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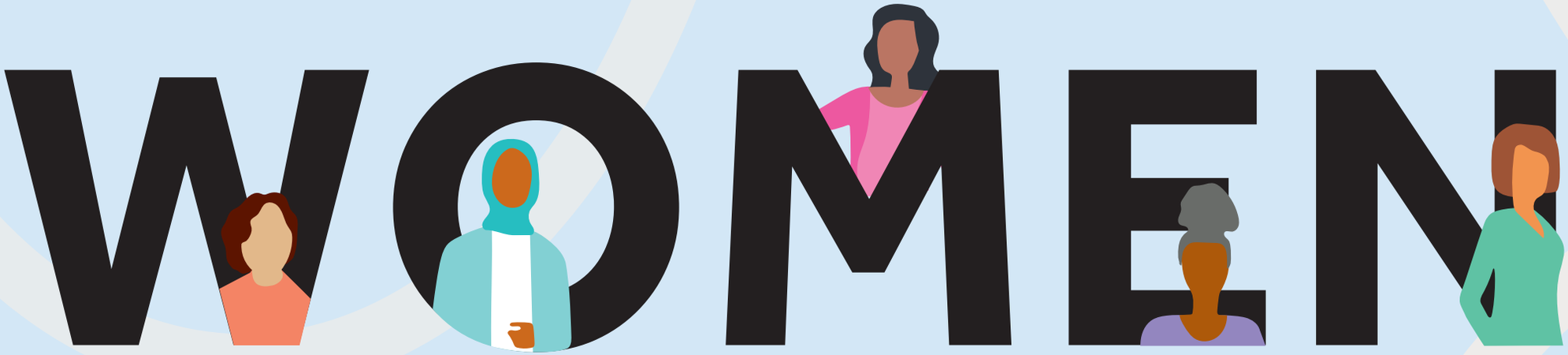


IN ENVIRONMENTAL SCIENCES (WiES)

How women can and must be engaged in the fight against climate change

Executive summary

The Women in Environmental Sciences (WiES) network is an inclusive cross-disciplinary network for women working in ecology and environmental sciences, based at the University of Manchester, UK.

WiES held its first workshop in 2018 and learning outcomes from the first workshop were applied to a follow-up workshop in 2019. This report demonstrates the importance of women's knowledge and involvement in addressing environmental challenges and the aims of the United Nation's Sustainable Development Goals (SDGs). It highlights the systemic inequalities that currently limit women's full participation in environmental challenges and shows how women are disproportionality impacted by environmental degradation, climate change, and hazards.

The WiES network and events have created a forum for women to come together to promote their roles in environmental sciences through presentations from female experts and knowledge exchange sessions. This report presents summaries of both the 2018 and 2019 events, including the presentations and knowledge exchange sessions, reflections by presenters/facilitators, and participant evaluation outcomes. It offers a toolkit for creating more events and opportunities to empower women to take up opportunities in environmental sciences.

CONTENTS

WHY WOMEN IN ENVIRONMENTAL SCIENCES?

01 WHY WOMEN IN ENVIRONMENTAL SCIENCES?

Women in Environmental Sciences (WiES) is a network of academics, professionals, and students from a diverse range of backgrounds whose work and interests cover a range of disciplines including environmental sciences, ecology, engineering, social sciences, and the arts as they relate to environmental sustainability. It was launched in June 2018 by Dr Cecilia Medupin with an award from the University of Manchester's Office of Social Responsibility. More information about the network is available at https://www.meri.manchester.ac.uk/wies/about/.

The network aims to encourage, support, and empower women working in environmental sciences by:

- Creating a platform and a social space to ensure that regular and effective engagement about women and environmental issues takes place.
- Developing the institutional support needed to help empower women at all levels to cope with the problems of equality, health, poverty, and food insecurity; and other challenges of climate change such as water and air quality impacts.
- Promoting and encouraging access to lifelong learning for women who are returning to education.
- Encouraging knowledge sharing and promoting opportunities for mentoring to initiate a new generation of informed environmental science advocates, activists, and practitioners.

Image Credit: Cecilia Medupin
Convener, WiES, University of Manchester, UK

Throughout history, women have faced challenges of gender discrimination arising from cultural or religious barriers, childbirth and childcare, and inequality in pay.

Over the past three decades, there has been some progress in women's empowerment in politics and education, including an increase in women's participation in higher education, especially in the humanities and social sciences. However, in STEM (Science, Technology, Engineering and Mathematics) fields, more systemic change is needed.

Women have crucial roles to play in the necessary transformations to the way we live, if human beings are to survive climate change. The challenges facing the environment, for land, air, and water, require women to take stronger initiatives in the future to create a sustainable world. Women, most especially in deprived and rural communities in less economically developed nations, feel the impact of environmental damage and pollution. Therefore, the role of women in environmental sciences is crucial at local, regional, national, and international levels. Women's empowerment is needed in family units, urban and rural communities, education systems, and industry and regulatory institutions.

The WiES network is a vehicle created to foster and support new groups of women interested in environmental sciences and to promote activities in their local communities related to the United Nations' Sustainable Development Goals (SDGs). Through collective interaction and the sharing of ideas, the WiES network appeals for changes in policies to mitigate the impact of environmental change and degradation on women's lives throughout the world.

WiES held two events (in 2018 and 2019) guided by the 17 SDGs. The SDGs can be broadly summarised as aspirations to ensure that 'no one is left behind' by the serious consequences which will follow global warming. To achieve this, the objectives of the SDGs should be integrated, inclusive, and applied across the planet. This is currently difficult to achieve. The initial research for these goals as it pertains to women was carried out in only four countries: Pakistan, Colombia, Nigeria, and the United States. According to the UN female researchers themselves, this is largely because of the difficulty of collecting accurate data, especially from some of the world's poorer countries. This makes the drive for a fairer, more equitable distribution of resources ever more urgent as the less economically developed countries of the Global South have the lowest carbon footprints but will suffer the greatest consequences of climate destruction.

The WiES events aimed to provide a platform where women with diverse experiential and disciplinary backgrounds could participate co-operatively in engaging discussions and networking. WiES is a platform created to raise the bar for women's participation and, through the meetings, complex environmental issues were discussed openly and safely to provide a basis for pursuing policy changes.

The vision was to provide a network of female environmentalists and researchers empowered to make choices and decisions within their own organisations and communities. The WiES network aligns with the public engagement agenda of UK Research and Innovation (UKRI) and forms part of the investment in 'Engaging Environments' by the UK's Natural Environment Research Council (NERC). The events enabled women, to freely and confidently share knowledge, skills, passion, and experience in a context where they would not feel the pressure of competition with one another.

The events were also linked with the aim of the host university, the University of Manchester, to widen participation, inclusiveness, and communication for and with people from diverse backgrounds. The target audience included academics, early career researchers, postgraduate students, and members of the public with a general interest in the environment. The key learning outcomes were generated from invited speaker presentations, knowledge exchange sessions, and participant reflections on the events.

This report presents the key messages from the events to provide resources for anyone working with women, the environmental sciences, and their communities. It offers a toolkit for developing more effective participation strategies that are inclusive, collective, and progressive, in all spheres of life, to create a sustainable future for all.

WOMEN AND SUSTAINABLE DEVELOPMENT GOALS (SDGs)

02 WOMEN AND THE SUSTAINABLE DEVELOPMENT GOALS (SDGs)

Gender equality and women's empowerment are the bedrock of the SDGs.

If environmental challenges are to be effectively addressed, the roles of women at different stages of their lives need to be considered. All women are encouraged to continually engage in discussions, interactions with other women, and seeking ways to develop their skills irrespective of challenges to equality, diversity, cultural demands, and their communities. Furthermore, interdisciplinary environmental themes provide an important meeting point where more people can work together to provide key outcomes that could be implemented on a day-to-day basis.

The WiES network events have so far addressed many of the SDGs, which were integrated into the events through talks and knowledge exchange sessions. The agenda for the SDGs can be usefully appropriated by events aimed to facilitate women's engagement in the environment. They help to increase awareness and promote impact-driven research and discussion, consolidated by a chance to simulate likely future problems.

The WiES forum contributes to the need for more information and data to address the challenges faced by women, as highlighted by UN Women. [1] Greater participation and accountability is needed to improve the mechanisms at national, global, and other high level political forums, through which a stronger space for civil society participation could be created. Constructive discussion is needed between policy makers and those advocating for greater equality and representation in civil society organisations to monitor and accelerate change for women and girls.

Transformative policies are also required in relation to essential services, which are underfunded or unavailable in most countries (e.g., health, water, sanitation, shelter). In summary, progress towards achieving the SDGs remains slow and may not reach those who need it before 2030. A road map for moving ahead is needed.

The application of SDG themes to aspects of research enhances the awareness of researchers and research contributors about the potential impact of their work. This means that academic researchers are more inclined to design their research in line with aspects of the SDGs. Furthermore, the SDGs aim to consider people, welfare, and development so applied and integrated research is encouraged.

Through discussions and knowledge exchange sessions between grassroots communities and academics, the status quo of higher education institutions 'knowing it all' can be challenged in favour of diverse, practical solutions. In addition, networks are created generating further motivation to engage different stakeholders.

The following summarises how the WiES events engaged with the SDGs to demonstrate the impact of global challenges on women and to promote women's participation in solving challenges in environmental sciences:

Gender equality

SDG 5 on gender equality and the empowerment of all women and girls is a standalone SDG on gender. In many nations, gender discrimination is still woven though legal and social norms. Violence against women remains a pandemic affecting all countries. SDG 5 was addressed in the 2018 UN women's report, 'Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Development'. [2]

Equal access to high quality education

Inclusive and equitable high quality education provides access to learning for all, and promotes lifelong learning opportunities. It is the focus of SDG 4. Adult literacy is increasing but women still account for nearly two thirds of the world's illiterate citizens. According to a UN report 'girls comprise the majority of the world's-out-of-school children'. [3] A UNESCO report on women in science in 2018 reported that less than 30% of the world's researchers are women. [4]

It is vital to understand the factors that deter women from pursuing careers in STEM. The STEM and Gender Advancement (SAGA) project financed by the Swedish International Development Cooperation Agency (SIDA) investigates the drivers and barriers to a career in science and engineering. SIDA developed a toolkit that includes methods, indicators, and a framework to produce more precise data that can be used to shape women's careers in STEM fields. The toolkit is based on an international standard which can be compared across countries. The overall aim of the project is to integrate these new instruments at national and regional levels. [5] Women represented only 26% of STEM graduates and 24% of the STEM workforce in 2019. [6]

There are some initiatives in UK higher education institutions (HEIs) to support students from low income and deprived communities to access higher education. At the University of Manchester, this occurs through various schemes including the Manchester Distance Access Scheme (MDAS), launched in 2013. [7] In addition to MDAS, the university increased partnership and public engagement activities by providing funds for outreach events at local, national, and global levels. An example of global educational outreach is 'Transformation by Innovation in Distance Education' (TIDE), which collaborates with UK HEIs and the British Council to promote skills in countries such as Myanmar. While UK universities have continued to support schemes such as Women in Engineering, Science Girls, and Women in STEM, statistics show that more is needed to generate change.

Rebuilding socio-ecological relationships through farming systems

The concept of rebuilding socio-ecological relationships by using agricultural communities fits with the objectives of SDGs 1 (no poverty), 2 (zero hunger), and 11 (sustainable communities). Women and children are the most vulnerable to climate change and environmental disasters. Therefore, it is important to work towards promoting community networks, good farming practices, knowledge exchange, and interaction between researchers and local farmers.

Acknowledging climate change and adapting new farming techniques in water-stressed regions allows farming communities to reduce the impact of poverty, hunger, diseases (SDG 3), and loss of life. As McAllister and Wright [8] have evidenced:

> *where agroecological farmers were exposed to more plural ways of thinking, being and acting together, levels of autonomy from coercive structures were increasing, as were both a sense of efficacy and optimism to effect socio-ecological change.*

This relates to objective SDG 13, which represents a force for climate action to mitigate wars, emphasising the importance of bringing about positive and substantial socio-ecological change. Socio-ecological interaction promotes a new way of thinking and could help to rebuild communities affected by disaster.

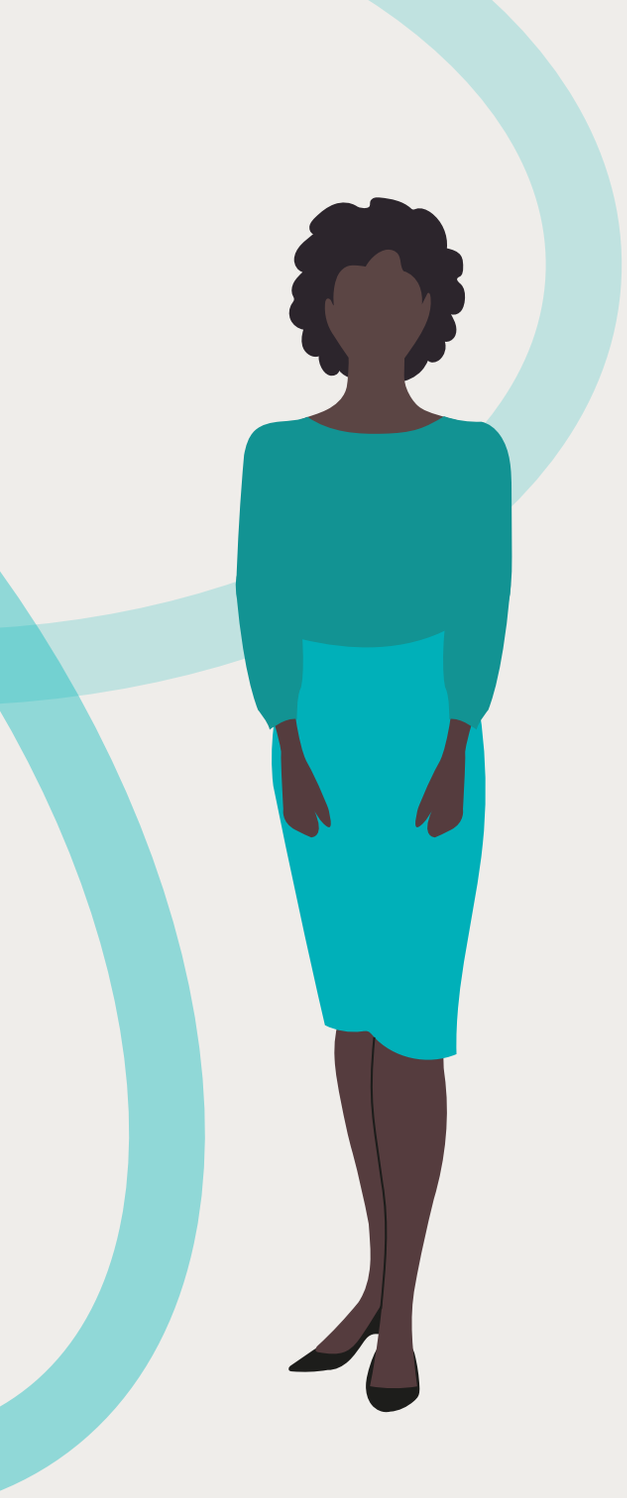
Urban green infrastructure, human health, and wellbeing

WiES addressed the challenge of natural green space in urban areas and its impact on health using the city of Manchester in northwest England, UK, as a case study. Talk 5 directly related to community health, thereby increasing awareness of the effect of greenspace on the lifespan of human beings, including older people. The lifespan of people, including older people who live in deprived areas, could be shortened by a lack of natural green spaces. This links to SDG 10, to reduce inequalities and improve good health, and SDG 3, which is concerned with wellbeing. The concept of sustainable cities and communities is addressed under SDG 11.

The Office for National Statistics in the UK has shown that women have a longer life expectancy than their male counterparts. [9] It is therefore especially important to consider the health of older women. WiES made links between health and climate change to show how climate change can impact on human health, highlighting the climate action objective of SDG 13.

Research on the health benefits of green space as an adaptation to different socio-economic populations has shown that deprived areas that are less green and have fewer trees could impact on the quality of life of vulnerable groups living there. [10]

WiES therefore also addressed SDG 10 by identifying the inequalities between different socio-economic groups. There is no question that the benefits of green spaces to human health outweigh the disadvantages.



Getting women into industry

SDG 8 aims to promote sustainable, inclusive, and sustainable economic growth, with full and productive employment and decent work for all. Only 50% of the world's working age women (15 or over) are in the labour force compared to over 75% of working age men. Globally, women earn 24% less than men. It is vital that female professionals can enter and succeed in key industries related to managing environmental conditions and change but in the UK only 16.5% of the engineering workforce was female in 2022. [11]

Construction is a key industry in the drive to build sustainable infrastructure and communities (SDGs 9 and 11). However, in this industry women build a career in a challenging environment. According to an industry report:

> Data from the Office for National Statistics (ONS) has revealed that over the last decade the percentage of women taking up skilled trades and holding senior management positions within construction firms has barely changed. [12]

For every female apprentice in the construction industry in the UK there are 56 male apprentices. [13] Women also lack mentorship and the overall lack of strong female role models discourages women from advancing in the field. By openly identifying and addressing the challenges for women in this industrial sector, more girls and women could be empowered to study to achieve quality education (SDG 4) and be empowered (SDG 8) to work in STEM related roles. Women's financial empowerment cascades into the family and community development. Through the acceptance of women in these roles, changes to policies that favour women will encourage innovation, growth, reduce inequalities at the workplace and foster development.

The WiES conferences included discussions about decent work in industry and economic growth, and encouraging women to apply for roles that interest them, which links to SDGs 8, 9 and 10.

Citizen Science: on the brink of an open science revolution

The exploration of citizen science combined with community development and storytelling offers a route to enable diverse communities to have a meaningful stake in discussing and tackling environmental science issues such as climate change and pollution. Knowledge exchange session 6 of the WiES conferences addressed SDG 4 for quality education, highlighting its potential to enable communities to drive policy changes, as well as addressing gender equality issues (SDG 5) and sustainable communities (SDG 11).

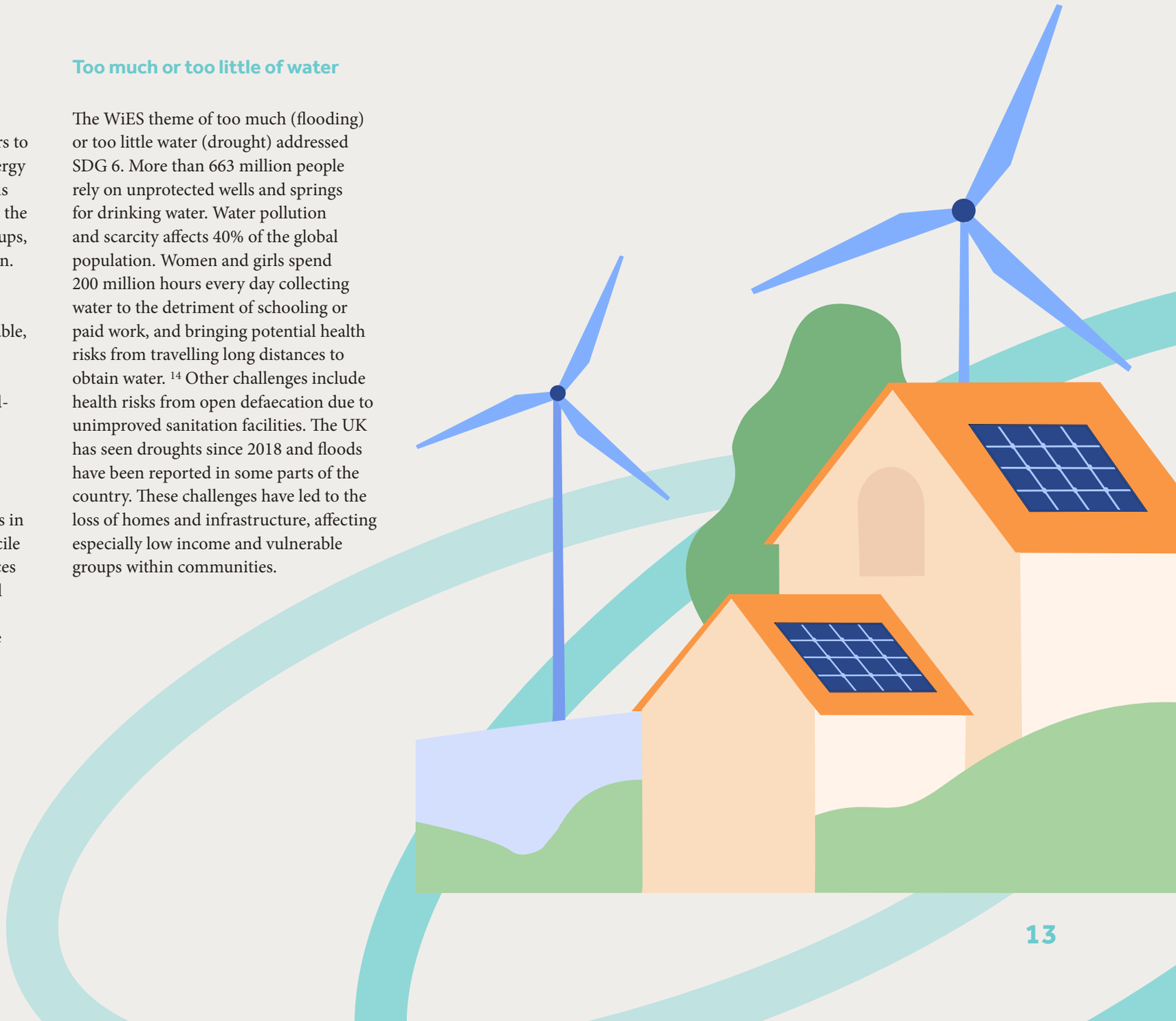
Knowledge exchange session 5 on 'Environmental changes, society, culture, and health' also addressed the objectives of SDG 4 for encouraging participation between communities and researchers, awareness creation, and integration. This is linked to reducing inequality (SDG 10) and strategies to encourage inclusive participation in communities (SDG 11). Educating young children, community education through citizen science, and public engagement are key instruments for promoting environmental health and community participation. This way, the environment could be sustained for the future.

Energy for all

Globally the challenge of energy is leading researchers and policy makers to consider the necessity of a mixed energy economy. In emerging economies this could constitute a major challenge to the sustenance of families and social groups, which are usually managed by women. Hence, the WiES events addressed SDG 7, regarding the need to ensure access to affordable, reliable, sustainable, and modern energy for all. The key questions considered in the WiES discussions were: What does a mixed-energy economy look like in the UK, post-Brexit, and is there a financial and environmental impact on local communities? How do changes in energy supply influence communities in developing countries? Can we reconcile competition for other energy resources with sustainability and governmental regulation? Is it more beneficial to individuals and communities to have a reliable energy supply rather than ensuring clean, sustainable energy?

Too much or too little of water

The WiES theme of too much (flooding) or too little water (drought) addressed SDG 6. More than 663 million people rely on unprotected wells and springs for drinking water. Water pollution and scarcity affects 40% of the global population. Women and girls spend 200 million hours every day collecting water to the detriment of schooling or paid work, and bringing potential health risks from travelling long distances to obtain water. [14] Other challenges include health risks from open defaecation due to unimproved sanitation facilities. The UK has seen droughts since 2018 and floods have been reported in some parts of the country. These challenges have led to the loss of homes and infrastructure, affecting especially low income and vulnerable groups within communities.



THE WiES EVENTS

03

03 THE WiES EVENTS

This report summarises two events held by the WiES network, one in 2018 and one in 2019, including presentations and knowledge exchange sessions. The WiES events aimed to:

- Bring together women with diverse ethnicity and disciplinary backgrounds to promote inclusiveness, widen participation, and foster discussion.
- Reflect the interdisciplinary nature of the environmental sciences through the selection of speakers.
- Understand the position and potential role of women in the environmental sciences, including academic, policy, and professional spheres.
- Provide an empowering and informal atmosphere to motivate participants and facilitate networking.

"The talks by the women were really inspiring and enthusiastic."

"The atmosphere was inclusive."

Each event began with a welcome and introduction from the WiES network convener, Dr Cecilia Medupin.

The morning was dedicated to presentations by female presenters, who spoke on different environmental themes related to the SDGs. In 2018 these included energy, leadership and women's empowerment, scientific research, policy, and the delivery of impact; in 2019 they covered the themes of zero poverty, zero hunger, health and wellbeing, education, decent work and economic growth, reduced inequalities for sustainable cities, and climate change. There were opportunities for questions and answers after each presentation. The themes for the 2019 presentations were based on feedback from the 2018 event.

Lunch and time for networking followed the morning session before knowledge exchange breakout sessions in the afternoon. Each breakout session expanded on the role of women as it pertained to the earlier presentations as well as other environmental themes. These included environmental changes and health, water, society, and communication (2018); and the role of women in rebuilding ecological communities, environmental changes and health, society and communication, citizen science, and women in industry (2019).

Each breakout session had a facilitator, and the small groups gave participants the opportunity to interact, engage more deeply in the topics covered in the morning presentations, and delve into other matters that related to the workshop theme. Participants and facilitators each shared their experiences, asked questions, and made contributions to the discussions. Based on feedback from the 2018 event, the 2019 breakout sessions were longer to give more time for knowledge exchange.

Evaluation was conducted for each event as an important element of learning from the format, structure, and themes.

"It has been good to see and hear from many professional women in this sector."

"The breakout session was a great opportunity to interact and give voice to opinion on key issues."

Summary of the WiES events and their impact

TALK 1 AND WORKSHOP 1

Hydrocarbon exploration and production: challenges and prospects for women in a mixed-energy economy

Professor Cathy Hollis
Petrophysics and petroleum geology specialist, Department of Earth and Environmental Sciences, University of Manchester, UK.
Image Credit: Cathy Hollis

SDGs: **4, 5, 7**

Sub-targets of SDGs: **4.3, 4.5, 4.7a, 7.1-7.3**

KEY OUTCOMES

- In the Global South, mixed energy economies could be a challenge for developing/emerging economies; research is needed into how to help these economies in their transition.
- In the Global North, the transition to renewable energy is limited by the reliability of supply, requiring technical solutions.
- Women are reliant on domestic energy and are potential agents of change due to their domestic responsibilities, citizen purchasing power, and professional contributions.
- Community outreach, education, and professional support networks can improve opportunities for women and support the transition to mixed-energy economies.

TALK 2

Being a female environmental scientist leader and follower: passion, challenge, and rewards

Dr Tayo Adebowale
Cirkadia, UK; environmental consultant and director of NGO/policy organisations.

SDGs: **4, 5, 8**

Sub-targets of SDGs: **5.1, 5.4, 5.5, 5.6a, 5.6c, 4.4, 4.5, 8.8**

KEY OUTCOMES

- Involve volunteers and communities from diverse backgrounds in your environmental strategy – be inclusive and respectful.
- Organisations should have flexible working policies to recognise women's caring responsibilities.
- Women should be empowered to make choices and establish an appropriate work-life balance.
- Everyone focuses on a leader, but followers also achieve many things.

TALK 3

Conducting policy-relevant, interdisciplinary research on climate change: delivering impact

Professor Alice Larkin

Climate science and energy policy specialist, Department of Mechanical, Aerospace and Civil Engineering, University of Manchester, UK.

SDGs: **4, 5, 13**

Sub-targets of SDGs: **4.3, 4.5, 5.5, 13.2, 13.3**

KEY OUTCOMES

- Policy-relevant research has positive implications for society and policy makers are always keen to hear from researchers.
- Researchers should make sure they understand the context of research questions and seek support from line management to improve dissemination.
- Interdisciplinary research and impact remain male dominated in some research institutes.
- Connect with networks, groups, and partners in your field of expertise, and identify ways of engaging audiences to enhance research opportunities and impact.

TALK 4

Rebuilding socio-ecological relationships through farming systems

Dr Georgina McAllister

Agroecologist, Centre for Agroecology, Water and Resilience, Coventry University; UK; Programme Director, GardenAfrica.

SDGs: **1, 2, 3, 13**

Sub-targets of SDGs: **1.5, 2.3, 2.4, 3.9d, 13.1, 13.3b**

KEY OUTCOMES

- Natural disasters have implications for food security, health, stability, safety, and the security of communities
- Farming communities can be re-built through socio-ecological interactions rooted in local culture, heritage, innovation, and knowledge. Self-help methods are more effective and empowering than those led by external agencies.
- The environmental challenges faced by rural communities in the Global South could initiate research and applications of socio-ecological interactions in the Global North.
- Building relationships across social, political, and academic divides can produce the positive impacts needed to face environmental challenges.

TALK 5

Urban green infrastructure and its links with human health and wellbeing

Professor Sarah Lindley
Specialist in urban green infrastructure and GIS; School of Environment, Education and Development, University of Manchester, UK.

KEY OUTCOMES

- Urban green spaces, infrastructure, and human health are interrelated.
- Access to green spaces is essential to wellbeing but unevenly distributed, with less green space in deprived areas of the city.
- Greener futures could be enhanced by communication between, and inclusion of, interest groups in planning and development.
- Women live longer than men and have even more to gain from access to green space throughout their lives.

SDGs: **3, 11, 13**

Sub-targets of SDGs: **11.1, 11.3, 11.7, 11.7a**

WORKSHOP 2

Implementing environmental science through integral roles

Dr Emma Gardner
Head of Environment at the Diocese of Salford, UK
Image Credit: Emma Gardner

KEY OUTCOMES

- Sustainable procurement is needed to reduce organisations' environmental impact.
- Environmental decision making should include employees from diverse backgrounds.
- Organisations should review leadership and priorities to facilitate women's equal involvement in environmental decision making.

SDGs: **4, 5, 7, 12**

Sub-targets of SDGs: **4.1, 12.2, 12.5-12.8**

WORKSHOP 3

Integrating science, society and sustainability: too much or too little of water

Dr Rosalind Bark
Specialist in Ecological Economics, University of East Anglia, UK.
Image Credit: Rosalind Bark

KEY OUTCOMES

- Water is important to human health and wellbeing but increasingly brings threats (droughts, floods) and is subject to environmental pressures (population increase, pollution).
- Water awareness needs to be increased among affected groups, among which women and children are disproportionately affected.
- Different measures can be taken to involve communities in the better management of water.

SDGs: 6,10

Sub-targets of SDGs: 6.3, 6.4-6.6,

WORKSHOP 4

Women in industry: who wants to stand on a building site in the rain?

Ms. Claire Brown
Early career researcher, Mechanical and Aerospace Engineering, University of Manchester/University of Salford, UK. of Manchester, UK.

KEY OUTCOMES

- Climate change is exacerbating challenging working conditions for women in industries such as construction.
- Women should be encouraged to speak up and support one another to foster change.
- Organisations should take measures to increase the diversity of the workplace, which in turn improves working conditions for all.

SDGs: 4, 8,9

Sub-targets of SDGs: 8, 6

WORKSHOP 5

Environmental changes, society, culture, and health: awareness, communication, and control

Professor Ann Webb
Air quality specialist, Department of Earth and. Environmental Sciences, University of Manchester, UK.
Image Credit: Ann Webb

KEY OUTCOMES

- Managing and raising awareness of the impacts of environmental change requires solutions at all levels, from the local to the global.
- Effective strategies seek to provide solutions to the challenges already faced by diverse communities and low income groups. Experts should develop equal partnerships and learn from community needs.
- Public engagement activities benefit from imaginative approaches.

SDGs: **3, 4**

Sub-targets of SDGs: **3.4,3.7,3.9, 4.1**

WORKSHOP 6

Citizen Science: on the brink of an open science revolution

Ms. Kat McGavin
Learning & Engagement Manager, EarthWatch Institute, Oxford.

KEY OUTCOMES

- Citizen science refers to the involvement of non-scientists in data collection and/or analysis and is becoming increasingly popular.
- Citizen science projects can increase the range of environmental data and projects that can be undertaken.
- Participant involvement in scientific research increases the accessibility and democratisation of science, and can lead to behaviour change.

SDGs: **4, 5**

Sub-targets of SDGs: **4.6,4.7**

PRESENTATIONS

04

04 PRESENTATIONS

This section presents summaries of the presentations made to the WiES conference by female experts in environmental sciences. It includes the key messages from these talks alongside personal reflection on the events by the presenters.
Each talk aligned with the SDGs.

Talk 1
Hydrocarbon exploration and production: challenges and prospects for women in a mixed-energy economy

Professor Cathy Hollis, University of Manchester, UK

Women are the primary energy managers at home, which means they could play powerful roles in extending sustainable modern energy. For example, in some contexts this could mean moving away from burning wood or animal dung that smokes heavily. The use of energy resources in the home often lies with women, especially in developing parts of the world.

Many questions remain about the transition to sustainable energy sources. What does a mixed-energy economy look like in the UK, post-Brexit, and is there a financial and environmental impact on local communities? How do changes in energy supply influence communities in developing countries? Can we reconcile competition for other energy resources with sustainability and governmental regulation? Is it more beneficial to individuals and communities to have a reliable energy supply rather than ensuring clean, sustainable energy?

In this talk, Professor Hollis introduced the global oil producers and discussed how energy supply has changed the roles of women in households. For these reasons and more, the management of the home and energy resources lies with women. The talk emphasised the behavioural and lifestyle changes required to accommodate sustainable energy sources. It also highlighted that the female to male ratio of employment in petroleum exploration is lower than in other areas of the oil and gas industry. Other parts of the talk considered the role of women in the hydrocarbon industry – past, present, and future – and final thoughts on a mixed energy economy.

"Follow your enthusiasm, in every field of interest, and do not be afraid to step away from something that is not usual."

Women in the hydrocarbon industry: past, present, and future

PAST

- Industry focus on exploration.
- Lack of female facilities offshore.
- Unsafe working environment.
- Long periods away from home, limited flexible working.
- Culture of being 'one of the boys', progression through contacts.

PRESENT

- Female-male ratio in the environmental sciences at university is approximately equal, but lower in geology and petroleum engineering. [15]
- Women are under-represented at all levels of the oil and gas industry from entry-level (25%) to senior management and executive roles (20%). [16]
- Gender pay gap in the oil and gas industry is approximately 20%. [17]

FUTURE

- Greater gender and cultural diversity, reflecting growing influence of national oil companies.
- Wellsite and field working conditions improving.
- Smart fields/wells allow remote operations.
- More focus on optimisation of existing resources.
- Technically innovative career opportunities.

Final Thoughts: a mixed energy economy

- Fossil fuels will remain in the energy mix for decades, with focus on improved hydrocarbon recovery.
- Clean energy still requires geo-technical and sub-surface engineers. There is a critical need for female scientists and engineers.

Reflections by Professor Cathy Hollis

Geoscience is a core skill in the exploration and production of hydrocarbons, requiring the integration of fundamental physics, chemistry, maths, and geographical information systems. Petroleum geologists also have to be able to draw interpretations from disparate – sometimes contradictory – datasets, analyse risk and uncertainty, and understand economic principles. There are two key strands of petroleum geoscience: exploration, where potential new oil and gas reserves are identified; and production, which is focused on optimising the amount of oil or gas that is produced from a field. Although the first oil was found in Pennsylvania in 1859, it was not until the mid-twentieth century that oil production had an impact on the everyday lives of most families. With the proliferation of hydrocarbon production during the 1950s and 1960s came a change in lifestyle, particularly in Western economies – personal motorised transportation, frequent air travel, widespread use of plastics and polymers derived from petroleum products, and drug development.

The number of women studying geology at degree level progressively increased, coupled with an increase in the number of female geoscientists in the oil and gas industry. Nevertheless, it is only in the last 10 years (2009–19) that a significant number of women have been visible within the management structure and boards of international oil companies. There are numerous reasons for this. In the UK, it was not until the late 20th century that female accommodation was available on offshore UK oil and gas facilities, so many women were not able to develop core skills needed to progress their careers. Only in the 21st century have flexible working and career breaks been offered and considered to not inhibit career progression. Office hours for petroleum geologists can be long and frequent travel is expected but improved technology has helped to facilitate home-working and reduce the number of days away from home. Many international oil companies expect their best staff to rotate positions and work internationally. Opportunities for women to work overseas have grown, and are offered through open internal advertisement. However, some companies still do not routinely offer joint postings for women who are married to, or in long-term relationships with, partners in the same company. Finally, the levels of machismo in the industry, which women were expected to adhere to if they were to succeed, are becoming less acceptable.

Today, there is a wider acceptance of the importance of work-life balance for all employees, with the offer of career breaks and flexible working for both parents. Better use of technology and an acceptance of the importance of diversity and inclusiveness has also made a real difference to the progression of women. However, there remains a poor gender balance on executive committees and within the workforce, with evidence of a significant gender pay gap. There are signs that this gap is being closed through affirmative action, but there is still a long way to go.

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 that the Earth's population has faced – climate change.

Decarbonisation of our planet is critical to protecting many countries from extreme weather, economic decline, and political unrest. Female scientists have a central role to play in managing this transition within energy companies, which will include diversification of power generation, transformation of transportation systems, carbon sequestration, and gas storage.

Novel and integrated knowledge transfer, research leadership, cross-disciplinary integration, and team working will be required, all of which are more effective when delivered by diverse and inclusive teams and managers. Communication of the complex scientific challenges around this transition to governments, policy makers, and the public is imperative.

The energy revolution of the mid-20th century, when oil and gas provided power and fuels to all homes in the West, had a direct impact on women's careers. Routine tasks at home were made easier, opening up opportunities for training and employment. The energy revolution is now taking place globally. However, in many cultures, women continue to carry more caring responsibilities within the family than men, and therefore a continuous, reliable supply of power is fundamental to them building their career. Nevertheless, with the parallel challenge of climate change management, there is a real risk of a decline in the standard of living, which can threaten female education, training, and employment. Managing the energy transition effectively is a new global challenge that will affect the lives of all women.

Key messages

- **In the Global South, mixed energy economies could be a challenge for developing/emerging economies; research is needed into how to help these economies in their transition.**
- **In the Global North, the transition to renewable energy is limited by the reliability of supply, requiring technical solutions.**
- **Women are reliant on domestic energy and are potential agents of change due to their domestic responsibilities, citizen purchasing power, and professional contributions.**
- **Community outreach, education, and professional support networks can improve opportunities for women and support the transition to mixed-energy economies.**

Talk 2

Leader and follower: passion, challenge, and rewards in environmental sciences

Dr Tayo Adebowale, Cirkadia, UK

"Women have choices."

Dr Adebowale shared some of her personal experiences in this sector:

I am passionate about the environment. In a holistic sense, almost all we do, and the choices we make, at work or at home, can have an impact on the environment. So, giving some thought to what impact that might be, and how we can reduce the negative and increase the positive, makes sense. This is a sort of 'eco proofing', similar to 'rural proofing', in which the impacts of policies were assessed to ensure they did not have unforeseen negative impacts on rural areas. Being a female scientist can have its challenges and one could strongly argue that it is still a male dominated area – but many females have walked this path before us, even if they have not been well documented. Quite simply, having a job where I 'feel I am doing more than my bit' for the environment is rewarding.

The pros, cons and in-betweens of being a woman in science

Pros

Rarely is there a dull moment – working in science is fascinating most of the time.

New opportunities and new environmental disciplines are emerging all the time, which you have a chance to shape.

In-betweens

It can be difficult to get a job in this sector.

Volunteering is one possible route to employment – this should be a symbiotic relationship, where you are learning new skills and gaining experience, and the organisation benefits from your input.

Cons

It can be harder to be heard as a woman and being assertive can be seen by some as being aggressive.

There are few women on boards, and little diversity.

The workplace does not always respect, or value, women's roles as caregivers within families.

Local, national and global issues

The regional and local scales really do matter; they can influence and change national and global policy and strategy as well as impact regions, communities, and local people's lives.

Do not underestimate the difference roles such as non-executive directorships in the public section can, and do, make to the environment. One is privileged to influence and create national policy and strategy, and work on a global agenda.

"For every activity you are involved in, do the eco-proofing."

Reflections by Dr Olutayo Adebowale

It seems very fitting that today on Women's International Day, I finally find some free time to reflect on my talk of 2018 – what a lovely opportunity.

In a nutshell, we still have a long way to go before we see equality in the field of environmental sciences, particularly in senior positions and in the boardroom. This should not be read as meaning there are not enough women with the necessary skills and expertise, as quite simply I believe there are.

I would like to share with you an experience I had recently, which really made me reflect on my talk, and things we could do better. I was invited to give a talk on my work as a scientist to 9- and 10-year-olds at an inner city primary school. The children asked me so many insightful questions, but the question that made me literally stop in my tracks was:

'Who was your inspiration as a child to become a scientist?'

The anticipation from the children, of a wonderful answer to this question, was intense…

I had to answer honestly and said that as a child my education did not include any female scientists from whom I could seek inspiration. The disappointment in the bright sea of eyes in front of me was palpable! I was left feeling somewhat guilty, that I could not live up to their expectations, and give a 'name'. But why was this, why are women scientists not written into our history books, while men are? Surely, this needs to change, and we should be teaching our children about the fantastic things that women scientists have done in the past, and indeed, continue to do today. In February 2020, Katherine Johnson, a Black American, passed away at the grand old age of 101. Johnson worked at NASA, and her calculations of orbital mechanics were critical to the success of the first and subsequent US crewed space flights. (If you have not seen it yet, watch the film Hidden Figures, which tells the tale of the important, albeit forgotten, role women played in the space programme – it is a great film).

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 to truly address the 'climate emergency' and the many environmental challenges we face, locally, nationally, and globally.

To inspire more women into environmental sciences, we should be encouraging every course to include a module on environmental sciences. To meet the zero-carbon challenge, and the many other environmental challenges, we need people from a wide range of disciplines working together, all with a core understanding of the possible impacts of their disciplines on the environment, and how they can mitigate the negative, and increase the positive, impacts. After all, Katherine Johnson was a mathematician, yet she was fundamental to the US space flights.

I should add that finally, after much soul searching and reflection on the most challenging question I received from the children, I realised that I owe my inspiration for my career as a scientist to my parents, who believed in the importance of education, and of science – although I did not realise it at the time. My mum, in particular, was a staunch advocate of women, 'having their own certificate'. I could not agree more; it has served me well!

Key messages

- **Involve volunteers and communities from diverse backgrounds in your environmental strategy – be inclusive and respectful.**
- **Organisations should have flexible working policies to recognise women's caring responsibilities.**
- **Women should be empowered to make choices and establish an appropriate work-life balance.**
- **Everyone focuses on a leader, but followers also achieve many things.**

"It's good to be passionate about the environment to work as an environmental scientist."

Talk 3
Conducting policy-relevant, interdisciplinary research on climate change: delivering impact

Professor Alice Larkin, University of Manchester, UK

> *"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."*

Professor Larkin began by providing a brief description of the Tyndall Centre at the University of Manchester. The Tyndall Centre is a group of thirty academics, postdoctoral researchers, professional services staff and some PhD students. This centre is based in the Mechanical Aerospace and Civil Engineering Department (MACE). The shared office spaces are caves and commons (private workspaces alongside shared spaces for team working). Members of the centre come from different disciplines and many work across disciplines.

Professor Larkin is an interdisciplinary researcher and stated that the starting point of research impact should be to ensure researchers conduct policy-relevant research, identifying the overall implication of the research for society. She identified the mechanisms for engagement and discussed activities that had led to her policy research. She emphasised that engagement stems from understanding the context of the research questions.

Her presentation delved into proactive engagement mechanisms including:

- Stakeholder interviews,
- Industry and policy workshops,
- Written and oral communication.

Reflections by Professor Alice Larkin

I was delighted when I was asked to talk about interdisciplinary policy-relevant research at the WiES event, to share some of my personal experiences and reflections on issues of gender during my academic journey. However, prior to being asked, I had reflected much more on the progression and development of women in science and engineering careers more generally, and not really considered the specifics of, firstly, interdisciplinary research, and secondly, conducting policy-relevant research.

Through a more gender focused lens, there are in fact some parallels between some of the barriers women can face generally, and some of the barriers colleagues face when doing interdisciplinary and policy-relevant research. For example, interdisciplinary research continues to be viewed by some as less academic, because it tends to conduct activity that is 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. Similarly, traditional grant review panels have tended to have a disciplinary focus.

This means that publishing interdisciplinary papers and seeking funding for interdisciplinary projects can face more impediments than conventional activity. This is particularly the case if the work spans the physical and social disciplines (rather than being across physics or social disciplines). Even when a panel aims to be 'interdisciplinary', there will be reviewers who do not have an appreciation of either the physical, or the social sciences, and their very different approaches – and on average these proposals can receive a lower rating. Inevitably, when a project or paper works across disciplines, it will be using language that is common to those involved, meaning that it will appear less 'technical', which can be interpreted as less academic or less robust. Being more understandable should be a strength not a weakness of a project or study, but it can be viewed very differently to this. Similar to how many women need to work extra hard or go the extra mile with their work to gain recognition, I would suggest that interdisciplinary researchers, particularly those that span physical and social sciences, face similar challenges. So is it doubly hard for women?

Turning then to the added aspect of conducting policy-relevant research, which is itself often a form of interdisciplinary research, and I would argue that the same applies here. Academia tends 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. Engineering and physical scientists have an important role to engage policy makers with research findings, cutting through jargon, and articulating uncertainty and limitations of studies. However, this type of work, as reflected on in the WiES event, requires additional time resource that many simply do not have, particularly if they have commitments to family and wellbeing to consider. It is important for line managers to be supportive of researchers wishing to engage with other non-academic audiences, providing the time and support to do so, as the rewards can be great.

With the impact agenda now firmly within the remit of how universities are measured externally, institutions are becoming increasingly better at valuing the time for taking research findings to different people, perhaps submitting evidence to parliamentary inquiries, or even giving evidence in person. Support from colleagues to do this, even from an early stage, should not be underestimated. Early career researchers can get a huge sense of making a difference by engaging in such activities, but such engagement can also turn out to be quite high profile. Media training, public speaking, and writing for policy makers training can all help build confidence.

Key messages

- **Policy-relevant research has positive implications for society and policy makers are always keen to hear from researchers.**
- **Researchers should make sure they understand the context of research questions and seek support from line management to improve dissemination.**
- **Interdisciplinary research and impact remain male dominated in some research institutes.**
- **Connect with networks, groups, and partners in your field of expertise, and identify ways of engaging audiences to enhance research opportunities and impact.**

"Policy engagement takes time but it made me feel like I was doing something useful."

Talk 4
Rebuilding socio-ecological relationships through farming systems

Dr Georgina McAllister, GardenAfrica, Centre for Agroecology, Water and Resilience, Coventry University

Dr McAllister shared her experience of working and researching in a rural region in Zimbabwe, following a hurricane. She explained the drivers for socio-ecological systems breakdown in different contexts, and the roles of researchers, practitioners, and local communities in facilitating inclusive processes to reinvigorate these relationships.

In less developed economies, women on average make up 43% of the small-scale agriculture labour force so farming is a primary source of identification and ecological knowledge helps to transcend other divisions. [18]

Dr McAllister noted that 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 one's neighbours' wealth 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 as well as understanding the landscape and the people are all needed and must work synchronously.

Self-help methods are generally more effective than those led by non-governmental organisations (NGOs) as they are more useful and empowering to the local communities.

The women in communities supported each other, which allowed them to conveniently feed their children and pay their children's school fees.

Communities of agroecological practice experience stresses and shocks, as well as institutional pressures, which can be both constraining and enabling. Vulnerability to stresses and shocks is influenced by factors including resilience (which is not always equitable); choices and decisions regarding the agroecosystem; and agency (which is relational). These in turn influence everyday relationships, affecting the capacity for peace and the power to effect change.

Learning to pool skills and perform collectively builds further capacity and impetus for ongoing action.

Perceptions of self- and collective-efficacy influence human development, enabling adaptation to change. In this way, human agency promotes the belief that we are producers of experience and shapers of events.

Socio-ecological characteristics of agroecology

According to a report by CIDSE, agroecology is: [19]

- Rooted in local culture, identity, tradition, innovation, and knowledge.
- Contributes to healthy, diversified, seasonally, and culturally appropriate diets.
- Knowledge-intensive and promotes horizontal (farmer-to-farmer) contacts for sharing knowledge, skills, and innovations, together with alliances of farmers and researchers.
- Creates opportunities for, and promotion of, solidarity and discussion between and among peoples from culturally diverse backgrounds.
- Supports peoples and communities in maintaining their spiritual and material relationship with the land and environment.

Socio-ecological changes

- Population increases.
- People bringing different cultural beliefs and changing world views.
- Authoritarian nationalism and political opportunism.
- Corruption and political factionalisation.
- Erosion of systems of knowledge and trust.
- Pressure on natural resources leading to deforestation, soil erosion, and landslides.
- Changing land-use practices including chemical inputs and mono-cropping resulting in exhausted soils and declining yields.
- Over-exploitation and pollution of water sources.
- Rising poverty and social tensions.

Adaptive capacity

- Active knowledge recovery mobilised through an emerging sovereignty discourse.
- Syncretic blending of different knowledge, beliefs, and practices.
- Farmer-to-farmer learning resulting in a more established knowledge base.
- Expanding out from initial farming focus (which in turn leads to social justice).
- Development of cultural peacebuilding approach using discursive practices.

Projecting new horizons and changing world views

- Building vertical alliances (although these may be initially tentative). Engaging with power holders on environmental regulations and encouraging consultations between traditional leaders and resource users.
- Building horizontal alliances through bonding: constructing positive images of a common future together and forging a belief that one's own welfare is increased through the increased welfare of others.
- Landscape-level activities, including terracing and tree planting for soil stabilisation; contours for surface water management; and dams for aquaculture and management of inter-seasonal variability.
- The process of adaptation as collective action built confidence and a shared sense of collective identity. In so doing, it enhanced social trust, co-operation, exchange, reciprocity, and tolerance of difference.
- Long-term ecological research is valuable as it allows lasting relationships to be built. [10]

Key messages

- **Natural disasters have implications for food security, health, stability, safety, and the security of individuals and communities, which affect those on low incomes the most.**
- **Farming communities can be re-built through socio-ecological interactions rooted in local culture, identity, tradition, innovation, and knowledge. Self-help methods are more effective and empowering than those led by external agencies.**
- **The environmental challenges faced by rural communities in the Global South could initiate research and applications of socio-ecological interactions in the Global North.**
- **Building relationships across social, political, and academic divides can produce the positive impacts needed to foster adaptation in environmentally challenged communities.**

Talk 5
Urban green infrastructure and its links with human health and wellbeing

Professor Sarah Lindley, School of Environment, Education and Development, University of Manchester, UK

The future of urban areas can be sustained through the implementation of practices that will lead to a greener future. These practices should include interaction with affected communities in the planning process and development of urban areas. The example of urban Greater Manchester demonstrates that inclusivity, which occurs particularly around green spaces, ensures that the voices of local communities are heard and contribute effectively to making their cities greener.

While green infrastructure reduces heat, noise, and air pollution, it also influences people's social welfare in terms of behaviour and mood.

Green spaces are important for an ageing population

but in Manchester, as in many cities, healthy ageing is unevenly distributed based on the (lack of) availability of green spaces and the economic welfare of different areas.

The Accessible Natural Greenspace Standard (ANGSt) [20]

Natural England, a public body in the UK, recommends the Accessible Natural Greenspace Standard (ANGSt). ANGSt is a powerful tool in assessing current levels of accessible natural greenspace, and planning for better provision. The three underlying principles of ANGSt are:

a) Improving access to greenspaces,

b) Improving naturalness of greenspaces, and

c) Improving connectivity with greenspaces.

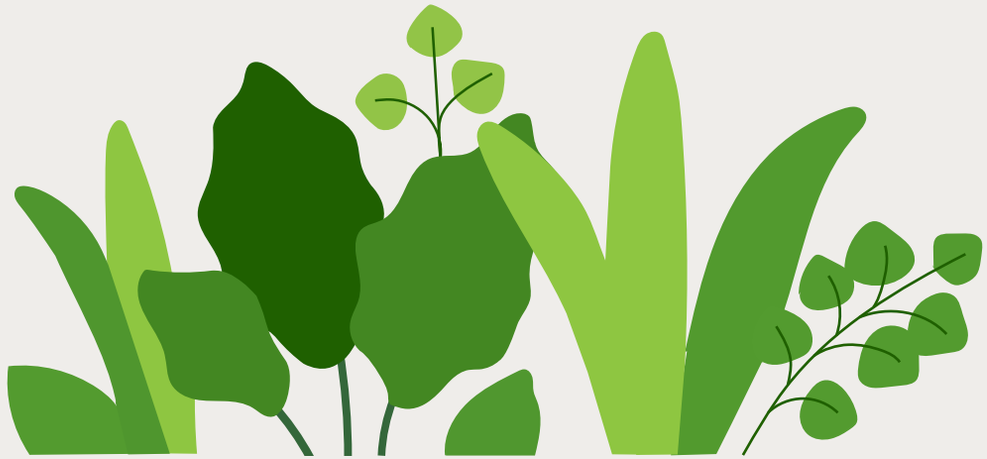
The standard recommends that everyone, wherever they live, should have accessible natural greenspace in line with the below guidelines:

- of at least 2 hectares in size, no more than 300 metres (5 minutes' walk) from home;
- at least one accessible 20 hectare site within 2kms of home;
- one accessible 100 hectare site within 5kms of home; and
- one accessible 500 hectare site within 10kms of home; plus a minimum of one hectare of statutory Local Nature Reserves per thousand population.

Professor Lindley's research has further highlighted the importance of greenspaces to an isolated ageing population and a healthy community, highlighting the following benefits of green space availability and uses: [21]

- Enjoyment of the experience provided by the natural world and its wonders;
- Opportunities for social interaction;
- Facilitation of diverse activities, which bring exhilaration and surprise, peace, and restorative and evocative thoughts;
- Provision of independence.

Image Credit: Sarah Lindley



Reflections by Professor Sarah Lindley

The event was an excellent opportunity to connect with a new audience.

It gave me an opportunity to disseminate emerging findings from the multi-disciplinary 'Green infrastructure and the Health and wellbeing Influences on an Ageing population' (GHIA) project (funded by NERC, the Arts and Humanities Research Council (AHRC) and the Economic and Social Research Council (ESRC) under the Valuing Nature Programme – NERC grant reference number NE/N013530/1). As a direct result of presenting at the event, I was invited to present to the Manchester Statistical Society in 2020. Several academic and PhD student members of physical geography research groups and the Female Academics Network also attended the event and found it useful for networking and connecting to people with allied interests.

Key message

- Urban green spaces, infrastructure, and human health are interrelated.
- Access to green spaces is essential to wellbeing but unevenly distributed, with less green space in deprived areas of the city.
- Greener futures could be enhanced by communication between, and inclusion of, interest groups in planning and development.

KNOWLEDGE EXCHANGE WORKSHOPS

05

05 KNOWLEDGE EXCHANGE WORKSHOPS

This section presents summaries of the knowledge exchange breakout sessions moderated by facilitators during the WiES events. It includes a short summary of each session, key messages, and reflections from facilitators and participants. The knowledge exchange sessions provided an important space for discussion and information sharing between presenters, facilitators, and participants based on the themes of the earlier presentations.

Session 1
Female environmental leaders/followers: having impact at any level

It is important that education breaks down, rather than reinforces, the gender barriers between boys and girls from childhood.

A step change is needed to break gender stereotypes

and a discussion about stereotyping needs to be initiated among different groups to remove barriers to women's professional development and progress. For example, while men could be perceived as being assertive in professional spheres, corresponding behaviour by women could be seen as aggressive. Therefore, women need to work harder to express themselves professionally through their roles.

There is now more support and solidarity among women, even between those pursuing diverse careers. Women should encourage each other positively rather than being competitive. It is important that employing organisations have open discussions about career breaks and encourage their staff to do so. This should be seen as the norm rather than an exception because a positive work-life balance is healthy. Employees should be supported to choose their own priorities.

At the national level, women can make a huge impact through their contributions towards positive change in environmental policy. This in turn filters down to the grassroots level.

Key messages

- **Social barriers and stereotypes inhibit women's access to, and success in, environmental career pathways. Women and support from organisations are needed to effect change.**
- **Women have important roles to play in environmental policy change at all levels.**

Session 2
Implementing environmental science through integral roles

Facilitated by Dr Emma Gardner, Sustainability Directorate, University of Manchester, UK

Sustainable procurement is key in all organisations to reduce their environmental impact.

It is important for scientists to communicate and present their research to diverse groups in formats that can be understood by non-technical readers.

Focusing on the language of communication is important to fulfilling the ultimate aim of getting environmental messages across.

When undertaking environmental decision making practices, it is important for organisations to consciously and collectively delegate responsibilities equally and fairly. Staff should be encouraged to undergo training and development. In this context, women need to be more confident and empowered to apply for positions of their choice.

Opportunities for women can be facilitated by promoting positive changes in leadership and by rethinking priorities to consider a diversity of skills, culture, and inclusion. For example, there is a need to invest emotionally in the environment and this can be achieved through thinking about future generations and creating positive working opportunities in the environment sector.

At present, inequality in how boys and girls are treated at an early age pervade social and professional practices. Women can be kept in the background due to societal/cultural beliefs; women therefore need to support each other to overcome these challenges rather than being competitive with one another. Networks that support and encourage women to develop their skills can drive positive change.

Key messages

- **Sustainable procurement is needed to reduce organisations' environmental impact.**
- **Environmental decision making should include employees from diverse backgrounds.**
- **Organisations should review leadership and priorities to facilitate women's equal involvement in environmental decision making.**

Session 3
Integrating science, society and sustainability: too much or too little of water

Facilitated by Dr Rosalind Bark, University of East Anglia, UK

Water resources are key to all living things, yet droughts and floods are common and climate change projections suggest they will become more frequent and long lasting in the future.

Globally, women and children are disproportionately affected by droughts and floods.

It is important to consider what options are available to integrate knowledge within and between communities to minimise the impact of these hazards. This includes identifying opportunities to partner with groups to reduce the impact of these challenges, and considering ways to drive change.

The growth of the human population will also impact on water quantity and quality, both of which represent important factors in relation to human health and wellbeing. Education and increased awareness are needed on how to use water efficiently and how human activities negatively affect water quality. The lack of sufficient, good quality water could initiate behavioural change and raise awareness of other environmental health and social issues.

Opportunities for engaging communities in water awareness and management include:

- Encouraging local participation to report environmental pollution.
- Introducing water management awards to organisations, hostels, and buildings.
- Creating catchment partnership groups to manage waterbodies, involving interested members of the local community, researchers, and businesses.
- Facilitating community interaction at key sites, such as rivers. In less developed economies, these are social places for women, where they obtain water and wash. In the Global North, social activities around rivers could include organised walking groups.

Key messages

- **Water is important to human health and wellbeing but increasingly brings threats (droughts, floods) and is subject to environmental pressures (population increase, pollution).**
- **Water awareness needs to be increased among affected groups, among which women and children are disproportionately affected.**
- **Different measures can be taken to involve communities in the better management of water.**

Session 4
Women in industry: who wants to stand on a building site in the rain? Facilitated by Claire Brown, MACE, University of Manchester, UK

Claire Brown, MACE, University of Manchester, UK and participants

Changing climatic conditions (e.g., increased rainfall, very low/high temperatures) impact every aspect of the environment. This include workplaces, such as construction sites, and the materials being used in them. Women working in the construction industry face challenges to their health, role delivery, career development, etc.

The construction industry is a male-dominated workplace, and more awareness is needed about health matters that affect the roles of women especially. Women also face barriers in the workplace including in the design of Personal Protective Equipment (PPE), which is not suited for all women, including those who are heavily pregnant. It is common for women to leave a company due to unfavourable conditions, such as discrimination or the incorrect interpretation of policies.

Women should be encouraged to speak up to create the change needed to correct these situations by submitting complaints anonymously. Female leaders in construction are required to support new colleagues. Women's groups within businesses could serve as support networks to help address complaints and boost female confidence, making them less isolated. Flexible hours should be encouraged in businesses to support women and others with caring responsibilities, and to avoid overwork among all employees.

A diverse, inclusive workforce creates a better work environment for all and should be encouraged.

Open and effective staff recruitment exercises can foster engagement and interest in the industry from underrepresented groups,

such as women and different ethnic groups. Promoting female representatives and their presence at career fairs may encourage more women to apply for jobs in the industry. Industries in which women are underrepresented could also employ women at lower educational levels and support initiatives that encourage girls to take up STEM subjects at A-level.

Key messages

- **Climate change is exacerbating challenging working conditions for women in industries such as construction.**
- **Women should be encouraged to speak up and support one another to foster change.**
- **Organisations should take measures to increase the diversity of the workplace, which in turn improves working conditions for all.**

Session 5
Environmental changes, society, culture, and health: awareness, communication, and control

Facilitated by Professor Ann Webb, Department of Earth and Environmental Sciences, University of Manchester, UK

This session engaged with the following questions:

- How can we educate women, particularly those in disadvantaged communities, to respond to environmental changes in a sustainable way while also protecting the health and wellbeing of themselves and their families?
- How can we partner with (local) groups to reduce environmental impact on women and children?

Higher temperatures and increasing air pollution are two major environmental challenges that have the potential to affect human health across the globe. International political will may be required to face the climate challenge but local initiatives can be used to reduce and mitigate the impacts where they are occurring, protecting local people and their environment.

It is important to acknowledge that women and children are the most vulnerable to climate change effects.

They can be more susceptible to disease, especially young children and pregnant women, and women frequently bear the burden of providing food, water, and care for the family. This challenge increases if climate change impacts on the availability of food and water, which can further exacerbate other negative effects on health. These effects are felt first and most harshly by the already disadvantaged.

In approaching these questions, we must recognise the challenges faced by low income and vulnerable groups in our communities. While environmental issues may not be the priority of those on low incomes, by addressing their immediate needs (e.g., providing food for children and families) environmental awareness can then be introduced. To gain traction, environmental knowledge and action needs to provide a practical benefit, such as turning wasteland into an allotment to provide food for the local community.

Increasing awareness and promoting effective communication to diverse groups needs to be achieved in ways that are inclusive. Scientists and academics are at risk of talking down to community groups, even inadvertently and while trying to help. It is important to consider the language used and not lecture/inform as a distant expert, but work with people in equal partnership. The subject expert may know the theory, but the community knows how this truly impacts their lives.

The following actions could be taken to encourage sustainable mitigation of climate effects:

1. Promote healthy eating campaigns and a culture of sustainable dieting.
2. Promote actions such as "Clean Air Day" to encourage sustainable energy use and raise awareness in ways that educate across diverse groups.
3. Encourage cycling to benefit fitness and reduce air pollution.
4. Introduce free public transport before 7am and after 7pm to improve the safety, security, and confidence of those who need to travel, as well as providing a financial incentive to leave the car at home (for those who have one).

Methods of engaging with widespread communities include:

1. A focus on children, who are a good conduit to engage and educate families, and to raise awareness of environmental issues.
2. Effective advertisement of public engagement activities to encourage more participation from members of the communities.
3. Researchers making their research more impactful by connecting with the needs of their local communities at the planning stage and throughout the research dissemination processes.
4. Turning community environmental engagement activities into social/popular events to attract more diverse groups of people, e.g., inviting 'celebrity scientists' to events or engaging selected NGOs to attend university open events.
5. Using music and arts to communicate important environmental issues.

Reflections by Professor Ann Webb

The WiES event brought together a broad range of people, predominantly but not exclusively women, to discuss environmental issues that affect our society and how these might be mitigated. At one level these are really big questions whose solution needs a concerted effort and real political will at national and international level. My own area of expertise (ozone and ultraviolet radiation) has demonstrated, through the Montreal Protocol, that international initiatives can mitigate potential environmental disasters. Climate change is a bigger, more complex issue, but also one with more scope for local, grassroots initiatives that can have an impact now, in the communities where they occur.

The breakout sessions led to spirited discussions amongst a vibrant group of contributors, where everyone was comfortable expressing their views, especially after I learned my biggest lesson of the day. I was pulled up for (quite unconsciously and unintentionally) using language that could be construed as divisive or patronising (as in 'us the experts, and you who are not'). Fair enough, I will strive to do better. I stand by my own expertise but recognise that it is limited. 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 with the consequences.

Key messages

- **Managing and raising awareness of the impacts of environmental change requires solutions at all levels, from the local to the global.**
- **Effective strategies seek to provide solutions to the challenges already faced by diverse communities and low income groups. Experts should develop equal partnerships and learn from community needs.**
- **Public engagement activities benefit from imaginative approaches.**

Session 6
Citizen science: on the brink of an open science revolution

Facilitated by Ms. Kat McGavin, Earthwatch Institute, Oxford

This session focused on how research institutions can collaborate and engage with local groups to promote education for women of diverse age groups through citizen science. Citizen science is also known as volunteer monitoring, community science, crowd science, and civic science. It refers to the collection and analysis of data by members of the public, typically relating to the natural world as part of a collaborative project with professional scientists. Such public participation in scientific research is also called participatory action research (PAR).

This participatory approach to engagement aligns with the UK-wide NERC Community for Engaging Environments research project. [22] This project aims to engage a broad range of audiences, including those typically less represented in public engagement activities, through partnerships with NGOs, academics, and community groups. Studies show the local communities can be trained to effectively use technologies to address pressure points in air, soil, water, and sound pollution – for example, the EU Horizon 2020 project Making Sense, which aimed to show the work done by empowered citizens of Barcelona (Spain), Pristina (Kosovo) and Amsterdam (the Netherlands). [23] These groups addressed environmental issues through technology.

The discussion highlighted the relationship between researchers, policy makers, and members of the community. Integration between these groups is needed to protect and ensure environmental sustainability of natural resources. A bottom-up, participatory approach to leadership is necessary to make science more accessible and to empower underrepresented groups and local communities.

Reflections by Dr Toos van Noordwijk, Earthwatch, UK

Thousands of citizen science initiatives (i.e., projects that engage non-scientists in data collection and/or analysis) have sprung up in recent years. Involving non-scientists in research can bring a wide range of benefits, including:

- access to more or different types of data (e.g., from private land or over a wide geographic area);
- enabling collaboration across different stakeholders and communities, creating shared benefits and understanding; and,
- combining different forms of knowledge (e.g., data about the physical environment with local knowledge or data about how people experience the environment).

Dr Toos van Noordwijk, Earthwatch, UK
Image Credit: Toos van Noordwijk

Earthwatch framework

Earthwatch has developed a framework that articulates six key pathways to impact:

1. Collecting data or evidence to inform environmental management;
2. Collecting data or evidence to inform policy creation or monitoring;
3. Inspiring personal behaviour change among participants;
4. Inspiring participants to become champions and influence their social network;
5. Inspiring political advocacy; and,
6. Inspiring direct community action.

In addition, citizen science provides an alternative route into involvement with scientific research. This can be particularly valuable for groups and communities that are underrepresented at university.

Citizen science projects can be a first step to engaging with scientific topics and techniques.

In addition, it provides opportunities for non-scientists to conduct research that is relevant to them and may not be on the agenda of major academic institutions. Citizen science can thus contribute to the democratisation of science.

To facilitate this, 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. The NERC funded Engaging Environments projects, which started in 2019, aims to facilitate this.

There are many types of citizen science projects, spanning from long-term monitoring by highly skilled volunteers, to community-led actions to address a specific pollution source, and education projects conducted by schools or museums. These projects can all create positive environmental change but do so in different ways.

Citizen science can thus empower communities - and women in particular – to become more involved in environmental sciences and to benefit more from environmental research. It also enables these groups to have greater impact and to leverage not just the data, but also their social networks to drive positive environmental change.

Key messages

- **Citizen science refers to the involvement of non-scientists in data collection and/or analysis and is becoming increasingly popular.**
- **Citizen science projects can increase the range of environmental data and projects that can be undertaken.**
- **Participant involvement in scientific research increases the accessibility and democratisation of science, and can lead to behaviour change.**

EVALUATION

06

06 EVALUATION

Evaluation is an important aspect of any successful project and was key to the WiES events. It provides information both on who attended the events and on their response to them. Evaluation of the WiES network was sought from presenters and participants at both events. Lessons were learned from the 2018 event and implemented in the organisation of the 2019 event.

The vast majority participants were very satisfied or satisfied with the events (90% in 2018, 88% in 2019) and reported that they provided many opportunities for interaction as planned – 65% of participants at both events reported that there were many exchanges or that everyone got a say, versus no participants reporting interaction as one-way.

The age groups (18-55) and career stages represented at the events ranged from students to early career and more experienced professionals, with a balance across different age groups. Most participants were academics, including students, but participants also came from industry, civil society, policy making, and the general public. The ethnic diversity was greater at the 2018 event (14% Black/Black British; 6% Hispanic; 6% mixed; and 6% Asian, compared to 67% White British/other White) than at the 2019 event (3% Black/Black British; 6% Hispanic; 3% mixed; and 8% Asian/Asian British, compared to 79% White British/other White).

The feedback from the 2018 event showed a preference for longer knowledge exchange and breakout sessions, so the time allocated to these sessions was increased from 20 to 40 minutes. However, feedback from 2019 showed that longer sessions still would have been beneficial. In general participants would have liked a longer day covering more topics suggesting value in the events and interest in additional content. Promotion of the events and community engagement was also identified as key to attracting diverse audiences.

2018 responses to
What is the one thing you liked the most?

2019 responses to
What is your take home message from this event?

Participant stories

Returning to education

Claire Brown
University of Manchester, UK
Participant in 2018 and facilitator in 2019

The WiES network has been pivotal in helping me facilitate my change in career. I attended the first session in the summer of 2018. I had seen the advert on a social media portal and thought that it looked like a great workshop to attend. What I found so fascinating is that everyone there was, like me, driven by their passion; their passion for making a difference and acting on that enthusiasm to change society. Having a workshop to enable discourse around a variety of topics led delegates to feel impassioned about choices that they could make. For some, it might have been a reaffirmation that their career choices and job role were where they needed to be. For me, it was a trigger to confirm that I needed to step away from a commercial business.

The day after the event was a decision point for me. I had applied for and was offered a PhD studentship at the University of Manchester. Almost 19 years since I had first begun my post-18 education, it was an opportunity for me to re-enter the academic world. The WiES workshop enabled me to have confidence in my decision to accept and start my PhD journey in September 2018.

One of the successes of these organised events is that of networking. 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.

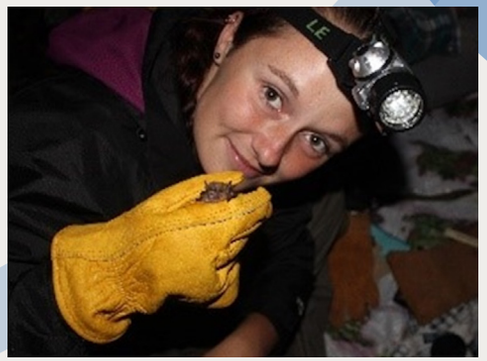
For those who are new to their role, or looking for upward movement and progression, I am sure that these events have proven to be useful and practical.

In 2019, I was honoured to be able to help and support the second WiES event and took on the role of a facilitator for one of the sessions. I was particularly interested to hear about some of the barriers that people had experienced or anticipated that they might experience in certain roles. My group was dynamic and forward in their opinions, but respectful and great at listening to others. These are all qualities that should be embraced by any business. Our discussion was full of honest experiences that people had witnessed or experienced first-hand, from the space scientist who found out there was no female toilet in the laboratory to the environmental consultant who had been impressed by the University of Manchester's gender-neutral toilets. We were able to discuss how in some examples it was other women who were restricting access or progression. The group was also keen to explore ways to take action and make the changes that we felt were necessary. We talked at length about supporting each other, rather than seeing it as a competition to win against another woman. The influence of positive role models was also highlighted, as was the value of the STEM Ambassador volunteer scheme, of which I am also a supporter.

Most importantly, at the end of the breakout session my group had an opportunity to feedback what we had discussed, all in an atmosphere of support and life-long learning. I would like to finish with a quote from Maya Angelou :

I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel.

Connecting with women



Danielle Hinchcliffe, University of Manchester and Salford University, Participant in 2018
Image Credit: Danielle Hinchcliffe

Having just joined the University of Manchester six months into my postdoc, I was very interested to see the WiES event advertising an event that would focus on encouraging and inspiring women in environmental sciences. My new postdoc involved developing physiological markers to measure animal responses to environmental stress and so, while not directly embedded in the field, my previous years of study as an ecologist made me feel confident enough to register to attend.

Up to that point, I had found my experience at Manchester to be quite isolating and lonely. I was desperate to connect with other women who may be sharing similar experiences and challenges, to who I could potentially look to as role models and generally build a network that could provide both personal and professional support. Fortunately, I had done my PhD at a university that was actively working towards achieving equality in the workplace and was surrounded by remarkable women with impressive careers.

Therefore, coming to Manchester I was already enthusiastic to network and continue the fight against issues such as the gender pay gap, and promoting equal opportunities in the workplace. The event itself was a series of presentations followed by question-and-answer sessions, with an additional breakout session to give participants a chance to engage in discussions around environmental sciences as an interdisciplinary research theme and the role of women. That said, not all participants were women – I recall a couple of men present which I personally found encouraging.

All the plenary speakers were women, and they were outstanding. This was the first time I was able to meet Dr Cecilia Medupin, a lecturer within my department at the university and convenor of the WiES workshop. It was hard to believe that this fantastic lady was on the same floor as me in the same building, and yet there was no real facilitator within our school for interaction – until this workshop. Professors Cathy Hollis and Alice Larkin gave motivational talks that shared their own personal experiences and advice for how to grow and navigate our career paths.

One thing that really stood out as a common piece of advice was that, as women, we should be building each other up and not tearing each other down. Women face enough tough times trying to fight for gender equality and have their potential and achievements rightfully recognised. We most certainly should not be viewing each other as competition, but instead as powerful allies. The breakout sessions were particularly useful as each session focused on specific themes that had been identified as relevant, engaging, and useful. It was a safe space where we could talk openly, passionately, and productively about our research fields and identify SDGs.

Overall, the event encouraged inclusiveness, positivity, and a strong work ethic. As a scientist who tackles environmental conservation issues at both local and international levels, I found the plenary from Dr Olutayo Adebowale particularly inspiring when she discussed her experience in leadership at the global scale and how she was able to make such transitions in her career. For me, the take-home message was that

as women we should look to each other for mentoring, support, and development, so that we can climb the career ladder faster and more efficiently.

There is a need for more women to take on leadership roles in science but these opportunities must first be made available and more accessible for the next generation of women. We must lead the way by working together.

Safe streets

Sue Pascoe
Friends of the Earth, Safe Streets for Children group.
Participant in 2019
Image Credit: Sue Pascoe

I felt privileged to be invited to the WiES event in 2019. It was really inspiring to see what can happen in communities, and to see the efforts individual women are making. The projects that were highlighted were close to my heart, and it was encouraging to be asked to give feedback on the work Safe Streets for Children is doing in the local community in South Manchester.

Sharing information makes for good communication and reinforces good work through example.

Positive stories then get emulated by others. An example of this is the Walking Bus project, which started at Alma Park Primary School with other schools following suit. One school has now been promised a 'School Street', which will mean there is limited access to cars, improving the air quality as well as safety of children walking to school.

Scientists are going to have a challenge in the years to come. It will be so important that scientists reach out into the community, and that willing citizens engage with scientists to work on environmental projects, both close to home and further afield. I sincerely hope that more conferences like the WiES events can happen, and that researchers can glean information from what is happening in the local environment. Universities need to be places of inspiration for us all: the flow of knowledge can then be attuned to meet the needs of the ordinary citizen, and we can all work together to create a better future.

The Safe Streets for Children group of Friends of the Earth

Safe Streets for Children was created to tackle the huge problem of air pollution and children's safety as they walk to school. In south Manchester, UK, women have come together in the face of an air pollution emergency: in the area of Levenshulme, air pollution has exceeded or is approaching dangerous limits (as defined by the World Health Organisation, which states that 90% of all the world's children currently breathe unsafe air). [24]

Awareness raising with Safe Streets for Children included the health benefits of walking to school and a campaign to increase the number of children walking to school. This is a case of having to start somewhere, with local knowledge facing local issues and highlighting problems experienced everywhere. This group, which was set up to help children walk to school safely, has grown in its outreach to join forces with the Bee Network (a proposed integrated transport network for Greater Manchester) and London-based parent-led action group Air Team. On Twitter, Clean Air Levenshulme disseminates information with the aim of joining the community together to tackle pollution.

Environmental sciences are for everyone and women need to know they can use their knowledge to effect change.

07 THE WiES TOOLKIT

The WiES toolkit is based on experiences from the 2018 and 2019 events and wider network. It brings together key learning outcomes so that others can draw and build on them in advancing the importance and role of women in environmental sciences.

Bringing women together

- More open and safe avenues are needed in which women can come together to build networks and communities and be inspired about common issues.
- Events can provide a chance for women to listen to presentations, voice their opinions, share experience, and listen to the challenges faced by others while being motivated and enthused by experienced female leaders.
- Quality engagement takes time to design, build, establish, and evaluate. The same goes for forming project teams and building capacity. This should be planned for from the start.
- Events should provide plenty of time for discussion and knowledge sharing.
- It is important to promote information sharing to ensure that events reach diverse groups and networks.
- Communication is key to equal participation so researchers must use accessible, respectful language and listen to feedback from communities.
- Partnerships and networks facilitate research, communication, and career progression.

Understanding the position and potential role of women in environmental sciences

- A step change is needed to break gendered stereotypes and organisations should rethink priorities to better value diversity.
- Inclusiveness and widening participation are important values for sustainable leadership/followership in any organisation.
- Women should be empowered to make choices in their careers and about their work-life balance.
- Trust and respect are important for building relationships between researchers, practitioners, and the public.
- Environmental topics can create opportunities for communal identity, tolerance, inclusivity, and collectiveness.
- Environmental research and the importance of gender equality can be disseminated through education, beginning with children.

Reflecting the interdisciplinary nature of the environmental sciences

- Environmental sciences have many different facets and are interdisciplinary in nature.
- Environmental research should relate to the context on the ground and have a sustainable aspect to it, providing self-help solutions to everyday problems to engage communities.
- The SDGs offer a framework to structure engagement on key challenges facing society, especially around the environment and gender equality.
- Ecoproofing and effective engagement are key elements for conducting research with impact
- Women and girls need to be part of the solution not least because they are disproportionately affected by environmental disasters, conditions, challenges, and transitions.

Providing an empowering and informal atmosphere

- Women should be encouraged and empowered to speak up to create organisational change. In turn, women should promote effective communication towards the change they would like to see.
- Diverse workforces are better workforces and can be built through open and effective recruitment, leadership, and equal opportunities.
- Women are encouraged to participate more in STEM recruitment fairs to encourage others.
- Citizen science approaches should be considered for environmental research, as it empowers society, enhances participation, and inspires action.
- Community interaction and involvement should be central to research planning.
- Conducting local, grassroots research and community outreach are appropriate routes to create national and international impacts.
- We can all do more!

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Dr Rosalind Bark is Lecturer in Ecological Economics, School of Environmental Sciences, University of East Anglia, UK. Her research interests focuses on water resources management in times of change and integrating ecosystem services (including cultural ecosystem services) in decision making. This has involved using non-market methods to monetarily value urban green space, instream flows, and ecosystem services in water scarce environments, market-based instruments design as part of basin scale water resources management reform and restoration, as well as several studies on sustainable agriculture. Rosalind is a member of the Centre for Social and Economic Research on the Global Environment (CSERGE) and the 3S (Science, Society and Sustainability) Research Group.

Ms Claire Brown is a chartered environmentalist and environmental professional with over 15 years' experience in public, private, and third sector working in Greater Manchester and Northwest England. Claire has worked in landscape planning and management and is currently undertaking doctoral research at the Department of Mechanical, Aerospace and Civil Engineering (MACE), *University of Manchester, UK,* in power networks, focusing on heating cooling in houses in a changing climate.

Dr Emma Gardner is the Diocesan Head of Environment at the Catholic Diocese of Salford, UK. She also manages the flagship Laudato Si Centre, which enables the Diocese to play its part in addressing the climate and ecological crisis and work together to take action. Prior to this role, Emma was Head of Environmental Sustainability, University of Manchester, UK, for over eight years. She led on the development and implementation of the university's environmental sustainability plan which covers the university's four faculties, several major research institutes, professional support services, and cultural assets. Emma was responsible for developing and implementing an enabling framework for the delivery of the university's carbon reduction targets as set out in the carbon management plan. In addition, her directorate supports the delivery of the sustainable travel plan, sustainable waste plan, and other areas including biodiversity and sustainable design and construction of new builds and major refurbishments. Emma Gardner received a MSc in Environmental Resources then a PhD in Sustainability from the University of Salford, UK. Emma has worked in diverse roles in industry and environmental consultancy on wider environmental issues and sustainability.

Dr Danielle Hinchcliffe is Teaching Fellow at the University of Salford, UK, having gained a PhD in molecular ecology from the University of East Anglia, UK, and worked as Senior Scientist for the NGO Operation Wallacea. Following this role, Danni became a post-doctoral researcher at the University of Manchester, UK, and was a Research Fellow at Chester Zoo. Danni is passionate about science communication and outreach, particularly women in STEM, and working towards a diverse, interesting, and welcoming science community that is inclusive and rewarding for all.

Professor Cathy Hollis is Chair of Carbonate Geoscience and Professor of Petrophysics and Petroleum Geology at the University of Manchester. Before joining University of Manchester, Cathy worked for 15 years in industry, as a consultant carbonate sedimentologist for Badley Ashton and Associates (1995–2001) and as a reservoir geologist for Shell (2001–2007), including a period as Team Leader for the Carbonate Research Team (2005–2007). She is the research group lead for sedimentary basins research in the Department of Earth and Environmental Science, as well as co-ordinating carbonate research within the group. Cathy is principal investigator on an industrial research consortium (PD3) with the Universities of Bergen, Bristol, and Liverpool, and she actively collaborates with research groups in France, Germany, and Qatar. She was appointed to the UK REF2021 assessment and since 2014 she has been an Associate Editor for Sedimentology.

Professor Alice Larkin is Professor of Climate Science and Energy Policy, University of Manchester, UK. Alice is Head of the School of Mechanical, Aerospace and Civil Engineering and a researcher in the Tyndall Centre for Climate Change Research, University of Manchester. Alice trained as an astrophysicist in Leeds, did her PhD in climate modelling at Imperial College, then worked in science communication. She returned to academia joining the Tyndall Centre in 2003 to research conflicts between climate change and aviation policy. Her work on carbon budgets helped shape the UK's Climate Change Act and inclusion of aviation within policy frameworks. She became a professor in 2015, received a Researcher of the Year award from the University of Manchester in 2016, and leads Engineering and Physical Sciences Research Council (EPSRC), UK, projects on the water-energy-food nexus and decarbonising shipping.

Professor Sarah Lindley is Professor of Geography, School of Environment, Education and Development (Geography), University of Manchester, UK. Sarah received her first degree, in geography, from the University of Hull and then received a NERC scholarship to study for an MSc in Geographical Information Systems at the University of Edinburgh. She pursued her doctoral and postdoctoral studies at the Atmospheric Research and Information Centre (ARIC), Manchester Metropolitan University Metropolitan University, on the topic, 'Development of a spatially resolved emissions inventory for local air quality management applications'. Sarah has progressed in her careers at the Centre for Urban and Regional Ecology (CURE), School of Planning and Landscape, University of Manchester, and as Lecturer and Senior Lecturer in GIS, School of Geography, University of Manchester.

Dr George McAllister is Assistant Professor at the Centre for Agroecology, Water and Resilience at Coventry University. Having worked in NGOs since the early 1990s, George's experience spans both humanitarian and development sectors in Europe, the Middle East, South East Asia, Pacific and sub-Saharan Africa. George has a 1st Class BA Hons degree in Peace Studies from the University of Bradford, and a Master's degree in Post-War Reconstruction and Development from the University of York. At this point she developed an interest in creating more inclusive and sustainable forms of community engagement, which view the environment and its hosts as part of the long-term solution. This invariably drew her to agroecology. Co-founding UK NGO GardenAfrica in 2001, George has been co-developing innovative plant-based livelihoods approaches with farmers and civil society organisations which explore strategies to stimulate localised economic opportunity while navigating socio-ecological change.

Dr Cecilia Medupin is Senior Lecturer at the Department of Earth and Environmental Sciences, University of Manchester, UK. Dr Medupin has a proven track record of leading the design, delivery, and evaluation of interdisciplinary environmental science workshops. Nationally, Cecilia is the convener of Women in Environmental Sciences (WiES), a co-investigator on NERC's Community for Engaging Environments, and a member of the British Ecological Society's equality and diversity working group. Cecilia brings her experience of being an African woman with diverse experience of living and working in the UK. She is the convener for the pilot study on Connectivity and Inclusivity in Higher Education - A solutions-based approach.

Dr Toos van Noordwijk leads the science, policy and innovation team at Earthwatch Europe, an environmental NGO and independent research organisation. With a background in both conservation research and public engagement, she is active in various international networks to advance citizen science as a tool to create positive environmental change. She has a passion for the natural world in all its weird and wonderful forms and is committed to providing opportunities for people from all walks of life to explore, enjoy and benefit from nature too.

Professor Ann Webb is Professor of Atmospheric Radiation, Head of Department and Former Associate Dean, Graduate Education, at the Department of Earth and Environmental Sciences, University of Manchester, UK. Ann's research work remains at the interface between disciplines, with radiation and (sun)light as a central theme. She has strong collaborations with the Medical School and photobiologists as well as modelling and experimental work in the atmospheric sciences. She has held numerous roles at the World Meteorological Organisation (WMO), was President of CIE (Commission Internationale de l'Eclairage, or International Commission for Illumination), and is currently UV Working Group lead for the International Radiation Commission and member of the Editorial Board for the WMO Commission for Instruments and Methods of Observation (CIMO) Guide.

10 NOTES

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