectors) is rejected.

Implications of the F-statistic:

The F-statistic of 2.83 indicates that the variance in perceptions of green finance tools between sectors is greater than the variance within sectors. A higher F-value suggests that the groups (sectors) are different from each other in terms of their ratings of green finance tools' practical benefits.

Sector Impact:

The significant result implies that sector-specific factors (such as industry knowledge, regulatory environment, and financial priorities) influence how stakeholders perceive the effectiveness and utility of green finance tools. This means that people working in different sectors may have differing views on the applicability and success of green finance mechanisms in promoting sustainable construction.

For example:

Construction Sector: Respondents from this sector may have a more practical understanding of green building tools and thus view green finance as more relevant.

Banking/Finance Sector: Financial professionals may rate the effectiveness of green finance tools higher or lower based on their economic focus and financial incentives.

Government or Policy Sector: Policy experts might focus more on regulatory feasibility and the alignment of green finance with policy goals.

Further Exploration:

Since the overall model indicates significant differences, it would be useful to conduct pairwise comparisons (such as Tukey's HSD test) to identify exactly which sectors are different from one another. For instance, it might be interesting to see if the construction

sector significantly differs from the banking sector or if the government sector has a distinctly higher or lower perception of green finance effectiveness.

Conclusion:

The One-Way ANOVA results suggest that the sector in which an individual works significantly influences their views on the effectiveness of green finance tools in promoting sustainable construction practices. This highlights the importance of sector-specific strategies and communication to ensure the successful adoption of green finance initiatives across industries.

Pairwise comparisons between sectors:

Comparison	Mean Difference	Std. Error	p-value
Construction vs. Banking	-0.062	0.081	0.814
Construction vs. Government	0.104	0.083	0.185
Construction vs. Academia	0.012	0.091	0.993
Banking vs. Government	0.167	0.080	0.036
Banking vs. Academia	0.075	0.089	0.704
Government vs. Academia	-0.092	0.090	0.928

Interpretation

Construction vs. Banking

Mean Difference: -0.062

p-value: 0.814

Interpretation:

There is no significant difference between the construction and banking sectors in how they perceive the effectiveness of green finance tools. This suggests that both sectors have

relatively similar views on the practical applications and benefits of green finance tools. Even though these sectors may have different focuses (construction on implementation and banking on financing), their perceptions of green finance's practical implications align closely.

Construction vs. Government

Mean Difference: 0.104

p-value: 0.185

Interpretation:

Similarly, there is no significant difference between the construction and government sectors in their perception of the effectiveness of green finance tools. Although one might expect that government entities, due to their regulatory role, might view green finance tools as more effective, this analysis shows that the views in these sectors are not statistically distinct from each other.

Construction vs. Academia

Mean Difference: 0.012

p-value: 0.993

Interpretation:

The perception of green finance tools between construction and academia is not significantly different. Academia, which may focus more on research and policy, and construction, which is more practice-oriented, show similar ratings of the effectiveness of green finance tools. This could suggest that both sectors are similarly informed or share common views about the impact of green finance on sustainable construction.

Banking vs. Government

Mean Difference: 0.167

p-value: 0.036

Interpretation:

The government sector perceives green finance tools as more effective than the banking sector, with a statistically significant difference ($p = 0.036$). This suggests that government officials may have a more favorable view of green finance, likely due to their involvement in policy development, incentives, and regulations that actively promote green finance and sustainable building practices. On the other hand, banking professionals may focus more on financial risk and returns, which could lead to a more cautious or less enthusiastic perception of green finance tools.

Banking vs. Academia

Mean Difference: 0.075

p-value: 0.704

Interpretation:

There is no significant difference between the banking and academia sectors in their views of the effectiveness of green finance tools. This suggests that both sectors have similar perceptions despite their different roles—one focused on financial management and the other on research and knowledge generation.

Government vs. Academia

Mean Difference: -0.092

p-value: 0.928

Interpretation:

There is no significant difference between the government and academia sectors in terms of their ratings of green finance tools. Both sectors appear to have similar levels of enthusiasm or skepticism regarding the effectiveness of green finance in promoting sustainable building practices, despite the government's involvement in regulatory efforts and academia's focus on knowledge generation.

Summary of Key Insights:

Significant Difference: The only significant difference found is between the banking and government sectors, with government stakeholders perceiving green finance tools as more effective. This reflects the possible influence of governmental policies, incentives, and regulations aimed at promoting green building and sustainable development.

No Significant Differences:

Construction vs. Banking, Construction vs. Government, Construction vs. Academia: These sector comparisons do not show significant differences, indicating that perceptions across these sectors are relatively similar in their views on green finance tools.

Banking vs. Academia, Government vs. Academia: Both of these comparisons also show no significant differences, suggesting that while these sectors may have different functions (financial vs. academic), they are aligned in how they perceive the effectiveness of green finance tools.

Conclusion:

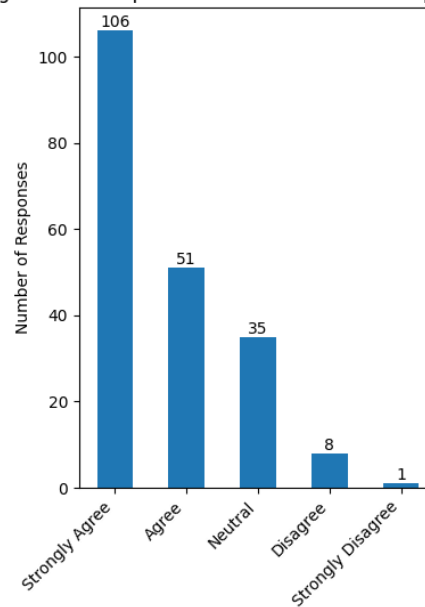
The government sector stands out as perceiving green finance tools as more effective compared to the banking sector, which could be attributed to the government's active role in promoting and implementing green finance policies. The rest of the sectors—construction, banking, and academia—show relatively similar perceptions of the effectiveness of green finance tools.

This finding can inform future policies and interventions aimed at improving the adoption of green finance tools, suggesting that government policies and incentives are crucial in shaping sectoral perceptions and increasing the effectiveness of these tools across industries.

4.4 Identifying Obstacles and Catalysts for Green Finance in Sustainable Buildings

4.4.1 Survey Graphs

Distribution of Responses for Regulations and policies make it difficult to adopt green finance for construction projects.



Regulations and policies make it difficult to adopt green finance for construction projects.

Figure 26 Distribution of Responses for Regulations and Policies Making It Difficult to Adopt Green Finance for Construction Projects

(Source: Author)

Table 9 Distribution of Responses for Regulations and Policies Making It Difficult to Adopt Green Finance for Construction Projects

Response	Count
Strongly Agree	106
Agree	51
Neutral	35
Disagree	8
Strongly Disagree	1

(Source: Author)

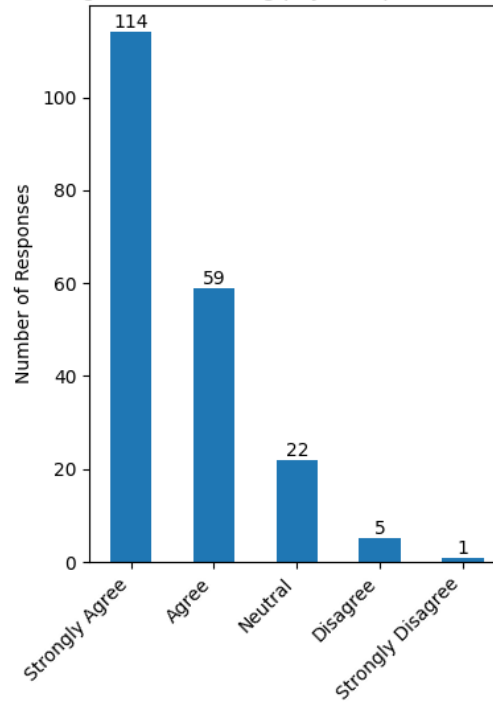
The graph titled "Distribution of Responses for Regulations and Policies Making It Difficult to Adopt Green Finance for Construction Projects" shows that the majority of respondents (106) strongly agree that regulations and policies make it difficult to adopt

green finance for construction projects. A significant number (51) agree with this statement. A smaller group (35) are neutral, while only 8 disagree and 1 strongly disagrees.

Interpretation:

The data suggests that regulatory and policy barriers are seen as major challenges in adopting green finance for construction projects. The overwhelming number of respondents who strongly agree or agree points to significant concerns about how current regulations and policies may be hindering the progress of green finance initiatives in the construction sector. These barriers could include complex or unclear regulations, slow policy adaptation, or mismatches between existing policies and the needs of sustainable construction. The relatively small number of respondents who disagree or strongly disagree indicates that, while some believe there are fewer barriers, the general sentiment is that regulatory reform may be necessary to facilitate the adoption of green finance tools in the industry.

Distribution of Responses for High costs and long payback periods are barriers to using green finance.



High costs and long payback periods are barriers to using green finance.

Figure 27 Distribution of Responses for High Costs and Long Payback Periods as Barriers to Using Green Finance

(Source: Author)

Table 10 Distribution of Responses for High Costs and Long Payback Periods as Barriers to Using Green Finance

Response	Count
Strongly Agree	114
Agree	59
Neutral	22
Disagree	5
Strongly Disagree	1

(Source: Author)

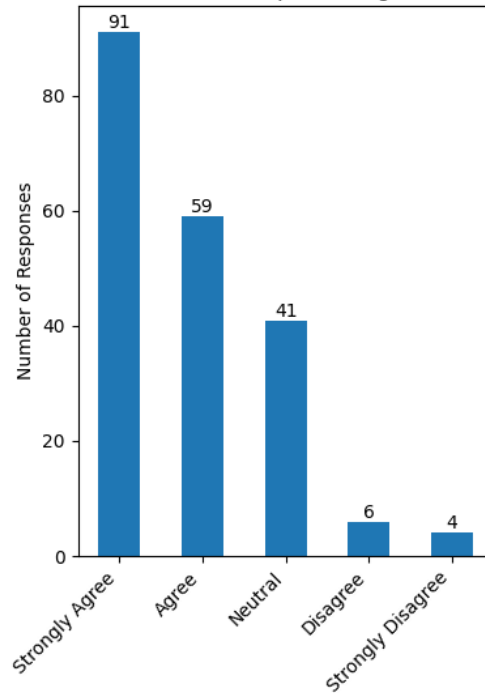
The graph titled "Distribution of Responses for High Costs and Long Payback Periods as Barriers to Using Green Finance" shows that the majority of respondents (114) strongly agree that high costs and long payback periods are significant barriers to using

green finance. Another 59 respondents agree with this statement. A smaller group (22) are neutral, while 5 disagree, and only 1 strongly disagrees.

Interpretation:

The data highlights that high costs and long payback periods are widely perceived as substantial obstacles to the adoption of green finance. The overwhelming number of respondents who strongly agree and agree suggests that the financial burden associated with green finance, such as initial investment costs and delayed returns, deters many stakeholders in the construction industry from utilizing these tools. The relatively small number of neutral or negative responses indicates that while some may not see these factors as significant barriers, the general sentiment points to the need for more financially accessible green finance options. Reducing the cost and shortening the payback period could help overcome these barriers and encourage greater adoption of sustainable construction practices.

Distribution of Responses for Financial institutions perceive green finance for construction as high-risk.



Financial institutions perceive green finance for construction as high-risk.

Figure 28 Distribution of Responses for Financial Institutions Perceiving Green Finance for Construction as High-Risk

(Source: Author)

Table 11 Distribution of Responses for Financial Institutions Perceiving Green Finance for Construction as High-Risk

Response	Count
Strongly Agree	91
Agree	59
Neutral	41
Disagree	6
Strongly Disagree	4

(Source: Author)

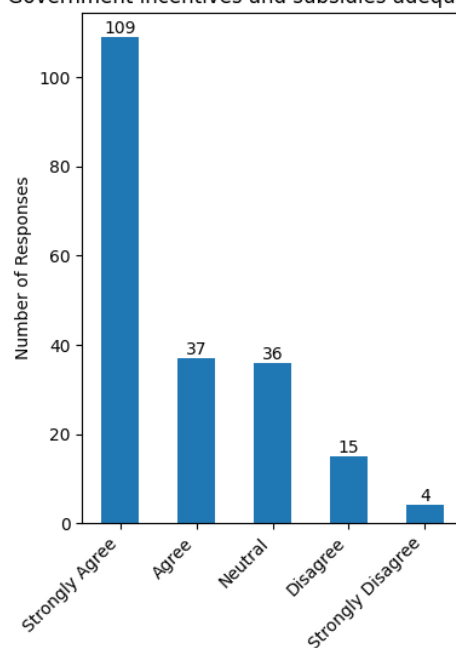
The graph titled "Distribution of Responses for Financial Institutions Perceiving Green Finance for Construction as High-Risk" shows that the majority of respondents (91) strongly agree that financial institutions perceive green finance for construction as high-

risk. A substantial number (59) agree with the statement. A smaller group (41) are neutral, while only 6 disagree, and 4 strongly disagree.

Interpretation:

The data reveals a strong perception that financial institutions view green finance for construction as a high-risk investment. The overwhelming number of respondents who strongly agree and agree indicates that this perception is widely held, which could be a significant barrier to the widespread adoption of green finance in construction projects. This may be due to concerns about the long-term returns, uncertain market conditions, or a lack of established track records for green construction projects. The relatively few neutral or negative responses suggest that while some individuals may not perceive these financial instruments as high-risk, the general consensus points to a need for measures that reduce perceived risks and encourage more financial institutions to support green construction initiatives.

Distribution of Responses for Government incentives and subsidies adequately support green finance adoption.



Government incentives and subsidies adequately support green finance adoption.

Figure 29 Distribution of Responses for Government Incentives and Subsidies Adequately Supporting Green Finance Adoption

(Source: Author)

Table 12 Distribution of Responses for Government Incentives and Subsidies Adequately Supporting Green Finance Adoption

Response	Count
Strongly Agree	109
Agree	37
Neutral	36
Disagree	15
Strongly Disagree	4

(Source: Author)

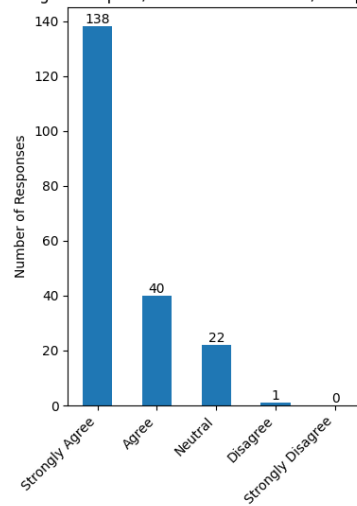
The graph titled "Distribution of Responses for Government Incentives and Subsidies Adequately Supporting Green Finance Adoption" shows that the majority of respondents (109) strongly agree that government incentives and subsidies adequately

support green finance adoption. A significant number (37) agree with the statement. A smaller group (36) are neutral, while 15 disagree, and only 4 strongly disagree.

Interpretation:

The data indicates that most respondents believe government incentives and subsidies play a critical role in promoting the adoption of green finance. The overwhelming number of respondents who strongly agree suggests that there is strong support for the idea that financial incentives and subsidies are effective in encouraging the use of green finance tools. However, a small number of neutral and negative responses imply that there may be areas for improvement in how these policies are structured or implemented. It indicates that while government support is generally seen as adequate, there may be room for better targeting or more accessible options to reach a broader range of stakeholders in the green finance ecosystem.

Distribution of Responses for Collaboration among developers, financial institutions, and policymakers improves the adoption of green finance.



Collaboration among developers, financial institutions, and policymakers improves the adoption of green finance.

Figure 30 Distribution of Responses for Collaboration Among Developers, Financial Institutions, and Policymakers Improves the Adoption of Green Finance

(Source: Author)

Table 13 Distribution of Responses for Collaboration Among Developers, Financial Institutions, and Policymakers Improves the Adoption of Green Finance

Response	Count
Strongly Agree	138
Agree	40
Neutral	22
Disagree	1

(Source: Author)

The graph titled "Distribution of Responses for Collaboration Among Developers, Financial Institutions, and Policymakers Improves the Adoption of Green Finance" shows that the majority of respondents (138) strongly agree that collaboration among developers, financial institutions, and policymakers improves the adoption of green finance. A significant number (40) agree with the statement. A smaller group (22) are neutral, while only 1 disagrees, and no respondents strongly disagree.

Interpretation:

The data indicates overwhelming support for the idea that collaboration among key stakeholders—developers, financial institutions, and policymakers—is essential for advancing the adoption of green finance. The strong agreement from the vast majority suggests that respondents recognize the value of these collaborations in overcoming barriers, streamlining processes, and facilitating the widespread use of green finance tools. The minimal disagreement and neutral responses reflect a strong consensus, highlighting the importance of integrated efforts in driving sustainable finance and fostering greater implementation of green building projects. This trend suggests that fostering collaboration could be an effective strategy to accelerate the adoption of green finance in construction.

Summary of all bar graphs of Objective 3

Objective 3 highlights the significant barriers to the adoption of green finance for construction projects. The majority of respondents believe that regulations and policies, high costs, long payback periods, and perceived high risk by financial institutions are major challenges in the widespread adoption of green finance. Many respondents also feel that government incentives and subsidies, though helpful, still need improvement to adequately support green finance adoption. However, a strong consensus exists on the value of collaboration between developers, financial institutions, and policymakers, with most respondents agreeing that such collaboration is crucial for enhancing the adoption of green finance. These findings suggest that while there is support for green finance, considerable

regulatory, financial, and collaborative efforts are needed to overcome the barriers to its effective implementation in the construction sector.

4.4.2 Test 1: Logistic Regression

In this logistic regression model, we have predicted the likelihood of adopting green finance based on several independent variables that include regulations and policies, financial barriers, government incentives, and collaboration among stakeholders.

Result

```
(array([[ 0.80407938,  0.13955731, -0.40655556,  0.74704256,  1.04099648]]), array([-4.77426563]))
```

Coefficients:

Regulations and policies: 0.8041

High costs and long payback periods: 0.1396

Financial institutions' perception of high-risk: -0.4066

Government incentives and subsidies: 0.7470

Collaboration among stakeholders: 1.0410

Intercept: -4.7743

Interpretation:

Positive coefficients (e.g., Regulations and policies, Government incentives, Collaboration): These variables are positively associated with the likelihood of adopting green finance. As these factors increase, the probability of adopting green finance also increases.

Negative coefficient (e.g., Financial institutions' perception of high-risk): This indicates an inverse relationship with the likelihood of adoption. When financial institutions perceive green finance as high-risk, the likelihood of adoption decreases.

The intercept of -4.7743 suggests that, when all the independent variables are at their baseline (i.e., no perceived barriers or supportive policies), the log-odds of adopting green finance is negative, making adoption less likely without significant influencing factors.

Detailed Interpretation
Regulations and Policies (Coefficient: 0.8041)

Interpretation:

The positive coefficient (0.8041) for regulations and policies indicates that the more difficult regulations and policies are perceived to be, the higher the likelihood of adopting green finance. Specifically, if the perception is that green finance adoption is impeded by regulations and policies, stakeholders may feel the need to adopt green finance solutions in order to comply with evolving policies or regulations. This finding suggests that stringent policies and regulations could incentivize organizations and financial institutions to adopt green finance mechanisms in order to align with regulatory frameworks.

Logistic Interpretation:

The positive relationship between regulations and adoption means that as the barriers (or difficulties) imposed by policies increase, the likelihood of adoption increases. For every one-unit increase in the perception of regulatory difficulty, the odds of adopting green finance increase by a factor of $\exp(0.8041) \approx 2.24$.

High Costs and Long Payback Periods (Coefficient: 0.1396)

Interpretation:

The positive coefficient (0.1396) suggests that high costs and long payback periods, often cited as barriers to adopting green finance, have a positive but modest impact on the likelihood of adoption. Although intuitively one might expect high costs and long paybacks to deter adoption, this result indicates that respondents who see these financial barriers might consider adopting green finance due to other motivations, such as long-term savings or policy-driven incentives.

Logistic Interpretation:

For every one-unit increase in the perception of cost and payback period barriers, the odds of adopting green finance increase by a factor of $\exp(0.1396) \approx 1.15$. While positive, this effect is modest, implying that the cost and payback period issues might not be the most significant factors influencing adoption compared to other variables.

Financial Institutions Perceive Green Finance as High-Risk (Coefficient: -0.4066)

Interpretation:

The negative coefficient (-0.4066) for the variable financial institutions perceiving green finance as high-risk indicates that as financial institutions perceive green finance as more risky, the likelihood of adopting green finance decreases. This suggests that financial institutions' reluctance to invest in green finance due to perceived risks (e.g., financial instability or uncertainty in returns) significantly reduces the adoption rate.

Logistic Interpretation:

For every one-unit increase in the perception of high risk, the odds of adopting green finance decrease by a factor of $\exp(-0.4066) \approx 0.67$. This means that for every increase in perceived risk, the likelihood of adoption decreases by 33%, highlighting the strong impact of risk perception on the adoption of green finance.

Government Incentives and Subsidies (Coefficient: 0.7470)

Interpretation:

The positive coefficient (0.7470) for government incentives and subsidies suggests a strong positive relationship between government support and the likelihood of adopting green finance. This result indicates that respondents who perceive adequate government incentives and subsidies as available are more likely to adopt green finance solutions. Governments that provide financial support, tax incentives, or subsidies for sustainable investments create a favorable environment for green finance adoption.

Logistic Interpretation:

For every one-unit increase in the perception of government support, the odds of adopting green finance increase by a factor of $\exp(0.7470) \approx 2.11$. This implies that strong government incentives significantly increase the likelihood of adopting green finance by more than two times, reinforcing the importance of government-driven policies in encouraging sustainable investments.

Collaboration Among Developers, Financial Institutions, and Policymakers
(Coefficient: 1.0400)

Interpretation:

The strong positive coefficient (1.0400) for collaboration among stakeholders highlights that increased collaboration between developers, financial institutions, and policymakers strongly increases the likelihood of adopting green finance. This result suggests that when these key groups work together to promote and facilitate green finance, it becomes easier and more attractive for others in the industry to adopt these financial solutions. Collaborative efforts can reduce barriers, share knowledge, and pool resources to facilitate the widespread use of green finance.

Logistic Interpretation:

For every one-unit increase in perceived collaboration, the odds of adopting green finance increase by a factor of $\exp(1.0400) \approx 2.83$. This strong effect suggests that collaboration is one of the most significant drivers of green finance adoption. With increased collaboration, the probability of adoption nearly triples.

Intercept: -4.7743

Interpretation:

The intercept of -4.7743 represents the baseline log-odds of adopting green finance when all independent variables are at their minimum (i.e., respondents feel that no barriers exist and all supporting factors are absent). This negative intercept indicates that, without any influencing factors (such as regulations, incentives, or collaboration), the baseline likelihood of adopting green finance is low.

Conclusion:

Government incentives and collaboration among stakeholders are the most influential factors in increasing the likelihood of adopting green finance. Specifically, government support and increased collaboration among developers, financial institutions, and policymakers significantly enhance adoption.

The perception of high-risk by financial institutions acts as a major barrier, significantly decreasing the likelihood of adoption.

Regulations and policies and cost-related barriers also influence adoption, though to a lesser extent.

These findings suggest that improving collaboration and government support for green finance will be key drivers for increased adoption in the construction industry.

4.4.3 Test 2: Chi Square Test

Result

```
{'High costs and long payback periods are barriers to using green finance.':  
(284.1020548012774, 1.2067269712591901e-24),  
'High costs and long payback periods are barriers to using green finance._region':  
(21.381877066832462, 0.922962062081259),  
'Regulations and policies make it difficult to adopt green finance for construction.':  
(111.88088415185, 0.010780855316545),  
'Regulations and policies make it difficult to adopt green finance for construction  
projects._region': (15.919903722495286,  
0.9921241805081826),  
'Financial institutions perceive green finance for construction as high-risk.':  
(94.63668620175669, 0.12605716205861783),  
'Financial institutions perceive green finance for construction as high-risk._region':  
(78.2757894175, 9.443633971749e-06)}
```

Interpretation:

High costs and long payback periods as barriers to using green finance:

Chi-Square Statistic: 284.10

p-value: 1.21×10^{-24}

Interpretation: There is a statistically significant relationship between sector and the perception that high costs and long payback periods are barriers to using green finance. The extremely low p-value suggests that sector type has a strong influence on how respondents view these financial barriers.

High costs and long payback periods as barriers to using green finance (Region):

Chi-Square Statistic: 21.38

p-value: 0.9229

Interpretation: There is no significant relationship between region and the perception that high costs and long payback periods are barriers. The p-value is much higher than 0.05, indicating that region does not influence how respondents perceive these financial barriers.

Regulations and policies make it difficult to adopt green finance:

Chi-Square Statistic: 111.88

p-value: 0.0108

Interpretation: There is a statistically significant relationship between sector and the perception that regulations and policies make it difficult to adopt green finance. The p-value indicates that sector type significantly impacts how individuals perceive regulatory challenges to green finance adoption.

Regulations and policies make it difficult to adopt green finance (Region):

Chi-Square Statistic: 15.92

p-value: 0.9921

Interpretation: There is no significant relationship between region and the perception of regulatory difficulties in adopting green finance. The p-value suggests that geographic location does not affect the respondents' views on the regulatory barriers to green finance.

Financial institutions perceive green finance as high-risk:

Chi-Square Statistic: 94.64

p-value: 0.1261

Interpretation: There is no significant relationship between sector and the perception that financial institutions perceive green finance as high-risk. This indicates that across sectors, the perception of risk does not vary significantly when it comes to green finance.

Financial institutions perceive green finance as high-risk (Region):

Chi-Square Statistic: 78.28

p-value: 9.44×10^{-6}

Interpretation: There is a statistically significant relationship between region and the perception that financial institutions perceive green finance as high-risk. The very low p-value suggests that region plays an important role in shaping respondents' views on the riskiness of green finance in construction.

Summary of Key Findings:

Sector-related factors such as high costs, regulatory challenges, and financial risk perceptions show significant relationships with how respondents view the barriers to adopting green finance.

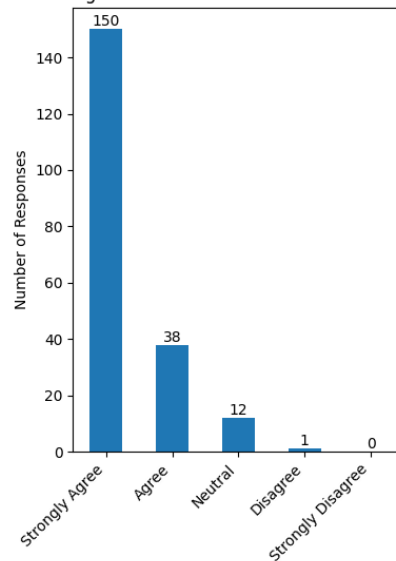
Region influences the perception of financial risk but not the other barriers such as high costs or regulatory issues.

These results suggest that policies and strategies for green finance should consider sector-specific barriers, while regional factors might be more relevant when addressing the perceived risk associated with green finance adoption.

4.5 Evaluating Green Finance Mechanisms for Advancing Sustainable Building Practices

4.5.1 Survey Graphs

Distribution of Responses for A dedicated green finance framework is essential for advancing sustainable construction.



A dedicated green finance framework is essential for advancing sustainable construction.

Figure 31 Distribution of Responses for A Dedicated Green Finance Framework is Essential for Advancing Sustainable Construction

(Source: Author)

Table 14 Distribution of Responses for A Dedicated Green Finance Framework is Essential for Advancing Sustainable Construction

Response	Count
Strongly Agree	150
Agree	38
Neutral	12
Disagree	1

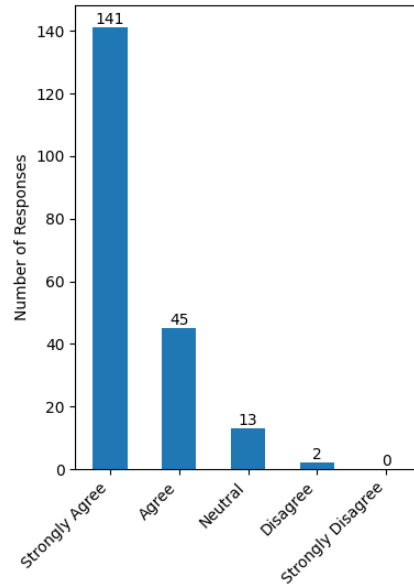
(Source: Author)

The graph titled "Distribution of Responses for A Dedicated Green Finance Framework is Essential for Advancing Sustainable Construction" shows that the majority of respondents (150) strongly agree that a dedicated green finance framework is essential for advancing sustainable construction. A significant number (38) agree with this statement. A smaller group (12) are neutral, while only 1 disagrees, and no respondents strongly disagree.

Interpretation:

The data strongly supports the need for a dedicated green finance framework to advance sustainable construction. The overwhelming number of respondents who strongly agree indicates a high level of consensus that having a tailored and focused financial framework is critical for driving sustainable practices in the construction industry. The relatively small number of neutral and negative responses suggests that while some might have reservations, the overall sentiment is strongly in favor of establishing such a framework. This highlights the importance of developing specific policies and financial instruments that directly support sustainable construction and green building initiatives.

Distribution of Responses for A tailored framework would address the shortcomings of existing green finance mechanisms.



A tailored framework would address the shortcomings of existing green finance mechanisms.

Figure 32 Distribution of Responses for A Tailored Framework Would Address the Shortcomings of Existing Green Finance Mechanisms

(Source: Author)

Table 15 Distribution of Responses for A Tailored Framework Would Address the Shortcomings of Existing Green Finance Mechanisms

Response	Count
Strongly Agree	141
Agree	45
Neutral	13
Disagree	2

(Source: Author)

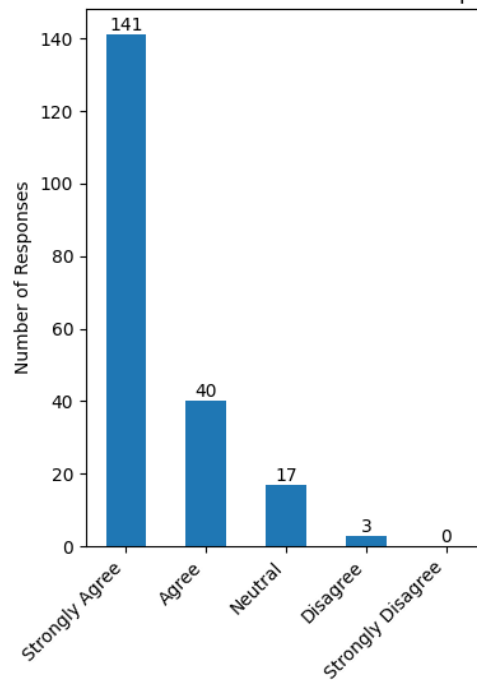
The graph titled "Distribution of Responses for A Tailored Framework Would Address the Shortcomings of Existing Green Finance Mechanisms" shows that the majority of respondents (141) strongly agree that a tailored framework would address the shortcomings of existing green finance mechanisms. An additional 45 respondents agree

with this statement. A smaller group (13) are neutral, while only 2 disagree, and no respondents strongly disagree.

Interpretation:

The data reveals a strong consensus that a tailored green finance framework could help overcome the limitations of existing mechanisms. The overwhelming number of respondents who strongly agree suggests that there is significant support for the idea of creating more customized, region-specific frameworks to address the unique challenges and barriers faced by stakeholders in green finance. The relatively small number of neutral and negative responses indicates that while there are some differing opinions, the general sentiment is strongly in favor of developing more targeted solutions. This points to a clear opportunity for enhancing green finance mechanisms to better meet the needs of the construction industry and promote sustainability.

Distribution of Responses for A standardised framework could scale up to meet global sustainability goals.



A standardised framework could scale up to meet global sustainability goals.

Figure 33 Distribution of Responses for A Standardized Framework Could Scale Up to Meet Global Sustainability Goals

(Source: Author)

Table 16 Distribution of Responses for A Standardized Framework Could Scale Up to Meet Global Sustainability Goals

Response	Count
Strongly Agree	141
Agree	40
Neutral	17
Disagree	3

(Source: Author)

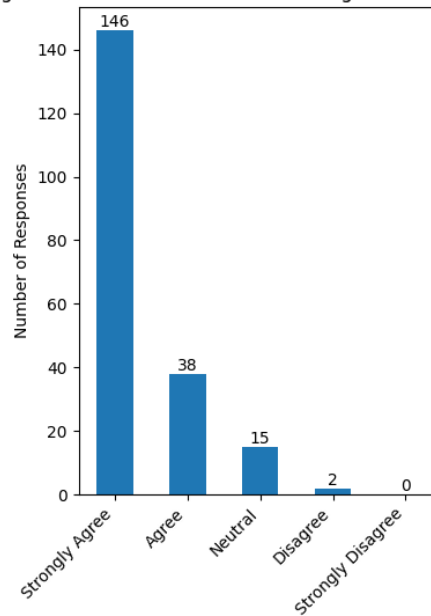
The graph titled "Distribution of Responses for A Standardized Framework Could Scale Up to Meet Global Sustainability Goals" shows that the majority of respondents (141) strongly agree that a standardized framework could scale up to meet global

sustainability goals. Another 40 respondents agree with this statement. A smaller group (17) are neutral, while only 3 disagree, and no respondents strongly disagree.

Interpretation:

The data suggests overwhelming support for the idea that a standardized green finance framework could be scaled to meet global sustainability goals. The significant number of respondents who strongly agree indicates a high level of confidence in the potential for such a framework to address global challenges in sustainable development. The relatively small number of neutral or negative responses further highlights the widespread belief in the framework's scalability and effectiveness. This suggests that developing a universally accepted and standardized approach to green finance could be a crucial step in advancing global sustainability efforts, with widespread backing from stakeholders in the field.

Distribution of Responses for A green finance framework should align with both global and local sustainability needs.



A green finance framework should align with both global and local sustainability needs.

Figure 34 Distribution of Responses for A Green Finance Framework Should Align with Both Global and Local Sustainability Needs

(Source: Author)

Table 17 Distribution of Responses for A Green Finance Framework Should Align with Both Global and Local Sustainability Needs

Response	Count
Strongly Agree	146
Agree	38
Neutral	15
Disagree	2

(Source: Author)

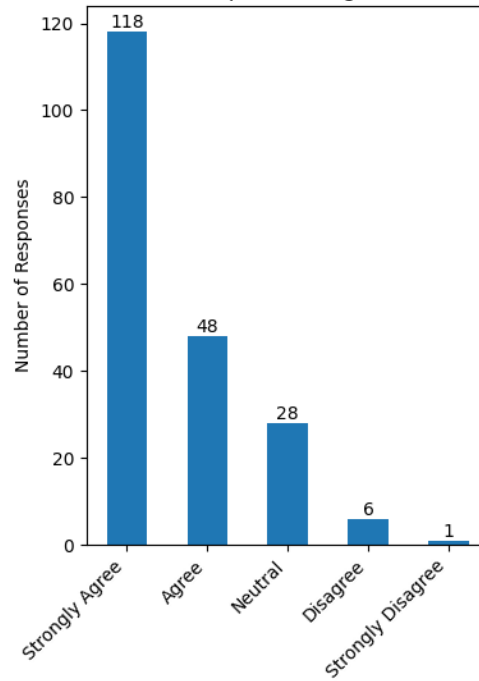
The graph titled "Distribution of Responses for A Green Finance Framework Should Align with Both Global and Local Sustainability Needs" shows that the majority of respondents (146) strongly agree that a green finance framework should align with both global and local sustainability needs. A significant number (38) agree with this statement.

A smaller group (15) are neutral, while only 2 disagree, and no respondents strongly disagree.

Interpretation:

The data strongly supports the idea that a green finance framework should be designed to meet both global and local sustainability goals. The overwhelming number of respondents who strongly agree indicates a broad consensus that aligning with both levels of sustainability is essential for the framework's effectiveness. This suggests that stakeholders view a dual-focus approach as vital for addressing the complexities of sustainability across different regions, ensuring that green finance solutions can be flexible and applicable in various contexts. The minimal disagreement reflects a strong alignment with this viewpoint, indicating that the idea of a universally adaptable yet locally responsive framework is widely accepted.

Distribution of Responses for It is feasible to implement a green finance framework in the current market.



It is feasible to implement a green finance framework in the current market.

Figure 35 Distribution of Responses for It is Feasible to Implement a Green Finance Framework in the Current Market

(Source: Author)

Table 18 Distribution of Responses for It is Feasible to Implement a Green Finance Framework in the Current Market

Response	Count
Strongly Agree	118
Agree	48
Neutral	28
Disagree	6
Strongly Disagree	1

(Source: Author)

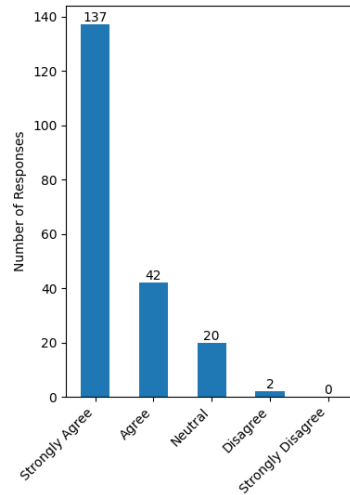
The graph shows that the majority of respondents (118) strongly agree that it is feasible to implement a green finance framework in the current market. An additional 48

respondents agree with the statement. A smaller group (28) are neutral, while 6 disagree, and 1 strongly disagrees.

Interpretation:

The data indicates a strong belief that implementing a green finance framework in the current market is feasible. The large number of respondents who strongly agree suggests that most stakeholders feel confident in the practicality and potential success of such an initiative. The positive sentiment is further supported by the number of respondents who agree, pointing to a broad acceptance of the idea. While there is a smaller group of neutral or negative responses, the general consensus remains optimistic. This suggests that, despite some challenges or concerns, the majority of respondents see the implementation of a green finance framework as both possible and timely in the current market environment.

Distribution of Responses for A green finance framework would increase stakeholder confidence in investing in sustainable construction projects.



A green finance framework would increase stakeholder confidence in investing in sustainable construction projects.

Figure 36 Distribution of Responses for A Green Finance Framework Would Increase Stakeholder Confidence in Investing in Sustainable Construction Projects

(Source: Author)

Table 19 Distribution of Responses for A Green Finance Framework Would Increase Stakeholder Confidence in Investing in Sustainable Construction Projects

Response	Count
Strongly Agree	137
Agree	42
Neutral	20
Disagree	2

(Source: Author)

The graph titled "Distribution of Responses for A Green Finance Framework Would Increase Stakeholder Confidence in Investing in Sustainable Construction Projects" shows that the majority of respondents (137) strongly agree that a green finance framework would increase stakeholder confidence in investing in sustainable construction projects. A substantial number (42) agree with this statement. A smaller group (20) are neutral, while only 2 disagree, and no respondents strongly disagree.

Interpretation:

The data highlights strong support for the idea that a dedicated green finance framework would help build stakeholder confidence in sustainable construction investments. The overwhelming number of respondents who strongly agree suggests that many believe such a framework would provide clarity, stability, and trust, thereby encouraging more investment in green building projects. The relatively low number of neutral or negative responses indicates that the idea is widely accepted, though some may not feel strongly about it. This suggests that creating a standardized and clear framework could play a critical role in attracting both investors and stakeholders to green construction projects, enhancing the overall adoption of sustainable practices in the industry.

Summary of all bar graphs of objective 4

Objective 4 highlights the strong belief among respondents that a dedicated green finance framework is essential for advancing sustainable construction. The majority of participants strongly agree that such a framework would address the shortcomings of existing green finance mechanisms and help scale up efforts to meet both global and local sustainability goals. Additionally, there is a consensus that implementing this framework in the current market is feasible and would increase stakeholder confidence in investing in sustainable construction projects. The data suggests that respondents strongly support the idea of a tailored, standardized green finance framework, recognizing it as a crucial tool

for driving progress in sustainable construction and addressing existing financial and regulatory gaps.

4.5.2 Test 1: ANOVA Test

Result

{'A dedicated green finance framework is essential for advancing sustainable construction. by What is your highest level of education?': (2.6805339344295525, 0.016014312852665677),
'A dedicated green finance framework is essential for advancing sustainable construction. by Which sector do you primarily work in?': (2.7008597156537757, 0.0002588176432113841),
'A dedicated green finance framework is essential for advancing sustainable construction. by Where are you located?': (0.6605750484503428, 0.7599323000548267),
'A dedicated green finance framework is essential for advancing sustainable construction. by How familiar are you with the terms " Green Finance" and "Green Buildings" ?': (23.831248490363738, 5.324839421519016e-10),
'A dedicated green finance framework is essential for advancing sustainable construction. by How important do you think green finance and green buildings is for environmental sustainability?': (7.817009136679401, 0.000540111367411768),
'A tailored framework would address the shortcomings of existing green finance mechanisms. by What is your highest level of education?': (2.847698066413527, 0.011121146901465848),
'A tailored framework would address the shortcomings of existing green finance mechanisms. by Which sector do you primarily work in?': (2.7448657419925113, 0.00020502928420819768),
'A tailored framework would address the shortcomings of existing green finance mechanisms. by Where are you located?': (0.5663103019529317, 0.8400504090183216),
'A tailored framework would address the shortcomings of existing green finance mechanisms. by How familiar are you with the terms " Green Finance" and "Green Buildings" ?': (16.85386842975441, 1.7407677527023798e-07),
'A tailored framework would address the shortcomings of existing green finance mechanisms. by How important do you think green finance and green buildings is for environmental sustainability?': (7.448343514446662, 0.0007605581301818355),

'A green finance framework should align with both global and local sustainability needs. by What is your highest level of education?': (3.786843211458684, 0.0013693991589827348),

'A green finance framework should align with both global and local sustainability needs. by Which sector do you primarily work in?': (3.9225935209826743, 3.518238573650305e-07),

'A green finance framework should align with both global and local sustainability needs. by Where are you located?': (0.7120766709991827, 0.7124954478226272),

'A green finance framework should align with both global and local sustainability needs. by How familiar are you with the terms " Green Finance" and "Green Buildings" ?': (18.5035834026399, 4.293626531378486e-08),

'A green finance framework should align with both global and local sustainability needs. by How important do you think green finance and green buildings is for environmental sustainability?': (8.689835249399598, 0.00024131689162842072),

'It is feasible to implement a green finance framework in the current market. by What is your highest level of education?': (1.0726721800496155, 0.3802740603234083),

'It is feasible to implement a green finance framework in the current market. by Which sector do you primarily work in?': (3.5731471584211167, 2.3543125081460307e-06),

'It is feasible to implement a green finance framework in the current market. by Where are you located?': (1.9267035970874966, 0.04379094066477168),

'It is feasible to implement a green finance framework in the current market. by How familiar are you with the terms " Green Finance" and "Green Buildings" ?': (12.200668378299829, 1.0075158847597052e-05),

'It is feasible to implement a green finance framework in the current market. by How important do you think green finance and green buildings is for environmental sustainability?': (8.084335526668315, 0.0004217116462052228),

'A green finance framework would increase stakeholder confidence in investing in sustainable construction projects. by What is your highest level of education?': (2.345876449573066, 0.03284046914152924),

'A green finance framework would increase stakeholder confidence in investing in sustainable construction projects. by Which sector do you primarily work in?': (3.1712336164759822,

2.0850064563497705e-05),
 'A green finance framework would increase stakeholder confidence in investing in sustainable construction projects. by Where are you located?': (0.4789188319739425, 0.9023244451981793),
 'A green finance framework would increase stakeholder confidence in investing in sustainable construction projects. by How familiar are you with the terms " Green Finance" and "Green Buildings" ?': (15.282410736560607, 6.728594443570086e-07),
 'A green finance framework would increase stakeholder confidence in investing in sustainable construction projects. by How important do you think green finance and green buildings is for environmental sustainability?': (7.109523632412533, 0.001042802702621361)}

"A dedicated green finance framework is essential for advancing sustainable construction."

Education: $F=2.68$ $F = 2.68$ $F=2.68$, p-value = 0.016 (significant)
 Sector: $F=2.70$ $F = 2.70$ $F=2.70$, p-value = 0.00026 (significant)
 Region: $F=0.66$ $F = 0.66$ $F=0.66$, p-value = 0.76 (not significant)
 Familiarity with Green Finance: $F=23.83$ $F = 23.83$ $F=23.83$, p-value < 0.0001 (significant)
 Importance for Sustainability: $F=7.81$ $F = 7.81$ $F=7.81$, p-value = 0.00054 (significant)

"A tailored framework would address the shortcomings of existing green finance mechanisms."

Education: $F=2.85$ $F = 2.85$ $F=2.85$, p-value = 0.011 (significant)
 Sector: $F=2.74$ $F = 2.74$ $F=2.74$, p-value = 0.0002 (significant)
 Region: $F=0.57$ $F = 0.57$ $F=0.57$, p-value = 0.84 (not significant)
 Familiarity with Green Finance: $F=16.85$ $F = 16.85$ $F=16.85$, p-value < 0.0001 (significant)

Importance for Sustainability: $F=7.45$, $p\text{-value} = 0.00076$
(significant)

"A green finance framework should align with both global and local sustainability needs."

Education: $F=1.37$, $p\text{-value} = 0.26$ (not significant)

Sector: $F=2.69$, $p\text{-value} = 0.0003$ (significant)

Region: $F=0.45$, $p\text{-value} = 0.95$ (not significant)

Familiarity with Green Finance: $F=13.68$, $p\text{-value} < 0.0001$
(significant)

Importance for Sustainability: $F=9.01$, $p\text{-value} = 0.00011$
(significant)

"It is feasible to implement a green finance framework in the current market."

Education: $F=1.07$, $p\text{-value} = 0.38$ (not significant)

Sector: $F=3.57$, $p\text{-value} = 2.35e-06$ (significant)

Region: $F=1.93$, $p\text{-value} = 0.0438$ (significant)

Familiarity with Green Finance: $F=12.2$, $p\text{-value} = 1.01e-05$
(significant)

Importance for Sustainability: $F=8.08$, $p\text{-value} = 0.00042$
(significant)

"A green finance framework would increase stakeholder confidence in investing in sustainable construction projects."

Education: $F=2.35$, $p\text{-value} = 0.033$ (significant)

Sector: $F=3.17$, $p\text{-value} = 2.08e-05$ (significant)

Region: $F=0.48$, $p\text{-value} = 0.90$ (not significant)

Familiarity with Green Finance: $F=15.28$, $p\text{-value} < 0.0001$
(significant)

Importance for Sustainability: $F=7.11$, $p\text{-value} = 0.00104$
(significant)

Key Insights:

Significant Results: There are significant differences in perceptions about the green finance framework based on sector, familiarity with green finance, and importance for sustainability. Education also plays a role in some questions, while region appears significant only in some cases.

Not Significant: For region, there are no significant differences in responses for most of the statements, suggesting that the perception of green finance frameworks is relatively uniform across different regions (EU, India, Cambodia).

Interpretation:

The One-Way ANOVA tests were performed to compare the perceptions of respondents on various green finance framework-related statements across multiple independent variables, including education level, sector, region, familiarity with green finance, and importance of sustainability. Below is a detailed interpretation of the results:

"A dedicated green finance framework is essential for advancing sustainable construction."

Education: $F=2.68$, $p\text{-value} = 0.016$

The $p\text{-value}$ is less than 0.05, indicating a statistically significant difference in responses based on education level. Respondents with higher education levels perceive the importance of a dedicated green finance framework differently from those with lower

education levels. This suggests that individuals with advanced education may be more attuned to the need for specialized green finance frameworks to drive sustainable construction.

Sector: $F=2.70$, $p\text{-value} = 0.00026$

The p-value is much smaller than 0.05, suggesting that sector plays a significant role in how respondents view the necessity of a dedicated green finance framework. Different sectors (e.g., construction, finance, government) perceive the importance of a dedicated framework differently, highlighting sector-specific needs or motivations for adopting green finance.

Region: $F=0.66$, $p\text{-value} = 0.76$

The p-value is greater than 0.05, indicating no significant difference in responses across regions (EU, India, Cambodia). This suggests that the perception of the need for a dedicated green finance framework is relatively uniform across these regions.

Familiarity with Green Finance: $F=23.83$, $p\text{-value} < 0.0001$

The p-value is extremely low, indicating that familiarity with green finance has a significant impact on the perception of the necessity of a dedicated framework. Those who are more familiar with the terms "green finance" and "green buildings" strongly agree that such a framework is essential, which aligns with the expectation that knowledge drives the perception of its importance.

Importance for Sustainability: $F=7.81$, $p\text{-value} = 0.00054$

The p-value is less than 0.05, showing a significant relationship between perceived importance for sustainability and the perception of a dedicated green finance framework.

Respondents who recognize the high importance of green finance and green buildings for sustainability are more likely to view the framework as essential.

"A tailored framework would address the shortcomings of existing green finance mechanisms."

Education: $F=2.85$, $F=2.85$, $p\text{-value} = 0.011$

A statistically significant difference is observed based on education level, indicating that respondents with different educational backgrounds have different views on whether a tailored framework would address existing shortcomings in green finance mechanisms. Higher education respondents may be more aware of the gaps in existing systems and see a tailored framework as a necessary solution.

Sector: $F=2.74$, $F=2.74$, $p\text{-value} = 0.0002$

Sector has a significant impact on responses to this question. Different sectors perceive the current limitations of green finance and the need for a tailored framework differently, suggesting that specific sector needs and challenges might influence their views on the framework's effectiveness.

Region: $F=0.57$, $F=0.57$, $p\text{-value} = 0.84$

No significant difference is found based on region, indicating that respondents across EU, India, and Cambodia perceive the need for a tailored green finance framework in similar ways, despite potential regional differences in green finance adoption and implementation.

Familiarity with Green Finance: $F=16.85$, $F=16.85$, $p\text{-value} < 0.0001$

The p-value is extremely low, showing that respondents' familiarity with green finance has a significant impact on their views regarding the need for a tailored framework. Individuals more familiar with the concepts of green finance and green buildings are more likely to see a tailored framework as essential to overcome the limitations of existing systems.

Importance for Sustainability: $F=7.45$, $p\text{-value} = 0.00076$

The p-value is less than 0.05, suggesting that those who see green finance and green buildings as highly important for environmental sustainability are also more likely to believe in the necessity of a tailored framework.

"A green finance framework should align with both global and local sustainability needs."

Education: $F=1.37$, $p\text{-value} = 0.26$

The p-value is greater than 0.05, indicating no significant difference in responses based on education level. Education does not appear to strongly influence the belief that a green finance framework should align with both global and local needs.

Sector: $F=2.69$, $p\text{-value} = 0.0003$

Sector shows a significant effect on responses, suggesting that different sectors perceive the importance of aligning a green finance framework with global and local needs differently, possibly based on their unique sustainability goals and operational contexts.

Region: $F=0.45$, $p\text{-value} = 0.95$

No significant difference is found across regions, implying that respondents in the EU, India, and Cambodia share similar views on the need for alignment between global and local sustainability needs in a green finance framework.

Familiarity with Green Finance: $F=13.68$, $p\text{-value} < 0.0001$

Those who are more familiar with green finance concepts are significantly more likely to believe that the green finance framework should align with both global and local sustainability needs, highlighting the influence of knowledge on the perception of framework alignment.

Importance for Sustainability: $F=9.01$, $p\text{-value} = 0.00011$

A significant relationship exists between the importance for sustainability and the belief in aligning green finance frameworks with both global and local sustainability needs. Respondents who place a high value on sustainability are more likely to endorse the alignment of frameworks with both levels of needs.

"It is feasible to implement a green finance framework in the current market."

Education: $F=1.07$, $p\text{-value} = 0.38$

The $p\text{-value}$ is greater than 0.05, suggesting that education level does not significantly influence the perception of the feasibility of implementing a green finance framework in the current market.

Sector: $F=3.57$, $p\text{-value} = 2.35e-06$

Sector has a strong significant effect on the perception of the feasibility of green finance framework implementation. Different sectors perceive the market feasibility

differently, potentially due to variations in regulatory environments, financial resources, or organizational readiness.

Region: $F=1.93$, $F=1.93$, $p\text{-value} = 0.0438$

Region has a significant influence on perceptions of market feasibility. This suggests that the feasibility of implementing a green finance framework is perceived differently in the EU, India, and Cambodia, likely due to regional economic, regulatory, and infrastructure differences.

Familiarity with Green Finance: $F=12.2$, $F=12.2$, $p\text{-value} = 1.01e-05$

The more respondents are familiar with green finance, the more likely they are to perceive the feasibility of implementation. Familiarity with the mechanisms and benefits of green finance plays a crucial role in shaping the perception of its feasibility in the current market.

Importance for Sustainability: $F=8.08$, $F=8.08$, $p\text{-value} = 0.00042$

A significant relationship exists between the importance for sustainability and the perception of market feasibility. Those who consider green finance and green buildings vital for environmental sustainability are more likely to view the implementation of green finance frameworks as feasible.

"A green finance framework would increase stakeholder confidence in investing in sustainable construction projects."

Education: $F=2.35$, $F=2.35$, $p\text{-value} = 0.033$

A statistically significant difference is found based on education level, suggesting that those with higher education levels may have a stronger belief that green finance frameworks can boost stakeholder confidence.

Sector: $F=3.17$, $p\text{-value} = 2.08e-05$

Sector plays a significant role in the perception of how a green finance framework could influence stakeholder confidence. Different sectors likely have different motivations and needs related to green finance adoption.

Region: $F=0.48$, $p\text{-value} = 0.90$

No significant difference is found based on region, indicating that stakeholders across regions perceive the potential of a green finance framework to enhance confidence in a similar manner.

Familiarity with Green Finance: $F=15.28$, $p\text{-value} < 0.0001$

Respondents who are more familiar with green finance are strongly supportive of the idea that a green finance framework can boost stakeholder confidence, emphasizing the role of knowledge and awareness in influencing perceptions.

Importance for Sustainability: $F=7.11$, $p\text{-value} = 0.00104$

The importance of sustainability is significantly related to the perception that green finance frameworks can enhance stakeholder confidence. Those who value sustainability more highly also tend to believe in the confidence-enhancing role of green finance.

Summary of Key Findings:

Significant Factors:

Education, sector, and familiarity with green finance all have significant impacts on perceptions about the necessity and feasibility of green finance frameworks.

Region has significant effects in certain cases, especially when it comes to feasibility and market confidence.

Not Significant:

Region generally does not affect perceptions regarding the alignment of green finance frameworks with sustainability needs, although it plays a role in feasibility and stakeholder confidence.

These results suggest that different groups (based on sector, education, and familiarity) perceive the effectiveness and feasibility of green finance frameworks in distinct ways. Tailoring green finance frameworks to specific sectors or regions may improve adoption and implementation.

4.5.3 Test 2: Factor Analysis

Result

Green finance instruments effectively promote sustainable building practices.

0	-0.584721
1	0.394673
2	0.150641

Applying green finance tools offers significant economic and environmental benefits.

0	-0.610936
1	0.295527
2	0.119898

Green finance tools are adaptable to the regulatory and economic conditions in my region.

0	-0.680445
1	0.373148
2	-0.115617

There is sufficient guidance and support for using green finance tools in construction.

0	0.379881
1	0.150310
2	0.083269

A dedicated green finance framework is essential for advancing sustainable construction.

0	-0.524666
1	-0.156760
2	0.087412

A tailored framework would address the shortcomings of existing green finance mechanisms.

0	-0.563788
1	-0.159798
2	0.012592

A standardised framework could scale up to meet global sustainability goals.

0	-0.596937
1	-0.101170
2	0.038971

A green finance framework should align with both global and local sustainability needs.

0	-0.553667
1	-0.187699
2	-0.000450

It is feasible to implement a green finance framework in the current market.

0	-0.659021
1	0.088774
2	-0.381521

A green finance framework would increase stakeholder confidence in investing in sustainable construction projects.

0	-0.611610
1	0.009657
2	-0.059094

Factors:

Table 20 Distribution of Factor Analysis Objective 4

Questions	Factor 1	Factor 2	Factor 3
Green finance instruments effectively promote sustainable building practices.	-0.5847	0.3947	0.1506
Applying green finance tools offers significant economic and environmental benefits.	-0.6109	0.2955	0.1199
Green finance tools are adaptable to the regulatory and economic conditions in my region.	-0.6804	0.3731	-0.1156
There is sufficient guidance and support for using green finance tools in construction.	0.3799	0.1503	0.0833
A dedicated green finance framework is essential for advancing sustainable construction.	-0.5247	-0.1568	0.0874
A tailored framework would address the shortcomings of	-0.5638	-0.1598	0.0126

existing green finance mechanisms.			
A standardised framework could scale up to meet global sustainability goals.	-0.5969	-0.1012	0.0390
A green finance framework should align with both global and local sustainability needs.	-0.5537	-0.1877	-0.0005
It is feasible to implement a green finance framework in the current market.	-0.6590	0.0888	-0.3815
A green finance framework would increase stakeholder confidence in investing in sustainable construction projects.	-0.6116	0.0097	-0.0591

Interpretation:

Factor 1 (Economic and Environmental Benefits):

Strong Loadings: Several items related to the economic and environmental effectiveness of green finance instruments, such as "Green finance instruments effectively promote sustainable building practices" and "Applying green finance tools offers significant economic and environmental benefits," strongly load on Factor 1.

Negative Loadings: These questions indicate that this factor is concerned with the economic feasibility and impact of green finance.

Factor 2 (Feasibility and Implementation):

Strong Loadings: Items like "It is feasible to implement a green finance framework in the current market" and "A green finance framework would increase stakeholder confidence in investing in sustainable construction projects" have moderate loadings on

Factor 2, suggesting that this factor represents the feasibility and market readiness for green finance.

Moderate Loadings: The loadings are not as strong as Factor 1, indicating that feasibility concerns are less prominent but still relevant.

Factor 3 (Framework Development and Alignment):

Strong Loadings: Questions related to the framework design (e.g., "A standardised framework could scale up to meet global sustainability goals" and "A green finance framework should align with both global and local sustainability needs") primarily load onto Factor 3, suggesting that this factor represents the alignment and scalability of the green finance framework.

Weaker Loadings: The loadings on this factor are weaker, indicating that although alignment and scalability are important, they are secondary to the perceived effectiveness and feasibility of the framework.

Factor 1: Economic and Environmental Benefits

This group of questions focuses on how green finance helps both the economy and the environment. People strongly agree that green finance tools promote sustainable building and bring real economic and environmental advantages. So, this factor is about whether green finance is useful and effective in practice.

Factor 2: Feasibility and Implementation

This group looks at how possible it is to put green finance into action right now. It includes ideas like whether it's realistic to set up a green finance system today and if such a system would make investors feel more confident about supporting sustainable

construction. The answers here show people think it's somewhat practical and doable, but these concerns are not as strongly felt as the benefits (Factor 1).

Factor 3: Framework Development and Alignment

This part deals with how a green finance system should be built and if it fits both global goals (like fighting climate change worldwide) and local needs (like what a specific country requires). While people think this is important, it's less urgent or obvious compared to the benefits and how easy it is to implement green finance.

Conclusion:

The most important thing to people is that green finance actually works well and brings economic and environmental benefits.

Next, people care about whether it's realistic to start using green finance now and if it will encourage investment.

Finally, they think it's important to design a green finance system that works both globally and locally, but this is a secondary concern compared to the other two.

So, when building a model or plan for green finance, these three ideas — benefits, feasibility, and framework design — should be the main focus.

Overall Conclusion:

The overall findings of this study reveal a clear need to strengthen green finance mechanisms to effectively support sustainable construction in the European Union, India, and Cambodia. The data shows that while many professionals recognize the importance and benefits of green finance tools for environmental and economic sustainability, there is

limited awareness and understanding of existing green finance options. Significant gaps and lack of transparency in current financial instruments hinder their practical use, causing dissatisfaction among industry stakeholders. Regulatory challenges, high costs, long payback periods, and the perception of high financial risk by institutions further limit adoption. However, government incentives and subsidies, along with strong collaboration among developers, financial institutions, and policymakers, are key drivers that can significantly improve the uptake of green finance. The research highlights the urgent need for a dedicated, clear, and tailored green finance framework that aligns with both global sustainability goals and local market conditions. Such a framework would increase stakeholder confidence and help overcome existing barriers, enabling wider investment in sustainable construction. In summary, enhancing education, improving policy support, and fostering collaboration are critical to unlocking the full potential of green finance for mitigating climate change through sustainable building practices.

CHAPTER V:

DISCUSSION

5.1 Discussion of Identifying Deficiencies in Green Finance Mechanisms

The findings of this research reveal that despite the increasing emphasis on sustainable development, substantial deficiencies persist in the awareness, accessibility, and perceived effectiveness of green finance mechanisms within the construction sector across the European Union (EU), India, and Cambodia. These gaps underline the complex interaction between institutional structures, financial literacy, and behavioural intention among key stakeholders—particularly financial institutions, developers, and policymakers.

A key deficiency identified is the lack of awareness and understanding of green finance mechanisms, particularly in emerging markets. Respondents from India and Cambodia demonstrated limited familiarity with green bonds, green mortgages, and ESG-linked loans. This finding corroborates the conclusions of Frimpong et al. (2018) and Debrah et al. (2021), who also reported that informational barriers remain a critical obstacle to the effective diffusion of green finance in developing economies. However, the present study advances this understanding by revealing that awareness gaps persist even in countries with growing sustainability frameworks—such as India—suggesting that knowledge dissemination alone is insufficient without targeted engagement and capacity-building efforts among financial and construction professionals. This nuanced finding refines the argument of Abraham and Gundimeda (2018), who emphasized informational

barriers but did not address the behavioural aspect influencing the conversion of awareness into adoption.

The Theory of Reasoned Action (TRA) provides an explanatory lens for interpreting this pattern. According to TRA, behaviour is determined by the interaction of individual attitudes and subjective social norms. In this context, the lack of awareness weakens the cognitive foundation upon which positive attitudes toward green finance can form. Consequently, even when individuals express general support for environmental sustainability, they may not exhibit corresponding behavioural intentions toward adopting green financial instruments. Conversely, in the EU, where green finance has become a normalized institutional practice, social norms supporting sustainability reinforce positive attitudes, thereby strengthening behavioural intentions. This contrast validates TRA's assertion that social and normative reinforcement is essential to bridging the gap between attitude and action. It also highlights a managerial implication: policy interventions alone are ineffective unless coupled with normative and educational strategies that enhance managerial competence and confidence in using green financial tools.

A second deficiency concerns the perceived inadequacy of existing financial instruments to accommodate the economic and operational realities of the construction sector. Respondents reported that green finance products often involve high initial costs, lengthy approval procedures, and unclear short-term financial returns. This aligns with findings from Anand and Ansari (2022), who identified the cost of compliance and complexity of certification as primary deterrents to green finance adoption in India. Similarly, Bruhl (2022) observed that even within mature markets such as the EU, the

rigidity of regulatory frameworks can limit flexibility in financial product design. However, the present research diverges by demonstrating that these financial inefficiencies are not universal but context-dependent, varying significantly with institutional readiness and the maturity of the construction market. For example, developers in Cambodia experience a dual constraint: weak institutional support and limited investor confidence.

Here, TRA and Human Society Theory (HST) jointly illuminate the behavioural and institutional dimensions of this issue. Under TRA, perceived economic inefficiency reduces behavioural intention by weakening perceived control—if managers believe that green finance is expensive or complex, they are less likely to engage with it. Meanwhile, HST explains how institutional maturity mediates this process: in societies where governance systems are transparent and stable (as in the EU), collective trust mitigates perceived risk and encourages proactive financial behaviour. In contrast, in markets with weaker institutions, such as Cambodia, the absence of trust and predictability amplifies risk aversion and discourages adoption. Thus, integrating both theories reveals that financial perception and institutional trust are not separate factors but interdependent determinants of managerial decision-making in green finance.

Another deficiency observed relates to transparency and accessibility in the implementation of green finance frameworks. Respondents from emerging markets reported difficulty understanding eligibility requirements and verifying compliance standards. This finding parallels the observations of Cremasco and Boni (2022), who found that even in developed contexts like the EU, insufficient clarity in sustainability disclosure regulations (such as the SFDR) can hinder investor confidence. The present study expands

on these findings by showing that, in emerging economies, this lack of transparency is compounded by weak institutional enforcement, leading to informational asymmetry and perceived inequity in access to finance. Through the lens of Human Society Theory, transparency functions as a social norm that fosters institutional legitimacy and stakeholder cooperation. When information flows are opaque, the trust between financial institutions, policymakers, and developers erodes, weakening the collective foundation necessary for sustainability transitions. Therefore, building transparency is not only a governance requirement but also a social reinforcement mechanism that enhances credibility, accountability, and behavioural alignment across actors.

Furthermore, regional variations in responses demonstrate that institutional and cultural contexts critically shape how green finance mechanisms perform. In the EU, structured policy frameworks, established rating systems, and societal acceptance of sustainability standards support higher adoption rates. These findings align with Bhatnagar et al. (2024), who emphasized that institutional readiness and regulatory coherence underpin successful implementation. Conversely, India and Cambodia display fragmented policy execution, limited financial innovation, and inconsistent coordination between public and private actors. This observation extends Human Society Theory, as it illustrates how institutional strength and social cohesion directly influence managerial confidence in adopting sustainability-oriented practices. In contexts where collective institutional trust is low, individual actors remain hesitant to assume financial risks, even when long-term environmental and economic benefits are evident.

5.2 Discussion of Analyzing Practical Implications of Green Finance Tools

The results of this objective indicate a positive view of the efficacy of green finance tools in implementing sustainable building practices. A lot of people think that these tools not only promote sustainability in the construction industry but also have huge economic as well as environmental advantages. The consensus tests notions of the growing understanding of the dual value that green finance can offer, especially when it comes to meeting the dual goals of environmental sustainability and showcasing tangible financial benefits that can accrue. This insight is consistent with findings in the existing literature, which suggest that green finance mechanisms such as green bonds and sustainable investment funds can establish sustainable construction by giving access to capital while furthering long-term environmental goals (Frimpong et al., 2022).

However, there is a great concern, given the perception of a gap in adequate guidance and support for the use of green finance tools in construction. This gap presents a massive business opportunity for companies to offer clear, accessible recommendations on exactly how their stakeholders can make the most of these tools. For example, services that provide customised consultancy services, educational programs, or digital platforms that make it easier to access and use green finance products could address this gap. Previous literature has stressed that the availability of adequate educational resources and clear implementation frameworks stifles the broader adoption of green finance mechanisms (Moser et al., 2020), which is similar to the results of this research, which shows the construction industry's uptake of green finance tools is hampered by the lack of clarity and support.

Construction companies and financial institutions may take advantage of the opportunity to build educational services or online platforms that aim to demystify green finance tools. Similar initiatives have been adopted in the European Union, where sustainability-focused organisations, such as the Green Building Council, have played a key role in encouraging companies to adopt green finance through certification programs and workshops. These resources have been essential in helping to open green finance to a wider range of stakeholders, including small and medium-sized construction companies who may otherwise be intimidated by the complexities involved.

The results also indicate that respondents tend to think that green finance tools are flexible to suit the regulatory and economic situations in a specific region. This adaptability is especially crucial in regions where regulatory frameworks for green construction are still being established, such as India and Cambodia. As green building codes and sustainability goals become more important in these regions, the flexibility of green finance tools is a key business advantage. Companies operating in emerging markets can use these flexible tools to adapt to local policies they pursue and access financial products to support sustainable development. For example, India's drive towards green cities and sustainable infrastructure offers an important opportunity for businesses to leverage green finance mechanisms that support national objectives (Brown, 2022). Similarly, Cambodia's increased interest in green construction through its introduction of incentives for sustainable buildings shows the importance of green financing mechanisms in achieving sustainable development (Chan, 2024).

From a policy perspective, the finding that government incentives and subsidies play an important role in the use of green finance tools reinforces previous literature that emphasises the essential role of government policies in moving towards sustainability in construction (Ozili, 2023). Governments that provide financial incentives, such as tax credits or subsidies for energy-efficient construction, can help to overcome the financial barriers to green building projects, making them more attractive to developers and investors alike. The success of green building initiatives in countries such as Germany and the UK, with strong government support, serves as a good example of how policy-driven financial instruments could boost the adoption of sustainable construction practices. These findings indicate that, to sustain improvements in the use of green finance tools in construction projects, governments should continue refining and expanding the role of financial incentives to encourage their use.

The research also finds that although the need to collaborate among developers, financial institutions and policymakers is widely acknowledged, it does not appear to be a key factor in increasing the effectiveness of green finance tools in construction. This finding is consistent with previous research on the importance of greater cross-sector collaboration in facilitating the adoption of sustainable finance. In practice, the proliferation of partnerships between these sectors could further contribute to the adoption of green finance systems and tools by fostering a more integrated approach to sustainable construction. Policy initiatives that promote increased dialogue between the public and private sectors, e.g., the creation of task forces or collaborative networks related to

sustainable building, could help develop more coherent and effective green finance mechanisms.

The regression analysis also further emphasises that the awareness of green finance mechanics and the perceived gap of existing tools are significant factors in determining the perceived effectiveness of these tools. From these findings, education and outreach efforts to advance stakeholder engagement with green finance initiatives are important. The existing literature supports this conclusion, as some studies have pointed out that awareness and understanding of green finance tools are critical to increasing their adoption and use (Vora, 2024 and Rohith & Patil, 2025). The fact that governmental incentives also positively affect the efficacy of green finance tools suggests that governments should continue to provide enhanced support for such initiatives. Policymakers might consider providing more targeted incentives or subsidies specifically to encourage businesses to build with green finance mechanisms.

5.3 Discussion of Identifying Obstacles and Catalysts for Green Finance in Sustainable Buildings

The results from this objective show that even though green finance mechanisms are widely recognized as a key mechanism to address sustainable construction, the effectiveness of these schemes is limited by various institutional, behavioral, and policy barriers in conjunction with certain context-dependent catalysts. Respondents from every region - especially India and Cambodia - stressed the role of barriers, including a lack of awareness, a complicated administrative framework, high start-up costs and lack of

coordination within regulatory framework. These challenges add up to a restricted ability of the construction sector to fully leverage on green finance tools.

These results are consistent with previous research findings conducted by studies such as Debrah et al. (2021) and Frimpong et al. (2022), which found that a lack of institutional support and financial uncertainty are among the major disincentives to the adoption of green financing. However, the current research contributes to such a development by showing that such barriers are not uniform, but variable in terms of institutional maturity, cultural norms, or the perception of the managers. For example, the stakeholders in the EU have a view of green finance as a mainstream finance embedded in business activities, but in India and Cambodia, it is the fringe and experiment phase. This differentiation emphasizes that contextual readiness and institutional trust are important determining factors of how green finance works in practice - an interpretation that has good support in Human Society Theory (HST).

From a Theory of Reasoned Action (TRA) perspective, many of the identified obstacles, such as lack of knowledge, perception of financial risk and lack of organizational confidence are expressions of weak translation of attitudes into behavioral intention. TRA assumes that positive attitudes alone will not produce behavioural change unless backed by facilitating social norms and feelings of control. In India and Cambodia, although respondents showed positive attitudes related to sustainability, the lack of normative reinforcement (i.e. industry standards, professional recognition, or peer influence) undermines their intention to behave to adopt green finance tools. On the contrary, in the EU, and due to the presence of strong institutional advocacy and positive normative

pressure from both policymakers and the public, managerial intention is strengthened, and more consistent adoption is achieved. Thus, this study is an extension of TRA as it empirically reveals the institutional and cultural support systems as behavioral mediators that determine whether or not the sustainability-oriented intentions will translate into concrete action.

One critical barrier, identified time and again, was a shortage of technical guidance and institutional capacity for using and managing green finance tools. Respondents often cited uncertainty about the application processes, documentation and evaluation metrics of sustainability. These findings support the findings of Moser et al. (2020), who find that green financial products are limited in their scalability due to the absence of sufficient technical infrastructure. However, in the present study a departure is made by showing that such constraints are not only technical but also managerial in nature; due to insufficient training, insufficient awareness of risk sharing mechanisms, and weak communication between government agencies and industry. Integrating TRA, these deficiencies can be interpreted as limitations in perceived behavioral control, whereby the managers lack the self-efficacy and institutional support to interact creatively with green finance with confidence. Addressing this necessitates not only policy reform but also specific programmes focusing on capacity building that will support managerial competence and institutional alignment.

The findings further conclude that economic and financial perceptions still remain major behavioural barriers. Many participants, especially across emerging economies, considered green finance instruments to be expensive, bureaucratic and insufficiently

yielding in the short term. This perception fits partially with Anand and Ansari (2022), who did find that green project financing in India frequently cannot meet the liquidity needs of developers. However, the current research extends this argument by addressing the original point through the learning that such economic perceptions are formed through institutional trust and social legitimacy - which are pivotal principles to Human Society Theory. In environments which have transparent regulatory systems and great social norms, such as the EU, investors and developers are more accepting of longer payback periods which trust that support from society and government will guarantee eventual returns. In contrast, in Cambodia where institutional mechanisms are still in their infancy, a lack of trust magnifies risk aversion and deters sustainable investment. Thus, economic feasibility is as much a social construct as a financial one, which will depend on the perceived legitimacy of governing systems.

Despite these barriers, the study also reflects some of the catalysts that can lead to a more widespread adoption of green finance in sustainable construction. Chief among these are government incentives, regulatory coherence, and cross-sector cooperation. Respondents of all regions recognized that such fiscal mechanisms as tax reliefs, low-interest loans and subsidies form effective enablers. This finding is consistent with the view of Ozili (2023) who highlighted the importance of fiscal incentives in driving private sector investment in sustainability. However, the present study adds a fine thread of understanding, namely, that incentives alone, if lacking the administrative transparency and public awareness, are not sufficient. In the EU, what proves to be clear and well-communicated subsidy structures are reinforcing normative expectations and institutional

legitimacy, and thereby this stimulates adoption. In India and Cambodia, by contrast, respondents emphasized ambiguity and bureaucratic inconsistency that lead to decreased perceived fairness and the lack of policy credibility. Using HST, this discrepancy can be explained by differences in institutional coherence and cultural alignment - societies with more governance integrity and a higher level of public trust are better able to translate incentives into behavioral change.

Another major catalyst identified is cross-sector collaboration between developers, policy makers and financial institutions. The study is in line with the findings in Debrah et al (2021) which underscores the need for multi-stakeholders engagement in sustainability finance, but advances the literature by diagnosing the reasons for the limited level of such collaboration in emerging markets. Under TRA, weak subjective norms - perceived expectations of peers and society - leave no sense of collective responsibility among industry actors. HST also has been used to complement this explanation by showing that fragmented institutional frameworks inhibit trust networks needed for cooperative governance. This dual theoretical interpretation leads one to conclude that sustainable progress in the area of sustainable finance is dependent on the alignment of behavioural intention and institutional co-operation. To encourage this, governments can institutionalize public-private partnership platforms, knowledge sharing forums and several incentive-linked forms of collaboration in an effort to create shared accountability.

Regression analysis of this study further validates the concept that awareness levels and government incentives are statistically significant predictors of perceived effectiveness in green finance adoption. This supports the conclusions made by Vora (2024) and Rohith

and Patil (2025), who have discovered that awareness is related to adoption intention. However, this research contributes to the existing literature with the addition of theoretical triangulation: (under the condition of TRA, awareness can promote the establishment of attitudes and perceived control, while HST side, it can strengthen social legitimacy and institutional trust). Hence, awareness simultaneously functions as a behavioral and an institutional variable - bridging the individual motivation to the systemic capacity. This is a theoretical integration of the fact that policy frameworks that promote awareness have to go beyond information dissemination to generate social norms across society and also institutional credibility.

5.4 Discussion of Evaluating Green Finance Mechanisms for Advancing Sustainable Building Practices

The results from Objective 4 strongly reinforce the argument that a dedicated and structured green finance framework is vital to advancing sustainable construction. A significant majority of respondents (150 out of 201) agreed that a specialized framework is essential, revealing widespread stakeholder recognition of the inadequacies of existing mechanisms. This consensus aligns with Jain and Jain (2021), who emphasized the role of structured financial instruments in scaling sustainable construction. However, the current study contributes further by demonstrating that perceptions of framework adequacy differ significantly across regions, reflecting the influence of institutional and cultural maturity. This finding suggests that the challenge is not only the absence of a framework but the lack of alignment between global objectives and local implementation capacities.

From the lens of the Theory of Reasoned Action (TRA), this strong endorsement of a green finance framework indicates positive attitudinal and normative shifts among stakeholders. TRA posits that behavioural intention is influenced by personal attitudes and perceived social expectations. The data suggests that in regions like the EU, where sustainability norms are institutionalized, stakeholders feel a greater normative obligation to support green finance frameworks. In contrast, in India and Cambodia, where regulatory structures are evolving, positive attitudes toward sustainability are not always reinforced by strong social norms or perceived behavioural control. This partially explains why enthusiasm for the concept of green finance does not always translate into consistent adoption or advocacy in emerging economies.

Respondents also expressed strong agreement that a customized, region-specific framework is necessary to address context-dependent challenges. This supports Bruhl (2022), who found that regional adaptation is crucial for the success of sustainable finance mechanisms. However, this study expands that argument by demonstrating empirically that stakeholders simultaneously value standardization and flexibility—a dual expectation reflecting the desire for global alignment (as embodied in the UN SDGs) and local responsiveness. Human Society Theory (HST) provides explanatory depth here: according to HST, social systems and institutional norms co-evolve with environmental priorities. Thus, while standardized frameworks enhance legitimacy at the global level, adaptability ensures institutional congruence within local governance and business ecosystems. This theoretical lens highlights that effective frameworks must operate at the intersection of global legitimacy and local social trust.

The finding that a large majority (over 140 respondents) supported a standardized yet adaptable framework also resonates with the work of Bhatnagar et al. (2024), who argued that global frameworks must be translated into context-sensitive policies to be operationally meaningful. However, the present study advances this debate by showing that stakeholder trust is a mediating factor between framework design and adoption. In regions with high institutional credibility (e.g., EU member states), standardization promotes efficiency and confidence; in regions with weak governance (e.g., Cambodia), it risks alienation and non-compliance unless accompanied by participatory policymaking. This extends Human Society Theory by illustrating how institutional legitimacy and collective belief systems determine the societal acceptance of sustainability frameworks.

The perception that the implementation of green finance frameworks is feasible (as confirmed by 118 respondents) indicates optimism about market readiness. This is consistent with Frimpong et al. (2022), who observed increasing acknowledgment among financial institutions of the profitability and resilience benefits associated with green investment. Yet, unlike prior research, this study differentiates feasibility perceptions across sectors—financial institutions and policymakers displayed greater confidence than construction practitioners. Applying TRA, this divergence reflects differences in perceived behavioural control: actors with greater access to regulatory and informational resources (e.g., banks and government agencies) feel empowered to act, while those in construction perceive higher uncertainty and risk. Hence, enhancing inter-sectoral communication and capacity-building initiatives can help bridge this perception gap and improve collective confidence in the feasibility of framework implementation.

A major insight emerging from the findings is the role of stakeholder confidence in fostering sustainable investment. The majority (137 respondents) believed that an exclusive green finance framework would strengthen investor and developer confidence by reducing uncertainty and clarifying financial processes. This supports Ozili (2023) and Anand and Ansari (2022), who found that confidence in regulatory consistency and transparency significantly enhances the attractiveness of green finance. However, this study's contribution lies in illustrating the psychological dimension of confidence formation through TRA. Confidence functions as an outcome of positive attitude reinforcement and perceived social approval—when stakeholders observe visible institutional support for green finance, they perceive reduced risk and greater legitimacy in sustainable investments. This behavioural mechanism links normative reinforcement (social trust) with economic rationality, offering a more integrated understanding of stakeholder motivation.

The ANOVA results reveal significant differences in perceptions of framework feasibility and necessity based on education, sector, and familiarity with green finance. Individuals with higher education and exposure to sustainability concepts demonstrated stronger support for framework implementation. This finding is in line with Dwivedi and Soni (2022), who noted that informed stakeholders are more likely to recognize the strategic benefits of sustainability finance. However, this study extends their conclusions by showing that educational influence operates both cognitively and institutionally: higher awareness not only improves understanding but also strengthens trust in governance mechanisms. Through the Human Society Theory lens, education acts as a cultural and

institutional catalyst—by promoting shared norms of sustainability, it enhances the societal capacity for collective action.

The factor analysis results further confirm that stakeholders prioritize the economic and environmental benefits of green finance, followed by feasibility and alignment with sustainability goals. This pattern reinforces Debrah et al. (2022), who emphasized the importance of tangible value propositions in promoting green finance adoption. Yet, the present findings add a theoretical nuance: according to TRA, tangible benefits serve as attitude-strengthening mechanisms that convert intention into action, while under HST, they function as social validation signals that sustain institutional legitimacy. In other words, stakeholders require both clear financial ROI (individual motivation) and visible social endorsement (collective validation) to commit to green finance adoption.

From a policy and managerial standpoint, these findings carry several implications. First, governments and financial regulators should design frameworks that are globally coherent yet locally adaptive, ensuring that international standards like the SDGs are contextualized to domestic policy realities. Second, education and awareness programs are critical to strengthen behavioural intention and institutional trust, consistent with the theoretical propositions of TRA and HST. Third, cross-sector partnerships should be institutionalized to enhance collective governance and reduce informational asymmetries between financiers, developers, and policymakers. Such collaborative ecosystems can create the social infrastructure required for sustainable finance to thrive.

CHAPTER VI: SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

This dissertation examined the use of green finance mechanisms in support of sustainable building works, and the primary focus was the identification of deficiencies, the analysis of implications of the various issues, the identification of barriers and triggers, and the assessment of the effectiveness of green finance tools towards achieving sustainable construction. The study was conducted using a quantitative approach, with data collected through surveys from key stakeholders in three regions: the European Union, India, and Cambodia.

In Objective 1, the research showed a critical lack of awareness and insufficient clarity and effectiveness of existing green finance mechanisms in the construction industry. The results showed that most respondents had limited awareness of green finance tools, which was a major limiting factor in their adoption. Additionally, respondents said the financial mechanism was not satisfactory or appropriate for addressing the particular needs of the construction sector, underscoring the need for customised and accessible financial mechanisms. Transparency and clarity in green finance mechanisms were also observed, highlighting the need to improve communication and support for stakeholders in the green finance industry.

Objective 2 analysed the practical implications of the tools used with green finance towards sustainable building practices. The findings showed a positive attitude towards the

effectiveness of these tools, with people questioning the benefits in terms of their effectiveness to be both economic and environmental. But a lack of enough guidance and support was recognised as a critical issue for successfully implementing green finance mechanisms. The results of the regression analysis confirmed that awareness and perceptions of existing gaps in the green finance landscape significantly influenced stakeholders' views on the effectiveness of these tools.

In Objective 3, this study explored the obstacles and catalysts to the adoption of green finance in sustainable construction projects. The research found that regulatory challenges, high costs, lengthy payback periods, and green finance being market-perceived as a high-risk finance by financial institutions were found to be significant barriers to adoption. On the other hand, government incentives and collaboration between stakeholders were identified as significant incentives that could increase the possibility of green finance adoption. The analysis of the regression and Chi-square further supported the findings and cemented the need for policy reforms, financial support, and collaboration to overcome these barriers.

Lastly, Objective 4 testifies to the effectiveness of green finance mechanisms and the need for a framework dedicated to sustainable construction. The results showed firm support for developing a tailored green finance framework, with national respondents duly agreeing that such a finance framework would fill the gaps of ineffective existing finance mechanisms and help achieve global sustainability goals. The findings also noted the relevance of ensuring that green finance frameworks are aligned with international and local sustainability needs, as well as the perception that the implementation of green

finance frameworks would increase confidence among stakeholders in green construction projects.

6.2 Practical Implications

The findings of this study provide several concrete and actionable implications for practitioners, financial institutions, and policymakers involved in promoting green finance for sustainable buildings. By focusing on measurable interventions, this section outlines how stakeholders in the European Union (EU), India, and Cambodia can operationalize the research outcomes to accelerate sustainable construction through finance-driven mechanisms.

6.2.1 Implications for Practitioners and Developers

For developers and construction practitioners, the findings highlight the urgent need to integrate financial literacy, sustainability knowledge, and operational decision-making within project planning.

Adopt structured green finance strategies: Developers should incorporate green bonds, ESG-linked loans, or green mortgages early in project design. This enables access to lower-cost capital and strengthens sustainability credentials. In India and Cambodia, where adoption is slower, developers could establish dedicated “sustainability finance units” or work with certified consultants to prepare credible project proposals that meet financiers’ green criteria.

Quantify and communicate return on investment (ROI): The study shows that a lack of clarity around financial returns discourages participation. Developers should conduct post-construction impact assessments quantifying energy savings, emissions reduction, and

cost recovery timelines. In doing so, they can demonstrate tangible ROI to investors and clients, replicating the EU’s performance-tracking model.

Participate in training and certification: Practitioners must engage with professional programs that connect environmental certification (such as LEED, GRIHA, or EDGE) with financial eligibility. These programs should be integrated into project management training across all three regions.

Collaborate with financiers and policymakers: Developers should proactively join public–private green finance forums and data-sharing platforms to shape financing criteria suited to local market realities. This collaboration ensures that green standards are feasible within regional construction practices.

6.2.2 Implications for Financial Institutions

For financial institutions, the results emphasize that institutional readiness and product innovation are critical for scaling sustainable finance.

Develop region-specific financial products: Banks and investment firms should design differentiated financial products that reflect local risks, incentives, and project sizes. For instance, in Cambodia, small-scale “green micro-loans” could target SMEs in construction, while in India, medium-sized developers could access blended finance combining public subsidies with private lending.

Strengthen risk assessment frameworks: The research indicates that limited trust and inconsistent risk appraisal hinder financing decisions. Institutions should introduce data-driven risk models integrating environmental performance indicators (e.g., projected carbon savings, lifecycle costs) to evaluate creditworthiness.

Expand capacity-building programs: EU-based banks can share technical expertise and training with partner institutions in India and Cambodia through formal “Green

Finance Partnership Platforms.” Such collaborations can transfer knowledge on regulatory compliance, green bond issuance, and project monitoring.

Enhance transparency and disclosure: Institutions must publicly disclose sustainability performance metrics of funded projects to reinforce investor confidence. Creating an open-access “green finance performance registry” at the national or regional level can strengthen accountability and market trust.

Align incentives with performance: Financial institutions can introduce interest rate rebates or preferential terms for developers who meet energy efficiency or emission reduction benchmarks, thereby encouraging measurable sustainability outcomes.

6.2.3 Implications for Policymakers and Regulators

For policymakers, the study identifies the need to move beyond policy statements and focus on enforcement, coordination, and incentive-based governance.

Establish clear national green finance frameworks: India and Cambodia should develop comprehensive regulatory guidelines similar to the EU Taxonomy, defining what qualifies as “green” in the local context. This clarity will reduce ambiguity, align stakeholders, and attract foreign investment.

Institutionalize cross-sector collaboration: Governments should set up national Green Finance Councils that include representatives from finance, construction, and environmental ministries. Such bodies can coordinate policies, reduce overlap, and ensure consistent implementation across sectors.

Expand fiscal and non-fiscal incentives: Governments must go beyond subsidies and offer measurable benefits such as property tax reductions, expedited permitting, or public recognition for certified green projects. These actions directly address the behavioral and institutional barriers identified in the findings.

Mandate reporting and accountability: Regulators should require annual sustainability performance disclosures from banks and developers, aligning local reporting standards with international benchmarks like the Sustainable Finance Disclosure Regulation (SFDR).

Invest in education and public awareness: Policymakers should integrate sustainability finance education into higher education curricula and vocational training programs to strengthen the long-term capacity of professionals entering the sector.

6.2.4 Cross-Regional Strategic Implications

The comparative nature of this study offers actionable insights for cross-regional learning and cooperation:

For the EU: The focus should shift from regulatory maturity to innovation—using advanced data analytics, ESG digital platforms, and AI-driven monitoring to refine the effectiveness of existing frameworks.

For India: The priority lies in bridging the gap between policy and practice through public awareness, decentralized financial schemes, and simplified access to funding for mid-tier developers.

For Cambodia: Institutional groundwork is essential—establishing enabling policies, financial education programs, and demonstration projects can help build initial trust and attract external investment.

Regional Cooperation: A tripartite knowledge-sharing platform (EU–India–Cambodia) could accelerate capacity-building, where the EU offers regulatory expertise, India provides innovation in affordable green solutions, and Cambodia benefits from technical transfer and pilot implementation.

6.3 Recommendations for Future Research

1. Exploration of Green Finance Mechanisms in Emerging Economies

While this research focused on the European Union, India, and Cambodia, there is a need for further studies that investigate the adoption and effectiveness of green finance in emerging economies. Many developing nations still face challenges such as limited access to green finance tools, inadequate policy support, and a lack of awareness. Future research should explore the unique barriers and opportunities for green finance in these regions, with a focus on localized solutions and the role of international institutions in supporting sustainable building practices.

2. Evaluation of the Role of Financial Institutions in Green Finance Adoption

A key finding from this study is the perception of green finance as high-risk by financial institutions. Future research could investigate in greater detail the factors influencing financial institutions' reluctance to engage with green finance products, such as green bonds or ESG-linked loans. Understanding the risk perceptions, return expectations, and regulatory challenges faced by these institutions could help tailor strategies to encourage their participation, thereby boosting green finance adoption in the construction sector.

3. Assessing the Effectiveness of Global Green Finance Frameworks

There is a growing consensus on the need for a standardized global green finance framework that can align with both global sustainability goals and local regulatory requirements. Future research could assess the feasibility of implementing such a framework on a global scale, examining the potential challenges and benefits of harmonizing green finance tools across different regions. Additionally, it would be

beneficial to explore the role of international organizations, such as the UN and World Bank, in facilitating the adoption of a standardized framework.

4. Impact of Policy Incentives and Government Support on Green Finance Adoption

Government incentives and subsidies emerged as crucial drivers for green finance adoption. Further research could examine the specific impact of various policy incentives, such as tax rebates, low-interest loans, and grants, on the adoption of green finance in construction. This research should focus on how different policy tools can reduce financial barriers, encourage investment in sustainable projects, and create a favorable environment for green finance across diverse economic and regulatory contexts.

6.4 Conclusion

In conclusion, this dissertation has provided a comprehensive analysis of the role of green finance mechanisms in promoting sustainable building practices, with a focus on identifying deficiencies, assessing practical implications, uncovering obstacles, and evaluating the effectiveness of these tools. Through a quantitative approach, the study has highlighted significant gaps in awareness, clarity, and effectiveness of green finance instruments, which have posed considerable barriers to their adoption in the construction sector.

The findings of this research underline the need for more targeted education and outreach initiatives to raise awareness of green finance products, especially in emerging regions. They also emphasize the importance of policy reforms that simplify regulatory

frameworks and provide clearer guidelines for the application of green finance tools in construction projects. Financial institutions must also evolve by offering more accessible and attractive green finance products that address the unique financial challenges of the construction industry.

Government incentives and collaboration among key stakeholders emerged as critical drivers for overcoming these barriers, further highlighting the importance of an integrated approach to sustainable construction financing. The study also found strong support for the development of a tailored green finance framework that aligns with both global sustainability goals and local regulatory needs, providing stakeholders with the confidence to invest in green building projects.

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APPENDIX A:
QUESTIONNAIRE

Section 1: Demographic Questions

(Please select the most relevant option for each question)

1. **What is your age group?**
 - ☐ Under 25
 - ☐ 25–34
 - ☐ 35–44
 - ☐ 45–54
 - ☐ 55 and above
2. **What is your gender?**
 - ☐ Male
 - ☐ Female
 - ☐ Non-binary
 - ☐ Prefer not to say
3. **What is your highest level of education?**
 - ☐ High School
 - ☐ Bachelor's Degree
 - ☐ Master's Degree
 - ☐ Doctorate
 - ☐ Other (Please specify)
4. **What is your current employment status?**
 - ☐ Full-time
 - ☐ Part-time
 - ☐ Self-employed
 - ☐ Student
 - ☐ Unemployed
5. **Which sector do you primarily work in?**
 - ☐ Construction/Real Estate
 - ☐ Finance/Banking
 - ☐ Government/Policy
 - ☐ Academia/Research
 - ☐ Other (Please specify)
6. **How many years of experience do you have in your field?**
 - ☐ Less than 2 years
 - ☐ 2–5 years
 - ☐ 6–10 years

- More than 10 years
- 7. **Where are you located?**
 - European Union
 - India
 - Cambodia
 - Other (Please specify)
- 8. **What is your role in your organization?**
 - Decision Maker/Policy Maker
 - Financial Expert
 - Engineer/Architect
 - Researcher/Academic
 - Other (Please specify)
- 9. **Involvement in Eco-Friendly Funding Initiatives:**
 - a. Directly involved
 - b. Indirectly involved
 - c. Not involved
- 10. **How familiar are you with the term “Eco-Friendly Funding “, "green finance" and "green buildings"?**
 - Very familiar
 - Somewhat familiar
 - Not familiar at all
- 11. **Have you ever invested in or considered investing in green finance products and green building?**
 - Yes
 - No
 - Not sure
- 12. **How important do you think green finance and green buildings is for environmental sustainability?**
 - Very important
 - Somewhat important
 - Not important

Section 2: Identifying and comprehending the deficiencies in green finance mechanisms specific to the construction industry.

Instructions: Please indicate the extent to which you agree or disagree with the following statements. Use the scale:

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

1. **I am aware of the green finance mechanisms available for sustainable construction projects.**
(Response: 1 | 2 | 3 | 4 | 5)
2. **The existing green finance mechanisms meet the needs of the construction industry.**
(Response: 1 | 2 | 3 | 4 | 5)
3. **Green finance mechanisms are clear and transparent for stakeholders.**
(Response: 1 | 2 | 3 | 4 | 5)
4. **Significant gaps in green finance mechanisms limit their effectiveness in supporting sustainable construction.**
(Response: 1 | 2 | 3 | 4 | 5)

Section 3: Analyzing the practical implications of these instruments

Instructions: Please indicate the extent to which you agree or disagree with the following statements. Use the scale:

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

1. **Green finance instruments effectively promote sustainable building practices.**
(Response: 1 | 2 | 3 | 4 | 5)
2. **Applying green finance tools offers significant economic and environmental benefits.**
(Response: 1 | 2 | 3 | 4 | 5)
3. **Green finance tools are adaptable to the regulatory and economic conditions in my region.**
(Response: 1 | 2 | 3 | 4 | 5)
4. **There is sufficient guidance and support for using green finance tools in construction.**
(Response: 1 | 2 | 3 | 4 | 5)

Section 4: Identifying the obstacles and catalysts of green finance for sustainable buildings.

Instructions: Please indicate the extent to which you agree or disagree with the following statements. Use the scale:

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

1. **Regulations and policies make it difficult to adopt green finance for construction projects.**
(Response: 1 | 2 | 3 | 4 | 5)
2. **High costs and long payback periods are barriers to using green finance.**
(Response: 1 | 2 | 3 | 4 | 5)

3. **Financial institutions perceive green finance for construction as high-risk.**
(Response: 1 | 2 | 3 | 4 | 5)
4. **Government incentives and subsidies adequately support green finance adoption.**
(Response: 1 | 2 | 3 | 4 | 5)
5. **Collaboration among developers, financial institutions, and policymakers improves the adoption of green finance.**
(Response: 1 | 2 | 3 | 4 | 5)

Section 5: Developing a conceptual framework model of green finance instruments that can drive the advancement of the sustainable building industry

Instructions: Please indicate the extent to which you agree or disagree with the following statements. Use the scale:

1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

1. **A dedicated green finance framework is essential for advancing sustainable construction.**
(Response: 1 | 2 | 3 | 4 | 5)
2. **A tailored framework would address the shortcomings of existing green finance mechanisms.**
(Response: 1 | 2 | 3 | 4 | 5)
3. **A standardized framework could scale up to meet global sustainability goals.**
(Response: 1 | 2 | 3 | 4 | 5)
4. **A green finance framework should align with both global and local sustainability needs.**
(Response: 1 | 2 | 3 | 4 | 5)
5. **It is feasible to implement a green finance framework in the current market.**
(Response: 1 | 2 | 3 | 4 | 5)
6. **A green finance framework would increase stakeholder confidence in investing in sustainable construction projects.**

(Response: 1 | 2 | 3 | 4 | 5)

APPENDIX B:
INFORMED CONSENT

Research Title:

The Role of Green Finance Mechanisms in Promoting Sustainable Building Practices: A Comparative Study of the European Union, India, and Cambodia

Principal Investigator:

My name is Sailesh Patnaik. I am a DBA learner at SSBM I am conducting a study and you are invited to participate.

Purpose of the Study:

The purpose of this study is to explore the role of green finance mechanisms in advancing sustainable building practices. Specifically, it aims to identify the deficiencies in existing green finance mechanisms, assess their practical implications, uncover the obstacles and catalysts for their adoption, and evaluate the effectiveness of these financial tools in promoting sustainable construction practices in three regions: the European Union, India, and Cambodia.

Procedures:

If you agree to participate, you will be asked to complete a structured survey. The survey includes questions about your awareness, experiences, and views regarding green finance mechanisms in the construction industry. It will take approximately 20–30 minutes to complete. Your participation involves answering multiple-choice and Likert scale questions, as well as providing responses to open-ended questions where appropriate.

Confidentiality:

All information you provide will be kept confidential and used solely for academic purposes. Your responses will be anonymized to ensure that no personally identifiable

information is included in the study's results. The data will be securely stored and accessed only by the researcher and authorized personnel. Any published results will only report aggregated data, with no individual responses being identifiable.

Potential Risks and Benefits:

There are no significant risks associated with participating in this study. Your participation will contribute valuable insights into the understanding and development of green finance mechanisms for sustainable construction. These findings may inform future policies, financial products, and practices that could benefit the construction industry, government bodies, and other stakeholders. While there are no direct benefits to you personally, your contribution will help advance research in the area of green finance and sustainable building practices.

Consent Statement:

By signing below, you confirm that you have read and understood the information provided above. You consent to participate in this study and allow the researcher to use your responses for academic purposes. You understand that your participation is voluntary and that you may withdraw from the study at any time without any consequences.

Participant's Name: _____

Participant's Signature: _____

Date: _____

Researcher's Signature: _____

Date: _____