"Integrating Sustainable Operations and Green Practices into General Insurance: Evaluating the Role of Environmental Economics in Risk Assessment and Product Innovation"

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Abstract

By managing and lowering risks associated with environmental, social, and governance (ESG) factors, the insurance industry makes a substantial contribution to the achievement of sustainable development. The insurance sector has been at the intersection of innovation and sustainability in recent years. There is growing pressure on general insurance businesses to match their operations with sustainable development goals as environmental concerns become more prominent and climate change increases. This change is strategic rather than just regulatory or reputational. Insure may lessen them environmental i impact while simultaneously increasing their long-term resilience and competitiveness by using green practices and sustainable operations. In addition, the concepts of environmental economics provide effective instruments for comprehending, valuing, and reducing the environmental externalities that influence contemporary risk environments. The present study examines how green practices and sustainable operations are being incorporated by general insurance businesses, and it assesses how environmental economics is influencing the development of creative, climate-resilient insurance solutions. The study is based on secondary & primary data. Descriptive statistics are proposed to be applied for the analysis. The article seeks to identify how general

insurance companies can use environmental economics concepts (such as externality pricing and environmental risk valuation) in conjunction with environmentally sustainable practices (such as digital transformation, paperless claims, and carbon-neutral offices) which will enable insurers to continue their financial and operational viability while making a significant contribution to a more sustainable future.

Keywords: *Environmental, Social and Governance factors, Insurance Industry, Innovation, Sustainable Development & Externalities.*

Introduction

By managing and lowering risks associated with environmental, social, and governance (ESG) factors, the insurance industry makes a substantial contribution to the achievement of sustainable development. The insurance sector has been at the intersection of innovation and sustainability in recent years. There is growing pressure on general insurance businesses to match their operations with sustainable development goals as environmental concerns become more prominent and climate change

increases. Climate change, which is defined by the ongoing increase in air temperature and necessitates a strong commitment to sustainability, is the most significant challenge facing the globe today. India was placed 45th out of 48 countries, which together account for 90% of the global economy, in the Climate Economics Index, which looks at a nation's overall climate resilience. The frequency and intensity of environmental hazards, from hurricanes, floods, and wildfires to heat waves and sea level rise, have alarmingly increased in the twenty-first century. These developments pose serious financial risks in addition to environmental and humanitarian issues. Particularly vulnerable to the negative consequences of climate change is the general insurance industry, which covers risks associated with business, property, motor, and health. Insurers are being forced to reevaluate how they evaluate, price, and manage climate risks as they become more costly and unpredictable. In the most catastrophic climate scenario, with a temperature rise of 3.2°C, India's economic losses are predicted to exceed 35% of its GDP. Therefore, sustainability goals and commercial interests are firmly intertwined and must be handled as an urgent priority. According to the World Meteorological Organization, a weather-related tragedy has occurred every day for the past 50 years, killing 115 people and inflicting $202 million in losses. India has recorded over 321 disasters in South-East Asia during the previous two decades. In 2021 alone, three cyclones, two floods, and an earthquake inflicted tremendous damage on the Indian subcontinent. (Capgemini (2025).

Insurers are now expected to be risk mitigators, risk educators, and even risk transformers in addition to indemnifying losses. Emerging international frameworks that are changing the expectations placed on financial institutions, including insurers, such as the Task Force on Climate-related Financial Disclosures (TCFD), ESG legislation, and green finance efforts, are supporting this shift.

As a result, the insurance industry has the potential to accelerate the transition to a more sustainable community. This is because insurers not only provide insurance, but also serve as risk managers and social influencers, playing an important role in educating and raising awareness in society. Implementing strategies that lessen their negative effects on the environment and increase productivity across all company activities is a key component of sustainable operations. This could include the following for general insurance companies:

Sustainable operations in Insurance

Paperless processing and digital documentation, Energy-efficient infrastructure and environmentally friendly purchasing, Telematics and remote inspections for environmentally responsible car tracking, Carbon emission reduction in customer service and logistics, promoting repair rather than replacement is one example of sustainable claims management.

These operating procedures offer cost savings and increased customer satisfaction in addition to bettering ecological performance. Additionally, incorporating sustainability into operations promotes competitive distinctiveness, regulatory compliance, and brand equity.

Innovation and Green Insurance Products

Innovation in insurance is becoming more closely linked to environmental sustainability. Low-carbon behavior is rewarded, the use of renewable energy is encouraged, and new eco- risks are covered by green insurance products. Among the examples are Usage-based insurance (UBI) or pay-as-you-drive (PAYD) for environmentally friendly driving Insurance for solar-powered homes or electric cars (EVs) coverage of climate-resilient infrastructure or green buildings Policyholder discounts for adopting sustainable behaviors. By matching premiums to actual, behavior-based risk, these products not only cater to changing customer preferences but also enhance insurers' long-term profitability.

Environmental economics and General insurance

A key framework for incorporating sustainability into general insurance businesses' operations and product offerings is provided by environmental economics. Environmental economics is a branch of economics which studies the interaction between economy and environmental aspects and how one influences others. By internalizing environmental costs, encouraging sustainable behavior, and utilizing

market-based instruments to promote long-term ecological balance, it aims to address market failures brought on by environmental externalities.

Environmental economics aids insurers in evaluating and better managing climate-related risks in the context of general insurance. Insurers can create more precise and ethical underwriting procedures by integrating environmental data, such as carbon footprints, land use, or climate vulnerability, into risk assessment models. This enables them to match premiums to exposure to environmental risk, thus incentivizing policyholders to reduce their risk. Product innovation is also aided by environmental economics. Green solutions that incentivize eco-friendly retrofits can be created by insurers. These goods demonstrate both environmental responsibility and financial protection.

From a behavioral standpoint, insurers can encourage clients to make sustainable decisions— like reducing their driving, using less energy, or constructing with recycled materials—by offering them environmental economic tools, such as incentives, subsidies, and rebates. Instead of focusing only on compensation, claims management can be refocused to encourage long-term repairs and loss avoidance. By using environmental economic concepts to support ESG-aligned portfolios, green bonds, and low-carbon infrastructure, general insurers—who oversee substantial capital reserves—can reduce their exposure to climate risk and promote sustainable development.

But there are still difficulties. These include varied rules, complicated risk modeling, a lack of environmental data, and differing customer readiness to embrace green products. Notwithstanding this, environmental economics provides insurers with a strong foundation for becoming more than just financial risk managers and proactive contributors to climate resilience.

To sum up, the application of environmental economics to general insurance enables the sector to develop creative, long-lasting, and financially sound solutions to environmental risks, boosting both corporate value and the welfare of society. The public's awareness of environmental issues is rising along with them, which causes expectations and market patterns to shift.

Consumer Expectations with changing market trends

Global environmental consciousness and climate change are raising customer expectations for sustainable, accountable, and transparent insurance practices. Customers in the general insurance market are looking for products and services that are in line with their environmental values and have higher expectations than just standard coverage. Green insurance products, such as EV insurance and climate-resilient home insurance, are becoming increasingly popular as coverage for environmentally friendly activities increases.

Customers choose insurers that use paperless procedures, have low carbon emissions, and make investments that are in line with ESG principles.

Insurers are under growing pressure to reveal their environmental effects and conform to frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD) or the UN Sustainable Development Goals (SDGs).

Behavior-linked and usage-based insurance, such as pay-as-you-drive, is becoming more and more well-liked. Active Participation by customers to anticipate & advise on lowering risk and enhancing resistance to climate-related disasters. More than 60% of consumers worldwide are prepared to pay more for insurance choices that are environmentally friendly. Artificial Intelligence (AI), remote claims, and digital underwriting are examples of tech- driven services that are improving eco-efficiency. Market-wide sustainability initiatives are being accelerated by laws such as the European Union (EU) Green Taxonomy and International Financial Reporting Standards (IFRS) sustainability standards. To lower climate risk and draw in value-driven customers, insurers are incorporating Environmental, Social and Governance (ESG) standards into investment portfolios. Governments are also taking steps to manage economic resources more effectively and efficiently while taking environmental norms into account.

Sustainability initiatives of global insurers in India

The "Indian Insurance and Sustainable Development" Earth Security Brief emphasizes how important the country's insurance industry is to promoting climate resilience and sustainability. It highlights that the

Insurance industry must adjust by incorporating Environmental, Social, and Governance (ESG) principles, creating cutting-edge products like climate risk and parametric insurance, and investing in green infrastructure, as rising climate risks threaten economic stability and could cut India's GDP by up to 35% by 2050. Growing policy support is indicated by measures like the General Insurance Council's acceptance of UN sustainable principles and regulatory agencies like Insurance Regulatory Development Authority of India (IRDAI). The industry has enormous potential to propel India's shift to a more secure and sustainable future, notwithstanding obstacles like a lack of data on climate risk.

Review of Literature

Theoretical ROL

Economic theory offers a rich foundation for understanding how insurance market's function, why regulation is necessary, and how individuals and firms make decisions about risk. Classical to modern economists, starting with Adam Smith in the 18th and 19th centuries, recognized that markets sometimes fail due to factors like high costs, scarce information, or limited supply—flood insurance being a prime example. Such failures justify government regulation and intervention, as seen with agencies like the Insurance Regulatory and Development Authority of India (IRDAI) and the National **Association of Insurance Commissioners (NAIC) in the US.**

A key mathematical underpinning of insurance is the Law of Large Numbers, formulated by Jacob Bernoulli in 1713. This law states that predictability increases as the number of observations grows, allowing insurers to estimate premiums and reserves more accurately.

Expected Utility Theory, developed by Daniel Bernoulli in 1738, explains that individuals make decisions based on expected utility rather than just monetary outcomes. Because people are generally risk-averse, they are willing to pay a premium to avoid large losses, even if the premium exceeds the expected loss—a principle that underlies insurance demand.

Externalities, explored by Arthur C. Pigou in 1920, highlight how market actions can affect third parties, such as through pollution or climate change. This concept drives growth in environmental and climate insurance, as well as related regulation.

The emergence of Game Theory by John von Neumann and Oskar Morgenstern in 1944 introduced the analysis of strategic interactions among competing insurers and stakeholders, including signalling, contract design, and screening—essential for effective policy design and risk-sharing.

Risk Aversion Theory, also from von Neumann and Morgenstern, emphasizes that risk- adverse individuals value certainty and thus seek insurance as a tool for risk transfer.

Modern Portfolio Theory (MPT), introduced by Harry Markowitz in 1952, revolutionized insurer investment practices by advocating for diversification to maximize returns for a given risk level, thereby supporting solvency and the capacity to pay claims.

In the 1960s, economists like Kenneth Arrow and Mark Pauly provided foundational insights into moral hazard, noting that individuals may behave more recklessly after obtaining insurance. Insurers counter this with deductibles, co-pays, and policy limits.

George Akerlof's concept of information asymmetry—detailed in his 1970 work "The Market for Lemons"—shows how one party (usually the policyholder) may have better information than the other, leading to adverse selection and moral hazard. Insurers attempt to manage this with screening and risk-based pricing.

Principal-Agent Theory, framed by Stephen Ross (1973) and refined by Jensen & Meckling (1976), explains conflicts that arise when agents (such as brokers) and principals (insurers or policyholders) have misaligned incentives. This misalignment can foster mis-selling, fraud, or over-insurance, necessitating regulation and incentive design.

The field of Behavioural Economics—spearheaded by Daniel Kahneman and Amos Tversky with their 1979 Prospect Theory—proves that consumers do not always act rationally. They may delay buying insurance, misjudge risks, or over-insure out of fear. These insights support innovations in insurance product design, marketing strategies, and regulatory nudges to encourage optimal protection and participation in insurance markets.

Emperical ROL

The present research investigates leadership's role in implementing sustainability in Nordic insurers. Findings suggest that Leadership is key in employee acceptance of sustainability. Effective change depends on internal support and engagement (Jóhannsdóttir et al.,2015). The study examines how climate change affects Kenyan public listed companies. Findings show the negative impact of climate change effects on profitability and limited integration into daily operations (Kihiko & Kinoti, 2016). Suggests framework to improve China’s catastrophe insurance market, economic & legal framework analysis. It emphasizes the "Whole-Nation System" in disaster relief and proposes market-based reforms for efficiency, better data use, and long-term sustainability (Qihao He, 2016). Explore the role of social protection in addressing climate-induced migration. Literature review & conceptual framework shows social protection can mitigate migration but must be flexible and climate informed. Gaps in long-term evidence and urban focus remain (Schwan & Yu, 2017) Content review of technical reports and policy documents on Mexico’s climate policies and their objectivity finds lack of comprehensive data and calls for more empirical work to validate climate initiatives in Mexico. Effectiveness of policy is questioned (Silva Rodríguez de San Miguel, 2018). Investigates socio-psychological and external factors affecting life insurance purchase and lapsation in India. Findings suggest that decision-making is driven by family, income, beliefs whereas lapsation is linked to mis-selling and awareness gaps **(Giri, 2018).** The paper compares public and private general insurers in India and evaluates their performance using financial indicators. Both sectors show growth, operational improvements. Findings recommend the use of technology **(Ahmed et al., 2018)**. Address the climate risk supervisory challenges in the insurance sector and propose international regulatory harmonization. Comparative regulatory analysis calls for unified standards, sustainable investments, and better climate risk modeling and integration into insurance supervision **(Broeke, 2018).** The paper examines industry growth patterns and identifies challenges and opportunities in the Indian insurance sector. Findings suggest that awareness and demand are growing, but the sector still has low penetration, highlights protection gap and tech adoption. **(Satish, 2019).** Paper shifts focus of sustainability accounting from impacts to risks/dependences; and importance of improved TCFD reporting usefulness. It highlights TCFD's potential in transforming corporate reporting and identifies current gaps in TCFD literature and scenario analysis, and advocates new research on integrated reporting **(O’Dwyer & Unerman, 2020).** Study customer perception of general insurance services. Key factors which influence customer perception are identified as loyalty, transparency, dependability. Findings suggest that insurers must meet service expectations **(Gangil & Vishnoi, 2020)**. Explore behavioral, social, and promotional influences on insurance choices in Namibia. Findings suggest that agents heavily influence decisions where most customers are satisfied, but some consider switching due to dissatisfaction **(Maseke & Iipinge, 2021)** Major U.S. insurers continue to have significant investments in fossil fuel assets, which exposes them to financial, regulatory, and reputational risks related to climate change.The research urges investors to move toward low-carbon and sustainable investments, divest from fossil fuels, and embrace more transparent financial disclosures pertaining to climate change. It highlights how important insurers are to hasten the shift to a net-zero economy as institutional investors and risk managers **(Ceres, 2021)**. Analyze consumer behavior in general insurance with demographics. Findings suggest that trust and reputation matter more than cost. It also suggests that youth prefer innovative products over traditional **(Verma &** Yadav, 2021). Examine the role of records managers in climate action and sustainability in Canada. Findings suggest that organizations show sustainability commitment, but internal- external gap still exists. Suggesting better integration of climate education in records management would help to address the issue (Evans, 2021). Through the perspective of integrated thinking, research synthesizes studies on accountability in climate governance, emphasizing the necessity for cohesive, cross-sectoral

coordination and the fragmented nature of current governance structures. It proposes a conceptual model of "Climate Change Responsibility Circles" in order to bring accountability, collaboration, and outcome-elements across public, corporate, and civil society actors into alignment. Findings emphasize transparent and accountability driven climate action for successful implementation of climate action (Brunelli et al., 2021). Research examines how social justice norms; traditional system interacts with climate change in Samoa highlighting the influence of Western style individual insurance in undermining community-based adaption (CBA). Findings suggest that when insurance is integrated well along with traditional norms it can prove to be effective (Bartlett et al., 2022). Bibliometric analysis to map trends in insurance, environmental risks and climate change. The key themes identified are CO2 risk, natural hazard coverage, climate insurance and growing international collaborative networks. It offers a road map for further research (Nobanee et al., 2022). Assess customer satisfaction and the factors influencing life insurance policy purchase in India. Findings suggest that decisions are shaped by peers and demographics aspects. It emphasizes the need for LIC to tailor services to varied expectations of customers (Hussain et al., 2023). The report suggests that insurers should promote climate resilient strategies by encouraging safer rebuilding and risk reduction measures. They should provide risk sharing mechanisms and create incentives to maintain affordable and climate resilient insurance coverage which helps to prevent protection gaps (OECD, 2023). Emphasizes that to increase climate resilience, EU insurers need to innovate insurance products, improve climate data, and encourage risk-reducing behaviors. To reduce the widening climate protection disparity throughout Europe, the findings emphasize the necessity of more robust regulatory frameworks, open-access risk models, and cooperation (Hielkema, 2023). A systematic review of 97 studies analyzing climate change adaptation. They discovered that the majority of CGE models place more emphasis on planned adaptation strategies—like government-led infrastructure initiatives—while paying less attention to autonomous adaptation, which entails impromptu changes made by people or markets. The agricultural sector is the primary focus of the research, which is mostly carried out at the national level with little attention paid to regional or sector-wide variety. This highlights the need for more inclusive and thorough modeling approaches by exposing a sizable gap in capturing the entire range of adaptive behavior across economies (Wei et. al, 2023). Study assesses if Australian property valuers integrate climate risks in assessments. Findings suggest that valuers recognize risks but lack data/tools to act upon it. Availability of training and improved climate data would help the cause (Georgia Warren-Myers, 2023). Analyze how investors react to climate initiatives in Bursa Malaysia-listed firms findings suggest climate concerns affect investors, esp. in agriculture. Awareness alone is not an influential factor for decision making. Recommends more cross-sector studies to be conducted (Md. Mahmudul Alam, 2023). Examines the responsibilities of different built environment stakeholders with regard to climate adaptation and offers a thorough framework that charts these functions throughout the built environment's life cycle. It identifies national and local governments, communities, civil society, academia, and the private sector as key players and outlines their specific responsibilities in planning, implementing, and sustaining adaptation strategies (Shavindree Chrishani Nissanka, 2024). Provides guidance to insurance supervisors in incorporating climate related risks into existing policy making and framework.it highlights importance of governance, boards and risk management teams to address climate risk. provides guidance to insurance supervisors in incorporating climate related risks into existing policy making and framework. The paper calls for international regulatory harmonization, better climate risk modeling, and the promotion of sustainable investment practices to strengthen the resilience of the insurance sector (International Association of Insurance Supervisors [IAIS], 2025).

Objectives

To evaluate how much green practices and sustainable operations are being incorporated into the business models of general insurance businesses.

To assess the application of environmental economic concepts in premium pricing and risk modelling.

To evaluate how innovation driven by sustainability affects consumer perception.

Methodology

This is a descriptive study based on analysis of 10 GICs, which tries to give an insight into how GICs are trying to incorporate sustainable practices into their operations, which will enable insurers to continue their financial and operational viability while making a significant contribution to a more sustainable future.

The study is based on both primary and secondary methods of data collection. Academic articles, industry reports, company reports, and regulatory publications are referred to.

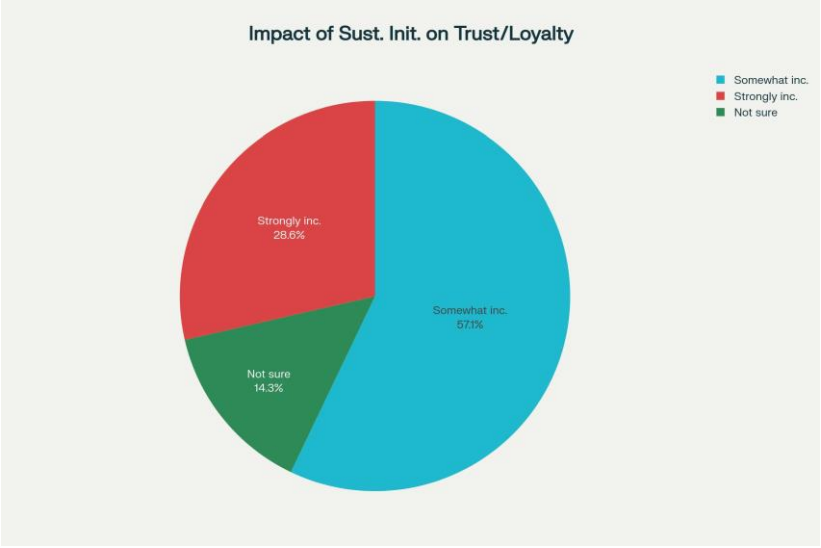
In the present article based on a convenient sampling method. Ten General Insurance Companies (Royal Sundaram GIC, Chola MS GIC Ltd, Bajaj Allianz General Insurance Company, ICICI LOMBARD GIC, Reliance general insurance, Go, Digit General Insurance Ltd, Future Generali India Insurance, Acko General Insurance, Universal Sompo, IFCO TOKIO GIC) are selected for the purpose of study.

Results and Discussions

All the ten companies sampled offer general insurance products. Among them few offer health insurance and the rest offer third party insurance such as motor, vehicle, home, fire, marine etc.

Based on the interviews conducted respondents have suggested that the companies integrate sustainability into their operations from moderate to great extent in its operations. In order to bring sustainability into its operations companies are resorting to digital documentation and e- policy issuance. They have also been taking steps to reduce carbon footprints by adopting minimal paper usage and avoiding unnecessary paper usage eg: ban paper cups, paper plates, set up green office infrastructure and energy efficient operations. They have also been engaging in eco-friendly claim processes and offering green insurance products like special provisions for e vehicles.

Fig: 1: Chart depicting influence of sustainable operations by companies on consumer trust and Loyalty:



Responses suggest that many respondents feel that sustainable operations adopted by companies do exert influence and help to enhance customer trust and loyalty.

57.1% of respondents believe sustainability initiatives somewhat increase trust and loyalty.

28.6% feel these initiatives strongly increase trust and loyalty.
14.3% are not sure about their impact.

Data on challenges faced suggest that cost of implementing the sustainability factor, knowledge about the importance of sustainability and regulatory constraints pose a major challenge for successful adoption of green practices into their operations. Data on whether the companies include the environmental concerns in pricing of the product suggests that most of the companies selected, in sample, have minimal incorporation of environmental concerns into their premium pricing, majority of them take only the externalities into consideration while pricing the product.

Fig 2: Chart depicting consideration of environmental risks in pricing models of selected companies.

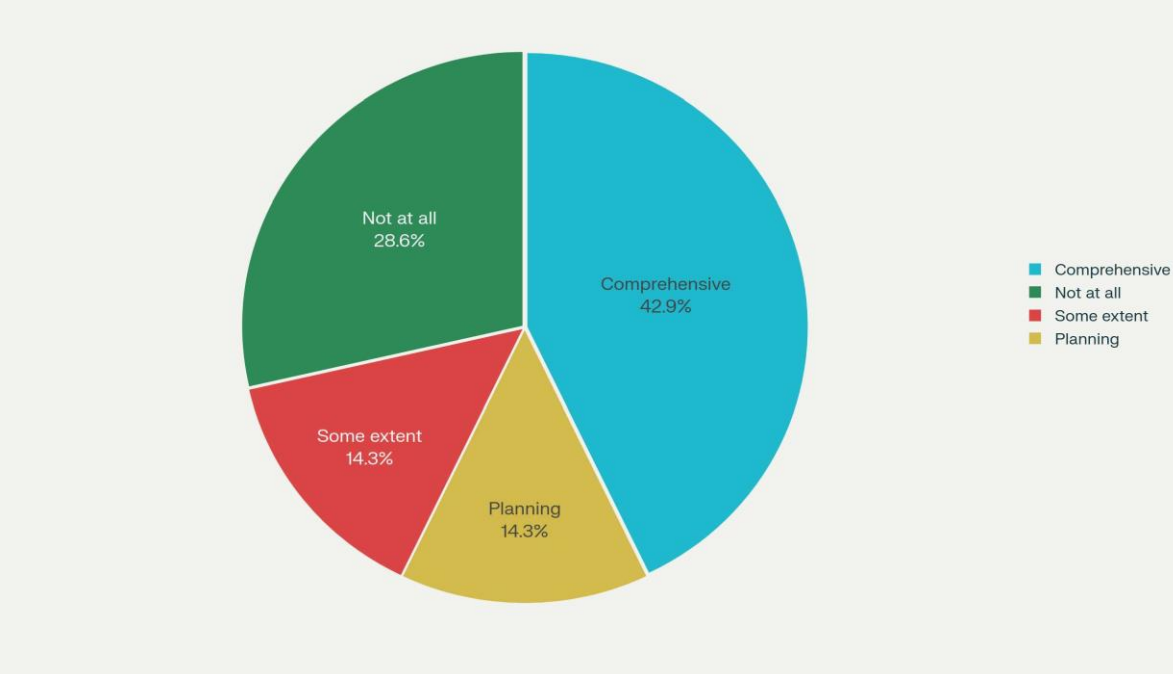
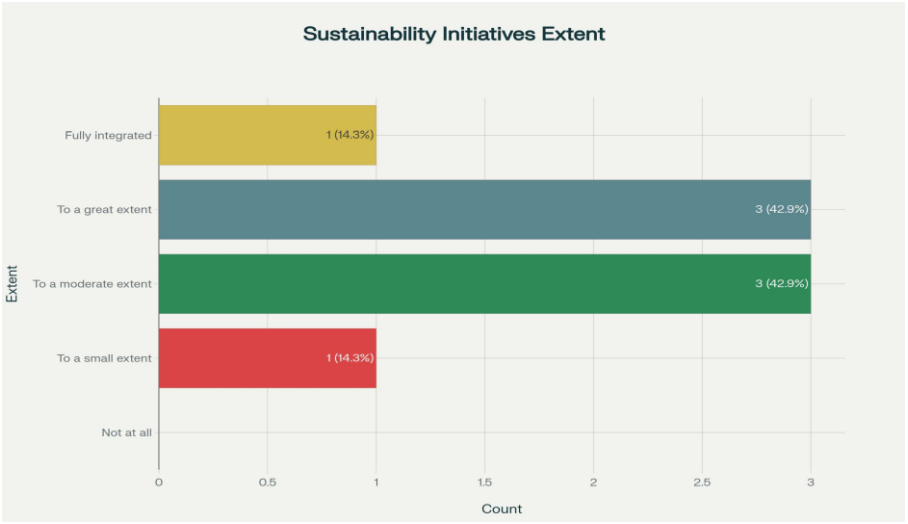


Diagram suggests that most of the companies consider the environmental risks into their pricing models.

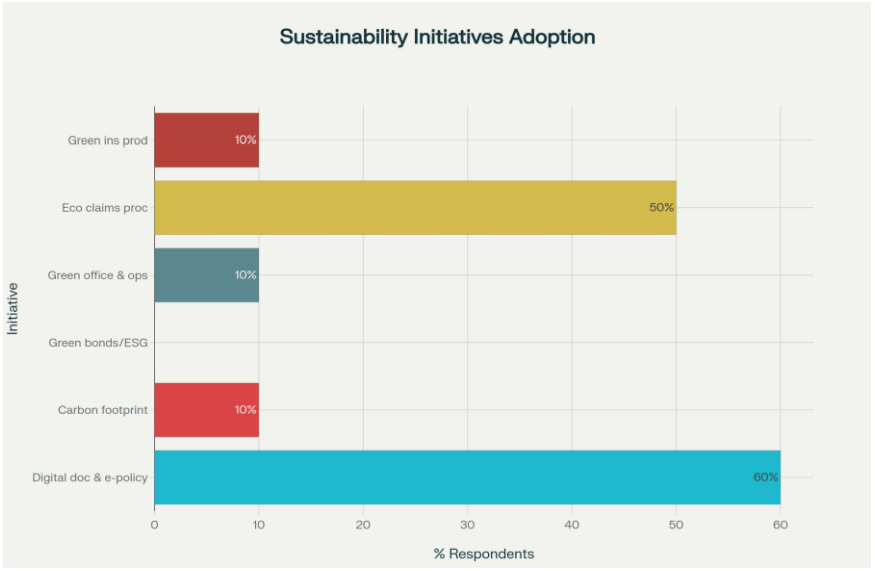
Responses also suggest that many have the consideration to incorporate environmental concerns into the pricing model. It also suggests that historical data available on types of claims would be the guiding principle in the pricing process till date. And most of these companies update the pricing model every 2 to 3 yrs to incorporate changing environmental concerns into their pricing model. The respondents (57%) also suggest that the companies are trying to develop new products which are environment friendly due to raising awareness. And 71% feel consumers also show more inclination towards such products.

Fig: 3: Diagram indicating the extent of integration of sustainability into the core strategy of (selected) companies:



The above diagram suggests that the selected General Insurance Companies have incorporated the sustainability operations into their business from moderate to great extent.

Fig 4: Indicating the various green practices adopted by selected companies.

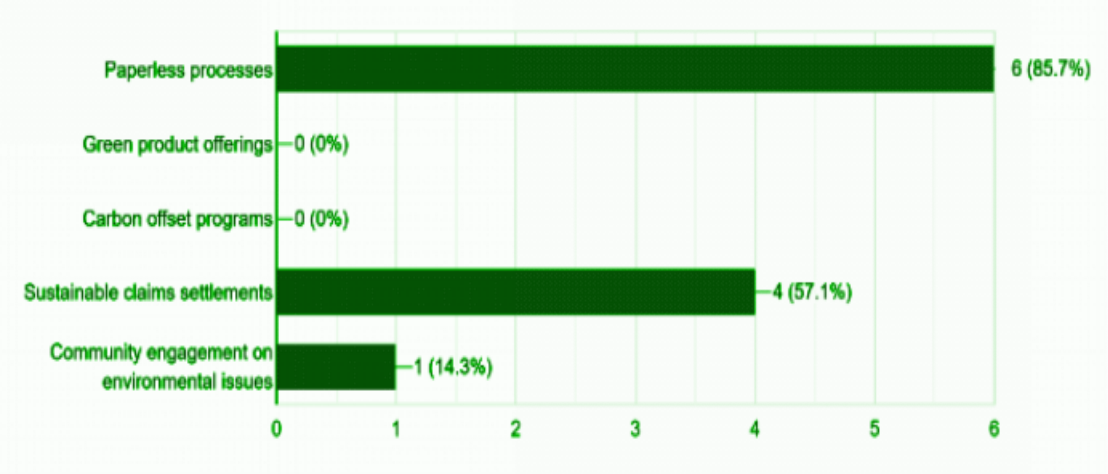


Amongst the various green practices, digital documentations and ecof riendly claims processes are widely accepted practices by the

(selected) companies.

Paperless process, sustainable claim settlements and community engagements on environmental issues are the important factors amongst others which have helped these companies to enhance their brand perception and gain trust of consumers.

*Fig 5: Sustainable driven innovative factors influencing brand perception of selected companies***.**



The above diagram suggests that amongst the various sustainable driven innovative factors, paper less processes and sustainable claim settlements are most influencing factors which influence brand perception.

Concluding remarks

The study is more descriptive analysis which provides an insight into working of GICs with the incorporation of sustainable practices into its operations. It does not make any generalisation rather aims to provide a quick glance into working of (selected) GICs w.r.t sustainable operations.

Limitations

The main limitation of the study is that it is based on smaller sample size as it aims at descriptive analysis and interpretation. For the deeper and better understanding of whether all the GICs aim at sustainable operations larger sample size is proposed to be selected. It is restricted to only private sector GICs.

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