Royal Academy of Engineering

Symposium report

Frontiers symposium

The nexus in action

Navigating the water-energy-food-environment nexus for climate-resilient and inclusive futures

7 to 9 February 2024

Who's Denilo (Unsplash)

Royal Academy of Engineering

Introduction to the Frontiers symposia

The Frontiers symposia bring together around 70 of the best early- and mid-career researchers and practitioners from industry, academia, non-governmental organisations (NGOs), and the public sector in multidisciplinary workshops that address fundamental development challenges.

The symposia's objectives are to encourage collaborative work that addresses international development challenges and to promote cross-disciplinary thinking among the next generation of engineering leaders.

Competitively allocated seed funding is available to strengthen the collaborations developed at the symposia.

الجمعيّة العلميّة الملكيّة
Royal Scientific Society

Higher Council for Science and Technology
المجلس الأعلى للعلوم والتكنولوجيا

iR&Df
صندوق دعم البحث العلمي والتطوير في الصناعة
Industrial Research and Development Fund

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Symposium

Delegates met for three sessions over two and a half days, which were interspersed with networking opportunities, receptions, and dinners. The symposium was held at the Jordan Museum in Amman, Jordan, in partnership with the Royal Scientific Society and the Higher Council for Science and Technology.

Frontiers insights: The nexus in action

The Frontiers event took place at the Jordan Museum in Amman, Jordan between 7 and 9 February 2024 and was co-organised with the Royal Scientific Society[1] and the Higher Council for Science and Technology[2]. The event, co-chaired by Dr Majd Al Naber and Professor Iqbal Mujtaba FREng, saw over 70 delegates from different disciplines and 22 countries come together to discuss how to leverage the water-energy-food-environment (WEFE) nexus to build climate-resilient and inclusive futures.

As climate change and conflict worsen complex challenges to water resources, energy supplies, food security, and ecosystems, there has never been a more urgent time to advance holistic solutions.

As Professor Iqbal highlighted, issues facing this nexus have direct impacts on human livelihoods, using water as an example: "Water is everybody's business." Three out of four jobs in the global workforce are either heavily or moderately dependent on water, while water scarcity has likewise been highlighted as a key driver of conflict. Water issues also greatly impact women, who in many communities often do not have access to sanitation services, which poses risks to their safety.

"Water is everybody's business"
Professor Iqbal Mujtaba FREng, University of Bradford

However, the interconnectedness of nexus issues offers a unique opportunity: it means that solutions can have exponential impacts across water, energy, food, the environment, and more. Improving access to clean energy, for example, can allow for safer, faster cooking methods in remote communities. In turn, this can reduce the negative health impacts that cookstoves can have on women, and reduce the amount of time spent cooking, freeing them up to engage in other income-generating activities. Underlining this, Dr Majd said, "The nexus is a concept of thinking."

"The nexus is a concept of thinking."
Dr Majd Al Naber, Science for Society Centre, Royal Scientific Society and West Asia-North Africa (WANA) Institute

At the same time, the nexus requires cross-disciplinary, international thinking to ensure equitability, resilience, and inclusivity in all solutions. Opening the symposium, Dr Raed Odeh, Assistant Secretary-General for the Higher Council of Science and Technology, said, "This symposium bridges the gap between cutting-edge research and practical action."

"This symposium bridges the gap between cutting-edge research and practical action."
Dr Raed Odeh, Higher Council of Science & Technology

The symposium brought an interdisciplinary approach to discussions on the WEFE nexus by bringing together engineers and non-engineers from a wide range of backgrounds and sectors. The event centred around three sub-themes:

- WEFE nexus for human security and inclusive society
- Research and development (R&D) and technology to leverage the WEFE nexus for smart and resilient cities
- Innovative uses for the WEFE nexus.

This report summarises the wide range of expertise and insight from the discussions and activities that took place at the symposium.

[1] https://www.rss.jo

[2] https://www.hcst.gov.jo/

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Dr Majd Al Naber

Dr Majd Al Naber is the Director of the Science for Society Centre at the Royal Scientific Society and the Director General for the West Asia-North Africa (WANA) Institute. She leads the effort to advance the use of science to inform and educate society and inspire policymakers for sustainable environments and better livelihoods. She is also a specialist in sustainability and integrated natural resources management and policies in arid regions.

Professor Iqbal Mujtaba FREng

Professor Iqbal Mujtaba FREng is a professor of chemical engineering at the University of Bradford, a fellow of the Royal Academy of Engineering, and a Fellow of the Institute of Chemical Engineers (IChemE). Professor Mujtaba leads research in distillation, energy, desalination, and wastewater treatment. He has also co-authored the textbooks Wastewater treatment by reverse osmosis, and Desalination technology: design and operation. He also co-edited the book, *Water-food-energy nexus, water management: social and technological perspective.*

Session one

WEFE nexus for human security and inclusive society

Session chairs

Dr Maha Al-Zu'bi, International Water Management Institute (IWMI) – MENA

Shaila Shahid, Tomorrow's Cities

Dr Sally Weston, University of Bristol

Presentations

1. WEFE nexus for fragile and conflict-affected contexts: enabling environment for the MENA region

   Dr Maha Al-Zu'bi

2. WEFE nexus in a changing climate in Asia-Pacific: learning from the humanitarian settings

   Shaila Shahid

3. WEFE nexus in sub-Saharan Africa: opportunities for the future

   Dr Sally Weston

Key takeaways:

- Climate change is worsening many WEFE nexus issues, such as drought impacting food production and water availability.
- Scarce resources can drive conflict but solutions that improve access to resources can help reduce this risk.
- Solutions must be co-created with local communities and tailored to their capacities, needs, resources, and goals.
- Innovators and researchers must ensure accountability to the communities they work with.
- Solutions aimed at building resilience in the WEFE nexus can also have big impacts on human wellbeing, including improving gender equity, incomes, and community development.
- There is a need to improve data collection across the nexus to better tailor solutions.

This session approached the WEFE nexus and its interactions with human security and inclusive society from three different regional contexts: the Middle East and North Africa (MENA), Asia-Pacific, and sub-Saharan Africa. Together, participants brainstormed ways to drive inclusive and human-centric solutions through the nexus.

WEFE nexus for fragile and conflict affected contexts: enabling environment for the MENA region

Dr Maha Al-Zu'bi, International Water Management Institute (IWMI) - MENA

Opening the first session, Dr Maha Al-Zu'bi outlined the WEFE challenges the MENA region faces. The region suffers from chronically limited water resources, which impacts food production and is only worsening with climate change. The situation is further complicated by conflict, youth unemployment, gender inequity, and weak institutional governance.

To demonstrate the initiatives that are helping build resilience across the nexus in the MENA region, Maha shared several initiatives from IWMI. In Egypt, water scarcity has led farmers to rely on irrigation. This has increased salinisation of soils in agricultural areas and caused declining water quality. Farmer incomes, the local economy, and the environment have been damaged as a result. Together with communities, IWMI have developed a roadmap to help support more sustainable implementation of irrigation systems.

In Morocco, they are working to identify fragilities in the WEFE nexus to better inform policy and practical decision-making. The project region has been hit with drought for the fourth year in a row, which has greatly impacted agriculture and water access. By examining water, energy, food, and environment systems in the context of drought, flood, and other risks, IWMI has been able to create a fragility index around nexus systems. This can help better inform policy and planning around watersheds for which the region is highly dependent. Reflecting on these ongoing projects, Maha underlined seven strategic action areas[3] for the region where currently there are the biggest challenges but also the biggest opportunities to improve nexus resilience:

1. Financing and investment
2. Data, analytics, and risk monitoring tools
3. Governance and policy coherence
4. Science-policy dialogue
5. Stakeholder engagement and outreach
6. Capacity building
7. Scaling up successful innovations

[3] https://www.iwmi.cgiar.org/Publications/Other/PDF/building_resilience_in_fragile_and_conflict-affected_agrifood_systems_through_a_water-energy-food_nexus_approach.pdf

WEFE nexus in a changing climate in Asia-Pacific: learning from the humanitarian settings

Shaila Shahid, Tomorrow's Cities

Shaila Shahid began her presentation by outlining the most pressing WEFE challenges in the Asia-Pacific region. More than 1.5 billion people in the region's rural areas lack adequate water supply and sanitation. She emphasised the importance of water in humanitarian contexts: "Water is the first line of defence for any disaster response mechanism." Around 150 million people also lack access to energy. Furthermore, half the world's undernourished people live in Asia. All these issues are set to worsen with increasing climate-induced disasters.

"Water is the first line of defence for any disaster response mechanism."

Exemplifying these issues in a humanitarian context, Shaila highlighted the Rohingya communities who have been forcibly displaced into Bangladesh. Since 2017, there has been humanitarian support to host communities to ensure peaceful co-existence. Building on these efforts, more than 116 organisations and ten United Nations (UN) organisations are now working together to coordinate a WEFE nexus approach, coordinating policies and tapping into the resources and knowledge sharing of the international community.

Closing her presentation, Shaila shared learnings from the approach taken to support the Rohingya population:

- Replicate and scale up practices that promote sustainable and inclusive WEFE systems.
- Build synergies between water, sanitation and hygiene (WASH) systems to promote climate mitigation and sustainability through multisectoral and action-oriented networks.
- Finance robust, inclusive, and adaptive social protection systems to address complex risks and ensure long-term resilience.
- Employ an 'accountability to affected population' (AAP) approach, which is an active commitment by humanitarian organisations and development actors to use power responsibly and be accountable to the communities they assist.

WEFE nexus in sub-Saharan Africa: opportunities for the future

Dr Sally Weston, University of Bristol

From the high prevalence of hunger to increasing natural disasters and rising conflict, sub-Saharan Africa faces complex challenges. These challenges also greatly vary from country to country. In the Central African Republic, for instance, there is high water availability but low water access, meaning the country requires increased infrastructure and tools to deliver water to people. In Niger, there is low water availability, so the country prioritises optimising existing water resources. To help explain opportunities to address these issues and build resilience, Dr Sally shared the progress of a project she is working on in Zimbabwe.

In the Zimbabwean region of Kariba, a project aims to empower communities to build up forests and local biodiversity using a nexus approach. To start with, the project is educating local farmers on conservation farming practices. These help increase agricultural yields, improving food security. At the same time, they reduce the need to cut down forests to cultivate more land. The preservation of local forests then also helps better regulate local temperatures and enhances water cycling. The project is additionally helping local communities start sustainable honey cultivation, which offers an additional income source that does not damage forests and supports biodiversity. All these new practices allow the community to sell carbon credits, providing funding for education initiatives and a new dam that helps balance hydropower and irrigation needs.

Reflecting on the project, Sally outlined opportunities for the WEFE nexus approach in sub-Saharan Africa. The African Union has recently developed Agenda 2063[4], which serves as a roadmap for achieving sustainable development across the continent. Sally underlined that while this is a significant step, top-down approaches such as these must be integrated with inclusion across communities and sectors to be effective. The Kariba project demonstrated the effectiveness of WEFE nexus approaches, but more funding for these types of programmes is needed to have an impact at the scale needed.

[4] https://au.int/en/agenda2063/overview

Group activity

Following the first session's presentations, participants were asked to discuss their experiences and the most pressing issues around the WEFE nexus concerning human security and inclusive societies. Together, they agreed that leveraging the WEFE nexus to build more inclusive and secure societies requires a series of enabling actions:

Governance and policy

- Advance good governance and policy that employs a WEFE nexus approach.
- Incorporate cultural factors into policy development.
- Enact more efficient taxation policies to direct financing towards WEFE issues.
- Foster political will on regional, national, and international levels.
- Involve stakeholders in policymaking to elevate community voices.

Community engagement and empowerment

- Co-create solutions with communities.
- Set and measure targets for improvement over time with local communities
- Raise awareness of WEFE nexus issues and opportunities and contextualise benefits to local needs.
- Develop projects that communities can run and maintain over the long term and build capacities where needed.
- Ensure fair and local governance of resources
- Involve and educate 'last mile' or marginalised communities.
- Employ a bottom-up approach to ensure local voices are heard.
- Adopt or enhance local solutions when possible.
- Build self-reliance in communities so they are not dependent on external aid.

Financing and resources

- Ensure consistent and adequate funding for WEFE nexus initiatives.
- Enable access to technology and finance for local communities and collaborative projects.

Conflict resolution

- Help to build community solidarity.
- Open dialogues between stakeholders from different backgrounds.
- Ensure the equitable sharing of resources or revenue.
- Inform stakeholders about the benefits of collaboration and co-creation.

Sustainability

- Adopt sustainable approaches that are tailored to local resource availability.
- Ensure new solutions are affordable and acceptable to different contexts.
- Consider how projects can support the environment while also improving local livelihoods, such as through sustainably increased agricultural yields, clean cooking methods, and water recycling.

R&D and technology to leverage WEFE nexus for smart and resilient cities

Session chairs

Mohammad Asfour, WADI

Tom de Block, Alliance for IoT and Edge Computing Innovation

Dr Nagham Saeed, University of West London

Presentations

1. Your dreams can come true: reconstruction guidelines as an example

   Mohammad Asfour

2. Collaboration between people and technology, today and tomorrow

   Tom de Block

3. Digital twins for sustainable smart cities

   Dr Nagham Saeed

Key takeaways:

- Developing resilient and sustainable infrastructure requires adapting to different contexts, climates, stakeholders, and political environments.
- Technology can be used to support inclusive and accountable data sharing.
- Smart cities not only employ innovative technology: they improve residents' lives across sectors – from transportation to energy, government services and more.
- Cultivating driven and reliable collaborators and mentors can help ensure progress on a solution, even when funding is limited.
- Community and cross-sectoral collaboration in projects is critical to addressing local needs sustainably and affordably.

How can people and technology work together to improve resilience and enhance community capacity? In this session, participants examined different approaches and opportunities for technology across the WEFE nexus while ensuring inclusivity. Session chairs shared guidelines and tools that can help support more sustainable communities, from infrastructural reconstruction to WEB3 and digital twins.

Your dreams can come true: reconstruction guidelines as an example

Mohammad Asfour, WADI

Mohammad began his presentation by explaining the concept of sustainable reconstruction – an approach that focuses on medium- and long-term rebuilding and sustainable restoration of critical resilient infrastructures in a city or community. This concept arose out of Mohammad's work in urban regeneration in the MENA region when he found that there was not an existing set of guidelines to address common issues in reconstruction.

The first version of the guidelines was developed during the creation of an affordable housing project that had little funding. From this, Mohammad and his collaborators presented their ideas at international and regional forums to create momentum around the concept. Now, based on their past success, they are working to open a hub to advance the guidelines' ideas and have published an official set of more than 200 recommendations[5] for sustainable reconstruction in the MENA region.

Using the guidelines as an example, Mohammad emphasised that creating sustainable solutions across the WEFE nexus requires patience and adaptability, especially when funding may be scarce[6]. It also means cultivating a set of collaborators and mentors who share the same enthusiasm for project goals. Resources such as these must be practical so they can be easily understood and implemented in target regions. Furthermore, they must consider the different climates, stakeholders, timeframes, and governance involved in a region or community.

[5] https://unhabitat.org/executive-summary-guidelines-for-sustainable-reconstruction-and-urban-regeneration-in-the-mena
[6] https://raeng.org.uk/programmes-and-prizes/programmes/international-programmes/frontiers/resource-library/resources-for-researchers/maintaining-connections-when-funding-is-scarce

Collaboration between people and technology, today and tomorrow

Tom de Block, Alliance for IoT and Edge Computing Innovation

In his presentation, Tom focused on the potential of technology to advance resilient and inclusive societies through the example of WEB3, which is based on blockchain. Trustworthiness is often a concern around technologies, including data-sharing concerns. However, Tom emphasised that open platforms such as WEB3 allow for more accountability because the record of transactions they collect are not centralised. In this way, data cannot be tampered with because it is public.

Another important concept when discussing how people and technology interact is data ownership. In the current format of the internet, people often do not have high levels of ownership over their data, yet, data is critical for developing solutions. However, WEB3-type platforms allow for data to be exchanged between those creating it and those requiring it.

Tom then offered some examples of WEB3-based projects. As WEB3 allows for micropayments, transactions can be broken into very small pieces of currency. This can then be used across different regions to provide payments for small actions such as funding carbon credits to communities and reforestation efforts. In addition, WEB3 has also been used as a decentralized reporting platform for whistle-blowers or for reporting wildfires.

Digital twins for sustainable smart cities

Dr Nagham Saeed, University of West London

Smart cities rely on technology, but a sustainable smart city uses it to improve people's lives reliably, efficiently, and in an environmentally friendly way. Nagham kicked off her presentation by unpacking the potential for smart cities in the context of the WEFE nexus: "We must develop sustainable and smart cities for all, not just the people who can afford it." Smart cities also cut across different sectors and layers comprising a city, for instance, including smart homes, services, or agriculture, as well as data collection, visualization, and application.

"We must develop sustainable and smart cities for all, not just the people who can afford it."

Building on the concept of smart cities, Nagham outlined the concept of digital twins. A digital twin is a virtual model of physical objects or systems that are connected through the Internet of Things (IoT). Using these can help better inform decision-making and understand a project's reliability and efficiency in practice. In a city, digital twins can be used to model a smart transport system, for example.

To help demonstrate the impact of digital twins, Nagham detailed a project undertaken in Malaysia, Africa, and the UK to inform policymaking in the respective communities. Researchers collected data from different communities around constructed wetlands. Using the digital twin, they were then able to design a model to identify the wetlands' effectiveness and opportunities to improve it.

This type of project, though, is not without challenges. In different contexts, adoption of digital technology and available WEFE open-source data can be low. Reusing models can also be difficult as they are largely informed by the specific location, which can make projects longer and more expensive.

Group activity

Participants then broke into groups to brainstorm inclusive and sustainable technological solutions for sample scenarios. For instance, one scenario asked them to consider how to improve the management of water, energy, and food resources in Mosul, Iraq, which has faced significant challenges in rebuilding after terrorist groups were driven out. Another focused on São Paolo, which has rapidly urbanised in recent years, leading to inadequate food security. The city also faces climate-increased impacts such as heavy rains and high winds. Other scenarios centred on different regions facing dual challenges, including Sahel, Burkina Faso which is contending with conflict and climate change-driven drought, and the Johor State of Malaysia, which is coping with rapid urbanisation and annual flooding.

Groups came up with a wide array of project ideas, from urban agriculture projects on Sao Paulo rooftops that also use solar panels, to climate-resilient irrigation systems in Mosul, and an artificial intelligence (AI)-based decision-making platform for watersheds in Malaysia. Across all the projects, participants surfaced critical insights for developing sustainable technological solutions for the WEFE nexus.

Developing innovative, new ideas to improve WEFE nexus resilience requires consultation and co-creation with the communities that will be affected. This type of dialogue also requires collaboration between different disciplines such as engineers, social scientists, legal experts, and local government. Furthermore, they should aim for inclusivity, bringing women, young people, and marginalised groups into the project as well. Participants highlighted that these open dialogues require trust building, not only between communities and researchers but also among different groups collaborating.

Ensuring the adoption and long-term use of solutions also means considering costs and maintenance: innovators should strive to make costs as low as possible and projects simple to use. Solutions that offer a new income stream or employment for communities can support their adoption as well as improve well-being.

Sander Traa (Unsplash)

Innovative uses for the WEFE nexus

Session chairs

Omar Abu Eid, Delegation of the European Union to Jordan

Shada El-Sharif, SustainMENA

Fiona Jeffrey OBE, Just a Drop

Presentations

1. EU vision to greening cooperation

   Omar Abu Eid

2. Leveraging WEFE-based innovative models to advance the green economy

   Shada El-Sharif

3. Making international development work sustainably

   Fiona Jeffrey OBE

Key takeaways:

- Sustainable development requires balancing the elements of the WEFE nexus for mutual benefits.
- Collaborative efforts involving local government and communities, non-governmental organisations (NGOs), and the private sector are crucial for impactful projects.
- Accessing climate finance for WEFE projects requires innovative approaches such as circular economy models, mapping environmental impacts, and developing private-public partnerships.
- Empowering women and young people means more than just including them: it means providing them with opportunities for capacity building, employment, and ownership over projects.
- Trust is fundamental – and requires transparency and open communication.
- Green growth can open new opportunities for economic development while creating more resilient communities.

Building on the ideas discussed, this session focused on innovative approaches and projects to support the WEFE nexus. With case studies from across the globe, speakers offered tips and experiences to help participants develop sustainable and inclusive WEFE solutions in the future.

EU vision to greening cooperation

Omar Abu Eid, Delegation of the European Union to Jordan

Omar kicked off his presentation by outlining the European Union's (EU) work around green cooperation. The EU has made climate action a priority through policies such as the Green Deal, pledges to double renewable energy usage by 2050, and the Covenant of Mayors, which connects municipalities for green collaboration. Critical to this, however, is also supporting continental and international cooperation as well as economic development at the same time. Summarising, Omar said, "Simply, green growth and green economies are the way forward."

"Simply, green growth and green economies are the way forward."

Additionally, the EU has worked with Jordan in recent years to improve climate resilience. As a result, collaborators learned that to create widespread impact, there is a need to mainstream greening, from infrastructure to education.

From this work, Omar then outlined several principles key to creating climate action that supports local economies and community wellbeing:

- Enhance innovation and entrepreneurship.
- Support youth and provide green education opportunities.
- Advance environmental rights and commitments, especially as they connect to human rights.
- Generate green job opportunities.
- Develop green legislation and finance.
- Adopt a green lens for humanitarian support as many people across the globe are being displaced due to the impacts of climate change.
- Open dialogues with the media around green communication and representing the challenges at hand accurately.
- Build initiatives with other states (where possible), partners, and across sectors such as energy, agriculture, water, and transport for joint action.

Leveraging WEFE-based innovative models to advance the green economy

Shada El-Sharif, SustainMENA

Shada's presentation provided a Jordanian perspective on WEFE-based innovative models, where there is an urgent need for new solutions as Jordan is the second most water-scarce country in the world. Sustainable development should be the overarching goal for solutions, Shada stressed, emphasising the need to balance the various elements of the WEFE nexus for mutual benefit. By linking them to the green economy, these solutions can attract investment, create jobs, and promote social inclusivity, particularly for marginalised groups like women and refugees.

Using Jordan's green growth plan as a case study, Shada illustrated how the country is transforming challenges into opportunities by focusing on initiatives such as waste-to-energy plants, renewable energy projects, ecotourism, and green innovation led by young entrepreneurs. Integrating green initiatives into national economic strategies is key, but strengthened governance and cross-sector collaboration are also needed to maximise the impact of WEFE efforts. When developing solutions, innovators should remember the importance of vision, regulation, private sector engagement, international partnerships, and youth entrepreneurship in driving forward sustainable development agendas.

Making international development work sustainably

Fiona Jeffrey OBE, Just a Drop

Fiona's organisation, Just a Drop, began in 1995 after she learned that one child was dying every 17 seconds due to dirty water, but just one pound could deliver clean water to a child for nearly 10 years. Fiona's background in tourism helped her mobilise businesses to actively support positive change and add value to society.

Her organisation brings together local government, non-governmental organisations (NGOs), and the private sector in what she calls the transformational triangle. Each partner can harness their unique role and expertise to reach project goals. For instance, governments can set frameworks, businesses can create an engine for change, and NGOs can drive delivery on the ground. In her experience, setting up self-help groups to build local capacities ensures long-term impact where some development projects can fall short – for instance, installing water pumps without giving the community the tools or education to maintain them.

In an innovative project in Kenya, Fiona, her team, and collaborators worked together to build sand dams in a community facing severe drought due to climate change. The dams help capture water for the drier parts of the year, while an installed water pump allows the community to access this water for a full year. The project has since had a positive chain impact on the community. People are safer and have more free time because they do not need to travel far to access water. With this spared time and improved water access, they can grow crops to feed their families and generate income. This also allows them to pay for schooling for children, enhancing their futures. For the environment, the sand dam raises the water level around the river, which regenerates the land and supports nature. Underlining the importance of collaboration in WEFE nexus projects, Fiona said: "We cannot achieve true impact without working together."

"We cannot achieve true impact without working together."

Group activity

After the presentations, participants broke into groups to develop solutions to challenges:

1. How can the WASH sector access climate finance to increase social and environmental impact?

2. What are some WEFE solutions that support the economic empowerment of women and young people in rural communities?

3. What are some WASH solutions that support water, energy, and food security and supply?

Addressing the first question, participants agreed that accessing climate finance would require innovative and cross-cutting approaches, such as employing circular economy models, public-private partnerships, and carbon crediting mechanisms. For the second question, groups highlighted that empowering women and young people means providing opportunities for employment and capacity building, from time-saving green tools such as solar panels that provide household energy to microfinance and skills training. They also emphasised that projects should be able to demonstrate economic benefits to communities. Groups discussing the third question brainstormed different ideas for innovative nexus solutions. These included installing sand dams that use biomimicry to prevent environmental disruption, rainwater harvesting for decentralised water management, and promoting water-saving techniques.

Across the groups, several principles emerged. Transparency and community involvement are fundamental to project success. Communities need clear communication that explains not only the benefits of a solution but also its impacts, positive and negative. The private sector, as well, can offer additional resources for environmental projects but they may need incentives to get involved. Critical to any solution is proper data collection, to understand the environment where a project will take place, community perspectives, and potential impacts.

Jonck Reels (Unsplash)

Dr Dureid Mahasneh

Chairman, Edama

Opening the symposium, Dr Dureid Mahasneh reflected on the ways water connects societies. Jordan shares water resources with Syria, Israel, Palestine, and Saudi Arabia. This connection means that water is always political and relies on shared agreements on human rights to water access. However, the war in Gaza and the Boko Haram's actions in Nigeria – where communities have been deprived of access to water – has shown that water access is not assured politically. Dureid underlined the importance of water rights, "If we do not respect human rights and rights to shared water, we cannot rely on agreements. It fosters conflict and mistrust."

"If we do not respect human rights and rights to shared water, we cannot rely on agreements. It fosters conflict and mistrust."

In Jordan, the WEFE nexus is an enormous challenge. The country is currently the second most water-scarce in the world, with only enough water for two million people, while the country is currently comprised of more than 11 million. Jordan also has a history of growing populations due to refugee immigration, which is impacted by conflicts in the region. This diversity, however, "makes us unique and makes us better."

"This diversity, however, makes us unique and makes us better."

Concluding his keynote, Dureid called for increased action and policy to ensure water and environment as human rights. He highlighted current areas of opportunity for improved WEFE nexus management in Jordan. For example, agricultural water use is high but much of the yields are exported. Transportation is largely reliant on fossil fuels which creates air pollution. Mobilising finance and policy to ensure a sustainable future is not only important: it is imperative.

Professor Iain Stewart

El Hassan Research Chair in Sustainability, Royal Scientific Society

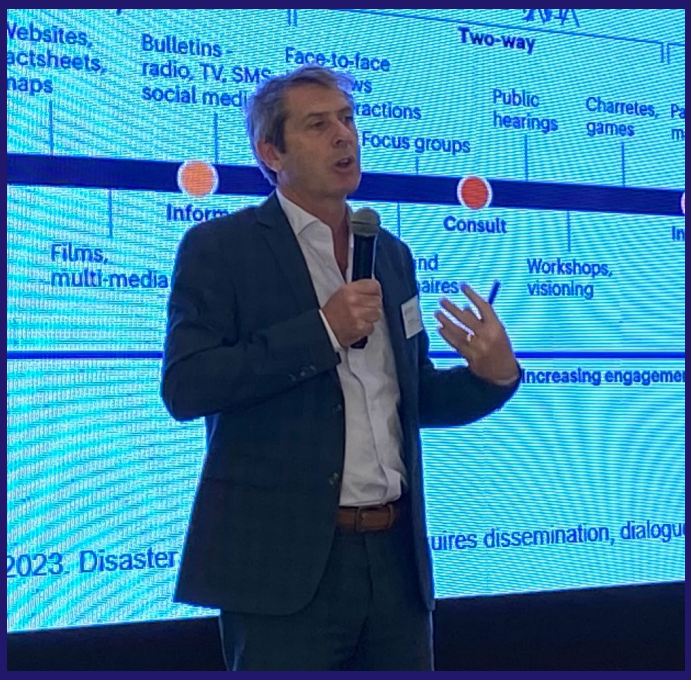
Making an impact in the WEFE nexus begins with effective communication because it requires collaboration with different groups. Complex technical details must be distilled into comprehensible messages for non-technical audiences, different disciplines, and communities.

To help break through this complexity, Iain outlined a comprehensive theory of change aimed at transforming how WEFE issues are communicated and understood. Key barriers include limited communication among experts, disciplinary silos, and deep uncertainty within scientific fields about communicating simplified messages of complex issues. To address these challenges, he proposed targeted activities, including academic training in strategic science communication, community-centred outreach initiatives, and the development of tailored media content for different audiences. Short-term outcomes, such as improving access to information, are an important stepping stone toward long-term impact in sustainable WEFE management.

To help participants employ effective science communications, he offered several tactics:

- Translate your own excitement to captivate others.
- Focus on people over ideas or theories.
- Include your perspective or experiences.
- Explain why your work is important first, then provide detail.
- Use stories and do not overuse facts or statistics.
- Understand your target audience so you can tailor messaging to them.

Concluding his presentation, Iain advocated for a purpose-driven approach to science communication, urging researchers to align their efforts with broader societal goals. Universities and research institutions can be catalysts for change, especially with a shift towards a culture of co-creation and interdisciplinary collaboration. Institutions must also embrace a humanitarian mission and prioritise sustainability and social justice in their research. Ultimately, he underscored that effective communication of the WEFE nexus is not only for science's sake but also a moral imperative in shaping a more equitable and sustainable future.



Insight session

After three days of discussion about the biggest challenges facing the water-energy-food-environment nexus and opportunities for interdisciplinary collaboration to develop solutions, participants were brought together for a final insights session. Event chairs underlined the urgency of WEFE nexus issues and how addressing these can drive progress towards sustainable development. Shocks such as war, pandemics, and disasters (both natural and manmade) can set progress back and lead to a worsening of climate change, pollution, water/food/energy insecurity, displacement, as well as many other negative impacts. The session had participants work together to develop short-, medium-, and long-term goals for progress on WEFE nexus issues.

Short-Term Goals

The short-term groups focused on the next one to five years, highlighting the need to address the most pressing issues such as conflict, climate action and disaster response to set the stage for longer-term progress:

Advance sustainability-driven business models:

- Offering sustainable microloans
- Creating models for cooperative financing in communities
- Increasing government support for sustainable technology (repurposing subsidies for more sustainable infrastructure, and innovation)
- Building better business-oriented awareness campaigns about the value of sustainability.

Develop financing for sustainable growth:

- Developing financing around climate, including climate compensation, such as the loss and damage fund
- Where needed, create new financing mechanisms.

Address conflict/crisis:

- Resolving conflicts
- Creating plans for displaced peoples (to return home, find new communities, or be better supported in their new location)
- Strengthening governance
- Providing shelter and food to crisis communities
- Ensuring access to safe water for all.

Start to build more resilient societies:

- Creating more defined climate action plans and making them available in local communities
- Enhancing disaster management, facilitating knowledge sharing around disaster response
- Addressing systemic waste
- Raising awareness of current issues and preparedness
- Researching current levels of care to better inform tools and approaches for the future.

Medium-Term Goals

The medium-term group focused on a range of five to 10 years in the future, building on the short-term, more immediate crisis-focused short-term actions:

Continue to build resilient societies:

- Keeping a vision of the long-term
- Limiting the impacts of climate change
- Developing both short- and long-term financial tools
- Reviewing failures of short-term actions to develop more successful ones in the future
- Identifying opportunities to scale up sustainable innovations.

Create pathways for collaboration and learning:

- Continuing to engage with communities through open dialogue, interviews, public consultations, and more
- Conducting roundtables between scientists/ academia, communities, government, and the private sector to set long-term agendas and collaborations
- Establishing a WEFE index based on the priorities of communities to track progress.

Long-Term Goals

The long-term group focused on a range of more than 10 years in the future – even looking beyond our lifetimes – identifying ways to reach 'moon-shot'/ complex global goals:

Facilitate sustainable economic growth:

- Creating mechanisms to ensure corporate accountability
- Fostering economic independence across the supply chain and ensuring supply chain resilience against shocks.

Enhance peace and collaboration:

- Creating stable governments
- Ensuring real, peaceful democratic processes
- Allowing for effective lobbying from the public/ citizens to their elected representatives
- Designing knowledge-sharing forums for different countries to learn from best practices/tools
- Developing mechanisms to ensure government accountability.

Protect the environment:

- Protecting resources and spaces for the public good
- Ensuring education for children, especially sustainability education
- Planning effectively for potential disasters and relief plans
- Phasing out fossil fuels.

Closing the discussion, the event chairs underlined how the short-term feeds into the longer term: they can improve social cohesion and reduce conflict through the WEFE lens. For instance, ensuring water access is an immediate need, but once this is achieved, you can build resilient and long-term water infrastructure. They also underlined that strategies to govern sustainably must start now but will impact humanity for generations. Closing out the event, they emphasised that 'humans should always be at the centre.'

Royal Academy of Engineering

Hisham Zayadneh (Unsplash)

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Royal Academy of Engineering
Prince Philip House, 3 Carlton House Terrace, London SW1Y 5DG