

ADAPTING TO A CHANGING CLIMATE

DEMOGRAPHIC TRANSITION IN DEVELOPING NATIONS

**Ruchi L. Sen
Saurabh Sen
Nilanjan Ray**

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Adapting to a Changing Climate: Demographic Transition in Developing Nations

Edited by

Ruchi L. Sen

*Sunbeam College for Women
Varanasi, Uttar Pradesh
India*

Saurabh Sen

*Sunbeam College for Women
Varanasi, Uttar Pradesh
India*

&

Nilanjan Ray

*Faculty of Management
JIS University
Kolkata, West Bengal
India*

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Editors: Ruchi L. Sen, Saurabh Sen, and Nilanjan Ray

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FOREWORD

I am pleased to write the foreword for the book “**Adapting to a Changing Climate: Demographic Transition in Developing Nations.**” The role of demographic factors in economic growth has been established by well-known scholars, including Nobel laureates, such as Arrow, K. J., Uzawa, H., Romer, Paul M., Lucas, Robert, Rebelo, Sergio, Morris, M. D., Seo, and Amartya Sen. The United Nations has been publishing the Human Development Report since 1990, and the economic well-being of a nation is measured in terms of the Human Development Index (HDI). Demographic factors, such as education and health, carry significant weight in the construction of the HDI. It is significant to note that, in recent decades, climate change has affected demographic indicators worldwide, especially in Third World nations.

I am sure the present volume will be helpful to researchers and policymakers.

A. K. Gaur
Professor and Former Head
Department of Economics
Faculty of Social Sciences
Banaras Hindu University
Varanasi, Uttar Pradesh
India

PREFACE

Climate change has emerged as one of the most complex and pressing challenges of the twenty-first century, influencing ecological systems, economic structures, social dynamics, and policy frameworks across the globe. Its multifaceted impacts demand interdisciplinary inquiry and collaborative scholarship that integrates perspectives from environmental science, economics, management, technology, social sciences, and public policy. The edited volume “Adapting to a Changing Climate” brings together scholarly contributions that examine climate change through diverse analytical lenses, ranging from digital activism and data mining to sustainable finance, green human resource management, entrepreneurship, agriculture, migration, and waste management. The chapters collectively explore how climate change intersects with economic growth, institutional systems, demographic transitions, consumption behavior, and governance mechanisms, particularly in developing and emerging economies.

Special emphasis has been placed on the Indian and South Asian contexts, while also incorporating global comparisons to highlight shared challenges and localized responses. The contributors employ a blend of theoretical reviews, empirical investigations, policy analyses, and case-based approaches to provide actionable insights for researchers, academicians, policymakers, practitioners, and students. This volume aims to enrich the existing body of knowledge on climate change adaptation and mitigation by offering integrative perspectives that connect sustainability with innovation, management practices, and socio-economic resilience. We sincerely hope that this book will stimulate further research, inform policy debates, and contribute meaningfully to the global discourse on sustainable development and climate-responsive strategies.

Ruchi L. Sen

Sunbeam College for Women
Varanasi, Uttar Pradesh
India

Saurabh Sen

Sunbeam College for Women
Varanasi, Uttar Pradesh
India

&

Nilanjan Ray

Faculty of Management
JIS University
Kolkata, West Bengal
India

List of Contributors

Amita Dubey	Sunbeam College for Women, Bhagwanpur, Varanasi, Uttar Pradesh, India
Aliv Banerjee	Department of Management, Meghnad Saha Institute of Technology, Kolkata, West Bengal, India
Debarshi Ghosh	Department of Management, Meghnad Saha Institute of Technology, Kolkata, West Bengal, India
Deepak Kumar Mishra	Department of Commerce, Dr. Ram Manohar Lohiya P. G. College, Bhairavtalab, Rajatalab, Varanasi, Uttar Pradesh, India
Indranil Bose	Department of Management, Adamas University, Kolkata, West Bengal, India
Indrani Ghosh	Adamas University, Kolkata, West Bengal, India
M. Zaheer Ahmed	Department of Commerce and Research, Dr Kalaignar M. Karunanidhi Government Institute of PG Studies and Research, Karaikal, Pondicherry, India
Moumita Ray	Faculty of Management, JIS University, Kolkata, West Bengal, India
Nitesh Tripathi	Department of Mass Communication, St. Xavier's University, Kolkata, West Bengal, India
Nilanjan Ray	Faculty of Management, JIS University, Kolkata, West Bengal, India
Pooja Pandey	Department of Commerce & Financial Studies, UTD, Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
Pradeep Kumar Asthana	Amity Business School, Amity University, Raipur, Chhattisgarh, India
Prantik Banerjee	Adamas University, Kolkata, West Bengal, India
Rashmi Tripathi	Department of Commerce, DAV PG College (BHU), Varanasi, Uttar Pradesh, India
Ruchi Sen	Sunbeam College for Women, Varanasi, Uttar Pradesh, India
Rakesh Kumar Dhar Dubey	School of Management Studies & Juridical Science, JIS University, Kolkata, West Bengal, India
Raj Kumar Bhattarai	Faculty of Management, Tribhuvan University, Kirtipur, Kathmandu, Nepal
Swati Agarwal	Department of Journalism and Mass Communication, Adamas University, Kolkata, West Bengal, India
Sushma Tiwari	Pt. Ravishankar University, Raipur, Chhattisgarh, India
Saurabh Sen	Faculty of Commerce, Sunbeam College for Women, Varanasi, Uttar Pradesh, India
Sumit Roy	Sri Balaji Institute of Modern Management, Sri Balaji University, Pune, Maharashtra, India
Shailesh Kumar Dwivedi	Department of Commerce, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chattisgarh, India
Tanmoy Majumder	Faculty of Management, JIS University, Kolkata, West Bengal, India
Vibhuti Shivam Dube	Babu Banarasi Das University, Lucknow, Uttar Pradesh, India

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Vikas Kumar

Department of Commerce, Govt. P. G. College, Obra, Sonbhadra, Uttar Pradesh, India

CHAPTER 1

The “Greta” Phenomenon: A Sentiment Analysis of Climate Change Discourse on Instagram Through Data Mining

Swati Agarwal^{1*} and Nitesh Tripathi²

¹ *Department of Journalism and Mass Communication, Adamas University, Kolkata, West Bengal, India*

² *Department of Mass Communication, St. Xavier’s University, Kolkata, West Bengal, India*

Abstract: Climate change is a major threat to sustainability and is one of the Sustainable Development Goals set by the United Nations, intended to be achieved by 2030. It has been a major concern for decades, but in recent years the issue has accelerated as climatic conditions have worsened. However, social media, a platform of the masses, has apparently come to its rescue. Social media platforms, such as Twitter, Facebook, and YouTube, are highly effective at amplifying voices and messages, enabling individuals to raise certain issues and seek redress. This is the ultimate power of social media, and time and again, it has been harnessed to bring revolutionary changes worldwide. One such revolution was led by Greta Thunberg, a Swedish environmental activist who initiated a protest in front of the Swedish Parliament and soon became a renowned figure worldwide. She posted images of the protest on Instagram, which were then shared by other influential activists, helping to spread her message globally. Netizens began discussing this on social media and shared their concerns over climate, leading to a snowballing of opinions. The impact of this Internet activism was so significant that world leaders ultimately paid attention to her demands. The campaign on sustainability and climate change by Greta Thunberg took the internet by storm, and she was featured on Time magazine as the ‘Person of the Year’ in 2019, making her the most famous teen of her time. The campaign, ‘School Strike for Climate,’ outside the Swedish Parliament in 2018, was aimed at prompting the government to reduce carbon emissions, and it spiraled into a larger movement that pushed world leaders to commit to environmental conservation. Greta’s activism advanced through her demonstrations and speeches, gathering momentum and reaching 5 million Twitter followers to mobilize public opinion. In this context, the study was conducted to assess the potential of social media and to harness its power to bring long-lasting change toward a better future. This chapter examines Instagram posts related to climate change discussion threads generated by various hashtags associated with the Greta Thunberg campaign and seeks to ascertain how they created a favorable discourse for environmental conservation.

* **Corresponding author Swati Agarwal:** Department of Journalism and Mass Communication, Adamas University, Kolkata, West Bengal, India; E-mail: swatijmc50@gmail.com

Keywords: Climate change, Greta Thunberg, Internet activism, Sustainability.

INTRODUCTION

The media is one of the most powerful tools for propagating messages and mobilizing the masses around a particular social cause. It has been found that media possesses the capability and foresight to spark major social revolutions and elicit the desired response from society toward a goal that improves the state of affairs. It plays a crucial role in raising awareness of environmental issues, as systematic, comprehensive coverage can inform people about environmental concerns that are sometimes laden with jargon and complex facts, which might otherwise lead them to ignore the issue altogether. In such a scenario, the media becomes the primary tool people rely on to obtain information and interpretations of environmental issues. The media explicitly helps them understand how these matters are related to the social, economic, and political structures of society.

Environmental concerns have always been pertinent and central to societal attention, but due to the technical nature of much of the data involved, such issues sometimes receive limited coverage in mainstream media and fail to capture the audience's sustained interest. Activism to protect the environment is not new; it has existed since ancient times, and the media has always served as a conduit for major transformation. With the rise of digital media, the public can now directly influence society. This phenomenon is today termed Internet activism or social media activism, a prevalent form of advocating for a particular cause or combating injustice inflicted on marginalized people.

DEFINITION AND MEANING - INTERNET ACTIVISM

Internet activism is an organized public effort to have the demands of society addressed by authorities or decision-makers with the support of the internet. It is a collective claim on an issue of importance to the public, using internet technology to create awareness and mobilize support. Internet activism represents advocacy for a cause that leverages social media channels, where hashtags are pivotal in mobilizing society and carrying out movements. This is often also called hashtag activism or social media activism, as social media offers a platform for people to reach a larger audience. Awareness is created on social media by showing solidarity through the use of hashtags, posts, and campaigns (Reid & Sehl, 2020).

Internet justice contributes to the strength of civil society and helps ensure that the power of the state and other institutions is not misused to exploit people, while making sure that the issues of the public are addressed by the state and lawmakers. Civil society thus works to ensure that justice prevails in society (Levine, 2000). Before the advent of digital means, mobilization and activism for

a cause were carried out through interest groups or non-governmental organizations, which required substantial monetary resources, media outreach, legal action, and extensive lobbying. However, the ‘diffusion’ of digital technologies has mitigated these difficulties, and this new ‘alternative model’ has provided faster and more cost-effective ways to organize support for a cause (Hopke, 2017).

ROLE OF MEDIA IN ENVIRONMENTAL PROTECTION

In India, in the 1920s, the Tata group planned to build a dam on the Mula and Nila rivers in Western Maharashtra. Although the dam was eventually constructed, local people protested its construction under the leadership of Pandurang Mahadev (Senapati) Bapat and V.M. Bhuskute; this movement became popularly known as the ‘*Mulshi Satyagraha*’. The protesters argued that the dam would submerge several villages and disrupt the ecology and local habitats. Many women participated in the protests and were also jailed. The *Satyagraha* received widespread attention due to coverage by the Bombay Chronicle, which regularly reported on the issue, discussing both the land rights of peasants and the need for electricity for Bombay, as well as empathetically addressing the concerns of those displaced from their ancestral lands.

Another notable event is the *Chipko* movement, a nonviolent social and ecological movement initiated by villagers, primarily women, in India during the 1970s. Villagers in the Garhwal region of Uttarakhand were heavily dependent on the forests for survival, including food, timber for fuel, water purification, soil stabilization, and agriculture. A government policy barred villagers from accessing the forests. Excessive deforestation led to soil erosion, depleted water resources, flooding of adjoining areas, and reduced agricultural yields. As the villagers and forests were interdependent, the destruction of forests threatened the entire ecosystem. This led to the ‘hug a tree’ *Chipko* movement, initiated by local women, such as Gaura Devi, Suraksha Devi, and others, which employed methods of *Satyagraha* to prevent deforestation. The idea was that humans would hug trees if loggers attempted to cut them down, thereby preventing logging and forcing the government to revise its decision. This peaceful protest received widespread media coverage.

In the 1970s, the Kerala State Electricity Board proposed a hydroelectric project on the Kunthipuzha River through Silent Valley, which would have submerged 8.3 sq km of rainforest, home to thousands of rare flora and fauna. Local protests evolved into a large movement, with the Kerala Sastra Sahitya Parishad (KSSP) playing a significant role in raising awareness about the ecological importance and biodiversity of the region. Consequently, the government declared Silent

CHAPTER 2

Agricultural Production Forecasting in Changing Climate Conditions: A Comprehensive Review

Sushma Tiwari¹ and Pooja Pandey^{2,*}

¹ *Pt. Ravishankar University, Raipur, Chhattisgarh, India*

² *Department of Commerce & Financial Studies, UTD, Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India*

Abstract: Most of the population of India depends on agriculture. Agriculture in India is mainly dependent on rainfall. Sowing, harvesting, transportation, and other crop-related activities rely heavily on the weather. In such a situation, changing climatic conditions can significantly impact agricultural activities. If farmers can predict weather patterns and understand their effects on crop production, they can plan agricultural tasks appropriately and perform them at the right time. Keeping this in mind, this chapter describes various statistical techniques for forecasting agricultural commodity production under changing climatic conditions. Climate plays a very important role in agricultural production. It influences crop growth, crop development, and ultimately crop yield. Climate also affects disease incidence, nutrient dynamics, and the efficacy of cultural operations. Any fluctuation or deviation in weather parameters can damage crops and lead to soil erosion. Weather also determines the quality of crop produce, from the field to storage and during transportation to the market. Unfavorable weather during transportation can impair crop quality, and adverse weather during storage can negatively affect seed vigor and viability. Thus, every aspect of agriculture is sensitive to weather conditions.

Keywords: Climate change, Crop yield forecasting, Production of agricultural commodities, Statistical models.

INTRODUCTION

According to meteorology, weather shows both spatial and temporal variation at a given place and time. For crops, short-term weather data and interannual seasonal fluctuations may be considered. At any given time, the magnitude of the deviation of the maximum value from its measure of central tendency indicates the variation in the parameter. The smaller the time unit, the greater the variability in a weather

* **Corresponding author Pooja Pandey:** Department of Commerce & Financial Studies, UTD, Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India; E-mail: poojapandey@bilaspuruniversity.ac.in

parameter. The magnitude of variation varies for different types of weather factors.

Temporal as well as spatially, precipitation is the most variable of all weather-influencing parameters. For every country aiming for food or nutritional security, forecasting crop production is a challenging task. India is an agriculture-dependent country, with most of its population relying on agriculture. The development of the country's agriculture is of prime importance, as it is directly and indirectly linked to farmers, private companies, and the government sector. According to Krupak, profitable agriculture is that which earns remunerative prices due to higher yields. Therefore, pre-harvest yield prediction is beneficial for proper planning of agricultural activities and for strategic marketing and storage decisions.

Agricultural productivity is inherently influenced by various climatic, biological, and technological factors, making accurate yield forecasting an essential tool for ensuring food security and guiding agricultural policy. Traditionally, crop-weather models have played a foundational role in yield assessment. Baier (1977) emphasized the value of such models in his pioneering work, highlighting how meteorological inputs can be correlated with crop performance to estimate yields effectively. With climate change becoming a more pressing concern, its impacts on major food crops have drawn considerable research attention. BIRTHAL *et al.* (2014) demonstrated the negative effects of climate variability on yields of staple crops in India, underscoring the urgency of adaptive strategies for food security.

Efforts to improve agricultural forecasting systems have evolved from statistical models to more complex machine learning and artificial intelligence-based approaches. The development of early warning systems and forecasting methodologies has been comprehensively reviewed by Basso, Cammarano, and Carfagna (2013), who underscore the role of timely data collection and interpretation in mitigating agricultural risks. Similarly, Chattopadhyay, Agrawal, and Kumar (2011) contributed to this field by developing epidemiological models to forecast specific crop diseases, such as white rust in mustard, which affect yield quality and quantity.

Recent advancements in computational technologies have opened new avenues for precision agriculture. For instance, Kaul, Hill, and Walthall (2005) applied artificial neural networks to predict corn and soybean yields, demonstrating the potential of machine learning algorithms to handle nonlinear relationships between environmental variables and crop performance. Building on such innovations, Das (2020) explored hybrid machine learning models for agricultural forecasting in his doctoral research, demonstrating improved predictive accuracy

compared to conventional methods. Support Vector Machines (SVMs) have also been utilized for yield prediction. Kumar, Kumar, and Sharma (2019) applied SVM techniques to rice yield forecasting in India, achieving promising accuracy and efficiency. Furthermore, integrating seasonal climate forecasts into global yield prediction models has gained attention. Lizumi *et al.* (2018) utilized multi-model climate ensembles for this purpose, establishing the effectiveness of ensemble modeling in managing climatic uncertainties. Long-standing studies, such as that by Fisher (1925), have emphasized the significant influence of rainfall on crop yields, a concept that remains relevant in modern agrometeorological research (Divisekara *et al.*, 2021). Meanwhile, Lobell and Gourdji (2012) explored the broader global impacts of climate change on crop productivity, suggesting that rising temperatures and erratic precipitation patterns could considerably alter agricultural outcomes worldwide. The increasing role of natural language processing (NLP) and neural machine translation in interpreting complex agricultural datasets has also been noted. Mishra and Dharm (2020) highlighted how NLP tools can enhance the interpretation of multilingual data sources, further enriching agricultural intelligence systems. Together, these studies reflect the multidisciplinary nature of yield forecasting research, which spans climatology, agronomy, data science, and artificial intelligence. With rising demand and climatic uncertainty, the continued integration of advanced technologies and traditional models is essential to ensure resilient, informed agricultural practices.

OBJECTIVES

The objectives of this chapter are as follows:

- To analyze the impact of climatic conditions on agricultural commodity production.
- To assess the influence of technological advancements on agricultural commodity production.
- To investigate the relationship between soil health and agricultural commodity production.
- To forecast agricultural commodity production under varying climatic and agricultural variables.

HYPOTHESES

- H0: There is no significant relationship between climatic conditions and agricultural commodity production.

Impact of Climate Change on India's Green Economy: A Comprehensive Analysis

Amita Dubey¹, Pradeep Kumar Asthana^{2,*} and Vibhuti Shivam Dube³

¹ Sunbeam College for Women, Bhagwanpur, Varanasi, Uttar Pradesh, India

² Amity Business School, Amity University, Raipur, Chhattisgarh, India

³ Babu Banarasi Das University, Lucknow, Uttar Pradesh, India

Abstract: Climate change is a tenacious universal issue that poses challenges to sustainable development and economic growth. The effects of climate change across sectors, including the economy, are a matter of great concern. As India is highly susceptible to climate change, it is imperative to understand the relationship between climate change and its impact on the green economy. This study examines the effects of climate change on India's green economy, encompassing sectors, such as renewable energy, sustainable agriculture, and green finance.

Keywords: Climate change, economic growth, green finance, sustainable agriculture.

INTRODUCTION

The green economy has attracted considerable attention in recent years as the world faces a dire need to address the effects of climate change and advance sustainable development.

A green economy denotes an economic system that aims to strike a balance between economic growth, environmental protection, and social well-being. An archetypal shift in thinking about growth and development, known as the "green economy," may improve people's lives and the environment while fostering long-term sustainability on both fronts (Guo *et al.* 2017). The green economy constantly uses energy resources to reduce climate risk and improve environmental performance (Maclean and Plascencia, 2012). It entails transitioning from resource-intensive and carbon-dependent industries to low-carbon, resource-efficient, and environmentally friendly sectors. The main reasons

* Corresponding author Pradeep Kumar Asthana: Amity Business School, Amity University, Raipur, Chhattisgarh, India; E-mail: pradeep83.sthn@gmail.com

for climate change are human activities like burning fossil fuels and deforestation, which are crucial global challenges in the present. Its impacts are far-reaching, affecting ecosystems, communities, and economies worldwide. Climate change creates strain, which poses problems for long-term growth and economic stability. Sustainable development can be accomplished through the green economy (World Bank, 2007). A sound economic strategy should promote creativity and the application of cutting-edge technology. The green economy aims for a macroeconomic plan for sustained economic growth that focuses on investments, employment, and skill development.

The three primary (<https://www.unep.org/>) focuses of the present Green Economy work are:

1. Promotion of the macroeconomic approach through regional, sub-regional, and national fora.
2. Introducing concepts of the green economy, with a focus on financial access, investments, and technology.
3. Assist in developing and implementing macroeconomic plans to help countries move to a green economy.

Multi-stakeholder collaboration for green economy growth is encouraged to accelerate and consolidate long-term transformations in utilization and production patterns. Aside from governments and non-profit groups, economies must strengthen ties with the business sector, which is a significant supporter of resource efficiency and the green economy (Fig. 1).

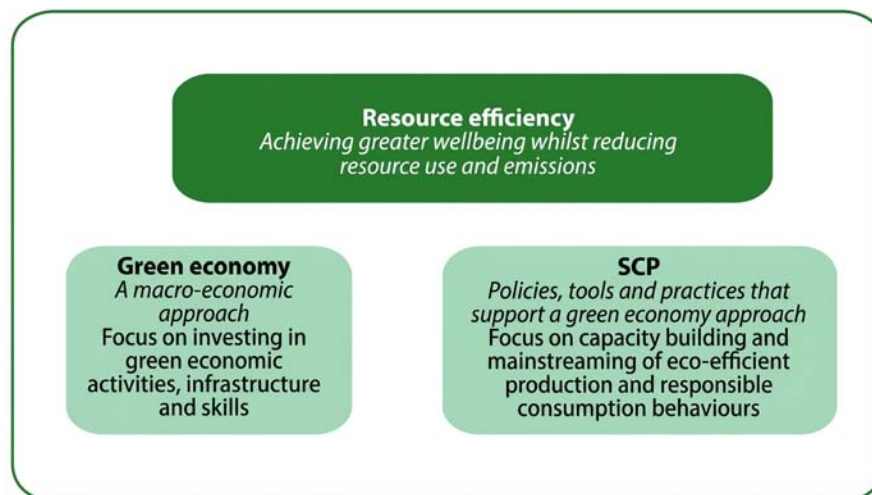


Fig. (1). Pillars of the Green Economy. **Source:**<https://www.unep.org/>

Climate change refers to enduring alterations in temperature and weather patterns. Despite the likelihood of some natural changes, human activity has been the dominant cause of climate change since the 1800s, primarily due to rising greenhouse gas emissions that trap heat in the atmosphere. The primary source of these pollutants is the combustion of fossil fuels, including coal, oil, and gas. As a result, temperatures rise as greenhouse gases accumulate, acting as a blanket that traps heat from the sun. Carbon dioxide and methane are two greenhouse gases that significantly contribute to the phenomenon of climate change. Long-term development and the green economy are under threat due to climate change. The threat of climate change is no longer imminent. The association between climate change and the green economy is multifaceted and interconnected. Climate change poses significant risks and challenges to economic systems, including those related to natural resource availability, extreme weather events, and disrupted supply chains. These disruptions can have far-reaching consequences for industries, businesses, and livelihoods.

By examining current policies, initiatives, and best practices, this study helps build a comprehensive understanding of the role of the green economy in addressing climate change in India. It aims to inform policymakers, businesses, and stakeholders about potential pathways to build a greener, more resilient economy. To achieve long-term development objectives amid climate change, it also underscores the importance of coordinated effort, technical innovation, and supportive policy frameworks.

OBJECTIVES

The objectives of this study are as follows:

1. To find the key climate change-related challenges faced by the green economy sectors in India.
2. To explore the impacts of climate change on India's green economy.
3. To evaluate the policies and strategies implemented by the Indian government to address climate change and promote a green economy.

RESEARCH METHODOLOGY

This study employed a descriptive research design to achieve its objectives. Secondary data were gathered from relevant reports, academic literature, and official documents. The collected data were analysed using statistical techniques and thematic analysis to identify trends, patterns, and key findings.

CHAPTER 4

Digital Banking as a Catalyst for India's Green Transition**Debarshi Ghosh¹, Nilanjan Ray^{2,*}, Aliv Banerjee¹ and Saurabh Sen³**¹ *Department of Management, Meghnad Saha Institute of Technology, Kolkata, West Bengal, India*² *Faculty of Management, JIS University, Kolkata, West Bengal, India*³ *Faculty of Commerce, Sunbeam College for Women, Varanasi, Uttar Pradesh, India*

Abstract: Digital banking has emerged as a powerful tool in driving India's transition towards a greener economy. Innovative digital payment systems, coupled with technological advancements and increased financial literacy, have the potential to revolutionize India's financial services sector by enhancing financial inclusion. Digital payments are flourishing in the developing world, and they can promote financial inclusion (Ligon *et al.* 2019). By promoting financial inclusion and reducing cash transactions, digital payments can play a pivotal role in India's green transition (Burrage, 2017) by minimizing the carbon emissions associated with the production, transportation, and disposal of physical currency. This chapter aims to theoretically explore the relevant literature and highlight the relationship between the adoption of digital payment systems and carbon-reduction initiatives in the Indian context.

Keywords: Carbon footprint, Carbon credit, Digital banking, Digital payment.

INTRODUCTION

One of the most important issues the world is currently experiencing is climate change. It is a worldwide issue that calls for immediate, collective action (Ibarra *et al.*, 2018). In today's rapidly changing world, businesses are increasingly turning to digitisation to reduce their carbon footprint and mitigate environmental impact (Woerner & Wixom, 2015). The ecosystem for digital payments has grown significantly in India, driven by the country's rising internet and smartphone penetration. By reducing the reliance on paper currency and physical transactions, digital payment systems can help decrease the environmental impact associated with the production, transportation, and disposal of paper money. This reduction in paper currency production can have a positive impact on carbon

* **Corresponding author Nilanjan Ray:** Department of Management Studies, JIS University, Kolkata, West Bengal, India; E-mail: nilanjan.ray@jisuniversity.ac.in

emissions by reducing deforestation and energy consumption in paper manufacturing. Another important factor contributing to the expansion of India's digital payments ecosystem is e-commerce. India has a lot of potential in the e-commerce sector because of the country's growing internet user base and advantageous market circumstances. As per Statista.com, the Indian e-commerce market, which is expanding exponentially, was valued at over 22 billion US dollars in 2018. By 2030, this amount was projected to increase to 350 billion USD. This growth in e-commerce has the potential to contribute to carbon-reduction efforts (Javalgi & Ramsey, 2000). Furthermore, digital payment systems can facilitate the transition to a low-carbon energy system by optimizing capital supply and generating financial demand for low-carbon energy technologies (Li *et al.*, 2023). One of the leading organizations that facilitates digital payments through infrastructure and back-end technology is the National Payments Corporation of India. The Bharat Bill Payment System (BBPS), Immediate Payment Service (IMPS), and Unified Payments Interface (UPI) are among its offerings.

LITERATURE REVIEW

Financial technology, or FinTech, is a term used to describe the intersection of financial services and technology (Iman, 2020). This emerging field has garnered significant attention in recent years, with researchers and academics recognizing its potential to revolutionize the financial industry. Several studies have explored different aspects of FinTech, including digital payments and digital banking. Digital payment platforms can enable the integration of environmental, social, and governance criteria into financial decision-making processes. This integration can help direct investments toward environmentally friendly projects and businesses, thereby contributing to the overall sustainability of the economy (Zhang, 2023). Digital payment and green finance are two interconnected areas that have gained significant attention in recent years (Puschmann *et al.*, 2020). A literature review conducted on these topics can provide valuable insights into the current state of research and identify potential areas for further exploration (Pan *et al.*, 2020). Several studies have addressed the relationship between digital payment and green finance. These studies have highlighted the potential of digital payment technologies to promote sustainable financial practices and support the transition towards a greener economy (Puschmann *et al.*, 2020). Numerous academics have elaborated on and clarified the meaning of green money. The idea of "green finance," a financial innovation that supports the transition to a green economy, emerged from growing concerns among many countries about environmental preservation and climate change adaptation (Bhatnagar and Sharma, 2022). As green finance links economic growth, environmental improvement, and the financial sector (Soundarrajan and Vivek, 2016), it can not only improve the

environment but also create a better future for ourselves (Jayasubramanian and Shanthi, 2014). On the other hand, some academics contend that green finance limits the potential for green innovation (Yu *et al.*, 2021). Globally, the COVID-19 pandemic has had a significant effect on nations. As a result, some academics contend that the COVID-19 effect on investments in green initiatives needs to be taken into account by the green financial system (Farhad *et al.*, 2021). Countries at varying stages of sustainable development should pay attention to green finance, which is intimately tied to economic development (Djukic and Ilic, 2021). To attain sustainable economic growth, a more logical and quantitative assessment of green finance is required (Alieva and Altunina, 2021). The conservation of the ecological environment and economic development can be positively correlated if the quantitative coordination between green financing and economic growth is further examined (Yin and Xu, 2022). Green finance is now a weapon in combating climate change and can help resolve issues with environmental-related financial products and services (Gagan *et al.*, 2022). Green finance now has a far greater positive impact on environmental protection due to advancements in financial technology (Sreenu, 2022). To address the conflict between green finance and the environment, a global approach will be adopted, accounting for the macroeconomic effects of monetary policy (EWA and Johannes, 2021). The mechanism by which green finance lowers environmental carbon emissions is significantly influenced by the growth of the digital economy (Zhang *et al.*, 2022). Green financing has a significant spatial spillover effect on environmental improvement and benefits the surrounding areas' ecological environment by incorporating spatial factors into the study (Li and Gan, 2020; Li *et al.*, 2022). Sustainable energy development and green finance are strongly intertwined. Green finance may support the development of the energy sector, whether viewed from a vertical trend or a horizontal comparison viewpoint (Zhang and Wang, 2019). Reducing green financial risks will help boost the income of green energy projects (Farhad and Naoyuki, 2019) because risk transmission occurs between energy commodity markets (Hela *et al.*, 2022) and green financial products. Green finance can support demand for sustainable energy and help drive an energy shift (Mara *et al.*, 2022). Simultaneously, the growth of green finance has aided China in achieving its sustainable development goals and significantly reduced the environmental crises caused by poor sustainability management and the outdated model of prior economic development (Bryan *et al.*, 2018; Sun *et al.*, 2018).

DIGITAL FINANCE FOR REDUCED CARBON FOOTPRINT

The use of technology, especially digital platforms and solutions, in the financial services industry is known as “digital finance.” By facilitating more effective and efficient financial transactions, it has the potential to significantly increase energy

Entrepreneurial Challenges in Developing Countries: Backbone of Global Climate Change

M. Zaheer Ahmed^{1,*}

¹ Department of Commerce and Research, Dr Kalaignar M. Karunanidhi Government Institute of PG Studies and Research, Karaikal, Pondicherry, India

Abstract: This chapter examines the role of climate-focused entrepreneurs in developing countries, highlighting the challenges they face and the opportunities they create in mitigating climate change. Key obstacles include limited capital access, inadequate infrastructure, policy instability, low market demand, skills gaps, and business risks. By integrating quantifiable success metrics and comparative case studies from South Asia, Africa, and Latin America, this chapter provides a data-driven perspective on climate entrepreneurship. The findings emphasize policy reforms, investment models, and infrastructure development as crucial factors in fostering green business ecosystems.

Keywords: Capacity building, Climate-focused entrepreneurship, Entrepreneurial ecosystems, Green startups, Infrastructure challenges, Innovative financing, Market awareness, Revenue growth, Regional disparities, Sustainable solutions.

INTRODUCTION

Climate change is a critical global challenge that disproportionately affects developing nations due to infrastructure deficits, financial constraints, and policy instability. According to the World Bank (2023), over 72% of global greenhouse gas emissions stem from unsustainable practices, exacerbating vulnerabilities in low-income economies. Entrepreneurs play a pivotal role in addressing these challenges through innovative solutions like renewable energy, sustainable agriculture, and circular economy models. However, in developing countries, they face significant barriers, including limited access to capital, unstable regulatory environments, and low consumer demand for sustainable products.

* Corresponding author M. Zaheer Ahmed: Department of Commerce and Research, Dr Kalaignar M. Karunanidhi Government Institute of PG Studies and Research, Karaikal, Pondicherry, India; E-mail: drrzaheerahmed@gmail.com

The Role of Entrepreneurs in Climate Action

Entrepreneurs drive climate solutions by developing renewable energy systems, sustainable agriculture practices, and circular economy models. However, in developing countries, they face major challenges, such as:

- **Limited access to capital:** Only 20% of SMEs in Sub-Saharan Africa have access to formal credit (World Bank, 2023).
- **Policy instability:** Frequent policy shifts cause 25% revenue losses for green startups (IFC, 2024).
- **Low consumer demand:** Green product market penetration is less than 5% in South Asia.

These barriers hinder the scalability of climate-focused businesses, despite their potential for significant impact.

Global Comparisons: Developed vs. Developing Nations

A stark contrast exists between developed and developing economies in climate entrepreneurship. The table below illustrates key disparities in green tech Venture Capital (VC) investment, startup success rates, and regulatory stability across regions.

Green Tech VC investment by region.

Region	Annual Green Tech VC Investment	Startup Success Rate (5+ years)	Regulatory Stability
China	\$50+ billion	75%	Stable, long-term climate policies
European Union	\$40+ billion	70%	Strong government incentives
United States	\$60+ billion	78%	Robust venture capital ecosystem
India	<\$1 billion	45%	Frequent policy changes
Brazil	\$ 500 billion	38%	Regulatory Inconsistencies
Africa	<\$ 500billion	35%	High Policy Risks

Source: World Bank (2023), International Finance Corporation (2023), European. Investment Bank (2023), MITT (2023), NITI Aayog (2023), AfDB (2023), UNDP (2023).

According to the World Bank (2023), only 35% of green startups in Africa survive beyond 5 years, compared to 70% in the European Union. In South Asia, the failure rate is even higher, with 50% of startups failing within the first three years due to policy instability and market fluctuations (IFC, 2024). These statistics highlight the urgent need for financial and policy support to improve the survival rates of green startups in developing countries.

Why This Study is Important

This chapter examines how developing countries can overcome entrepreneurial challenges and scale climate-focused businesses. By analyzing financial gaps, policy barriers, infrastructure deficits, and global case studies, it provides actionable recommendations to foster sustainable entrepreneurship in resource-constrained economies.

LITERATURE REVIEW

The Role of Climate Entrepreneurship in Sustainable Development

Entrepreneurship is a catalyst for economic growth, job creation, and technological innovation (Acs & Amoros, 2008). Climate-focused entrepreneurs drive sustainability by developing renewable energy solutions, circular economy models, and resource-efficient systems. However, the percentage of entrepreneurs engaged in green innovation varies significantly across regions:

- **European Union:** 28% of startups are climate-focused.
- **United States:** 24% of new businesses integrate sustainability.
- **China:** 30% of green-tech ventures receive state support.
- **India and South Asia:** Less than 10% of startups focus on sustainability due to a lack of policy incentives (Global Entrepreneurship Monitor, 2023).

This disparity underscores the need for policy reforms and financial support to foster climate entrepreneurship in developing nations.

Financial Barriers in Climate Entrepreneurship

Access to capital is a significant barrier for climate-focused entrepreneurs in developing nations:

- Less than 20% of SMEs in Sub-Saharan Africa and South Asia receive formal financing (World Bank, 2023).
- High borrowing costs and scarce venture capital limit scalability.
- The annual financing gap for green startups in South Asia is estimated at \$300 billion (Ahmed, 2025).

In contrast:

- China invests over \$50 billion annually in climate initiatives.
- The EU's Green Deal provides €1 trillion in sustainable investment funds.
- The US Inflation Reduction Act (2022) earmarks \$369 billion for clean energy.

CHAPTER 6

Container and Contentment: Consumption of Content and its Impact on Climate

Sumit Roy^{1,*}

¹ *Sri Balaji Institute of Modern Management, Sri Balaji University, Pune, Maharashtra, India*

Abstract: As we have progressed in fulfilling our basic and luxury needs, the imperative to innovate and accelerate material development has persisted. We have achieved a great deal and, in the process, have paid, and continue to pay, the price of the climate crisis. Humans continue to harbour an attitude of wanting more, and their house and mind are like a container. This container is getting bigger over time, and the owner is in no mood to stop filling it. Objects and excess necessities keep piling up, and contemplation about why so much is needed is often ignored. There is a perennial search for content and its combinations, where indulgence is expected to give consumers contentment. This amassing of objects has become pathological, and prolonged deprivation of buying things can adversely affect some individuals. This chapter conceptually analyses the connection between consumption and happiness, the quality of objects people possess, and the attitudes that can lead to happiness, along with their further implications for the climate. A research gap exists in identifying the types of content that satisfy consumers and the relevance of content generated by the industry. Industries continue to generate more content and variety to gain market share, and in the process, several diverse domains are neglected, raising serious questions about sustainability.

Keywords: Consumerism, contentment, climate, happiness, hedonism, phenomenology, sustainability.

INTRODUCTION

Necessity, consumption, purchasing, and a shopping spree today have become a unified entity. Do we live to shop or shop to live? According to GlobalData's e-commerce analytics, India's e-commerce market value is estimated to increase to INR 24.1 trillion (\$292.3 billion) by 2028. It is also estimated that global online retail sales will reach \$8.148 trillion in 2026 (eMarketer) (Howarth, 2024). "Keep consuming and be happy" has become the prevailing dictum today, and, sadly, the

* **Corresponding author Sumit Roy:** Sri Balaji Institute of Modern Management, Sri Balaji University, Pune, Maharashtra, India; E-mail: Sumitroyg212@gmail.com

climate crisis resulting from excess consumption remains largely unheeded and is receding into oblivion.

Global surface temperature was 1.09 °C [0.95 to 1.20] higher in 2011–2020 than in 1850–1906, with larger increases over land (1.59 °C [1.34 to 1.83]) than over the ocean (0.88 °C [0.68 to 1.01]). (IPCC 2023). Total world energy consumption and CO₂ emissions continue to increase steadily. From 1990 to 2004, world energy consumption increased by about 30% and CO₂ emissions by 26% (UN Department of Social Affairs – 2007). Over 780 million people globally are currently exposed to the combined risk of poverty and severe flooding, mostly in developing countries (World Inequality Lab study 2023). Historical cumulative net CO₂ emissions from 1850 to 2019 were 2400 ± 240 GtCO₂ (high confidence). Of these, more than half (58%) occurred between 1850 and 1989 [1400 ± 195 GtCO₂], and about 42% between 1990 and 2019 [1000 ± 90 GtCO₂]. (IPCC, 2022). Our shopping behaviour has shifted from necessity to mental satisfaction, and a trip to a pleasure realm is never-ending. To meet the demands, the industry's marketing and delivery systems are ready to fulfil them. It is estimated that by 2030, the number of delivery vehicles will increase by 36%, reaching approximately 7.2 million vehicles. This will not only result in an increase of about 6 million tonnes of CO₂ emissions, but it will also increase commutes by 21%, as vehicles will take longer to travel due to higher traffic congestion (earth.org 2024). Currently, the global average consumption associated with web surfing, social media, video and music streaming, and video conferencing could account for approximately 40% of the per capita carbon budget consistent with limiting global warming to 1.5 °C (Istrate, 2024). This chapter takes a deep dive into content consumption, its psychology, and the climate crisis.

The Evolution of Content

The history of content is the history of civilization. From the Paleolithic period to the Iron Age, it is content that evolved. The advent of chemistry dates back almost 100,000 years, when natural earth pigments were found in the Blombos Cave in South Africa. Alchemy and the quest for the Philosopher's Stone, an alchemical substance believed to convert base metals, such as mercury, into gold and silver, also involved the search for the elixir of life, through which humans sought rejuvenation and immortality. The ancient Greeks attempted to explain the chemical changes they observed and used. It was believed that natural objects consisted of only four basic elements: earth, air, fire, and water. Around the fourth century BC, Greek philosophers Democritus and Leucippus suggested that matter was not infinitely divisible into smaller particles but was composed of fundamental, indivisible particles called atoms. Over the next two millennia, alchemists, who engaged in chemistry and abstract philosophy during the Middle

Ages and the Renaissance, advanced the field of material transformation. Pottery, bricks, gypsum, paper, ink, minerals, chemicals, spices, medicines, metallurgy, extraction processes, and now digital content have come a long way. From the Stone Age to the Silicon Age, it is the arrangement of content for use and its permutations and combinations that make content highly sought after. Content, in the form of matter, is essential for civilization; however, its misuse and overuse can have drastic effects on the climate.

The existing body of research predominantly focuses on digital content, whereas this research considers content more broadly and defines content (noun) as everything included in a collection, held with or integrated into something, and as having both utility and intrinsic value. Digital content has been theorized as entities that are bit-based and dispersed through electronic channels, and the bulk of contemporary consumption is digital. The concept of content marketing is defined as “a marketing technique of creating and distributing relevant and valuable content to attract, acquire, and engage a clearly defined and understood target audience to drive profitable customer action” by the Content Marketing Institute (Abel, 2012: 11).

Society has evolved to a stage where convenience in living is in continual progress, and this progress in making convenience available has given momentum to innovation. Innovation is the mantra of every business organization, and it has its importance. At present, innovation is extended to product features, ingredient branding (Waldemar, Kotler, 2010), and making advertisements more appealing and far-reaching. Contemporary society is aspirational and inclined to consume, and is in no mood to compromise on the offerings from the market that continue to pour in intermittently. The attitude of not negotiating consumption has become epidemic. Parducci (1995), a renowned psychologist well known for his range-frequency theory of satisfaction, viewed happiness as a theoretical summation of separate momentary pleasures and pains (Sirgy, 2012).

The challenge is that even though there is an availability of a plethora of products and services, the domain of contentment is dynamic, and switching of content is common. Consumers are in a perennial race hunting for better content; comparisons have increased with social data, and this trend continues to gain traction. Today, various applications enable comparative analysis of content, and further refinement of products is engineered to match the exact needs of consumers. Content has evolved and will continue to evolve; marketers are constantly working on content that has appeal, and the challenge lies in how people evaluate content and how marketers appropriately map it.

Navigating Demographic Transition for Economic Growth: Crafting Development Policies for Success

Shailesh Kumar Dwivedi^{1,*} and Vikas Kumar²

¹ Department of Commerce, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chattisgarh, India

² Department of Commerce, Govt. P. G. College, Obra, Sonbhadra, Uttar Pradesh, India

Abstract: The demographic transition is a phenomenon that encompasses the evolution of population dynamics and age structures as societies progress through different stages of development. This chapter explores the multifaceted nature of demographic transition and its far-reaching implications for economic growth and development policies. By analyzing demographic trends, examining case studies, and assessing policy interventions, this chapter aims to provide comprehensive insights into the challenges and opportunities associated with demographic shifts.

Key findings underscore the importance of proactive policy responses in addressing labor force dynamics, strengthening social welfare systems, and fostering inclusive growth. Through investments in human capital development, promotion of innovation, enhancement of social protection systems, and utilization of technology, nations can effectively navigate demographic transition and unlock their potential benefits for sustainable development.

This chapter highlights the significance of understanding demographic transition dynamics and their impact on economic growth. By identifying policy lessons, proposing interventions, and addressing key challenges, policymakers and stakeholders can devise strategies to harness the opportunities presented by demographic change while mitigating its adverse effects. Ultimately, this chapter contributes to the discourse on crafting development policies that promote resilience, inclusivity, and prosperity in an era of demographic transition.

Keywords: Demographic transition, Development policies, Economic growth, Labor force dynamics, Social protection systems.

INTRODUCTION

In the modern era of globalization and socio-economic change, understanding the dynamics of demographic transition has become paramount for policymakers,

* Corresponding author Shailesh Kumar Dwivedi: Department of Commerce, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chattisgarh, India; E-mail: dr.shaileshdwivedi@gmail.com

economists, and social scientists alike. Demographic transition refers to the process through which societies progress from high birth and death rates to lower ones, usually as a result of industrialization, improved healthcare, and socio-economic development. This transition fundamentally alters the age structure and composition of populations, with profound implications for economic growth, social welfare, and development trajectories.

Definition and Significance of Demographic Transition

Demographic transition encompasses a series of stages that societies traverse over time. Initially characterized by high birth and death rates, societies enter the transition process as advancements in healthcare, sanitation, and nutrition reduce mortality rates, leading to population growth. Subsequently, birth rates decline due to various factors, such as increased education, urbanization, and access to contraception, resulting in a stabilization of population growth rates.

The significance of demographic transition lies in its transformative impact on societies. As populations age and birth rates decline, the demographic structure shifts towards older cohorts, altering the dependency ratios and labor force dynamics. This shift has profound implications for economic productivity, social welfare systems, and overall development strategies.

The demographic transition is a theory that describes the historical shift of populations from high birth and death rates to low birth and death rates as societies progress from pre-industrial to industrialized economies. This transition is typically characterized by several distinct stages:

Stage 1: High Birth and Death Rates: In the pre-transition stage, both birth and death rates are high, resulting in relatively slow population growth. This stage is typical of agrarian societies where limited access to healthcare, high infant mortality rates, and reliance on agriculture contribute to the high death rates.

Stage 2: Declining Death Rates: Industrialization and improvements in healthcare, sanitation, and nutrition lead to a significant decline in death rates while birth rates remain high. This results in a rapid population increase as more people survive into adulthood and have children.

Stage 3: Stabilization: Birth rates eventually start to decline due to factors, such as increased urbanization, education, and access to contraception. While death rates remain low, the reduction in birth rates leads to stabilization in population growth rates.

Stage 4: Low Birth and Death Rates: In post-industrial societies, both birth and death rates are low, resulting in minimal population growth or even population decline in some cases. Factors such as urbanization, women's empowerment, and changing societal norms contribute to lower fertility rates.

The discourse on navigating transformation, globalization, and sustainability has been widely explored across multiple disciplines, ranging from sociology and economics to organizational change and environmental policy. The selected literature provides a multidimensional understanding of how individuals, organizations, and nations respond to uncertainty, demographic shifts, and systemic disruptions. Walsh (2008) provided a historical-comparative perspective on immigration policy in Canada and Australia between 1945 and 2007, highlighting how globalization reshaped national identity, labor markets, and policy frameworks. Immigration is presented not only as a demographic phenomenon but also as a strategic tool for managing global integration. Similarly, Judy (2015) examined demographic transitions in China, emphasizing mitigation strategies for economic stability in the face of aging populations and labor shortages. These studies underscore the interplay between population dynamics and policy design in managing long-term national challenges. The theme of navigating uncertainty is central in a study by Haasnoot *et al.* (2013), who introduce “Dynamic Adaptive Policy Pathways” as a method for crafting robust decisions in uncertain environments. This framework resonates with the broader literature on resilience and adaptive governance, providing a structured approach for decision-makers to remain flexible amidst unpredictable future scenarios. Maddison (2008) complemented this by situating economic development within a long-run comparative framework, contrasting the “West and the Rest” in global economic history from 1000–2030. Likewise, De Vries and Van der Woude (1997) traced the Dutch economy’s trajectory between 1500 and 1815, offering insights into institutional and structural adaptations that sustained economic resilience. Collectively, these works establish a foundation for understanding how societies adapt and survive amidst structural transformation and uncertainty. The organizational and business dimensions of navigating change were addressed by Dhoke (n.d.), Anderson and Anderson (2010), and Sharma *et al.* (2023). Dhoke highlighted the paradigm shift from Industry 4.0 to Industry 5.0 in India, emphasizing the convergence of digitalization, human-centric innovation, and sustainable practices. Anderson and Anderson (2010) provided a practical roadmap for organizational leaders to manage transformational change, underscoring structured frameworks to navigate disruption. Sharma *et al.* (2023), in the context of the COVID-19 pandemic, showed how Small and Medium Enterprises (SMEs) employed adaptive strategies to remain resilient during crisis conditions. Together, these studies articulate the importance of organizational agility, leadership, and innovation in ensuring business continuity and

CHAPTER 8

A Comprehensive Overview of the Effects of Climate Change on Agriculture and Approaches for Mitigation

Rashmi Tripathi^{1*} and Deepak Kumar Mishra²

¹ *Department of Commerce, DAV PG College (BHU), Varanasi, Uttar Pradesh, India*

² *Department of Commerce, Dr. Ram Manohar Lohiya P. G. College, Bhairavtalab, Rajatalab, Varanasi, Uttar Pradesh, India*

Abstract: Climate change poses significant challenges to global agriculture, threatening food security, livelihoods, and ecosystems worldwide. This chapter provides a comprehensive examination of the effects of climate change on agriculture and explores effective adaptation and mitigation strategies to address these challenges. Key findings reveal that climate change alters temperature patterns, precipitation regimes, extreme weather events, soil health, pest dynamics, and aquatic ecosystems, disproportionately impacting vulnerable communities and smallholder farmers. Sustainable agricultural practices, technological innovations, and policy interventions offer promising pathways for building resilience, reducing emissions, and promoting inclusive and equitable development in agriculture. The importance of collaborative partnerships, interdisciplinary research, and holistic approaches to climate change adaptation and mitigation is underscored. A call to action is issued for policymakers, practitioners, and researchers to prioritize climate-smart agriculture, integrate sustainable practices, and foster inclusive decision-making processes to ensure the long-term sustainability of agricultural systems. The abstract concludes with an imperative for collective action to forge a resilient, sustainable, and equitable agricultural future in the face of climate change.

Keywords: Adaptation, Agriculture, Climate change, Crop production, Livestock, Mitigation, Policy interventions, Sustainable practices, Vulnerability.

INTRODUCTION

Climate change is one of the most pressing challenges facing humanity in the 21st century, with far-reaching implications for various sectors of society, including agriculture. The increasing concentration of greenhouse gases in the Earth's

* **Corresponding author Rashmi Tripathi:** Department of Commerce, DAV PG College (BHU), Varanasi, Uttar Pradesh, India; E-mail: rashmitripathi204a@gmail.com

atmosphere, primarily due to human activities, such as burning fossil fuels and deforestation, has led to significant alterations in global climate patterns. These changes manifest in rising temperatures, altered precipitation patterns, and more frequent and intense extreme weather events, all of which have profound effects on agricultural systems worldwide.

Background and Significance of the Study

Agriculture is not only a fundamental component of human civilization but also a critical driver of global economies and livelihoods. It provides sustenance, income, and employment for billions of people across the globe, particularly in developing countries where agriculture is the primary source of livelihood for a significant portion of the population. However, the stability and productivity of agricultural systems are increasingly threatened by the impacts of climate change.

Recognizing the profound implications of climate change for agriculture, there is a critical need for a comprehensive understanding of the complex interactions between climate variables and agricultural systems. This understanding is essential for developing effective strategies to mitigate the adverse impacts of climate change on agriculture, enhance resilience, and ensure the long-term sustainability of food production systems.

Overview of Climate Change Impacts on Agriculture

The impacts of climate change on agriculture are multifaceted and vary across different regions and cropping systems. Some of the key impacts include:

1. **Changes in Temperature Patterns:** Rising temperatures can alter the physiological processes of crops and livestock, leading to reduced yields, decreased animal productivity, and changes in cropping calendars.
2. **Altered Precipitation Regimes:** Changes in precipitation patterns, including shifts in the timing, intensity, and distribution of rainfall, can disrupt planting schedules, affect soil moisture levels, and increase the risk of droughts and floods.
3. **Extreme Weather Events:** More frequent and intense extreme weather events, such as hurricanes, droughts, heatwaves, and heavy rainfall, can cause extensive damage to crops, infrastructure, and livelihoods, leading to significant economic losses for farmers and rural communities.
4. **Impact on Soil Health and Fertility:** Changes in temperature and precipitation regimes can affect soil properties, nutrient cycling processes, and soil microbial communities, impacting the productivity and resilience of agricultural land.

5. **Changes in Pest and Disease Dynamics:** Warmer temperatures and altered precipitation patterns can create favorable conditions for the proliferation of pests and pathogens, leading to increased incidences of crop diseases and pest infestations.

Purpose and Scope

This chapter aims to provide a comprehensive examination of the effects of climate change on agriculture and to explore various approaches for mitigating these impacts. By synthesizing current research findings, case studies, and best practices, this chapter seeks to:

1. Enhance understanding of the complex interactions between climate change and agriculture.
2. Identify key vulnerabilities and challenges facing agricultural systems in the context of climate change.
3. Explore adaptation and mitigation strategies to build resilience and sustainability in agricultural production.
4. Inform policymakers, agricultural practitioners, researchers, and other stakeholders about effective measures for addressing the impacts of climate change on agriculture.

Through a multidisciplinary approach, this chapter examines the scientific, economic, social, and policy dimensions of climate change impacts on agriculture, with a focus on both global trends and regional disparities. By highlighting the interconnectedness of environmental, economic, and social factors, it seeks to contribute to informed decision-making and the development of holistic strategies for ensuring food security and livelihoods in a changing climate.

Review of Literature

Climate change has emerged as one of the most critical challenges to global agriculture, influencing both crop and livestock systems through rising temperatures, changing precipitation patterns, and the increased frequency of extreme events. The IPCC (2023) emphasizes that climate-induced risks to food and nutritional security are systemic and require integrated mitigation–adaptation responses. Historical analyses show that warming since 1980 has already reduced yields of major crops, such as wheat and maize, with Lobell *et al.* (2011) providing clear evidence of negative yield responses to temperature increases at the global scale.

Meta-analytical findings reveal that without adaptation, yields of staple crops decline significantly under modest warming. However, targeted adaptation

Role of Green Human Resource Management towards Ecological Sustainability: Evidence from a South Asian Perspective

Indranil Bose¹, Nilanjan Ray^{2,*}, Debarshi Ghosh³, Aliv Banerjee³ and Ruchi Sen⁴

¹ Department of Management, Adamas University, Kolkata, West Bengal, India

² Faculty of Management, JIS University, Kolkata, West Bengal, India

³ Department of Management, Meghnad Saha Institute of Technology, Kolkata, West Bengal, India

⁴ Sunbeam College for Women, Varanasi, Uttar Pradesh, India

Abstract: Green HRM, also termed green human resource management, is currently a popular trend in organizations. It involves incorporating environmental sustainability into human resource policies and practices. The goal of Green HRM is to encourage organizations to adopt practices that are beneficial for the environment and maintain ecological balance (Dumont, J. *et al.*, 2017). With strong emphasis and focus from top management on sustainability and the SDGs, corporations are now embracing green practices and formulating human resource policies to encourage environmental management initiatives. In today's corporate landscape, a company's triumph is no longer solely based on economic factors. Corporate sustainability mandates that organizations move beyond short-term financial objectives to also consider the long-term social, environmental, and economic ramifications of their operations. This transition is vital for organizations to succeed in the business sector and secure profitability for their shareholders (Baumgartner, 2013). This chapter aims to explore the correlation between Green HRM and the SDGs and to examine various Green HRM practices implemented in specific Indian companies. It emphasizes the competitive edge and the benefits these companies gain from such practices. The timing of this investigation is highly opportune, as private and governmental organizations have been prompted to implement policies aimed at slowing the rapid depletion of non-renewable resources and mitigating adverse societal repercussions.

Keywords: Eco-friendly, Green human resource management, Sustainability.

* Corresponding author Nilanjan Ray: Faculty of Management, JIS University, Kolkata, West Bengal, India; E-mail: dr.nilanjanmgmt@gmail.com

INTRODUCTION

Green Human Resource Management (GHRM) is a set of policies, practices, and systems that encourage a company's employees to act in an environmentally conscious, resource-efficient, and socially responsible manner. Since the 1980s, green management has gradually emerged as an important dimension of management practices. As a consequence of this development, practices such as green HR, green finance, and green production have increasingly come into the limelight across the globe. According to Ren *et al.* (2018), green management will emerge as the core of management practices in the coming years. This observation has been found to be significantly dominant in management debates, priorities, and challenges within global business strategic preferences. India, as one of the leading economies of the world, has also been adopting green practices and strategies for many years, and has recently emerged as one of the major hubs of green economic and industrial involvement.

OBJECTIVES OF THE RESEARCH

The following are the objectives of the present research:

- To understand the future of corporates in the context of emerging developments in the business environment.
- To discuss different aspects of entry-to-exit HR procedures observed in association with Green HRM in India.
- To study the adoption of Green HRM and its link with the accomplishment of SDGs.

RESEARCH METHODOLOGY

The present research is qualitative in nature, and the study has been conducted using secondary sources. Different aspects of the study, as reflected in the present research, attempt to explore the future of business organizations in a green and sustainable business environment, as well as the scope of HRM in actively participating in the green strategies of organizations, through which individuals can make a substantial impact on both society and the environment as a whole. Finally, a case study approach is used to discuss the green HRM applications adopted by many premier organisations operating in India.

THE FUTURE OF BUSINESS ORGANIZATIONS IN A GREEN BUSINESS ENVIRONMENT

Global organizations are confronting new realities, challenges, and opportunities in personnel management. The profound transformations in business models have

significantly affected companies, leading to a rise in skill deficiencies and the need for efficient workforce management (Schüler *et al.*, 2011).

Nowadays, businesses are challenged by a range of stakeholders, comprising primary stakeholders, such as owners, employees, customers, and suppliers, as well as secondary stakeholders, such as non-governmental organizations, activists, communities, and governments (Waddock *et al.*, 2002). In this context, companies are likely to embrace strong social responsibility and environmental awareness, driven by consumers' growing emphasis on ethics and eco-friendly initiatives. The societal and corporate agendas will thus align. This forecast is presented in the subsequent sequence.

According to PwC's 2022 Global Workforce Hopes and Fears Survey, which gathered feedback from nearly 54,000 workers across 46 countries and territories, 44% of employees in the Energy, Utilities, and Resources (EUR) sector believed their employer should take action to combat climate change. The percentage was even greater, reaching 49%, for individuals employed solely in the energy sector. Moreover, 48% of European workers expressed a greater inclination to acknowledge the significance of green skills. Conversely, among employees of energy companies, the proportion who recognized the importance of such skills rose to 52% (Table 1).

Table 1. Companies embracing green.

2010	2012	2013	2018	2020
The London Carbon Trading Exchange was established by the United Kingdom.	The United States has officially signed the Kyoto II agreement, assuming the role of a prominent advocate for implementing measures aimed at mitigating the acceleration of global warming.	With a strong commitment to upholding its cultural and heritage treasures, India has become a prominent figure in the corporate social responsibility (CSR) arena.	Petrol-powered cars are outnumbered by hybrid or fully electric vehicles on the road.	A team of researchers has verified that the pace of climate change is decelerating.

Source: Managing tomorrow's people (PWC Report, 2010).

In the current global business landscape, enterprises are facing heightened competition, regulatory scrutiny, and community expectations. Additionally, there is an increasing demand for environmental sustainability, necessitating strategies to mitigate environmental impacts from the provision of products and services. Clem (2008) suggested that the shift towards sustainability signifies a growing societal awareness of the importance of conserving and enhancing the Earth's resources for the benefit of future generations. As consumers become increasingly conscious of environmental concerns, demand for eco-friendly products is rising.

Migration Patterns, Climate Change, and the Economic Consequences for Marine Resource-dependent Communities

Indrani Ghosh¹ and Prantik Banerjee^{1,*}

¹ *Adamas University, Kolkata, West Bengal, India*

Abstract: Climate change is significantly disrupting marine ecosystems, causing global warming, ocean acidification, and rising sea levels, which deplete fish stocks and threaten biodiversity. These environmental changes force coastal communities, heavily reliant on marine resources, to migrate due to conditions, such as flooding and extreme weather. This migration, driven by both environmental displacement and voluntary relocation for alternative livelihoods, impacts local economies by causing the loss of traditional income sources, such as fishing and aquaculture, increasing poverty and instability, and disrupting local markets and tourism. The social and cultural fabric of these communities also faces challenges, including family separation, cultural erosion, and gender-specific impacts. Effective responses at policy and governance levels are crucial, with a focus on climate adaptation, community-based approaches, and sustainable practices. Future research should address knowledge gaps, particularly in socio-economic impacts and migration statistics, to support targeted interventions and resilience-building in marine resource-dependent communities.

Keywords: Adaptation strategies, Climate change, Coastal communities, Economic impacts, Marine ecosystems, Migration patterns, Sustainable practices.

INTRODUCTION

Climate change threatens maritime ecosystems and the communities that depend on them. Ocean acidification, sea level rise, and changes in temperature and precipitation are disrupting marine ecosystems and endangering fisheries and other marine sectors.

Understanding the complex connections between climate change, marine resources, and human societies is crucial for developing effective adaptation and resilience strategies (Birchall *et al*, 2023).

* **Corresponding author Prantik Banerjee:** Adamas University, Kolkata, West Bengal, India; E-mail: drprantikb@gmail.com

Background and Significance

Communities dependent on maritime resources are vulnerable to climate change. These communities depend on marine resources for food, income, and culture, rendering them vulnerable to oceanic changes. Coral bleaching, decreases in sea ice, and shifts in fish distribution caused by climate change are already affecting marine ecosystems and their communities. Policymakers, practitioners, and academics may develop ways to help coastal and marine communities adapt, build resilience, and promote sustainable development by studying the causes, mechanisms, and impacts of climate change.

Objectives and Scope of the Review

This review aims to analyse the effects of climate change on communities that rely on marine resources, with particular focus on economic outcomes and policy responses.

Specifically, the review will:

- Evaluate the existing knowledge regarding the effects of climate change on marine ecosystems and the well-being of coastal communities.
- Analyse the economic effects of climate change on communities that rely on marine resources, such as job losses, disturbances in fisheries and aquaculture sectors, and repercussions on local economies.
- Examine how policies and governance strategies address climate change in communities reliant on marine resources, considering national and international frameworks, adaptation and mitigation actions, and community-based methods.

CLIMATE CHANGE AND MARINE RESOURCES

Climate change can affect marine ecosystems in various ways, including ocean warming, which leads to greater thermal stratification and reduced upwelling, along with rising sea levels and increased wave frequency and intensity. Loss of sea ice, elevated risks of diseases among marine life, and declines in pH levels and carbonate ion concentration in surface oceans are also notable impacts.

Warming of the Oceans

Climate change has caused considerable warming of the ocean across most regions of the world. The ocean has absorbed about 93% of the additional heat, leading to notable warming in both the upper ocean (above 700 meters) and deeper waters (700–2000 meters), with the intensity of warming increasing since the 1980s. Globally, sea surface temperatures have risen by an average of 0.7 °C

since 1900 (Barange *et al.* 2018). Future warming of the upper ocean is expected to be most pronounced in tropical and Northern Hemisphere subtropical regions, while deeper water warming is anticipated to be more significant in the Southern Ocean (IPCC 2019; Gattuso *et al.*, 2015). Continued warming is projected to shift the suitable distribution ranges of many marine species towards the poles. Generally, species capable of migrating to cooler waters and finding suitable habitats will do so (Barange *et al.* 2018; Pinsky *et al.* 2013). Those unable to move will either adapt to the changing conditions or face local extinction unless extensive measures such as transplantation initiatives are implemented. Significant habitat losses are expected, particularly in the Arctic and coral reef ecosystems, resulting in changes to community structures, mismatches between predators and prey, and local extinctions (Doney *et al.* 2014; Free *et al.* 2019). Cold-water fish such as trout and salmon may disappear from significant portions of their current geographic distribution. Conversely, numerous fish species, like largemouth bass and carp, which thrive in warmer water conditions, may extend their ranges across European nations as surface water temperatures rise (Prakash 2021).

Rising Sea Levels and Coastal Erosion

The polar regions have undergone significant transformations, including shifts in the timing of annual melting seasons, changes in snow cover, and reductions in ice sheet and glacier mass, all contributing to rising sea levels. Globally, the mean sea level has increased by 0.16 meters from 1902 to 2015, with projections indicating further rises by 2100 ranging from 0.29 to 1.1 meters, depending on emission scenarios (IPCC 2019; Kopp *et al.*, 2014). The rate of sea level rise varies across regions, with the western Pacific experiencing a much higher increase compared to the eastern Pacific (Barange *et al.* 2018; Dangendorf *et al.* 2017). These changes will have diverse economic impacts, affecting coastlines and coastal productivity and increasing the risk of flooding. In the Arctic, there has been a substantial decline in annual sea ice extent, with rates of decrease ranging from 3.5% to 13% per decade. Similarly, mass loss from the Antarctic ice sheet has tripled between 2007 and 2016, leading to record low sea ice extents in 2017. Both the Greenland and Antarctic ice sheets are expected to contribute significantly to future sea level rise. While reductions in sea ice have opened new shipping routes, they also pose risks to traditional activities like fishing and hunting for polar species. Sea level rise, combined with more frequent and intense storms, will have detrimental effects on ocean and coastal infrastructure, including ports, aquaculture, and offshore energy facilities, with estimated annual costs reaching trillions of dollars. Additionally, millions of people worldwide, particularly the most vulnerable households, are at risk of displacement due to

A Nexus between Sustainable Management of Natural Resources and Climate Change: A Study on Medical and E-Waste

Tanmoy Majumder^{1,*}, Rakesh Kumar Dhar Dubey², Nilanjan Ray¹, Raj Kumar Bhattarai³ and Moumita Ray¹

¹ Faculty of Management, JIS University, Kolkata, West Bengal, India

² School of Management Studies & Juridical Science, JIS University, Kolkata, West Bengal, India

³ Faculty of Management, Tribhuvan University, Kirtipur, Kathmandu, Nepal

Abstract: The exponential growth of the technology and healthcare sectors has led to a surge in waste, particularly medical and electronic waste (e-waste), posing significant environmental and public health challenges worldwide. In response, the concept of sustainable management of natural resources has gained prominence as a holistic approach to mitigate the adverse impacts of waste generation and disposal. This chapter aims to identify challenges, innovative solutions, and best practices in sustainable natural resource management in the context of medical and e-waste. Through a comprehensive review of literature, case studies, and empirical analysis, it explores the complexities of waste management, emphasizing principles of waste minimization, resource recovery, and circular economy approaches. Additionally, it highlights the interconnectedness of environmental, social, and economic factors in shaping waste management strategies and explores the implications for broader environmental sustainability goals. This chapter offers practical insights for policymakers, industry stakeholders, and researchers to establish sustainable strategies for medical and e-waste management by utilising current scenarios from various geographic regions and sectors. Ultimately, it contributes to the ongoing discourse on sustainable waste management practices, offering pathways towards a more resilient and resource-efficient future.

Keywords: Colour coding waste management, E-waste management, Medical waste management, Natural resources, Sustainable management.

* Corresponding author Tanmoy Majumder: School of Management Studies, JIS University, Kolkata, West Bengal, India; E-mail: tanmoy.majumder@jisuniversity.ac.in

INTRODUCTION

In an era characterized by rapid technological advancements and burgeoning healthcare needs, the management of waste, particularly medical and electronic waste (e-waste), has emerged as a critical environmental and public health concern. In addition to posing serious threats to human health and ecosystems, the unsustainable disposal of these waste streams depletes natural resources and exacerbates environmental problems worldwide. The idea of sustainable management of natural resources has gained popularity in response to these urgent problems, underscoring the need for integrated strategies that balance environmental, social, and economic factors. When improperly disposed of, waste from electrical and electronic equipment can harm both the environment and public health. Furthermore, the exploitation of specific naturally occurring resources, some of which are becoming harder to obtain, is necessary for the growth of the electronic sector. Recycling is a viable approach for recovering commercially valuable commodities, such as metals, which are abundantly present in end-of-life electrical and electronic equipment. This practice not only mitigates resource depletion but also contributes to sustainable waste management strategies (Silveira, 2019). Medical waste, on the other hand, may contain pathogenic agents, making it potentially dangerous. As a consequence, medical waste management requires organizations to make decisions and implement measures to mitigate health risks (E. Insa, 2010). Chisholm *et al.* (2021) emphasized that the formulation of policies, recommendations, and solutions for medical waste management and sustainability can guide decision-makers in developing strategies that incorporate eco-friendly technologies for effective treatment and disposal of medical waste. This approach fosters collaboration between the healthcare sector, policymakers, and stakeholders, thereby strengthening the integration of sustainability principles into health policies and programs. The demand for healthcare facilities is increasing alongside the increase in medical waste. A systematic approach to healthcare waste management is required to minimize risks to both occupational and public health (Joshi, 2013). The sustainable development of human society requires stringent regulations governing the management of natural resources, including their extraction, use, and the disposal of waste generated during exploitation. Among these, medical waste poses a growing challenge due to its increasing volume and multifaceted impact across sectors. Given its significant implications for human health, the environment, the economy, and society, medical waste remains a complex issue. Proper management is particularly crucial, as it directly influences both community well-being and environmental integrity (Bucătaru, 2021). Healthcare waste often contains substantial amounts of highly hazardous substances, and inadequate waste management in the healthcare sector poses serious risks to human health and the environment. In many densely populated

developing nations in Asia, resource constraints exacerbate the challenges of properly managing medical waste. The absence of adequate training programs in waste management leads to a lack of awareness among employees and handlers, resulting in unsafe waste-handling practices and increasing the potential for significant health hazards (Khan, 2019). Biomedical waste that is improperly treated, particularly contaminated sharps, presents considerable public health risks by enabling the transmission of infectious diseases, such as HIV, dengue, and Hepatitis B, C, and E. Furthermore, the disposal of untreated biomedical waste facilitates the growth and genetic variation of pathogenic microbial populations in municipal waste, exacerbating physical injuries and posing significant health hazards (Chakraborty, 2014). As noted by Liu (2021), optimizing the processes of medical waste management, including its transportation and treatment, has emerged as a central priority for governmental health and environmental protection authorities at all administrative levels.

E-waste, defined as discarded, obsolete, or damaged electrical and electronic equipment, is recognized as a rapidly growing category of solid waste. It is classified as hazardous due to its composition, which includes toxic substances, such as heavy metals (*e.g.*, lead, cadmium, mercury) and Brominated Flame Retardants (BFRs). Improper handling of these materials poses significant risks to human health and the environment (Kaya, 2016). The hazardous nature of e-waste underscores the importance of implementing effective waste management strategies to mitigate its impact.

To address the environmental and public health risks associated with improper e-waste disposal, alternatives, such as recycling, exporting, and landfilling, are considered based on economic, social, technical, and environmental factors. Recycling, in particular, offers a sustainable solution by reducing the volume of toxic materials deposited in landfill sites (Alblooshi, 2022). The handling of e-waste, alongside biological waste, has garnered increasing attention in recent years, with regulatory frameworks emphasizing its proper management. The 2016 Solid Waste Management (SWM) Rules have provided specific guidelines for the management of e-waste, reinforcing the need for environmentally sound practices in this domain (Biswas, 2023).

REVIEW OF LITERATURE

Biomedical waste presents a persistent and increasingly complex challenge across both high-income and developing nations, with its volume steadily rising as healthcare and medical technologies advance. The improper handling and disposal of biomedical waste pose severe risks to environmental and public health, as inadequate waste management systems fail to keep pace with the growing

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Nilanjan Ray

Dr. Nilanjan Ray is an Associate Professor in the Department of Management Studies at JIS University, Kolkata, India, with prior academic and leadership experience at Adamas University and the Institute of Leadership Entrepreneurship and Development, where he also served as HoD and Director of IQAC. He holds a PhD in Marketing along with MBA, M.Com, and other professional qualifications, and is an Accredited Management Teacher certified by the All India Management Association. With over 12 years of teaching and 6 years of research experience, he has supervised doctoral scholars and guided more than 50 postgraduate research projects. Dr. Ray has contributed over 90 research publications in reputed journals and edited volumes with leading international publishers, along with holding patents and copyrights. He is actively engaged in academic reviewing, editorial boards, and the organization of conferences and FDPs, and is affiliated with several national and international professional bodies.



Saurabh Sen

Dr. Saurabh Sen, born on 25th October 1978, is an academician in Commerce with specialization in Accounts and Finance. He completed his PhD in Commerce from Banaras Hindu University (BHU) after his Master's degree and has developed a strong academic and research profile. He has authored over 30 research papers in reputed national and international journals and published two edited books with international publishers. Dr. Sen has actively participated in numerous conferences and seminars and is a life member of the Indian Accounting Association, as well as a founder member of its Varanasi chapter. He currently serves as Vice-Principal at Sunbeam College for Women, Varanasi, and is also a certified counsellor for IGNOU's MCA programme. In addition, he is involved in academic editorial work and has been recognized with nominations such as the Bharat Jyoti Award for his contributions to education and research.



Ruchi Sen

Dr. Ruchi Sen is an accomplished academician in Commerce with a strong record of academic excellence, having consistently secured first division throughout her education and earning second rank in her university graduation merit list. She completed her PhD in Commerce from Banaras Hindu University (BHU) and has over 16 years of teaching experience as an Associate Professor at Sunbeam College for Women, Varanasi, where she also serves as Joint Coordinator of IQAC. Dr. Sen has supervised postgraduate research projects and has contributed extensively to academic literature through publications in national and international journals, an edited research handbook with IGI Global USA, and authored books on Business Statistics and Monetary Theory and Banking in India. She actively participates in conferences and FDPs, and holds life membership in prominent academic associations, reflecting her continued commitment to teaching, research, and academic development.