

## Article

# Women in Environmental Sciences (WiES) and The UN SDGs: A Catalyst for Achieving a Sustainable Future for All

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**Abstract:** Women can serve as catalysts needed to achieve the United Nation's Sustainable Development agenda by 2030. The Women in Environmental Sciences network engaged women from culturally and professionally diverse backgrounds at two workshops held in the UK in 2018 and 2019. The interdisciplinary environmental sciences' meeting included presentations by leading women in academic and non-academic organizations. Through breakout sessions, effective interaction, and discussions between professionals and grassroots, an atmosphere of "leaving no one behind" was created. Participants' ages ranged from 18 to 55 years and more than 65% of the participants were under 35 years old, representing the productive working group. The mixed group of young and the old, academic and non-academic women provided a basis for insightful and lively discussions needed to bridge the gap between information disseminated to professionals and non-professionals, to students, and early career researchers. In this article, the following information are presented: Relevant literature in view of gender equality and environmental aspects, summary of the talks and discussions, how the talks aligned with the sustainable development goals (SDGs) and sub-targets, issues identified and avenues for change, evaluation and some quotations from the participants. The article showcases the opportunity for the implementation of SDGs in all organizations through the promotion of integrated discussions on environmental science aspects, gender, equality, diversity, inclusion, partnerships needed to inform effective policy changes at local, national, or global levels. This article provides insights to professionals/non-professionals, governmental, non-governmental organizations, higher education institutions, and local communities and women. By providing a summary of the talks and their alignment with SDGs, the Women in Environmental Sciences provide new ways of engagement required at these times to develop applied and strategic research, and open a dimension of how the SDGs can be implemented to cope with changing environmental conditions.

**Keywords:** women; environment; environmental sciences; equality; sustainable development goals (SDGs)

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## 1. Introduction

The United Nation's 2030 Agenda for Sustainable Development aims to alleviate the poverty in humans and of the planet. In order to address these goals, many action plans have been developed and delivered with concrete evidence from the global, regional, and national circles. However, what the sustainable development goals (SDGs) (see Figure 1) really mean from the grass root, local perspectives are not clearly understood in view of their implications, especially for women and children. Out of the 17 SDGs only eight have specific relevance to women's lives and only Goal 5 directly addresses issues of gender equality. The relevant SDGs are: 1 No Poverty; 3 Good Health and Well-being; 4 Quality Education; 6 Clean Water and Sanitation; 7 Affordable and Clean Energy; 8 Decent Work and Economic Growth; Goal 16 Peace, Justice, and Strong Institutions.



**Figure 1.** The United Nations' guide on the sustainable development goals (SDGs) 1 to 17.

In 2018, the UN Women reported that they lacked sufficient evidence from different parts of the world in order to decipher how women will respond to changes in the environment and climate change [1]. It also aimed to consider the role of women in other aspects of the SDGs, including Goal 5 which can only be effective if there is sufficient evidence. Presently, SDGs 1, 2, 4, and 6 have been considered in view of women in some parts of the world [1–3]. As at 2019, women in all parts of the world continue to face structural disadvantages and discrimination [3] in spite of environmental degradation, developed national policies, and activities taking place globally. In order to develop effective policies that are inclusive and all encompassing, more evidence and better use of data are needed in view of other aspects of the SDGs, if implementation is to be effective in subsequent years [3]. To foster development, academic researchers in higher educational institutions (HEIs) through the Global Universities Network for Innovation [4] share ideas and initiatives from around the world to provide support for HEIs towards implementing sustainable development across their functions and missions.

### 1.1. Gender Equality and Employment

The global unemployment rate stood at about 200 million people in 2016 and is set to increase. Among women, unemployment remains pervasive and this undermines the ambition to create decent work and sustainable routes out of poverty [5]. For example, as of 2019, the United Nations reports that no laws were in place to mandate equal pay for work of equal value [3]. Fifty percent of the world's working age women (15 or over) are in the labor force compared to over 75% of working age men. The World Bank reported that inequality within countries is higher today than it was 27 years ago and women earn 24% less than men globally [1,2]. The latest available data for 62 countries show that men's median hourly pay was 12% higher than women's, and for managerial and professional occupations, as well as craft and related trade work, plant machine operators, and assemblers, the gap was 20% [3]. From all indication, gender pay gaps are rooted in rigid social norms and cultural expectations about women's roles in society.

In most countries, women tend to bear the brunt of austerity measures [6], (<https://www.theguardian.com/world/2017/mar/09/women-bearing-86-of-austerity-burden-labour-research-reveals>) especially when it comes to welfare and public services. They are more likely to rely on public services and social protection to meet their basic needs and that means when public services such as health, childcare, water, and sanitation are cut back or become less affordable, it is usually women who fill the ensuing gap, spending more time on unpaid care and domestic work [7] with further lack of autonomy in decision-making [3]. Furthermore, because women are more likely to be employed by the public sector, they are particularly affected by staff and wage cuts in this sector. If there are budget cuts, women and girls are most at a disadvantage. The Women

Budget Group warned that Black and Asian single mothers in the United Kingdom (UK) stood to lose 15–17% of their net income as a result of planned freezes and cuts to in-work and out of work benefits. In order to foster gender equality in employment, recruitment firms and organizations need to make clear their inclusive policies, so that potential employees and women can know if the work environment is suitable for them. Also, a balanced recruitment drive in organizations should promote career progression among women while considering challenges to caring responsibilities [8]. Through these considerations, the inequality agenda of SDG 10 (reduced inequalities) can be explored for accountability and commitment for sustained development.

### 1.2. Gender Equality in Industry

Industrial and economic growth in any organization or nation can be enhanced if it is inclusive of diverse groups including women. Diversity has been shown to benefit innovation [9] and has a positive effect on career advancement [10].

In Europe, the UK has the lowest percentage of female engineers, with only 11% of the engineering workforce being females and 5% of registered female engineers and technicians (<https://www.wes.org.uk/content/wesstatistics> Accessed, 14 March 2020). According to the report, there is only one female apprentice in the construction industry in England to 56% of males as at the fourth quarter of 2016, and women represent only 12.8% of the construction workforce (<https://www.theguardian.com/uk-news/2016/mar/14/apprenticeship-system-gender-inequality-workplace-women>, Accessed 14 March 2020). These reduced numbers are linked to the risks of working in industry, e.g., risk of injury; some equipment are still designed with the menfolk in mind and women are at a higher risk of being injured in the field (Guardian newspaper Monday 8th October 2018). By using the construction industry as an example, other challenges identified include the pay gap, most especially for women of color. Women of color earn 81% less for every dollar paid to white men and lack mentorship. The overall lack of strong female role models in this industry discourages women from advancing in the field (See <https://theundercoverrecruiter.com/construction-needs-more-women/>). The application of SDG 8 can help build resilient infrastructure, promote sustainable industrialization, and foster innovation. Furthermore, by encouragement/motivation of women to take on roles in industry, sustained, inclusive, and sustainable economic growth, productive employment, and decent work for all can be envisaged.

### 1.3. Gender Equality in Leadership

Available evidence shows that an average of 24% of women are in political leadership globally—a 5% increase from 2010. Although women comprised 39% of the workforce in 2018, only 27% of these figures are in managerial positions. With gross underrepresentation in political leadership, women are limited in their contributions to decision making processes especially in matters of health, freshwater, food, violence, or reproductive rights [3]. While the role of female leadership in positions of authority was addressed by the UN Women, based on available data in some parts of the world [1,3,11], there are still gaps in women leadership. This is especially prominent in households and families where decisions of reproductive health, freedom from all forms of violence, allocation of resources are common. In many nations, gender discrimination is still woven through legal and social norms (<https://www.oecd.org/dev/discriminatory-laws-and-social-norms-still-hamper-gender-equality-says-oecd-development-centre-sigi-2019.htm> Accessed 17 June 2020) and all of these impact on the civic society [3] (<https://www.civicus.org/index.php/media-resources/news/blog/3931-why-we-need-more-women-leaders-in-civil-society-worldwide> Accessed 7th July 2020).

It is worth noting that, in spite of the challenges in female leadership, there have been celebrated women pioneers in the environment including Rachel Carson from the United States, who authored the book *Silent Spring*, where she challenged the world on the dangers of hazardous chemicals to the environment. There was Waagari Maathai who championed environmental conservation and women's rights through the Green Belt Movement in Kenya. Hindou Oumarou Ibrahim who

advocated for the cause of women in Chad, West Africa. Through the project, Association of Peul Women and Autochthonous Peoples of Chad (AFPAT), Hindou Ibrahim enabled the world to recognize the challenges to the rights of indigenous people during the crafting of the global climate change for a variety of outlets. The current chair of the United Kingdom's non-departmental public body. The Environment Agency, is a woman, Emma Howard Boyd, and she has the responsibility to oversee the UK's environment, wildlife, and communities. In recent times, there is also the Swedish environmental activist, Greta Thurnberg, who has gained international recognition for promoting the view that humanity is facing an existential crisis arising from climate change. While these few women have been mentioned, a Google search on the 15th of June 2020 showed diverse groups of women who have contributed to environmental advocacy and climate discussions (<https://www.globalcitizen.org/en/content/female-activists-saving-planet/>; <https://yourstory.com/herstory/2019/09/women-activists-climate-change>; <https://sfenvironment.org/zh/celebrating-women-environmentalists-during-womens-history-month>; <https://www.amightygirl.com/blog?p=11863>; <https://theecologist.org/2019/mar/08/25-female-climate-leaders-shaping-2019>). Even more so are the uncelebrated women who, within their families, have contributed to environmental protection as carers, energy managers, pollution controllers, waste managers [12], and in local communities, in different organizations and spheres. Thus, in order to open up opportunities for female mentorship, women should seek to help each other rather than see themselves as competitors [13]. Also, women's voices can be heard through collective action from community organizing in civil society [11]. Therefore, female leadership and inclusive decision making required for a sustainable future for women and girls can be promoted through open understanding of the current issues.

#### 1.4. Staying Power of Women

There have been reports that women are less assertive than men in the professional space. However, Park et al. [14] showed women were warmer but not less assertive. Women are shown to be willing to adapt, tolerate uncomfortable working conditions, and could leave the organization entirely when confronted with harassment. More than half of the women polled in the UK public service union (UNISON) have experienced some form of sexual harassment [15]. The staying power [16] of an individual woman can help change and inform policies that will benefit other women in the near future. For example, out of 19,285 professors in the UK, only 35 of them are black female professors according to a report in the financial times (<https://www.ft.com/content/7e2a2976-5eef-11ea-8033-fa40a0d65a98> Accessed 17th June 2020) published in March 2020 and at the UK tabloid, The Guardian <https://www.theguardian.com/education/2020/feb/27/fewer-than-1-of-uk-university-professors-are-black-figures-show> February 2020. These women would have faced a "culture of explicit and passive bullying which persists across higher education, along with racial stereotyping and racial micro-aggressions" [17]. Ref. [17]'s advice to future generations was to seek to minimize exposure to racism and learn to be strategic about which battles to take on. Furthermore, future generations should be open to whom might provide them with advice and not be solely directed by ethnicity, be prepared to move to different institutions, take up new roles across the UK in order to progress.

#### 1.5. Gender Equality in Education and Academic Research

Women make up more than two-thirds of the world's 796 million illiterate people according to [3]. Thirty-nine percent of rural girls attend secondary school and this is far fewer than rural boys (45%), urban girls (59%), and urban boys (60%) (<https://www.unwomen.org/en/news/in-focus/commission-on-the-status-of-women-2012/facts-and-figures>). Strategies to reduce the numbers of illiterate people have been explored through open and distance education in most parts of the world including African Council for Distance Education (<https://acde-afric.org/>) and Open University (OU) in the UK. These institutions have, as part of their objectives, ensured the need to promote open and distance learning, flexible and continuing education to all globally. The UK Higher Education Institutions(HEI) have explored ways of providing HE to students from low income backgrounds and from deprived

communities. For example, the OU UK reports that 25% of their undergraduate students live in the most deprived areas and 74% of their directly-registered students work full or part-time during their studies and, 60% of the undergraduate students were female ([open.ac.uk](http://open.ac.uk)). Access to HEI is also provided through various widening access programs such as the Manchester Distance Access Scheme (MDAS) (<http://www.access.manchester.ac.uk/manchester-distance-access-scheme/>). In 2019, the MDAS registered 29% females and 71% male students for the Science, Technology Engineering and Mathematics (STEM) subjects including mechanical and aerospace engineering, chemistry, electrical and electronics engineering, Earth and environmental sciences, and material sciences. In 2020, percentage of registered female students increased to 48% as the male students was reduced to 52% (communication with the University of Manchester, MDAS).

For academic research, available data obtained for 2016 showed that women in science accounted for less than 30% of the world's researchers [18]. These figures were distributed across the continents as follows: Central Asia had the highest record of 48%, Sub-Saharan Africa 32% (in particular, Tunisia), and south and west Asia (in particular, Myanmar) had 19%. In Europe, the highest recorded percentage of female researchers were found in North Macedonia with 52%, the UK had 39%, and the lowest record of female researchers were found in the Netherlands with 26% [18]. Although more precise data is required to produce informed reasons for these distributions including the challenges, drivers, and barriers to women in STEM, the STEM and Gender Advancement (SAGA) project aims to produce a framework with precise data that can be used to shape women's careers in STEM fields, integrate new instruments at all levels including national or regional (<http://uis.unesco.org/sites/default/files/documents/fs51-women-in-science-2018-en.pdf>). A strategy proposed by [19] suggests that female researchers need to discuss approaches that work well with them and their stakeholders.

The Women in Environmental Sciences (WiES) network brings women with diverse experiences, ethnicities, and disciplines into one place in order to promote inclusiveness, widen participation, and foster interesting discussion. It aims to support and inspire women to engage with their environment and to appreciate the multidisciplinary approach of environmental sciences needed to carry out research with impact and to influence change in communities. Through the meeting, WiES aims to merge grass roots with professionals to create multidimensional discussion between disciplines and around sustainability. The WiES network enables interaction and networking opportunities between health practitioners, social scientists, engineers, researchers, policy makers and, those who work in non-governmental organizations (NGOs); encourages and inspires a new generation of women to become environmental science advocates, activists, and practitioners.

The network, which aligns with the United Nations' sustainable development goals (UN SDGs), was established in 2018 and is hosted by the Manchester Environmental Research Institute, UK. Through the talks presented in 2018 and 2019, break-out sessions, and interactions, we imagined possible scenarios through implementation of the SDGs from women's roles in academia, non-academic environments, and interaction with members of the community and NGOs. The meeting revealed the prospect of collaboration, knowledge sharing, good practices, and exposed how each field of research linked to other aspects and to the SDGs. The events created the avenue through discussions to explore how diverse resources (human and non-human) could be distributed equitably, equally, and fairly, such that we all become prosperous and where such thoughts could be held. Through a gradual progression to 2030, this article provides information concerning the discussions, key outcomes held by the WiES, and provides an avenue to help us re-think our scholarships, engagement at the national, local, and community-based scenarios, and to view challenges/opportunities from different perspectives. While acknowledging the resources and knowledge in academia, there is also a wealth of unlimited resources beyond the four walls of academia, which gives us an opportunity for inclusiveness all round this new thinking.

## 2. Women in Environmental Sciences (WiES)

The Women in Environmental Sciences' forum was held in 2018 and 2019 at The University of Manchester, UK. The events, which hosted more than 130 participants, brought people together from across different disciplines and from all over the UK (see Figure 2). It started with a welcome introduction, guest talks, breakout sessions, network and exhibition sessions, and synopsis. The guest presenters and facilitators were invited from within and outside academia to give talks ranging from core and Earth sciences, to engineering, social sciences, and medicine. These interdisciplinary talks accommodated women from culturally and professionally diverse backgrounds while being united on the theme, environmental sciences, and sustainable development goals. Participants' ages ranged from less than 18 to 55 years old and comprised people from diverse ethnic groups. Quotations provided by the participants who agree and consent to use of their contents have been provided in the report. Through our workshop presentations and knowledge-exchange sessions held in 2018 and 2019 we explored themes that were linked to the following sustainable development goals (SDGs): 1 (No Poverty—NP); 2 (Zero Hunger—ZH); 3 (Good Health and Well-being—GH); 4 (Quality Education—QE); 5 (Gender Equality—GE); 6 (Clean Water and Sanitation—CW); 7 (Affordable and Clean Energy—CE); 8 (Decent Work and Economic Growth—DW); 10 (Reduce Inequalities—RI); 11 (Sustainable Cities and Communities—SC); and 13 (Climate Action—CA). By relating environmental themes with the SDGs, we provided a means at which people can understand how the poor, the vulnerable, and women are affected by environmental challenges, how they can be empowered in order to sustainably use and protect available natural resources. A summary of the WiES talks and key outcomes from the knowledge-exchange sessions are presented as follows.



**Figure 2.** Some participants at the 2019 WiES workshop Photo: Andy Tomsa ©2019.

### 2.1. Talks

#### 2.1.1. Gender Equality and Urban Green Infrastructures

In this talk, the presenter identified the inequalities between different socio-economic groups in view of urban green infrastructures. The benefits of green spaces to human health outweighed the disadvantages and this was supported by Kabisch in chapter 5 of Marselle et al. [20] which revealed the health effects of green space as an adaptation to different socio-economic and socio-demographic population groups. The presentation also showed that vulnerable groups of people, including the aged who live in less green areas with lower numbers of trees, are mostly impacted by the reduced quality of life. For example, we learnt that the health and lifespan of the aged in diverse communities could be linked to the natural green spaces available to them. By addressing the problem of urban green spaces, we recognize the challenge of natural green space and its impact on health, in particular, for the aged. The UK Office of the National Statistics showed that females have a longer

life expectancy (<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/nationallifetablesunitedkingdom/2015to2017>) than their male counterparts and this implied that aged women live longer than their men. Therefore, an awareness of natural green space, health, and age-related functions that affect all human beings including the aged, can inform the spaces allocated to them. Partnership with urban planners, developers, health organizations, and environmental regulators can help to provide informed decisions that can reduce inequalities between groups, improve life span, and improve good health and well-being for all.

By highlighting the impact of urban green infrastructure on health, living conditions of vulnerable groups, on women, the impact of climate change on urban communities, including the aged, the talk opened up a link between various SDGs. For example, available urban green infrastructure for all was proposed to inform good quality human and environmental health (SDG3), reducing inequalities (SDG10). Furthermore, the concept of sustainable cities and communities and the role of climate change in the talks helped to inform the strategies of SDGs 11 and 13, respectively.

Therefore, this shared understanding could help researchers to inform policies that can reduce inequalities between groups including gender and socio-economic groups.

### 2.1.2. Gender Equality and Available Energy Resources

In this talk, the presenter shared some information about mixed-energy economy including clean, renewable energy and the potential prospects for women. It stated that during the mid-20th century, the energy revolution in western countries had a direct impact on women's careers. In the 21st century, a global revolution is taking place but women's responsibilities and energy use in the home still differ from men's. Globally, more than 80% of the world's energy resources are still sourced from fossil fuels. In marginalized, low income developing economies, women's use of energy for domestic activities varies from the men. For example, the collection of firewood for cooking, the use of kerosene for cooking stoves, the actual cooking, and the exposure of women to heat are all factors that influence women and restricts their plan to access other opportunities including education, training, and more chance for developing their careers, and reducing other risks, e.g., health [12]. Therefore, a continuous supply of reliable, affordable, and clean energy supply is fundamental to women's development. According to the presenter:

*"Clean energy still requires geo-technical and sub-surface engineers. There is a critical need for female scientists and engineers. In the coming decades, female technical leadership, and parity of pay and progression with men is essential if we are to manage the energy transition needed to address the most important global challenge of the Earth."* Cathy

The United Nations, through the SDG 7, aims to ensure access to affordable, reliable, sustainable, and modern energy for all by 2030. However, the application of this goal can deliver effectively if the policies surrounding its application are explored from the gender perspective (Goal 5) [21].

### 2.1.3. Gender Equality as a Catalyst for Achieving a Sustainable Future

In this talk, the presenter highlighted the fact that women have a voice and a choice concerning their lives, careers, and prospects. For this reason, children need to be taught that they can choose to study whatever field of study that is of interest to them irrespective of their gender. She stated that the term "career woman" used on professional women should not be accepted as the norm. Women have a right to family, a choice of their careers, and can make decisions as to when they choose to have their families, what they choose to study at higher education, and when they choose to do so. These decisions should not be decided by the community, employers, or career levels, but as women we should learn to accept ourselves for being women and to live lives according to our choices. This talk resonated with most of the participants who contributed energetically.

The talk also addressed other aspects, for example, environmental challenges affect vulnerable groups, women and children inclusive. Therefore, achievement of the SDGs is not only an important

goal for equity and equality, but also a catalyst for achieving a sustainable future for all. In order to effectively do so, women need to be empowered in all spheres of public roles at the regional, national, and local levels. Through involvement in political mobilization, women can play their roles in policy implementation and ensure that natural resources and how they affect women and children are protected. At a local level, more women can be involved in discussions through involvement in community groups, partnerships, and knowledge-exchange sessions such as provided through WiES. With examples, the presenter showed that the challenges confronting women in the environment, workplaces, and communities are either not acknowledged in ways that could bring about change, but were linked to ineffective leadership that is insufficient to impact such needed change. Furthermore, some ideas held by academics were confined to the higher educational institutions. The presenter stated that meetings such as the WiES create an enabling environment and open people up to different types of discussions. It also provides a platform to listen and to identify aspects necessary for further investigation and academic research.

A final aspect of this talk was the emphasis placed on the role of followership in leadership. We learnt that an effective community can benefit when both followers and leaders know their roles and effectively function in them. Therefore, as followers, we can learn effectively by engaging the role, knowing what it takes to become leaders, and developing the skills required to effectively lead and support people. Both bottom-up and top-down leadership in the environment sectors will communicate and enhance growth, development, and prospect. Some quotes from the presenter:

*"We need the passion to work at the environmental sector and the rewards are enormous. We meet new people who will save the environment. Let us inspire women to want careers in Environmental Sciences, a career which, despite its challenges, I have found incredibly rewarding, a career which allows women to really make a difference, a career in which as women, we can be pioneers in the many, new areas of work which will be needed in order for us to truly address the 'climate emergency' and the many environmental challenges we have, locally, nationally and globally."* Tayo

#### 2.1.4. Gender Equality and Policy-Relevant Academic Research

In this talk, the presenter shared information on how women can be more involved and engaged in academic research, especially where they wished to impact policy. For a start, it was pointed out that women were more likely to be engaged in caring responsibilities at home and may not follow-up on their research during those caring periods. However, while identifying the overall implication of this period in the life of the female researcher and the need to publish, the presenter shared some thoughts as follows: It is important for researchers interested in making a change to their environment, to ensure that the research is relevant to policy. Policy-relevant research could involve interaction with a lot of users. That is why a starting point of engagement is for the researcher to contact their friends and other networks with similar interests, and to get the support of their line managers. While policy-relevant research could demand time and energy, it is rewarding. Effective engagement stems from understanding the context of the research questions. This includes proactive engagement mechanisms including stakeholder interviews, industry and policy workshops, written and oral communication. To do this effectively, it is necessary to network with others who can contribute effectively to parts that may be different from our own research areas but, support the objective. Interdisciplinary research and impact is still male-dominated in some research institutes, with a few exceptions. Collaboration and integration will enhance research and could be applied to a wider range of people and communities. In order to foster impactful research and engagement with local communities, women need support and encouragement from their organizations in order to engage the public at local, national, or global levels. The need to have these research support structures shows that policy-relevant interdisciplinary research required to inform change and impact is not carried out in isolation but, requires genuine and effective support, especially for the female academic researcher. Some quotes from the presenter:

*"Interdisciplinary research continues to be viewed by some as less academic, because it tends to conduct activities that are broad and cross-cutting, rather than deep and disciplinary. Traditional academic journals have been set up with editors and reviewers who focus on deep and narrow areas. Academia has a tendency to be 'snobby' about work that is fit for non-academic audiences, yet policy-relevant research must bridge the academic-policy divide, and should not be the prerogative of the social sciences. And the more women we have playing their roles in shaping policy through science and engineering, the more policies will reflect the true diversity of society."* Alice

#### 2.1.5. Gender Equality in Community Development

In this talk, the presenter demonstrated the importance of academic engagement with members of some rural agricultural communities in southern Africa affected by natural disaster. To achieve this purpose effectively, the researchers identified a need to be inclusive in their engagements. They did so by bringing other practitioners and members of the local communities into the research so that the process of re-building relationships and communities is inclusive and sustainable for the long term. The concept of rebuilding socio-ecological relationships using agricultural communities helped the farmers to support each other. For example, following the sale of agricultural produce, some women were financially empowered to pay their children's school fees and to send the children to school. This implied that children within these communities, including the girls, are educated. Since each farmer was able to produce food on their lands, the level of hunger following the disaster was reduced, as each community shared their farm produce with others. Women and children are the most vulnerable to climate change and environmental disasters. Therefore, by working towards promoting community networks, good farming practices, knowledge exchange, and interaction between researchers and local farmers, a sustainable community is enhanced and promoted. With reference to an article written by the presenter [22], they showed that farmers were exposed to more plural ways of thinking and by acting together with academic researchers and other practitioners, positive and substantial social-ecological change results. Some quotes from the presenter:

*"By rebuilding relationships between researchers and farmers, trust and respect was built within the communities. There was a change in how people interacted after the hurricane, and the idea that one's wealth is increased by their neighbors' wealth which further promoted equal welfare for all. There was also a recorded sense of communal identity and an increase in tolerance towards one another. The concept of collectiveness, understanding the landscape and the people are needed in order to work synchronously. The women in the community supported each other, they could conveniently feed their children and pay their children's school fees."* George

Through inclusive engagement, the farming community and the researchers worked together to reduce the impact of climate change on the farmlands, helped the families out of poverty and hunger, and the women were financially empowered to educate their children in schools. These outcomes support diverse SDGs including SDG 1 which aims to eradicate poverty and SDG 2 for eliminating hunger, and by achieving SDGs 1 and 2, communities are sustained, thereby achieving SDG 11. Also, by acknowledging climate change and adaptation (SDG 13) of new farming techniques in water-stressed regions such as the case presented, farming communities can reduce the impact of poverty, hunger, diseases (SDG 3), and loss of lives.

#### 2.2. Knowledge-Exchange Sessions

##### 2.2.1. Gender Equality and Water Availability

The shared knowledge concerning the impact of too much or too little water on people during the workshop showed that most of the participants connected more with water quality rather than its quantity. While this outcome could be linked to the workshop attendees who mostly lived in the UK, it also showed accessibility and availability in most UK homes. Too much, as seen during floods,

have led to losses of homes and infrastructure in the UK, and this challenge mostly affected the poor and vulnerable groups within local communities. All participants, however, agreed that an increase in human population will impact on water quantity and quality. Private individuals/interested members of the local community, researchers, and businesses can get involved in catchment partnership groups in order to protect and manage waterbodies. Lack of sufficient, good quality water could initiate behavioral change and raise awareness of other environmental health and social issues. For some communities, rivers serve as social places for women, e.g., women wash together at the streams, obtain water. In the global north, these rivers could serve as meeting places for social groups, e.g., organized walking groups. The take home message from the session was that increased education and awareness is needed by all concerning how to use our water efficiently, how our activities negatively affect water quality, and to think of new ways whereby communities which lacked sufficient water could adapt their lifestyles to changing conditions.

#### 2.2.2. Gender, Health, and Climate Change

In this breakout session, the discussion centered around environmental changes, society, culture, and health: awareness, communication, and control. The participants felt that it was important to recognize and to acknowledge that women and children are the most vulnerable to climate change effects for the following reasons: They can be more susceptible to diseases, especially younger children and pregnant women; women frequently take the burden of providing food, water, and care for the family, therefore, challenges caused by climate change with corresponding impact on food and water availability can exacerbate other negative effects on health. The group recognized the challenges of the poor/vulnerable in our communities. For example, while environmental issues may not be the priority of the poor, by addressing their immediate need, i.e., providing food for children and families, environmental awareness can then be introduced. Other examples shared include turning wasteland into allotments. Through this method, communities can be encouraged, and this exercise will provide food for the local community. Another aspect considered was to promote inclusivity in communication; the use of language is important if diverse groups are to be involved in effective partnerships and sustainability. We can understand that the issue of climate change is bigger, more complex, and requires a contribution of both grassroots initiatives that can have an impact now, in the communities where they occur. Some quotes from the facilitator

*"The use of language is important especially during awareness creation and communication. Scientists/academics can talk down to community groups, even inadvertently and while trying to help. It is important to consider the language used and, do not lecture/inform (as the distant expert), but, work with people as equal partners. The subject expert may know the theory, but the community know how this truly impacts their lives."* Ann

By creating awareness of the impact of climate change on the health of women and children, aspects of SDG 3 (health and well-being) were explored. Inclusive and integrated communication encouraging participation between communities and researchers can reduce inequality in our communities. The concept of reduced inequalities meets the requirements of SDG 10 which aims to promote inclusive participation. These are some of the key instruments necessary for promoting environmental health, healthy lifestyles, community action, and well-being needed for a sustainable future.

#### 2.2.3. Education, Citizen Science, and Inclusiveness

In this breakout session, the participants learnt more about citizen science, which is also called volunteer monitoring/community science, crowd science, or civic science. By showing examples of public participation in scientific research from an international organization, the facilitator showed that a bottom-up participatory approach is necessary if science is to be made accessible to diverse groups and to empower communities. While the discussion also highlighted the strained relationship

between members of communities, researchers, and policy makers, the take-home message was that citizen science and other participatory research can be used to educate, promote research necessary to effectively protect and sustainably manage our environment. The role of women in this session was not wholly considered. However, the knowledge exchanged was new and interesting to the participants. By exploring citizen science, education, and the prospect of inclusive research, the group addressed aspects of SDG 4 for quality education. By exploring the possibility of integrated research and community science, this objective therefore addresses aspects of SDG 11.

### 3. Overview Table of Links of Identified Aspects to Sustainable Development Goals (SDGs)

Tables 1 and 2 provide contents on the themes discussed during the WiES workshops, their relationships with SDGs, sub-targets, key outcomes, and the institution/role of contributors. The relevant SDGs are 1 (No Poverty—NP); 2 (Zero Hunger—ZH); 3 (Good Health and Well-being—GH); 4 (Quality Education—QE); 5 (Gender Equality—GE); 6 (Clean Water and Sanitation—CWS); 7 (Affordable and Clean Energy—CE); 8 (Decent Work and Economic Growth—DW); 10 (Reduced Inequalities—RI); 11 (Sustainable Cities and Communities—SC), and 13 (Climate Action—CA).

**Table 1.** The themes of the Women in Environmental Sciences (WiES) workshops, relationship with SDGs, sub-targets, key outcomes, and the institution/role of contributor.

S/No	Title	SDGs	Sub-Targets of SDGs	Key Outcomes	Role of Presenter/Facilitator
1	Passion, Challenge and Rewards: The pros and cons of working as a Female Environmental Scientist, Leader and Follower, on local, national, and global issues.	4, 5, 8 4 = QE 5 = GE 8 = DW	4.4–4.5, 5.1, 5.4–5.5, 5.a, c, 8.8	Be truly passionate about the environment to work as an environmental scientist; Be inclusive—involve your communities; friends, family are equally important—work is not everything; make your own choices	Environmental Consultant and Director/NGO, Policy organization
2	Environmental changes, society, culture, and health: Awareness, communication, and control	3, 4 3 = GH 4 = QE	3.4, 3.7, 3.9, 4.1	Increase environmental awareness/promote effective communication to diverse groups in ways that are inclusive; children are a good way to educate families and to raise awareness of environmental issues	Air Quality Specialist, Higher Education Institution
3	Rebuilding social-ecological relationships through farming systems	1, 2, 3, 13 1 = NP 2 = ZH 3 = GH 13 = CA	1.5, 2.3, 2.4, 3.d, 13.1, 13.b	Environmental challenges and adaptation: Socio-ecological interactions are rooted in local cultures, identities, tradition, innovation, and knowledge. Rebuilding relationships between researchers and communities e.g., farmers can help to build trust and respect	Early Career Researcher, Higher Education Institution Agroecologist, NGO
4	Conducting policy-relevant, interdisciplinary research on climate change: A personal reflection on delivering impact.	4, 5, 13 4 = QE 5 = GE 13 = CA	4.3, 4.5–4.7, 5.5, 5.c, 13.2–13.3	Policy-relevant research has positive implications for society; for academics interested in this type of research need the support from line management; a priority when for early career researchers is to reach out to people, find partners to work with on projects.	Climate Science and Energy Policy Specialist; Higher Education Institution
5	Citizen Science: On the brink of an open science revolution	4 4 = QE	4.6, 4.7	Citizen science can contribute to the democratization of science. Bottom-up participatory approach is necessary in order to make science more accessible to diverse groups and to empower underrepresented groups/local communities	Learning Manager, International NGO

**Table 2.** The themes of the WiES workshops, relationship with SDGs, sub-targets, key outcomes, and the institution/role of contributor.

S/No	Title	SDGs	Sub-Targets of SDGs	Key Outcomes	Role of Presenter/Facilitator
6	How can job roles in the construction industry be more appealing for women? What support do women need to transition into industries?	5, 8, 10 5 = GE 8 = DW 10 = RI	5.5, 8.8, 10.2, 10.3	Open and effective staff recruitment can foster engagement and interest in industry; promote women representatives and presence at careers fairs	Early Career Researcher, Higher Education Institution
7	Integration of science, society, and sustainability: Too much or too little of water: How can we integrate knowledge within and between communities to minimize the impact of floods/droughts on women and children? What can we do?	3, 6, 10 3 = GH 6 = CW 10 = RI	3.9.3, 6.2–6.5, 10.3	Insufficient, good quality water can initiate behavioral change; can raise awareness of other environmental health and social issues; promote water quality use on campus through control measures and by the introduction of water management award to hostels and buildings	Specialist in Ecological Economics, Higher Education Institution
8	Hydrocarbon exploration and production: Challenges and prospects for women as we move into a mixed-energy economy	4, 5, 7 4 = QE 5 = GE 7 = CE	4.3, 4.5, 4.a, 7.1–7.3	Women need to help other women to move up the professional ladder; diversity and inclusion are important for any organizations' health and progress; people's ability to adapt and modify their lifestyles and behaviors is vital for changing energy economy	Petrophysics and Petroleum Geology Specialist, Higher Education Institution
9	Urban green infrastructure and its links with human health and wellbeing	11, 13 11 = SC 13 = CA	11.1, 11.3, 11.7, 11.a, 13.2, 13.3	Urban green spaces, infrastructure, and human health are interrelated. Green spaces are beneficial even to all including an ageing population. The voices and contribution of members within local communities including women are necessary during the planning and development and creation of urban green spaces.	Specialist in urban green infrastructure/GIS Higher Education Institution

#### 4. Sub-Targets, Issues Identified, and Avenues for Change

Tables 3 and 4 provide SDG sub-targets, identified issues from WiES workshops, and some recommendations for issues identified. The relevant SDGs are 1 (No Poverty—NP); 2 (Zero Hunger—ZH); 3 (Good Health and Well-being—GH); 4 (Quality Education—QE); 5 (Gender Equality—GE); 6 (Clean Water and Sanitation—CWS); 7 (Affordable and Clean Energy—CE); 8 (Decent Work and Economic Growth—DW); 10 (Reduced Inequalities—RI); 11 (Sustainable Cities and Communities—SC), and 13 (Climate Action—CA).

**Table 3.** Relevant SDG sub-targets identified from the WiES workshops, issues identified, and recommendations.

SDG Sub-Targets	Issues Identified	Recommendations
4, 5, 8 4 = QE 5 = GE 8 = DW	To develop key skills for leadership positions more female mentors are needed; conceived notions that boys are better than girls still persist in some places; most women have caring responsibilities which could delay upward career movement; many women are not found in senior leadership positions nor are their voices heard in decision-making processes; women who speak in public places or board meetings could be seen as too assertive, therefore poses a challenge to speak where necessary; most organizations still have closed-door policies towards the role of women.	Identify and develop relevant skills required in the environmental job sector of choice; from home, children should be taught that there is no discrimination between boys and girls; women have a voice and a choice in their decisions; women need to support and encourage each other positively; they are encouraged to participate in community or organizations' events and not to be intimidated; they should present their findings as professionally as possible, even in board meetings; women should also aspire to take on leadership roles when available; they can influence their communities and policies from the bottom. Followership is as important as top-down leadership; by getting involved or volunteering for tasks, women can help strengthen policies and enforce legislation; diversity and inclusion are important for any organizations' health and progress; although women of color face additional challenges, they are encouraged to identify other people who have experienced similar challenges, identify how the issues were managed and remain focused; when looking for other jobs, seek to check recruitment and employers' policies on equality, diversity and inclusion before sending in job applications; women should have a passion for what they do and they will be successful in their roles. Organizations can influence change by having an open door policy towards the role of women and this should be seen as the norm.
3, 4 3 = GH 4 = QE	Women and children are more vulnerable to changing environmental conditions, e.g., excessive exposure to high temperature can lead to premature death. The priority of the poor are basic, immediate needs, e.g., food not environmental/health education. Poor communication to locales by scientists. Low numbers of girls in STEM courses, e.g., higher education.	Environmental education/awareness is necessary for the protection of environmental resources. Diverse groups of people will benefit from sound research when communicated with the right language. Effective advertisement of public engagement activities will encourage more participation from local communities. Explore diverse ways of engaging people, e.g., arts, music, encourage open discussion. Promote effective and inclusive education and research. Integration of people across social, political, and academic divides can produce positive impact needed to foster adaptation in environmentally challenged communities. Promote and strengthen public engagement and participation.

**Table 3.** Cont.

SDG Sub-Targets	Issues Identified	Recommendations
1, 2, 3, 13 1 = NP 2 = ZH 3 = GH 13 = CA	<p>During extreme conditions, e.g., climate change, natural disasters, the poor and the vulnerable are at a higher risk. Subsistence farmers in rural areas especially in developing countries, suffer losses including farmlands, and homes. Therefore, there is increased poverty, hunger, disease, and lack of support. Women work very hard on farmlands to support their families including paying the fees of their children in schools. Extreme poverty could imply the children receive no education including the girl-child. Rural locations in the global south could be excluded from information concerning early warning signs of natural disasters.</p>	<p>Encourage social-ecological rebuilding of communities by promoting effective engagement between academic researchers, local communities and local scientists; develop adaptation strategies for coping with droughts and flooding through applied research; seek to understand the communities, the people, and culture; local knowledge can be very important and effectual in academic research; ensure that the women are included as part of the strategic plan for rebuilding communities. Long-term socio-ecological research is highly valuable as it allows long-term relationships to be built.</p>
4, 5, 13 4 = QE 5 = GE 13 = CA	<p>The numbers of female students registered for STEM courses in higher education institutions are still lower compared to the male counterparts; women in academia publish less research articles and those with caring responsibilities have less time to identify new networks. Policy-relevant research is interdisciplinary in nature and time-consuming. The structures for encouraging more female publishers is still being researched.</p>	<p>Through programs such as the Manchester Distance Access Scheme, science public engagement outreaches/activities, women and girls interested in STEM courses are encouraged. We can, through recruitment opportunities, community collaboration, mentorship, engage more women in research and policy discussions. Women in academia can progress their research by networking with other researchers with similar interests either within or outside their institutions; Inspirational leaders and female mentors could open up new opportunities to motivate young women and girls; policy-makers are keen to hear from researchers; interdisciplinary research is interesting, but it involves patience, team work and perseverance.</p>
4, 5 4 = QE 5 = GE	<p>The role of citizen science in academic research is growing. Some traditional core scientists have difficulty in communicating with non-scientists</p>	<p>Universities should reward staff who engage with diverse communities and should enable communities to partner with scientists to research environmental issues that are relevant to them.</p>

**Table 4.** Relevant SDG sub-targets problems and recommendations.

5, 8, 10 5 = GE 8 = DW 10 = RI	<p>The rights of women to work in safe and secure environment is still a major challenge in most industries, e.g., construction. This also impacts on the number of female leaders in those institutions. As most tasks are still recognized as for men, some personal protective equipment are still designed for them. Most women in the industry still work in precarious conditions and face other challenges related to their health and well-being.</p>	<p>Women need to be more confident to apply for positions of their choices. In these types of male-dominated sectors, challenges to women could be addressed in the following ways: Deal with the problem in a professional way, align with other women within the organization for support, or contact colleagues working in other professional organizations; complain anonymously.</p>
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**Table 4.** Cont.

3, 6, 10 3 = GH 6 = CW 10 = RI	<p>Too much water (floods) or less (drought) are global challenges. People understand the role of water based on how they are affected personally; there is still a disconnection between the water managers and users in some places; most countries affected by drought or floods suffer scarcity, loss of infrastructure, challenges to agriculture, human health and economic constraints. These challenges influence children's education in some parts of the world. Effective adaptation to flood risks and droughts are major aspects for academic researchers.</p>	<p>Increasing flood and drought conditions affect all people. Therefore, scientists need to engage local communities to develop effective adaptation strategies e.g., through involvement in local catchment partnerships, support water research and community development. Awareness of water protection and security is still needed in most places; promote public engagement; Water managers, regulators, and local communities need to work together to protect their water environment.</p>
4, 5, 7 4 = QE 5 = GE 7 = CE	<p>Equal access for women in the energy industry is still low, but improving; women need other female mentors as role models; there are still gender disparities among the students studying for STEM courses in higher educational institutions; in most developing countries, mixed-energy economy is a prospect for the future; however, affordable, reliable, and modern energy needed for domestic use is still a challenge.</p>	<p>Encourage more women to study a course of their choices including STEM. This would create a chance to develop leaders who will later mentor younger colleagues. The prospect of a zero carbon challenge, other unforeseen environmental problems can be effectively managed when people from diverse disciplines work together, including women; engage in research that explores clean energy and its affordability for all including developing economies.</p>
11, 13 11 = SC 13 = CA	<p>Urban green spaces are not readily and safely accessible to all. The poor, vulnerable, and the aged suffer more in terms of adequate, safe, and affordable housing; safe, urban green spaces are mostly available to the economically empowered individuals. Women live longer than men, therefore the spaces available to the aged woman could either limit/promote her well-being. There is a still a gap between urban green spaces and the link with economic, social, and environmental aspects</p>	<p>Green spaces are beneficial even for an ageing population; urban green spaces can promote longevity, good health, and well-being for all including the vulnerable, aged, and the infirm; integrated research which accommodates humanities, science, and policy is effectual for developmental changes in our communities.</p>

## 5. Evaluation

### 5.1. Demography

Table 5 shows the age-groups and ethnicities of participants at the two WiES events organized in 2018 and 2019. Between the two events, participants' which dominated age ranged from 26–35 with a 9.3% decrease in 2019. There were small differences in the age groups 18–25 and 36–45 while the age group 46–55 increased by 12.6% in 2019. A majority of these participants were students, academics, professionals from academic and non-academic organizations. They represented the physically strong and productive groups. The British British/other white ethnic group were present in large numbers with a 13% increase in 2019; the Asian British increased by 3%. For the Black/Black British group, there was an 11% reduction in 2019, and there was no difference between the period for the Hispanics. Some reports have shown that minority groups were less represented at conferences ([https://www.nature.com/articles/d41586-019-03688-w?utm\\_source=fbk\\_nnc&utm\\_medium=social&utm\\_campaign=naturenews&sf225257037](https://www.nature.com/articles/d41586-019-03688-w?utm_source=fbk_nnc&utm_medium=social&utm_campaign=naturenews&sf225257037)) We aim to encourage these groups through effective advertisement and to continue to provide a friendly and enabling atmosphere for all.

**Table 5.** Demography of participants in terms of age groups and ethnicities between 2019 and 2018. N = number of participants.

Age Groups	2019 (%) n = 78	2018 (%) n = 41	Difference
18–25	30	29.3	0.7
26–35	37	46.3	-9.3
36–45	18	22	-4
46–55	15	2.4	12.6
<b>Ethnicities (%)</b>			
Asian/Asian British	9	6	3
Black/Black British	3	14	-11
British/other white	79	66	13
Hispanic	6	6	0

### 5.2. Take-Home Message from These Events

Below are the following take-home messages which participants shared with the organizers: Women Can; Environmental; Passion; Really Empowered; Change; Lots of Interesting Talks; Important; Choices; Impact; Influence; Interest; Interdisciplinary; Leadership; Volunteering; Research; Networking; Difference; Work; Expertise; Industry, Inclusive. Women in environmental sciences can change the community through communication, participation, learning, engagement in projects, interaction, network with others, build citizens. These could include the young, old and the disadvantaged.

### 5.3. Some Quotations from Participants

*"The breakout sessions led to spirited discussions amongst a vibrant group of contributors, where everyone was comfortable expressing their view. Expertise comes in all shapes and forms, and solving big problems requires knowledge from all aspects of the issue, from those who understand the theory to those who live the consequences."* Ann

*"Being able to meet and have an arena for open discourse in a friendly atmosphere is one of the elements that I personally hold dear. For those who are new to their roles, or looking for upward movement and progression, I am sure that these events have proven to be useful and practical."* Claire

*"The event encouraged inclusiveness, positivity and strong work ethics. As a scientist who tackles environmental conservation issues at both local and international levels, I found the plenary from Ty particularly inspiring when she discussed her experience in leadership at global scales and how she was able to make such transitions in her career."* Daniella

*"As a grandmother, I want to reiterate that our connection to life-giving forces is innate (for every individual), and that this knowledge is paramount when it comes to taking action that takes care of ourselves and our environment."* Sue

*"Women have a choice! It influenced my choice/decision to go back to the University after 15 years as a lead environmental consultant in industry."* Claire

*"I have learnt about choices, what I bring into a workplace. By learning about trends in the environment sector was informative."* Aisha

*"I have just started falling in love with environmental sustainability and will focus on this at the dissertation level towards my PhD and my career. I came because I wanted to see women who have been working in this area and to hear what advice they have for future generations. I would like to*

*focus on rural outreach when I go back to Kenya, impacting behavioral change for very young woman, children. The workshop gave insight into career choices and what I can do at different levels.” Jackie*

## 6. Conclusions

The WiES brings grassroots and professionals from culturally diverse backgrounds together into a safe space to discuss integrated environmental sciences and challenges through talks and specific break-out sessions. By cutting across individuals, organizations, diverse cultural groups, and diverse environmental disciplines, new research ideas are generated and explored, new ways of engagement that bring about positive change and impact are developed. Through discussion and integration with the broad SDGs, sub-targets for goals 1–4, 6–11, and 13 were identified as relevant and could be explored further through academic research, community engagement with researchers, behavioral or policy changes from a local and national level. The WiES suggest that strong female mentors are needed in all spheres of life including women in STEM, Humanities, and the Arts in order to encourage, promote, shape the change needed in the environmental sector and elsewhere. There was emphasis that women should remember that they have a voice and a choice in their decisions. Therefore, by exploring the SDG sub-targets in view of gender equality (SDG 5), this report contributes relevant information to the UN Women on equality, inclusion, participation, engagement in the environment, so that a sustainable future can be enhanced. The information shared from the workshop can also be adapted in university campuses and other organizations. Through diverse perceptions, open discussions, and safe spaces, we introduced another form of inclusion, participation, collective and knowledge-exchange sessions that gives birth to new ideas, innovation, change, and development. The WiES forms part of the five axes of the SDGs where people are connected with their planet in order to promote and enhance prosperity, peace, and effective partnerships.

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