

WOMEN ENTREPRENEURS AS CLIMATE CRUSADERS

A CASE STUDY OF WOMAN LED ENTERPRISES COMBATING CLIMATE CHANGE

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DOI: <https://doi.org/10.64558/blp/686103obgyqr>

ABSTRACT:

Climate change stands as one of the most daunting challenges that mankind is facing presently. Climate change poses various threats such as dwindling resources, increasing sea levels, erratic weather patterns, and less consistent growing seasons, all of which could have an impact on almost every element of our existence. In the year 2023, Asia remained the most disaster-prone region in terms of weather, climate, and water hazards. According to the World Meteorological Organization's (WMO) study, floods and storms caused the most reported casualties and economic losses, along with a great impact from heatwaves. (state of the climate in Asia, WMO-No. 1350). Controlling the global climate change. Mitigating this climate crisis has been a central objective of governments and regulatory bodies around the globe.

International initiatives like the Paris Agreement (December 12, 2015) and the Sustainable Development Goals (SDGs) of the United Nations have been launched to reduce greenhouse gas emissions and advance sustainable development. India's union budget for 2024 has been crafted with an emphasis on advancing green

energy, climate resilient agriculture and several other initiatives which focuses on achieving India's climate goals. In order to address these issues related to climate change, entrepreneurs will play a crucial role as leaders by fostering innovation and putting into practice workable solutions. This particular paper provides number of case studies and data-based reports analysed and reviewed to explore the connection between women led start-ups and the steps taken by women entrepreneur in mitigating the unusual climate changes and their capability to stand persistent in the face of threats posed by climate changes. In this paper, several case studies and data-based reports are reviewed to explore the relationship between women led enterprises and their ability to be resilient in the face of a changing climate or increase actions that mitigate changes in the climate. The paper emphasizes that women entrepreneurs with their unique knowledge and experiences, including close associations with nature-based production and management, can prove to be a invaluable human resource in the fight against climate change. They bring valuable knowledge to develop responses that effectively address environmental

problems and adapt to them. Additionally, improving the capacity of women entrepreneurs to empower them and augment their efforts with tech-related solutions to solve this particular ‘wicked’ problem is suggested.

KEY WORDS – Climate change, women led enterprises, women dominated sectors sustainable development goal, carbon emission, green economy, climate resilience

INTRODUCTION

Climate change, which refers to the prolonged alteration in weather patterns from the tropics to the poles, poses a significant challenge on a worldwide scale. It is a pressing issue that impacts various sectors. (Abbas et al. 2021) The consequences of climate change are far-reaching, affecting not only the environment but also societal well-being and development. As temperatures rise and extreme weather events become more frequent, the need for urgent action to mitigate these impacts has never been more evident. Climate change causes rising temperatures across the globe (Battisti and Naylor 2009; Schuurmans 2021; Weisheimer and Palmer 2005; Yadav et al. 2015). With the beginning of the industrial revolution, the problem of earth climate grew exponentially (Leppänen et al. 2014). It is reported that immediate attention and appropriate action may increase the likelihood of overcoming its devastating effects. According to the World Health Organization, between 2030 and 2050, climate-related illnesses like heat stress, malaria, and malnourishment will claim the

lives of a quarter of a million people (WHO, 2018).

Women are more likely to work in industries that are vulnerable to climate change. Climate change is expected to have a greater impact on women in sectors such as agriculture, forestry, healthcare, and tourism than men. *Camey C. et al. (2020)* In developing countries, women are the primary food producers, accounting for two-thirds of the global agricultural labour force. (*Doss C., & R. Meinzen-Dick. et al 2018*).

Women’s knowledge of natural resources can lead to the development of comprehensive solutions to climate change, which can have positive side effects. For instance, the field of climate action is beginning to acknowledge the role that women’s resource management expertise can play in implementing long-term, sustainable practices. Policies for low-carbon development that are equitable, efficient, and effective must focus on women as important and core stakeholders so that their expertise can be utilized (*PWC, UNGC 2022*).

Gender equality and women’s empowerment are crucial in order to combat climate change, with women playing a pivotal role in achieving the Sustainable Development Goals (SDGs). These objectives, which comprise 17 targets intended to direct worldwide efforts toward sustainable development by 2030, connect in three areas that are essential for taking meaningful action on climate change.

The Economic Dimension: Promoting sustainable business practices, advancing environmentally friendly innovations, and

reducing risks associated with climate change all depend on women's equitable participation in the green economy by enhancing women's economic agency, they are empowered to spearhead the transition to solutions for climate change and improve economies' resilience and efficiency.

Social Dimension: Women are needed in leadership roles to enhance the health, safety, and well-being of communities affected by climate change. At the same time, by ensuring women's equal access to resources, education, and decision-making, societies can enhance social resilience by creating more inclusive and effective approaches to adapt and mitigate against climate change.

Environmental Dimension: Women are critical actors in resource management and environmental stewardship. Their involvement in environmental decision-making leads to improved efficiency in the resource economy-contributes to more sustainable natural resource practices, and generates effective climate actions. Thus, empowering women to lead environmental projects is crucial to realizing the SDGs while addressing the negative impacts of climate change. (*Fernández et al., 2021*)

Due to their distinct experience, knowledge, and strong connections to nature-based production and management, women entrepreneurs have the potential to make uplifting contributions in the fight against climate change. They provide valuable evidence that can be utilized to develop options that effectively reduce and adapt to environmental challenges (*ICRW, 2020*).

Women are more likely than men to take

action that reduces emissions (*Oliver Wyman 2020*). Women in seven of 11 developed countries consider climate change to be one of the most important issues facing their communities and that significant changes must occur to their lifestyles (*Zainulbhai, 2015*). Evidence points to women entrepreneurs being more conscientious in greening their businesses, as well as being more active in seeking out green networking opportunities than their male counterparts (*Braun, 2010*).

This paper examines three distinctive women-led, green businesses that are working to effectuate climate change and explores barriers facing women and the role that technology may play in addressing those barriers to develop more effective climate change management strategies.

REVIEW OF LITERATURE

The stewardship of women entrepreneur in addressing issues related to climate change has received significant attentiveness in recent years. There are numerous researches evaluating the contributions made by women entrepreneur in the area of environment management, sustainable business practices and green business practices. The studies also highlight how women will be largely affected by the threats posed by climate change because of large number of women being employed in the sectors which are directly impacted by the climate.

Women and climate change: a unique perspective

Women are comparatively more involved in management of natural resources in comparison to their male counterparts and

can implement their knowledge to come up with innovative and sustainable solutions to counter the issues associated with climate change. Works by Doss & Meinzen-Dick (2018) emphasize that in the developing world, women are typically the key food producers and important stakeholders in managing natural resources. This positioning indeed empowers them to contribute meaningfully to resilience and adaptation strategies relating to climate. Moreover, it has been proved through research that women are more likely to adopt behaviours that reduce greenhouse gas emissions compared to men, which makes them key players in addressing climate change.

Women entrepreneur in green economy

In order to mitigate issues arising due to climate change it is necessary that women business owners involve themselves in sustainable business practices. Women are more inclined toward sustainable business practices when compared to their male counterparts. As cited by Braun (2010) and Fernández et al. (2021), women entrepreneurs exhibit more active green networking and have a greater tendency to engage in environmentally friendly business practices than men. They, therefore, are a force in driving an equitable, efficient, and sustainable economy based on green principles.

Difficulties faced by women entrepreneur

Despite being a crucial player in combating climate associated issues female entrepreneur face a lot of obstacles in their journey which often hinder their participation as well as limit their growth. These challenges based on the literature are

largely structural in nature, including limited financial framework for women and social capital restrictions related to entrepreneurial ecosystems due to gender discriminations, professional vs. caregiving responsibilities etc. The World Bank, 2014 report claimed Climate Innovations are locked out of the market because women have a harder time securing financing to meet high initial capital costs and long payback periods. Moreover, these are compounded by socio-cultural norms which create obstacles for the complete inclusion of women in decision-making processes and at leadership levels within the green sectors.

Role of technology and innovation

Technology will play a crucial role in empowering women entrepreneur to come up with sustainable and scalable solutions to combat climate change. Augmenting female-led enterprises with technology will help to improve efficiency, reduce operational costs and will help them to expand further in the market (pwc 2022). For example technology such as IoT-enabled bioreactors from women-led companies like Billion Carbon Solutions are used to turn waste into high-value by-products, helping address climate change. But, literature also highlights that there is a need to provide more focused support enabling women entrepreneurs in utilizing these technologies meaningfully to their advantage (IFC, 2023).

Policy Support and Finance framework

The literature review also emphasizes the importance of gender-sensitive financial instruments and policy changes to help fund-women led climate tech entrepreneurs. They suggested to design

innovative financial mechanisms including green finance, sustainable finance and gender-inclusive investment fund for empowering women-led businesses (*IFC 2023; We-Fi 2022*). Moreover, women leadership and mentorship programmes as well as digital literacy followed by policies encouraging more female in environmental sectors are critical for climate gap within the entrepreneurship developments (*UN Women, 2023*).

Future Research and Practice

Implications

The current literature recognizes how women entrepreneurs can contribute to climate action and yet research on effective strategies for addressing the barriers they experience is significantly lacking. If future work accounts for individual programs or policies, the intersection of emerging technologies and women's abilities to directly contribute to climate change mitigation/adaptation efforts should be further examined.

METHODOLOGY

Research publications, articles, and reports collected from various research databases were comprehensively reviewed by the study. This comprehensive examination highlights the need for targeted female-focused climate change solutions and promotes their unique strategies. There is an attempt to evaluate how these initiatives promoted by women fit into the overall preservation of climate, as well as the importance of their vision and agency in the development of climate change solutions.

Also, the study seeks to determine various ways in which technology contributes to

the effectiveness of these businesses. They try to define how one can avoid the existing issues with the help of new technology, and make climate-related projects more efficient. The report also provides an analysis of the potential benefits that technology may introduce in this field, such as being more efficient, making it easier to make data-driven decisions, and doing more.

In addition to highlighting the prospects of technology, the study pays significant attention to the common challenges that the female entrepreneurs face in their climate entrepreneurship. Such challenges include volatility in technology, social attitudes towards women, and limited resource availability. By examining these barriers, the study provides useful information on the multifaceted nature of such challenges and appropriate recommendations to help women entrepreneurs in their endeavours to tackle climate change.

CASE STUDIES: INSPIRING WOMEN LED ENTERPRISES

BILLION CARBON SOLUTIONS (INDIA)

Overview

By using food waste to produce nutrient rich fertilizer that will be used to improve the quality of the soil, Billion Carbon Solutions aims at solving the issue of soil degradation through proper utilization of a resource that otherwise would go to waste and enhance the emission of greenhouse gases further.

Founders:

Ankita Vijayvergiya & Nikhil Vijayvergiya

Background:

Climate change has had negative impacts

that are so severe that there is a need to find more effective strategies. One company that is standing out in this fight is Billion Carbon, a climate tech start-up from India founded by Ankita and Nikhil Vijayvergiya.

This company was born out of a sense of responsibility towards the environment and a wish to make an actual difference in society. Billion Carbon is an excellent demonstration of the fact that perseverant commitment and purpose enables a person to change the environment for the better.

Founding vision

Billion Carbon came into existence at the initial onset of the covid pandemic crisis. In this period, Ankita Vijayvergiya who was employed in a global corporation started wondering about the real purpose of her work. When the outbreak of the pandemic made the world come to a standstill, Ankita thought about the social aspect of her job and ultimately came to the realization that she is meant to be in climate work. In this process of self-discovery, She along with her brother Nikhil started their first start-up, Nature Healers which focused on encouraging sustainable lifestyle changes.

Problem identification

In collaboration with Nature Healers, the Vijayvergiya siblings identified an overlooked but crucial intervention area of the treatment of food waste which could help cut down greenhouse gas emissions. This is what prompted the establishment of Billion Carbon, a company that seeks to eliminate waste through the useful transformation of food waste into food products using BSFL technology.

After intensive research and development

for a number of years, Billion Carbon was officially entered the market in 2023.

The company's star product is an innovative, IoT-enabled bioreactor which transform food waste into high- value byproducts such as liquid biofertilizer and insect protein and lowering greenhouse gas emissions significantly.

Challenges and resilience Personal and Professional Balance

Motherhood and Entrepreneurship: Ankita had to try and find time for both being a mother and a first time entrepreneur. Very soon after the founding of BillionCarbon, she got to know that she was pregnant which was a mix of fun and fear. The physical wellbeing tasks and emotional weight during pregnancy and the bearing child phase, required her endurance. Nevertheless, all these challenges also brought valuable insights in how she would prioritize what is important in both business and family life.

Execution and Support

Appreciating the fact that she could not do it all herself, Ankita set out to create a strong support system. Her co-founder and brother, Nikhil, was very supportive and took some of the startup responsibilities upon himself. Emotionally and practically, her husband, her parents, and domestic helps relieved her so much as she juggled between motherhood and running a startup. This network became her anchor allowing her to continue having a lead role at BillionCarbon, while taking care of her baby.

Workplace Flexibility

The Power of a Home Office: It was at this time that Ankita began to run a home office not because it was comfortable but because

she had to. This was because all the work activities had to go on while she was actively working as a mother.

Strategic partners and growth

Billion Carbon was selected for the Accelerating Asia climate tech and sustainability accelerator, in conjunction with the United Nations Economic & Social Commission for Asia Pacific — enabled to attend through early 2024. The accelerator program was specifically tailored for female-led start-ups located in the Asia Pacific, and offered Billion Carbon a wealth of mentorship as well resources, exposure & networking opportunities! The program, Ankita said has guided her through the maze that climate tech investments can be.

Ankita pitched Billion Carbon's innovation at the second edition of ESCAP's Feminist Finance Forum in Bangkok, which she attended with all other accelerator participants in May 2024. She won a \$5,000 seed grant — her powerful pitch proving influential in the fight against climate change — that will help to broaden Billion Carbon.

Future outlook

The roadmap of Billion Carbon as such is an ambitious, but well-defined one. Kohler aims for one billion fewer tonnes of CO₂ by 2030. This is the goal with which the start-up passes, it has maintained that to make this a reality its technology must improve 10 fold now every year along with strengthening market position against competition. She is hopeful, because climate technology has – more recently — been regularly cited as an important investment segment and offers instruments for funding these innovative solutions.

The way Ankita deals with problems shows grit and determination. How Hayya believes- “It is never a no, but always about finding out other ways around it”, perfectly summing up what BillionCarbon aims to do.

TRINANO TECHNOLOGIES (INDIA)

Overview

Tri-nano technology creates a light-trapping nano coating that can be applied to both new and old solar panels. The coating created by Tri-nano Technologies raises productivity by 10% by enhancing the efficiency of solar cells to produce more energy. It also prolongs the life of the panels and helps reduce the need for cleaning.

Founder:

Dr. Anshu Dandia (cofounder & Director)

Dr. Harsh Sethi (co-founder & CEO)

Background:

Tri-nano technologies Pvt. Ltd. came into existence in 2022 by the collaborative efforts of Dr. Anshu Dandia & Dr. Harsh Sethi.

Trinano technologies is an Indian start-up which has developed a nanocoating for solar panels that improves power output and lowers maintenance costs. The technology has three properties: light trapping, anti- reflection, and self-cleaning. The nanocoating has also been tested at the National Centre for Photovoltaic Research and Education (NCPRE), IIT Bombay and National Institute of Solar Energy (NISE) and a 7% to 8% gain in power output was measured in nanocoated solar panel in comparison to the conventional commercial solar panels. (*Dandia et.al,2022*)

Problem identification & solutions

provided

India's major reliance on non-renewable sources such as fossil fuels burning poses a threat to environment. Burning of fossil fuels leads to the release of large amount of green house gases which facilitate to the climate related issues such as global warming. This indigenous nano-coating technology has the potential to significantly improve solar panel energy output and contribute to India's climate change and Net Zero targets.

Solar energy, particularly photovoltaic (PV) technology, has numerous advantages, including safety, dependability, efficiency, non-pollution, and widespread availability. PV power has grown in popularity worldwide in recent decades as part of the clean energy movement. With enormous market potential, PV power is expected to account for a significant portion of global energy consumption and be one of the primary energy sources this century (*xan et al., 2018, Bakhiyi et al., 2014*).

But along with the above listed advantages of solar energy solar panels themselves pose another environmental issue: once their useful life is up, they become a type of hazardous waste. During the first 25 years of development, solar panels had a long service life, making recycling waste panels unnecessary. However, a significant proportion of the first batch of solar panels installed are now being retired, and proper disposal of end-of-life solar panels is becoming an increasingly important environmental issue (*xan et al., 2018, Aman et al., 2015*).

The nanocoating Is eco-friendly, durable, and can be applied to panels without waste,

making it a sustainable solution for clean solar energy.

Tri-nano technology's nanocoating not only increases the energy output but also augment the panels with a self-cleaning technology and also helps in keeping the panels cooler leading to the reduction in cleaning cost as well as increasing the life-span of solar panels.

TECH-X-EARTHSPACE (INDIA)

Overview

TechXEarthSpace is a technology development company that focuses on developing innovative solutions to global challenges. This company is geared towards solving some of the key global challenges including climate change and environmental degradation in the long run. TechXEarthSpace's team is aiming at technology creation and its marketing for CO2 capture and utilization, hydrogen generation and storage, geo-energy, space mining, and exploration. The company also holds the view that the future of the planet and the inhabitants thereof, is safe in the hands of people and the company intends to make a difference.

Founders

Ms. Swati K J (Founder & CEO)

Problem Identification

TechXEarthSpace has realized the urgencies of originating unique as well as sustainable approaches to the major world issues humankind face today, especially the climatic change and the deterioration of the environment.

Management of the company understands the significance of issues in question and the applicability of modern technologies. Concerning areas of focus, TechXEarthSpace is formed to cater with

challenges as CO₂ emissions, hydrogen generation and storage, geo-energy, space resources and mining. The general problem is the absence of adequate technologies that can be implemented on a large scale to control CO₂ emissions and enhance sustainable resources of energy as well as resource acquisition from space.

Key innovations and projects

CO₂ Capture Technologies

TechXEarthSpace has created an indigenous technology for extracting CO₂ from atmospheric air. The company is seeking funding to advance this technology through a pilot project aimed at:

Removing CO₂ from biogas: Because biogas contains approximately 35% CO₂, removing it can improve clean combustion while reducing environmental impact.

Converting captured CO₂ to hydrogen (H₂): This step will improve the efficiency and sustainability of the process.

Geo-energy initiatives

The company is working on advanced CO₂ fracturing technologies that will replace traditional hydraulic fracturing methods. The technology aims to:

Create smooth fractures in a variety of

reservoirs without using chemicals.

Improved methane recovery in coal bed methane operations has the potential to recover more than 90% of methane. Increase oil recovery from conventional and unconventional oil and gas resources.

Make it easier to fracture geothermal reservoirs.

Subterranean Energy Storage

The business acknowledges that subterranean energy storage is a developing industry on Earth and in space. Important areas of attention consist of: storing hydrogen (H₂) and carbon dioxide (CO₂) to create CO₂ credits and useful byproducts. Getting ready for the upcoming storage requirements of the moon and Mars colonization.

Future Outlook

TechXEarthSpace is poised to make major strides in the fields of environmental sustainability and exploration of space. With ongoing R&D and strategic collaborations, the company is preparing to revolutionize CO₂ capture, geo-energy, and space mining technologies. Their commitment to developing cutting-edge solutions highlights their role in shaping a more sustainable and innovative future.

Table1 (Summarization of the case studies and common inference)

Aspect	Billion Carbon Solutions (India)	Tech-nano (India)	TechX Earth Space (India)	Inference
Overview	Converts food waste into biofertilizer using BSFL	Develops nano- coating to improve solar panel efficiency	Develops solutions for CO2 capture, H2 storage, and space exploration	All three companies focus on innovative, sustainable technologies to address environmental issues.
Founders	Ankita & Nikhil Vijayvergiya	Dr. Anshu Dandia & Dr. Harsh Sethi	Ms. Swati K J	All companies are founded by female individuals with strong leadership and a commitment to sustainability.
Founding Vision/Problem Identification	Identified food waste as a major contributor to GHG emissions	Addresses inefficiency and high maintenance of solar panels	Addresses global challenges like CO2 emissions and sustainable energy storage	All companies identified critical environmental challenges and developed innovative solutions to address them.
Key Innovations	IoT-enabled bioreactors to convert food waste into valuable byproducts	Nano-coating that enhances solar panel efficiency and longevity	CO2 capture technology, geo-energy initiatives, and subterranean energy storage	All companies developed advanced technologies to mitigate environmental impact and improve resource efficiency.
Challenges	Balancing motherhood with entrepreneurship, funding	Testing and commercializing new technology	Securing funding and advancing R&D	Each company faces challenges in technology development, funding, and scaling their innovations.

Strategic Partners/ Growth	Joined Acceleratin g Asia’s climate tech accelerator, received seed grant	Tested technology at NCPRE and NISE, achieved 7-8% efficiency gain	Engaged in R&D and strategic collaborations for future advancements	All companies seek partnerships, mentorship, and testing opportunities to validate and scale their innovations.
Future Outlook	Aims to reduce CO2 emissions by one billion tonnes by 2030	Contributes to India’s climate goals with improved solar panel technology	Poised to revolutionize CO2 capture, geo- energy, and space mining	All companies have clear, ambitious goals for their technology’s impact on sustainability and environmental protection.

CHALLENGES FACED BY WOMAN ENTREPRENEUR

Despite the critical role that women entrepreneurs play in mitigating climate change and their significant impact on promoting green entrepreneurship practices, they continue to face a slew of challenges that prevent them from reaching their full potential.

These difficulties are deeply rooted in systemic barriers, such as limited access to financial resources, gender biases within the entrepreneurial ecosystem, and the complexities of juggling professional responsibilities and traditional caregiving roles.

Women have historically been underrepresented in the areas that are often seen to be most crucial for climate solutions, which may exacerbate already-existing gender disparities. The industries with the highest climate capital attraction

ratios also have the lowest percentage of female business executives. For instance, the energy industry garnered more than half of the \$632 billion in average annual climate investment (including public and private sources) in 2019 and 2020 (*Climate Policy Initiative, 2022*). Women make up just 7% of startup founders in this sector (*IEA, 2022*).¹⁶ Only a small percentage of global venture capital funding goes to sectors like food, agriculture, and land use—where women may have comparative advantages—receiving \$11 billion in 2021, compared to \$16 billion for energy and over \$50 billion for transportation (*PwC, 2022*).

Figure 1. % Women in leadership is estimated using high-frequency data from LinkedIn for 155 countries to examine women’s representation in business in 2022 (Source: (World Economic Forum, 2022).

Climate innovations may need investors to make sizable upfront capital expenditures and extend their payback times, which may make it more challenging to draw in venture capital and other forms of funding (*World Bank, 2014*). A single renewable energy project may require billions of dollars in upfront funding, and breakthrough technologies—also referred to as “deep tech”—need intricate development procedures

and specific revenue models in order to scale successfully (*So, 2021*). In venture capital and standard bank loan lines (*Montoya et al., 2020; Brock & de Haas, 2022*), female founders typically have to contend with greater interest rates and smaller ticket sizes than their male counterparts. There is a dearth of technical support with a climate focus, such as helping small firms access climate financing and providing gender-inclusive technical assistance (*ANDE, 2022*).

Many women struggle to strike a balance between their personal and professional lives because they frequently juggle many roles, including those of lovers, caretakers, professionals, and occasionally the main administrators of domestic tasks. Because corporate structures and social expectations frequently fail to provide sufficient support for flexible work schedules, parental leave, or child care options that meet these needs, striking this balance can be particularly difficult. Trying to balance the demands of both worlds can cause stress, fatigue, and guilt in women, which can negatively affect their mental health and general wellbeing. These difficulties may also prevent people from advancing in their careers since taking time off for family

obligations or working fewer hours may be interpreted as a lack of dedication to their professions. (*Niang et al. 2019*).

In nations with strong social norms, women are subject to a greater number of social rules than men. Due to these standards, women entrepreneurs face particular challenges when trying to scale up their businesses. These challenges include: a lack of working capital and finance (money); administrative and regulatory requirements; a lack of management training or skills; marketing; technology; limited mobility; low risk-taking ability and lack of confidence (MarketLine); and sociocultural barriers (Macro environment) (*Bharthvajan 2014*). Gender inequality is well ingrained in the society as a result of these conventions.

SOLUTIONS TO OVERCOME TH CHALLENGES

In order to effectively bring their ideas to market, women entrepreneurs heading early-stage climate tech startups with significant growth potential and a focus on delivering large-scale climate impact need access to resources including incubators, accelerators, seed finance, and patient capital. The following kinds of funding options could be advantageous for these leaders in climate technology:

Financial assistance

Assistance from seed funds, incubators, and accelerators to help women-led businesses in their early stages develop and get ready for later-stage investment. (*IFC, 2023*)

Venture capital and private equity funding to hasten the deployment, scalability, and commercial feasibility of women-owned

and led climate solutions for wider industry- or commercial-level acceptance. (IFC, 2023)

Cutting-edge climate finance tools, such as green or blue finance, transition finance, sustainable finance, and sustainability-linked finance, are available through development finance institutions or financial intermediaries and are used to invest in climate technologies with a focus on women- owned or led businesses. (IFC, 2023)

Growth capital from banks, governments, and other providers to pay for large-scale technology deployment, especially to assist women-led businesses and infrastructure owners who no longer need new technology but instead require ongoing funding for low-carbon technologies that are already in place. (IFC, 2023)

ADDRESSING

THE GENDER DISPARITY

Increasing engagement – An atmosphere that encourages more female climate entrepreneurs who are prepared to embrace cutting-edge green-tech solutions must be established. More women should hold senior positions in corporations, banks, and venture capital firms that can help female climate entrepreneurs. (pwc analysis)

Knowledge development and technology integration

Women require knowledge-building sessions and workshops in order to engage with their communities and potentially develop and scale up businesses. The ongoing and systemic disparity in education levels and social status has harmed women's confidence in expanding their businesses. Technology integration, combined with targeted training, can help

bridge this gap. (pwc analysis)

Combining access and affordability policies with education initiatives can improve digital literacy. Addressing conscious and unconscious biases and stereotypes can help increase women's participation in digital environments. To increase digital trust among women and girls and maximize their opportunities in the digital era, it may be necessary to support such policies with cyber security initiatives. (pwc analysis)

Upskilling and proper mentorship

Women entrepreneurs in India can benefit significantly from acquiring essential business and management skills through mentorship programs led by successful and experienced professionals. These initiatives not only provide women with the knowledge and expertise required to navigate the complexities of running a business, but they also foster an environment of innovation and creativity within their companies. Mentoring makes it easier for women entrepreneurs to be connected to different people that will provide valuable information and bolster their confidence in matters to be undertaken. This in turn enables them to expand and sustain their businesses for economic growth and development thus enhancing chances of success. (PWC analysis)

DISCUSSION

The case studies and data showed the importance of women led businesses in addressing climate change through transformative, innovative and sustainable business practices. Women entrepreneurs are essential actors in the green economy, as they contribute unique perspectives,

knowledge and challenges faced with resilience. This presentation will summarize the results from the case studies, discuss implications for climate action more broadly and underline some of the structural barriers women entrepreneurs face in this domain.

The success stories of Billion Carbon Solutions, Trinano Technologies and TechXEarthSpace indicate that women owned businesses are well poised to drive sustainable innovations, having identified some of the most pertinent environmental issues concerning food waste management, inefficient use of solar energy, and CO₂ collection and harnessed technology to deliver scalable solutions. Women leaders in the form of Ankita Vijayvergiya, Dr. Anshu Dandia and Ms. Swati K J provide testimony to the fact that women entrepreneurs not only have the ability to recognize critical environmental problems but also to develop and commercialize innovative solutions in line with global climate goals.

The success of these businesses highlights an important intersection of gender and sustainability, that is, the potential for women's roles in natural resource management¹⁴ and in community-based solutions² to translate into effective climate action.¹⁶ For example, Billion Carbon Solutions'¹⁰ approach to transforming food waste into biofertilizer aligns with the principles of the circular economy and sustainable agriculture, both of which have long involved a predominately female workforce. Similarly, Trinano Technologies'¹³ nanocoating technology improves renewable energy efficiency — an

essential aspect of sustainable development —and TechXEarthSpace's¹² CO₂ capture and its associated geo-energy work aligns with global objectives for greenhouse gas emissions reduction.

Research has consistently shown that when women are involved in environmental decision-making, we develop more sustainable and inclusive climate policy. (*Oliver Wyman, 2020*) Women's unique awareness of community needs, as well as our tendency to adopt more environmentally friendly practices, can help make climate mitigation more successful. The firms featured here show that when women have access to resources and opportunities, we can catalyse transformative advances in climate resilience and adaptation.

However, the study stresses that if women are to realise their full potential as climate leaders they need tailored support to help them overcome sex-specific barriers. Women entrepreneurs in the green economy also have the potential to contribute significantly to achieving the Sustainable Development Goals (SDGs), particularly those related to gender equality (SDG 5), climate action (SDG 13), and sustainable economic growth (SDG 8). Thus, policies that enhance women's access to finance, technology, and markets are not only good for gender equality, they are equally important in terms of overall environmental and economic sustainability in the long term.

Women entrepreneurs in the climate sector face severe limitations that hinder their ability to contribute to climate action. Limited financial access, persistent gender biases, and the challenging trade-off

between professional and caregiving roles are all major barriers. Inequities in venture capital and traditional banking systems often favor businesses led by men, resulting in lower investment in women-led enterprises and higher interest rates (Montoya et al., 2020).

This funding deficiency hinders the ability of these nations to grow and progress in climate technology. Moreover, female representation in the energy industry remains low, which is true for the founders of startups as well who amount to only 7% (IEA, 2022). This constrains the type and quality of climate solutions. These challenges are further compounded by societal demands or culture regarding caring for the elderly as class females such as Ankita Vijayvergiya experience while dealing with both entrepreneurship and family responsibilities.

To empower women entrepreneurs in climate action, it is critical to address structural barriers through targeted measures: introduce gender palm funding, flexible financial tools especially in fields such as sustainable farming and clean energy; strengthen networks/ support systems through female link-ups and educative resources, close to climate technology incubators; ensure gender sensitive policies such as paternity/maternity leave and flexible working hours.

LIMITATION

This particular paper was largely based on prior existing research work i.e secondary data. Interaction with woman entrepreneur in the climate sector would provide valuable insights about the real-time problems that women entrepreneur face.

Also this will allow in better understanding of the motivation behind the initiative and various challenges faced throughout the entrepreneurial journey.

CONCLUSION

The review paper provided number of case studies to assess the role of female entrepreneurs prevalent in the climate & green-entrepreneurship related sectors. Star-ups and businesses lead by women can play a major role in combatting the challenges posed by the rapid climate change. Women in business are often subjected to gender biases, limited access to the capital, social expectations on their role as a caregiver at homes. These obstacles often limit the ability of female entrepreneur to scale ideas and work on their full potentials in order to contribute to climate actions.

It is necessary to eliminate these obstacles in order to increase the influence of women in the sectors related to climate control and successfully capitalize on the contributions of female entrepreneurs. It is important to develop gender sensitive funding models, developing reinforced networks with mentors, augmenting women entrepreneur with technology such as artificial intelligence to empower them and promoting support environment in the workspace can help in mitigating the obstacles women face in their entrepreneurial journey.

By addressing the above mentioned issue, we can create a more equitable and innovative climate economy. Providing support to female entrepreneurs not only recognizes their individual contributions but also broadens the scope of solutions necessary to mobilize the climate

challenge. A collaborative effort to address these barriers would catalyse movement toward a more sustainable and inclusive future for everyone we want all voices and capabilities to be heard and harnessed in the global climate solution.

REFERENCES

- Battisti, D. S., & Naylor, R. L. (2009). Historical warnings of future food insecurity with unprecedented seasonal heat. *Science*, 323(5911), 240–244. <https://doi.org/10.1126/science.1164363>
- Weisheimer, A., & Palmer, T. (2005). Changing frequency of occurrence of extreme seasonal temperatures under global warming. *Geophysical Research Letters*, 32(20).
- Doss, C., & Meinzen-Dick, R. (2018). Women's land tenure security: A conceptual framework. Seattle, WA: Research Consortium.
- Meinzen-Dick, R. S., Brown, L. R., Feldstein, H. S., & Quisumbing, A. R. (1997). Gender, property rights, and natural resources. *World Development*, 25(8), 1303–1315. [https://doi.org/10.1016/S0305-750X\(97\)00027-2](https://doi.org/10.1016/S0305-750X(97)00027-2)
- Ministry of Information and Broadcasting (India). (n.d.). National Action Plan on Climate Change (NAPCC).
- Ministry of New and Renewable Energy (India). (2024, January 29). Tri-nano technology (solar panel). <https://mnre.gov.in/tri-nano-technology-solar-panel/>
- UN Women. (2023, June 5). Seven Asian women-led climate tech startups making a positive environmental impact. <https://www.unwomen.org>
- UN Women. (2023, April 21). Why climate change matters for women. UN Women Data Hub. <https://data.unwomen.org/features/why-climate-change-matters-women>
- UNFCCC Secretariat. (2022). Dimensions and examples of the gender-differentiated impacts of climate change, the role of women as agents of change and opportunities for women. New York: UNFCCC. https://unfccc.int/sites/default/files/resource/sbi2022_07.pdf
- World Bank. (2023, May). What works in supporting women-led businesses? [Video]. World Bank. <https://www.worldbank.org>
- World Economic Forum. (2022). Global Gender Gap Report 2022: Insight report. Geneva: World Economic Forum. https://www3.weforum.org/docs/WEF_GGGR_2022.pdf
- Women Entrepreneurs Finance Initiative (We-Fi). (2022). The case for investing in women entrepreneurs. Washington D.C.: Women Entrepreneurs Finance Initiative. <https://we-fi.org/wp-content/uploads/2022/06/We-Fi-Case-for-Investment.pdf>
- Rainard, M., Smith, C. J., & Pachauri, S. (2022). Gender equality and climate change mitigation: Are women a secret weapon? *Energy Research & Social Science*, 89, 102515.

- <https://doi.org/10.1016/j.erss.2022.102515>
- Sinha, V. (2019). We can solve climate change – if we involve women. *World Economic Forum*. <https://www.weforum.org>
 - 6BRIDGE. (2011). Gender and climate change overview report. Institute of Development Studies.
 - Montoya, A. M., Parrado, E., Solís, A., & Undurraga, R. (2022). Bad taste – gender discrimination in the consumer credit market. *Journal of Financial Studies*, 15(4), 105–120.
 - Brock, J. M., & De Haas, R. (2022). Gender discrimination in small business lending: Evidence from a lab-in-the-field experiment in Turkey. *Small Business Economics*, 58(2), 743–765. <https://doi.org/10.1007/s11187-021-00490-1>
 - UN Women. (2023, June 28). Why South Asian women have a key role in tackling the climate crisis. *World Economic Forum*. <https://www.weforum.org>
 - World Health Organization. (2018). Climate change and health. <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>
 - Time’s running out: Is India ready to handle 34,600 tonnes of solar waste by 2030? (n.d.). *Environmental Journal*. <https://www.environmentaljournal.in/solar-waste>
 - Global status of recycling waste solar panels: A review. (n.d.). *Journal of Energy and Waste Management*, 23(1), 56–73.
 - Exploring opportunities for women entrepreneurs driving climate solutions. (2023). IFC. <https://www.ifc.org>
 - Pioneering Indian start-up develops food waste solutions to combat climate change. (2024, July 8). *Indian Start-Up Review*. <https://www.indianstartups.in>
 - Women’s economic empowerment: Women’s enterprises in a changing climate: Barriers and opportunities. (n.d.). *UN Women Report*. <https://www.unwomen.org>
 - World Economic Forum. (2022). Global Gender Gap Report 2022. Geneva: World Economic Forum. https://www3.weforum.org/docs/WEF_GGGR_2022.pdf
 - <https://www.zaubacorp.com>
<https://www.billioncarbon.com>
<https://mnre.gov.in/tri-nano-technology-solar-panel>
<https://www.techxearthspace.com>
 - UNFCCC Secretariat. (2022). Dimensions and examples of the gender-differentiated impacts of climate change, the role of women as agents of change and opportunities for women. New York: UNFCCC. https://unfccc.int/sites/default/files/resource/sbi2022_07.pdf