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GENDER AND INNOVATION: IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT

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Abstract
This paper explores the intersection of gender and innovation, with the importance of integrating a gender-responsive approach within innovation systems to promote inclusive and sustainable development. This study employs a qualitative narrative literature review using sources from Google Scholar, Scopus, Web of Science and international organisations. This paper argues that integrating gender-responsive innovation policies and fostering inclusive research methodologies can help achieve the Sustainable Development Goals (SDGs) better especially in developing countries. This paper provides a road map for future research agendas by providing recommendations for scholars, policymakers and practitioners who seek to bridge the nexus between gender, innovation and sustainability.

Keywords
Gender, equality, innovation, awareness, opportunity.

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1. Introduction

Innovation has gained popularity in business, governmental and scientific discourses as a key component of economic growth and solving global problems like poverty, environmental stress, financial crises and diseases. According to several studies (Lundvall, 1992; Malerba, 2002; Verspagen, 2005; Alsos *et al*., 2013), innovation is a key driver of economic growth in sectors, countries and regions. It is also crucial for firms to sustain and regain a competitive edge over time. New combinations of production components, such as the creation of new goods or services, the introduction of new production methods, the opening of new markets to new sources of intermediates and raw materials and the restructuring of an industry, are still frequently used to characterise innovation. The breadth and viewpoints of current studies on innovation are vast and include local, regional or national innovation systems of businesses, institutions and governmental bodies, as well as innovation processes within firms (Fagerberg, 2005). Besides this, social innovations in the public sector have garnered increasing attention in recent years (Alsos *et al*., 2013).

Innovation-related gender issues are rarely discussed. Innovation research lacks studies of where innovation occurs and in particular, who participates in innovation (Fagerberg *et al*., 2005). Beyond simply recognising and talking about gender disparities, a gender-responsive strategy ensures that men's and women's voices are heard and that gender norms, roles and relations are considered when new products and services are being developed (Jamuna, 2023). At the same time, advocates for gender equality and gender scientists have stressed the necessity of more inclusive and advanced innovation networks, procedures and regulations (Schiebinger, 2008). But there are still some

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obstacles to overcome; one is figuring out how to use science, technology and innovation to enhance women's roles in development through research and invention. There has been an ongoing conversation, however, one that has been gender-blind for decades over the role of technological and scientific advances in progress. Organisations on a global scale only began to recognise gender equality as a pressing concern and the financial costs of a nation's untapped scientific potential at the turn of the millennium (Benería *et al*., 2015).

Improving gender equality and constructing sustainable routes are both pressing issues. The prevailing development paths have shown to be both gender inequitable and unsustainable from multiple and diverse points of view, including labour and manufacturing, demographic and reproduction, food and agriculture and water, sanitation and energy. Gender inequality and the market-focused, neoliberal growth patterns that cause and exacerbate economic, social and environmental unsustainability are interconnected. Environmental pressures related to climate change, biodiversity loss and pollution are a result of the disturbing intersections of gender inequality and unsustainability; consequently, shocks have the potential to erode gendered rights and capacities even further.

On the other hand, there is a possibility that sustainability and gender equality can work in tandem, strengthening one another along different routes (UN Women, 2016). This study explores how gender and innovation are inseparable and looks at how gender roles and inequalities affect who innovates. By bringing together evidence from several studies and field cases, it shows how innovation can be made more inclusive and tackle key development problems and the Sustainable Development Goals (SDGs).

2. Methodology

This study discusses the interlinkage between gender and innovation and sustainable development through a qualitative review of literature. In this study, we have reviewed peer-reviewed journals, policy briefs and institutional reports published between 2000 and 2024 with alignment of the theme of the study such as gender and innovation, gender responsive policies, sustainable development and the role of women in science and technology. Sources are primarily acquired from the scholarly platforms like Google Scholar, Scopus and Web of Science, but also from credible global institutions such as the United Nations, UNESCO, UN Women and the International Council for Science. Thematic coding and content analysis techniques have been used in this study to identify key patterns, contradictions and emerging trends in the literature. The study enables us to delve deep into the complex, multidimensional nature of gender in innovation and affords nuanced framings toward developing inclusive and sustainable innovation strategies.

3. Innovation

The importance of innovation in driving economic growth and fostering prosperity in nations and regions is increasingly being recognised (Lundvall, 1992; Verspagen, 2005). According to Malerba (2002), innovation is vital for advancing technology in various industries and sectors.

It is also believed to be the deciding factor for individual organisations seeking to reinvent their business model to sustain competitive advantage over time, especially in ever-changing markets. Since all entrepreneurial endeavours necessitate new ideas and

approaches, innovation plays a pivotal role in the literature on entrepreneurship (Shane, 2003).

A new way of doing things, a different set of procedures, a different set of marketplaces, other sources of inputs and outputs or even a complete overhaul of an entire industry can all be considered an innovation (Schumpeter, 1934). Many studies on innovation have focused on how it works inside companies, how it works in systems, including many companies, institutions and governments, how it changes over time and what happens as a result of creative thinking (Fagerberg, 2005). Various aspects of innovation have been the subject of research, including its inputs and outputs (Smith, 2005), its procedure (Garud *et al*., 2013) and its discursive and policy-oriented aspects (Doloreux & Parto, 2005).

However, the case studies of advanced economies have formed the basis of most works on innovation and economic growth. Nonetheless, there's been a recent uptick in curiosity about how developing nations may reap the benefits of innovation and entrepreneurship (Si *et al*., 2021). Varieties and levels of innovation can occur across the three traditional phases of development: factor-driven, efficiency-driven and innovation-driven. This is connected to various conceptions that recognise entrepreneurs as important players in the economy (Bozhikin *et al*., 2019); business in a developing nation can vary from privately held firms to those owned by states, from small and medium-sized enterprises run by individuals to the informal sector and even by subsidiaries of international corporations (Welter *et al*., 2015).

4. Innovation from a gender lens

Several academic disciplines, including feminist science and technology studies, political science, history of science, business economics and human geography, have promoted gender as a pertinent factor in connection to innovation (Lindberg & Schiffbaenker, 2013). Beyond just recognising and talking about the gender gap, a gender-responsive innovation strategy considers gender norms, roles and relations, as well as women's and men's perspectives and experiences, when developing new solutions (HIP, 2022).

There has been a noticeable difference in the treatment of gender in studies of innovation and entrepreneurship, even though the two fields are intimately related. The gendered nature of entrepreneurship has been shown in a growing body of research on the topic (Minniti, 2009). Since relatively straightforward comparisons of male and female entrepreneurs have long predominated, this study area has expanded to include gender as a lens through which to examine entrepreneurialism. Because of this, we can shift our focus from analysing individual differences to investigating how gender is inherent to context, meaning and experience (Ahl & Nelson, 2010).

This is why scholars in management and entrepreneurship have only begun after the turn of the millennium to take an interest in the idea of gender and innovation. It seems like people are not obvious when they innovate, which could explain why there has not been much research looking at innovation from a gender viewpoint. In contrast, there have been more studies looking at entrepreneurship and gender. Entrepreneurship study focuses on entrepreneurs, whereas innovation research largely ignores innovators and their contributions (Berglund *et al*., 2012). The call for more diverse and inclusive innovation strategies, networks and practices has given rise to a new area of study: gender and innovation. Politicians and scientists in Europe and beyond are devoting more and more time and energy to studying and addressing innovation, since an increasingly

dynamic and knowledge-based economy is the result of innovations (Lindberg & Schiffbaenker, 2013).

While studies examining the relationship between gender and innovation are few, those that exist have had a significant impact on related fields of study. This shows that innovation research is multi-disciplinary (Fagerberg, 2005). Therefore, to lay the groundwork for future research and development in this field, a comprehensive review and synthesis of existing literature on gender and creativity has been done (Alsos *et al*., 2013; TM & Joseph, 2021). There has been no mention of gender in the innovation conversation for a long time and a serious discussion on gender has only emerged in the last ten years. If we wish to comprehend and support innovation as a development engine, we must do so from a gender perspective. In many areas of the economy, women drive technological innovation, although their methods may vary greatly from men's. For technological advancement to address women's and men's unique issues, it is crucial to consider the widely varying gender trends in numerous fields (Goldey *et al*., 1997). Surprisingly, there is a lack of research on gender and innovation in the entrepreneurship literature, given that innovation is a central topic in this field (Landström *et al*., 2012). New research on gender and innovation, however, ought to build on previous work on gender views on entrepreneurship. Innovation and gender are central to the many themes explored here. Despite the breadth of coverage, certain subjects receive more attention than others. There are several gender-related aspects to consider when considering innovation and its impact on university scientists. These include how gender plays a role in patenting, commercialisation, academic entrepreneurship and relationships between universities and industries. Other areas where gender plays a role include social and public sector innovation and innovations adopted differently by men and women. There appears to be a shortage of studies on gender and creativity in entrepreneurial settings and private sector companies outside of the diversity literature. Innovation policies, processes and support programs have also received little attention from researchers who have taken a gendered viewpoint (Alsos *et al*., 2013).

Greenhalgh et al. (2005) note that studies on gender and innovation exhibit great diversity in terms of the theoretical frameworks and research methodologies considered. Research utilising quantitative approaches, such as surveys and/or registration data and focusing on research and innovation has been the most prominent in economics. A similar predicament exists in the literature concerning the impact of gender diversity on innovation. Qualitative methods - especially case studies - are heavily utilised in the literature when it comes to innovation policy, organisational and public sector innovation. The field of social science studies in Europe has been more impacted by feminist and gender studies; for example, one approach has been to dismantle ideas (Lykke, 2010). When we look back at the beginnings of studies on gender and entrepreneurship, we see that they were criticised for several reasons, including an overemphasis on case studies, an absence of quantitative methodologies, oversimplified approaches to data analysis and the use of gendered terms and measurements (Brush, 1992; Dolinsky *et al*., 1994).

Education, scientific careers, publications, wage gaps and work-life balance are some areas where sex-disaggregated indicators have made significant strides and where there are still gaps in providing relevant and reliable data for several nations and regions. With the rise of gender equity-focused institutional programs and efforts, the long-standing conventions and practices that stand in the way of systemic change have become more apparent (Abreu, 2020). The advancement of gender equality and women's empowerment could be propelled by technological innovation, which also shows

tremendous promise in addressing humanitarian and development issues. Despite these advantages, there is a significant danger that technological innovations can cause harm to the people who are supposed to be using them and therefore, reducing this danger is essential. Furthermore, there are a variety of obstacles that lead to the creation and maintenance of disparities in gender in innovation and technology and women and men do not necessarily reap the same benefits from these areas. Innovations that don not take gender into account will not help the people who need them the most, which means the market will miss out on opportunities and the world economy will lose. Moreover, it could worsen things for people already vulnerable to gender inequality (HIP, 2022).

Empirical studies on gender and innovation typically take a two-pronged approach: one that treats gender as a variable and another that treats innovation as a consequence. Studies of innovation in companies owned by men and women and research on gender disparities in university settings regarding patenting, commercialisation, etc., all reflect this viewpoint. Statistical comparisons of men's and women's propensities to innovate are common in this work (Alsos *et al*., 2013). Though gender is not a significant predictive variable with regards to industry membership, other factors such as the existence of government or private research grants are significant (Bozeman & Gaughan, 2007). This implies that the connections between gender and innovation in the workplace might be more complex than has been previously understood (Alsos *et al*., 2013). One might explore the impact of each policy on men and women by taking a "gender as variable" perspective in the area of innovation research. Viner et al. (2004), for example, concluded that research awards are disproportionately received by women. This might be attributed to the sexism that exists within research on innovation and innovation policies. Nählinder et al. (2012), Kvidal and Ljunggren (2014), Charlesworth et al. (2019), DeTienne and Chandler (2007) and others who study the impact on men and women regarding research results in the area of innovation might do so since these studies are attracted to those industries and subjects that are traditionally represented by women.

The feminist literature's conceptual development of gender forms the basis for the three gender views offered here (Lykke, 2010). Based on this new information, scholars who study gender in the context of innovation, entrepreneurship and other fields argue that we need to stop analysing gender in isolation and start investigating how gender permeates all of these areas (Carter & Shaw, 2006). Research that shifts its focus from "gender as a variable" to "the process of doing gender", rather than merely employing gender as an explanatory variable, is called for (Achtenhagen & Tillmar, 2013). Examining gender in connection to innovation has benefited from new viewpoints that disentangle gender from specific individuals and instead perceive it as a product of processes, organisations, discourses and policies. Most studies on inventions, innovation processes and innovation systems have obscured the role of actors (Berglund *et al*., 2012). Therefore, these viewpoints are essential for illuminating the gendered nature of innovation (Alsos *et al*., 2013). Changing and transforming the relationship between gender and innovation can be studied by adopting a process view on gender (Foss & Henry, 2016). As our gendered view of innovation's results shifts, we can look at it from a broader viewpoint and eventually, acknowledge that innovations in service and social innovation are valid forms of innovation. An underlying power structure associated with the gendering of innovation, in which masculine discourses predominate, may be to blame when these changes are slow (Alsos *et al*., 2013). Researching the gender gap in innovation participation, comparing men and women regarding how much sway each has in innovation discourses and tallying the number of women and men contributing to

innovation processes are all important questions (DeTienne & Chandler, 2007). The integration of gender perspectives with innovation strategy can be greatly beneficial; these initiatives need to be carried out with greater understanding and insight about gender dynamics and processes. Gender perspectives need to be analyzed with due consideration to the context and structural considerations with regard to gender inequality in the area of innovation (Alsos *et al*., 2013). Innovation and entrepreneurship are predominantly addressed with strategies that overlook the challenges that micro and small businesses run by women face within the informal sector. Supportive measures such as mentorship and learning opportunities can make women businesses gain greater market share and financial resources that will enable them to be more actively involved with innovation sectors. The greater inclusion of women in higher management is critical to women-inclusive innovation. This can be made possible with greater empowerment of women in management and intellectual property (Abreu, 2020).

5. Gendered innovations & SDGs

A long process led to the adoption of the 2030 Agenda for Sustainable Development in September 2015, which included 169 related targets and 17 Sustainable Development Goals (SDGs). The agenda aimed to achieve universal, integrated and transformative sustainability. Numerous targeted programs and studies have been developed to assist nations in reaching the objectives by 2030 (Elder *et al*., 2016). Participants at the Gender Summit[2] also paid close attention to how sex-gender sensitive research would play a role in achieving the Sustainable Development Goals (SDGs) when the UN was about to ratify them a month later. If only SDG5 and its nine aims to achieve more gender equality and empower women are considered, then it seems that less than 10% of all targets acknowledge the unique needs of women and girls, despite the promise that the 17 SDGs are more gender-aware than the Millennium Development Goals. However, the International Council for Science found, when they looked at the SDGs from a scientific perspective; that seventy-eight of the goals were primarily concerned with "gender" and/or "women" (Lee & Pollitzer, 2016). New ideas in government, economics, science and technology that shake up "business as usual" are being acknowledged to speed up the attainment of the SDGs for everyone (Nguyen *et al*., 2022).

There has been a lot of talk about how science and technology can help solve problems related to sustainable development. Many people have pledged to work together in the academic, scientific and technological communities, particularly in developing nations, to help bridge the global technology gap, improve communication between scientists and policymakers and develop international research collaborations focused on sustainable development.

Social innovations, such as e-learning platforms that bring classrooms to individuals or mobile banking initiatives that empower women entrepreneurs, can effectively disrupt established norms and expand people's knowledge, skills and possibilities. This is especially the case for women who are already at a disadvantage because of their age, race, socioeconomic situation, handicap, place of origin or migration status (UN Women, 2009). However, it is also becoming more obvious that people can

[2]The Gender Summit 6 Asia Pacific (GS6AP) took place in Seoul, South Korea, from August 26-28, 2015. The summit concluded with the adoption of the Seoul Declaration, which emphasized the importance of integrating gender perspectives into scientific research and innovation to achieve more effective and sustainable outcomes.

ignore or reject technological advancements, that they might bring about unanticipated complications and that not everyone benefits equally from them. New technology poses risks of bias and opportunities for abuse, posing new human rights concerns for the 21st century, while women are underrepresented in essential innovation sectors like STEM (UN Women, 2009). According to the UNESCO Report Cracking the Code (United Nations, 2020), the gender gap in STEM fields is not caused by intrinsic ability but by socialisation factors such as career development, entrepreneurial culture and stereotypes. Accordingly, a rapid comprehensive strategy is necessary to solve the gender gap in STI (Science, Technology and Innovation). Partnerships are crucial in achieving this and ensuring that tomorrow's digital society is equal. Given the dynamic nature of modern society and the intricate nature of power dynamics, it will require the concerted efforts of many different groups to bring about meaningful change.

6. The way forward - recommendations for policymakers in developing countries

The process requires collaboration between the government, higher education institutions, the corporate world and civil society in developing countries in terms of encouraging innovation - the way forward (Van Tulder, 2018). But it is essential that all stakeholders are thoroughly aware of gender inclusion needs (Van Tulder, 2018). Let us always keep in mind that women have requirements in civil society and can supply new perspectives to problem-solving (Biesecker & Hofmeister, 2010). In developing countries, with regard to innovation policies other than research carried out in higher learning institutions, other stages need to be taken into consideration with the aim of understanding that knowledge is usually produced during the stages of problem definition and solving. It must inspire everyone involved to see the need of gender equality and take action based on this realisation (Baga *et al*., 2022).

To make gender capable of participation in innovation, developing countries need to do more than talk; they need to produce real plans that fit their own local needs and limitations. Some practical suggestions for improving gender equality in innovation are offered in this chapter. First, there ought to be the formation of special task forces comprising representatives from different sectors like business, science, women's affairs and education to plan and monitor balanced innovation strategies. Secondly, legislation that governs research projects and funding should include objectives for gender balance, e.g., providing funds for women-led enterprises and ensuring that there are men and women in research groups. Schools also need to update their textbooks and prepare teachers to encourage girls to study science and technology at an early age. Women researchers and women entrepreneurs must be given mentorship, training and business consultancy at local hubs or centers, especially in rural areas. Furthermore, there needs to be greater representation of women in decision-making positions where policies of innovation are formulated and this can be done by training them and giving them greater opportunities to participate. Such ideas are designed to meet the needs of countries of the Global South, where gender inequality and weak systems of innovation usually go hand in hand. Having more women on board not only makes innovation more equitable but also smarter and more efficient. Filling the innovation gender gap isn't just the nice thing to do, but it is at the heart of helping countries to grow in a way that is fair, inclusive and sustainable.

7. Conclusion

Most research on innovation focuses on processes, goods or organisations rather than individuals, meaning gender in innovation is mostly unexplored. Innovation is a very gendered field, according to the existing research focusing on gender in innovation (Alsos *et al*., 2013). One way to lessen gender inequality is to combat gender stereotypes and work toward gender parity in technological access. Greater social and economic progress can be achieved when women are given equal opportunities to reap the benefits of innovation. A gender-responsive strategy is helpful to ensure that technology and innovation are used sustainably.

Promoting sustainable development can be achieved by giving women a voice in managing natural resources, as they are frequently the main consumers. Technological advancements and new ideas can make the world more sustainable (Jamuna, 2023). Many undervalued but viable alternatives exist for achieving sustainability and gender parity. Feminist ideas and practices are present in many places, including rural and urban areas, cooperatives and movements led by women, the scholarly works of feminists and international organisations and bureaucracies. We must identify these trailblazers and carve out a place for their ideas and actions in policy and theory. The rationale of "homo economicus" and the current patterns of production and consumption that promote structural inequality and unsustainability are both challenged by these ideas. They provide options that could lead to environmentally friendly changes that are fair to women and other marginalised groups (UN Women, 2016).

In light of this, the event will examine current trends and international initiatives to close the gender gap and will talk about the various obstacles that prevent women from taking part in STI just as much as men. The panellists will share their diverse experiences and viewpoints on different issues, including educational content and orientation, promoting cultures that support women's empowerment and creating enabling workplace environments, among others, that could trigger the necessary transformative changes. Inviting all participants, regardless of gender, to share stories of success and failure about STI for SDGs and ideas and suggestions for achieving gender equality (United Nations, 2020) is a noble call. In the policy domain, raising awareness is paramount. Firms and governments should make the most of available resources if they truly believe that innovation is a key driver of competitive advantage. But they must be aware that they are not harnessing the full potential of their human resources when women are excluded from the processes of innovation. When this happens as a result of unintended and unconscious gendered dynamics, countries and companies must do what is required to enable women to make such contributions (Alsos *et al*., 2013). Technology has great potential to bridge barriers between the sexes. But for this to happen, technology must be designed with parity between the sexes in mind. Technological progress must be genuinely inclusive through adopting a gender-responsive approach.

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