Scottish Freshwater Group

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Hydro Nation Scholars Programme

Scottish Freshwater Group 104th Meeting

Virtual host: UK Centre for Ecology and Hydrology
22nd April 2021, 10:00AM

Scotland the Hydro Nation: Valuing and protecting Scotland's water resources while responding to global water challenges

#HNSFG104

#ScotlandHydroNation

About the Scottish Freshwater Group

Promoting expertise and collaboration on a wide range of issues related to the freshwater environment – one of Scotland's most precious natural resources

Why we exist

Scotland's freshwaters are of national importance and their sustainability is vital. Our SFG community is passionate about making a difference to the freshwater environment. We aspire to give our best efforts and lead a legacy impact in the world. Our purpose is to shape meaningful outcomes for Scotland's freshwaters and beyond. We also encourage others to grow and continue the invaluable work we do in the future.

How we get things done

The SFG plays a key role in bringing together many people connected with freshwaters. We adopt a future-focused, independent and comprehensive approach to this major natural resource. We support the sharing of knowledge, experience and best practice among our members. We create the conditions for learning, experimenting and influencing collaborative outcomes across disciplines. It is a place where we can all have conversations and do work related to the freshwater environment. This inspires projects on issues of local, national and global importance (e.g., climate change). The SFG Team helps our members by coordinating contributions, goings-on and engagement strategies.

What we do

We gather twice yearly (in spring and autumn) at SFG meetings. These events are informal and usually hosted by life partner Stirling University. Our SFG agendas focus on a common theme of interest or open topic discussion in a supportive setting. They comprise a blend of talks, bite-size presentations and lunchtime poster session. Sometimes we explore different approaches to SFG meetings (e.g., workshops, Bio-blitz activities). This promotes interaction between our members and adds value to the bigger picture.

What else we do

Our Action Team (ATs) help SFG members to collaborate on fundamental issues and drive our ambition for Scotland's freshwaters. We have designed these ATs for everyone in the SFG to take part in small and big ways. They provide opportunities to infuse our expertise, enthusiasm, aspirations and people connections. We are building relationships, surfacing talent and integrating membership strengths for maximal impact. This will enhance the SFG's collective potential to influence environmental and people outcomes.

We also need to develop the SFG's adaptive capabilities and position in the 21st century. The sustainability challenges facing freshwater resources and shifting conditions necessitate considerable community-level response. This means greater situational collaboration and upskilling competencies for creating a better future. Our ATs will enable us to serve this larger purpose and improve how the SFG works.

The SFG Action Teams

These ambitious SFG projects are facilitating conversations between our members on fundamental issues. This is leading to community-level aspirations for driving much needed 21st century change. These inspiring efforts will shape meaningful outcomes for Scotland's freshwaters and beyond.

We always need motivated SFG members to engage with our Action Teams (ATs). These will run as short (<1 year), medium term (1-5 years), or long term (>5 years) project-based collaborations as needed to have impact and develop our future capabilities. Each AT has a dedicated lead and cluster of SFG members evolving a shared vision and delivery plan. They are action-oriented and responsible for transforming ideas into practical products. We trust our ATs will involve the wider SFG community along their cultural journeys. This means opportunities for everyone to contribute to environmental and people outcomes.

Current Action Team projects and lead contacts:

- Action Team No. 1: Sustainable minds for tackling 21st century environmental challenges (Kerr Adams)
- Action Team No. 2: Enabling the future of citizen science in and around freshwaters (Roger Owen)
- Action Team No. 3: Shaping SFG's Innovation Hub (Claire Neil)
- Action Team No. 4 : SFG's Climate Change Group (Heather Anderson)

Future Action Teams:

- More AT projects are being planned and announcements will follow via SFG communication materials
- Call for SFG membership suggestions on freshwater and people-related goals for future AT projects

Join us and take part

SFG membership and making contributions

Our evolving membership has supported the SFG's existence and influence on freshwaters for more than 50 years. Everyone will be integral to sustaining our community's longevity and vitality for decades to come.

We have an extensive and increasing network of ~200 listed SFG members. We connect people from broad-ranging backgrounds (e.g., universities, research institutes, government and non-government agencies, industry) and diverse career profiles (e.g., students, academics, practitioners, resource managers, policy makers, civil servants, consultants, citizen scientists and professional retirees).

Joining the SFG community is free and simple by completing the SFG membership form. It is open to anyone who is enthusiastic about freshwaters and our collective purpose. All SFG members can expect frequent updates about SFG events, news and activities.

If you would like to offer a talk, poster or workshop for future SFG meetings, contribute to our Action Teams or get involved with other development opportunities – please contact us via the SFG mailbox or social media on Facebook and Twitter.

104th SFG Meeting

The 104th SFG meeting takes the theme, *Scotland the Hydro Nation: Valuing and protecting Scotland's water resources while responding to global water challenges*. The theme aims to showcase the important research and innovation being conducted by present and past Hydro Nation scholars, SFG Action Teams, and the wider SFG and early-career academic communities, with presentations from a diverse range of backgrounds and expertise.

The Scottish Freshwater Group is coordinated by Pauline Lang (Scottish Environment Protection Agency) and the SFG Team. The themed 104th virtual meeting is hosted by Laurence Cavalho (UK Centre for Ecology and Hydrology) and co-organised by Rita Noelle Moussa (University of Aberdeen), Julze Alejandre (Glasgow Caledonian University), and Kerr Adams (University of Edinburgh) of the Hydro Nation Scholars Programme. Special support was also provided by Jonathan Fletcher, Craig MgDougall, and Elliott Hurst from University of Stirling, also Hydro Nation scholars.

We encourage SFG members to view posters and presentation abstracts. Posters are now available in the SFG website.

The social media hashtag for this SFG meeting is #HNSFG104 and #ScotlandHydroNation.

Future SFG meeting

Next SFG meeting will be held on a Thursday in October 2021. An announcement will be communicated by the SFG Team, with further updates to follow via e-circular and social media.

104th Meeting Agenda

09:45 Pre-meeting for SFG speakers and presenters

09:50 Zoom waiting room opens – we warmly ask SFG members to join early on the day

10:00 SFG 104 Welcome, Theme & Introductions
- Pauline Lang, Scottish Freshwater Group **(@Scottish_FwGrp)**
- Bob Ferrier, Hydro Nation Scholars Programme **(@ferrier_bob)**
- Rita Noelle Moussa, University of Aberdeen **(@Rita_NoMoussa)**

10:15 **Sub-theme 1: Protecting Scotland's water resources using innovative solutions**
Moderated by Rita Noelle Moussa

Lucille Groult, University of Dundee **(@GroultLucille)**:
- Water pollution by Contaminants of Emerging Concern from consumer products in Scotland: what precautionary solutions for source control?

Indira Menezes, Robert Gordon University:
- Scale-up of a photocatalytic treatment unit for degradation of biocidal agent source

10:45 **Poster Session 1**, Moderated by Kerr Adams **(@KerrAdams10)**

11:20 Comfort break

11:35 **Sub-theme 2: Connecting the value of water to Scotland's communities and beyond**
Moderated by Julze Alejandre **(@JulzeAlejandre)**

Craig McDougall, University of Stirling **(@CraigMcDougall_)**:
- Valuing inland blue space: A contingent valuation study of two large freshwater lakes

Sydney Byrns, University of Stirling **(@sydbyrns)**:
- Co-developing strategies to promote inclusive water governance in Malawi

Victoria Porley, University of Edinburgh **(@VictoriaPorley)**:
- Development of low-cost, sunlight-activated materials for water treatment in rural India

12:20 Lunch break

104th Meeting Agenda

13:20 **Sub-theme 3: Responding proactively to global water challenges**
Moderated by Rita Noelle Moussa

Diana Souza Moura, Robert Gordon University:
- Microplastics as a vector for micropollutants in aquatic environments

Lydia Niemi, University of the Highlands and Islands **(@LydiaNiemi)**:
- Assessing pharmaceutical occurrence and distribution in effluent-receiving surface water

13:50 **Poster Session 2**, Moderated by Kerr Adams

14:05 **SFG Action Team Updates**
Moderated by Julze Alejandre

SFG Climate Action Group No. 4: Heather Anderson **(@handerson107)**:
- Climate Emergency Response Strategy: An Opportunity to Feedback

SFG Sustainable Minds Action Team No. 1: Louise Lavictorie **(@DrLouLavictorie)** and Kerr Adams:
- Findings from the SFG Ecological Footprint Survey

14:35 SFG Reflections, Announcements & Meeting Close

104th Meeting
Poster Presentations

Virtual posters are posted on the SFG website

Jonathan Fletcher, University of Stirling **(@Jon_fletcher1)**:
- Nature for water: understanding the value of utilising aquatic plants for freshwater restoration

Ilgaz Çakin, University of the Highlands and Islands:
- Reed Bed Use Within Scotch Whisky Distilleries to Treat Wastewater: A New Toolkit to Help Maximise Performance

Michalis Georgiou, Glasgow Caledonian University, **(@MichalisGeorg)**:
- Mechanisms of Impact of Blue Spaces on Human Health

Manuel-Thomas Valdivia, University of the Highlands and Islands **(@ManuelThomas86)**:
- Nanomaterials and photonic solutions. Novel 'at source' approaches to stop hospital-derived pharmaceuticals

Charlie Perfect, SFG Climate Action Group:
- Introducing the SFG Climate Factsheet

Rachel Helliwell, Centre of Expertise for Waters, **(@RachelHELLIWELL9)**:
- WaterWall in Motion. Scotland a Hydro Nation: Uniting Communities Through Film

Iain Sime, NatureScot:
- Modelling extreme drought in Scotland

Niamh Smith, Glasgow Caledonian University. **(@N_iamhSmith)**:
- Factors determining usage of urban blue spaces: A systems-based approach to identify leverage points

Hydro Nation Scholars SFG Meeting Abstract

Water pollution by Contaminants of Emerging Concern from consumer products in Scotland: what precautionary solutions for source control?

Lucille Groult, University of Dundee

Diffuse water pollution by Contaminants of Emerging Concern (CECs) is characterised by increasing detection into environmental bodies over the past years, multiple sources (from pharmaceuticals to consumer products), and little knowledge regarding chemicals' fate and impact to aquatic life and human health, making evidence-based regulation of CECs difficult.

Nevertheless, the mass effect of CECs itself, not to mention phenomenon like cocktail effect or persistence, raises concern regarding potential escalation of their impacts. Consequently, even if evidence is not sufficient yet for regulation purposes, actions need to be taken far upfront in order to limit intensification of impacts and ease implementation of alternatives.

This project explores options to reduce pollution from CECs in Scotland at one of its sources: Personal Care and Household Products. It considers a precautionary approach applied to the whole product cycle. Preliminary results on green marketing and social media network analysis may be presented.

Scale-up of a photocatalytic treatment unit for degradation of biocidal agents at source

Indira Menezes, Robert Gordon University

Pesticides are one type of biocidal agents used in agriculture worldwide which have become an environmental concern. After their use, pesticides cannot be treated by conventional wastewater treatment methods and thus are often discharged into aquatic environments and result in harmful effects to non-target organisms. Advanced oxidation processes such as heterogenous photocatalysis can be applied to destroy pesticides from wastewater at source before they reach the environment. To date, the application of this promising technology has been hindered by the lack of an economic and reliable means of supplying UV irradiation and the separation of the catalyst and water post treatment. Using an iterative design process, a photocatalytic treatment unit will be deployed in Scottish farms for the removal of pesticides at source, representing a step towards moving this technology from the laboratory to full-scale application.

Valuing inland blue space: A contingent valuation study of two large freshwater lakes

Craig McDougall, University of Stirling

Water bodies, or blue spaces, offer a range of health and well-being benefits. Many of these benefits occur in waterside spaces and do not require direct water contact. For example, non-water based physical activity (e.g. walking and running) and reduced stress as a result of viewing water from a distance. However, research dedicated to understanding the economic impact of changes to freshwater ecosystems predominantly focuses on water-based recreation and water quality. As a result, the economic impacts of changes to waterside space are often overlooked. This study used the contingent valuation method to determine public preference for the protection of lakeside quality, in terms of lake views, path quality and lakeside access, at two large freshwater lakes in Scotland (Loch Lomond and Loch Leven). The aim of the study was to estimate willingness to pay among a sample of adults in Scotland (n = 1056) for the protection of lakeside quality. Results indicate that the majority of respondents are willing to pay for the preservation of lakeside quality at each lake. Based upon the most conservative estimates obtained, mean willingness to pay for the protection of lakeside quality was £12.06 per household per year at Loch Lomond and £8.44 at Loch Leven. These findings provide valuable economic data and suggest that changes to waterside space at destination water bodies have nationally important economic impacts. Greater consideration of the economic impact of changes to lakeside space is recommended in order to develop cost-effective and socially optimal water resource management policies at large freshwater lakes.

Co-developing strategies to promote inclusive water governance in Malawi

Sydney Byrns, University of Stirling

In responding to global water challenges, localised action needs to be well-understood in context to avoid perpetuating ineffective, often colonial, top-down global strategies. Water governance involves multiscalar interactions between structures, processes and traditions that determine how power and responsibilities are exercised and how decisions are made. The complex web of water stakeholders in Malawi (spanning sectors and levels) are not well understood at a system level. One aim of this research is to develop a rich picture of the day-to-day water governance structure and context in Malawi through social network analysis of the water sector. This presentation will include preliminary stakeholder map of actors and institutions in the water sector of Malawi, and a glimpse into how their roles intersect according to national policies and legislation.

Development of low-cost, sunlight-activated materials for water treatment in rural India

Victoria Porley, University of Edinburgh

Research into developing light-activated semiconductor materials for facilitating chemical reactions is very active, and has found some excellent candidates for application to water treatment. However, there is often a disconnect between scientific interest and real-world applications, with many novel materials being very expensive, only operating under UV light or requiring complex system installation. The aim of this research is to develop materials which are low-cost and practical to use on a decentralised scale in rural communities without a dependable water supply. It has been found that a simple synthetic route using low-cost and abundant materials results in a product with good reactivity under visible light, meaning water treatment under sun light can be possible.

Microplastics as a vector for micropollutants in aquatic environments

Diana Souza Moura, Robert Gordon University

Plastics have become a serious environmental issue. The discharge of untreated waste water can lead to the input of microplastics (<5 mm) and pharmaceuticals into freshwater systems. It can also be responsible for the input of nutrients, which can lead to the formation of mass occurrences of toxin producing cyanobacteria. The most commonly reported cyanotoxin are the microcystins. Microcystins and pharmaceuticals can impact human and animal health. It is known that micropollutants can, under certain conditions, adsorb onto the surface of microplastics particles. It is therefore of importance not to underestimate micropollutant concentrations when monitoring these compounds in water. This study will investigate the environmental conditions that lead to adsorption and desorption of selected pollutants on commonly occurring types of plastic and elucidate the potential role of microplastics as vectors for cyanobacterial toxins and pharmaceuticals into the food web.

Assessing pharmaceutical occurrence and distribution in effluent-receiving surface water

Lydia Niemi, University of Highlands and Islands

Pharmaceuticals, a class of emerging environmental contaminants, are extensively used and introduced into municipal sewers an waterways. Many pharmaceuticals are recalcitrant to removal during wastewater treatment; particularly conventional, less advanced wastewater treatment plants (WWTPs), such as those employed in rural areas, are unable to fully degrade these pollutants. Pharmaceuticals have a direct pathway into the environment with the release of WWTP effluent into surface water, where their impact is not fully characterised. This research investigated pharmaceutical introduction and occurrence in municipal wastewater, removal in a rural WWTP, and temporal and spatial trends in an effluent-receiving river. Currently, pharmaceuticals do not have environmental quality standards in the UK for maximum allowable concentrations in wastewater effluent and surface water. One of the potential outcomes from this work is to provide evidence-based research to support policy changes for inclusion of pharmaceuticals on water pollution control lists and updated regulatory standards in the UK.

Hydro Nation Scholars World Water Day Blog Articles and Exhibition Links

Taking away the ‘pandemic blues’ in blue

by: Julze Alejandre, Glasgow Caledonian University

The Covid-19 pandemic affects not just the physical health of people but their mental and social health as well. Before the spread of coronavirus, common mental health problems such as anxiety and depression have been impacting people’s quality of life — their productivity and social relationships. In 2019, 14% of adults in Scotland reported two or more signs of anxiety whilst 12% reported two or more signs of depression. An increasing proportion of people who attempted suicide also worsens the mental health epidemic. This situation put pressure on the NHS due to the increasing demand for psychological and pharmacological interventions which may persist and be aggravated by the pandemic. The implementation of restrictive lockdowns affecting how people socialise and interact has potential impact on mental health and pose a global health concern.

Prior to the pandemic, the delivery of mental health services has been confronted by barriers negatively affecting patient enrolment and adherence to life-saving interventions. Most of these are due to inadequate healthcare funding, low staff knowledge and training, as well as inaccessible, unaffordable, and stigmatised mental health services. Alternatively, social prescribing has been widely piloted across Britain as a complementary and personalised health and social care service aiming to improve mental and social wellbeing of people without resorting to clinical interventions. People who benefited from social prescriptions are those with mental and social health concerns due to debilitating life events such as unemployment, sickness, and bereavement.

Green or nature prescriptions is a social prescribing variant that utilises ecosystem services of green (e.g., forestlands) and blue (e.g., lochs) environments. Green prescriptions have been piloted in Scotland through the Green Exercise Partnership (GEP), however, this mainly focused on improving the quality and accessibility to green spaces to normalise its use for health improvement. This slightly undercuts the richness and the health-promoting benefits of Scotland’s natural water environments.

Blue spaces or natural water environments have positive impact on human health and wellbeing. The health-giving benefits of blue spaces are associated to its natural features that expedite stress reduction and restoration through physical and social activities. Blue spaces also provide good ventilation and fresh air which is critical in reducing risks to coronavirus infection. Combining this to other features such as heat island reducing effect, noise abatement, and natural soundscapes, blue spaces create a favourable environment for physical and social activities such as swimming, surfing, river running, fishing, sightseeing, or any other structured or unstructured recreations.

These physical and social activities facilitate stress reduction, recuperation, and restoration which are vital for mental health improvement.

According to Attention Restoration Theory (ART), the soft fascinating features of nature including blue spaces, play a key role in providing restorative benefits to humans. Humans are innately fascinated and connected with nature, however, this will be optimised if individuals are encouraged to escape from habitual activities and immerse themselves in nature. For some, this escape means freedom and adventure within the vastness, fragility, and depth of blue environments. To others, going to blue spaces means connecting to a pacific or peaceful environment providing solitude, euphoria, and refreshment. Some equate this to a homey state characterised by tranquillity, calmness, and serenity. These demonstrate that time spent in nature can improve mental fatigue and concentration through unforced brain use, eventually restoring individuals’ attention capacity.

The health benefit of blue spaces accentuates the greater need to protect it and improve its quality. Aside from visible pollution, natural water environments are at risk to emerging pharmaceutical pollution. Active pharmaceutical ingredients pose serious risks to water environments and the behaviour and life cycle of aquatic organisms. The increasing demand for antidepressants may results to its increasing concertation in blue spaces, putting at risk water biodiversity and drinking water quality. Aside from social prescriptions, there is a need to make existing mental health therapeutics more environmentally friendly. For instance, prescribing green pharmaceuticals contributes to minimising environmental risks of medicines by using environmental criteria in drug prescription. However, this requires in-depth investigation on the development and adoption of environmental classification of medicines and changes in established pharmaceutical prescribing practices.

In a post-Covid world, a sustainable healthcare intervention such as social or nature prescriptions and the prescription of green pharmaceuticals is a fundamental healthcare pathway. It does not only emphasise the important relationship of human health and the environment but also contributes to planetary health improvement. Promoting this sustainable healthcare strategy in health and social care settings through prescriptions of health and social care workers will strengthen public awareness on the health benefits of natural water environments. This will highlight how valuable water is and could drive investments to initiatives that aspire to protect, conserve, and make blue spaces more accessible for all.

From waste to energy

by: Rita Noelle Moussa, University of Aberdeen

"Healthy rivers carry water to homes, farms, schools and businesses. Along the way they nourish entire ecosystems and provide important habitat for native plants and animals. Environmental water is an important tool to ensure these natural systems survive and thrive for the benefit of all"

Office of Environment and Heritage
(New South Wales, Australia).

Human activities and wastewater discharges in the rivers landing up in the ocean are affecting natural water resources. The maintenance of the aquatic ecosystem is essential to achieve a balance between natural water cycle and human water activities. For this purpose, we aim to increase the sustainability of the natural and social water cycle by reducing waste to a minimum load while reusing and making most of the reusable resources. It is time to provide better protection for our water resources. This latter includes the treatment of wastewaters before being discharged in water bodies. During the last decades, the recovery of valuable chemicals from wastewater has increased, especially the recovery of nitrogen and phosphorus. These two elements were being added to synthetic fertilizers to increase the health of our soils and improve the quality of our food crops. In addition to the extraction of the previously cited chemicals, pharmaceutical products can be extracted and redirected to be used for other industrial purposes. Moreover, wastewater treatment can produce energy under specific conditions. This energy can be used for electrical or heating purposes. Due to current environmental challenges such as global warming and acid rain formation, we observe a growing demand for sustainable and renewable energy sources. Wastewater treatments are not only able to treat our waters but also to produce and extract products and energy. Therefore, the usual expense needed to produce these extracted products and energy are reduced. We engage ourselves with a new circular system based on reusing current waste without increasing it with new production systems. We aim for a healthier water environment for our generation and the future generations that will follow.

Trying to value the invaluable: A case study of wild swimming at Loch Example

by: Craig McDougall, University of Stirling

Michael: Hey Katie, how are you? Have you heard the news? A new development has been planned on the banks of Loch Example. Apparently, chemicals will be flowing straight into the loch and wild swimming will no longer be safe. The community council are preparing an objection, but we are finding it really hard to convey the importance of Loch Example. I know you have done some environmental economics stuff before, can you help us out?

Katie: Hey, that's terrible news but I am happy to help. Yes I'm still doing the environmental economics stuff - I'll start from the top. Valuing the natural environment and the services (you might see some people refer to these as ecosystem services) that it offers is challenging and valuing water can be particularly tricky given its unique physical properties. Ultimately, you really want to know the total economic value of Loch Example and this is made up of the various ecosystem services that it offers. Some of these are quite easy. For instance, you could find out how changes to water quality as a result of the new development will effect the fish stocks in Loch Example. You could then estimate the economic cost of this change in fish stock relatively straightforwardly, as the value of fish can be easily attained. The challenge that you face is that many of the services that Loch Example offers are not traded in traditional markets and generate 'non-market' benefits. You can't go into a shop and purchase one of your wild swims, but clearly this still have value!

Michael: Thanks for this Katie! So how do we get a better understating of these non-market values? Is it even possible?

Katie: Yes, it's possible. Economists have been working on this problem for decades and methods used to estimate non-market values are quite commonly used in environmental decision making. These can be categorised as stated preference and revealed preference methods. For revealed preference approaches you need to interpret people's choices and behaviour in real-life markets and estimate their value of Loch Example accordingly. If you created a short survey for all wild swimmers at Loch Example and asked how often they visit the loch, how far they travel, how long it takes them to travel and what mode of transport they use, you can begin to understand the economic expense that wild swimmers are willing to spend to swim at the loch. This starts to paint a picture of the non-market value.

Michael: Brilliant, but what about the people who don't use the loch? I think people value Loch Example for many reasons, even if they don't use it regularly.

Katie: Good question, this is where stated preference methods can be used, these are a little trickier. Basically, stated preference methods rely on people's behaviour and choices within a hypothetical market. These methods are really useful for understanding the economic cost of a policy that hasn't actually happened yet. In your case, you will need a survey explaining the potential changes to Loch Example and an opportunity for local residents to contribute financially to avoid these changes if they wish to. A pretty standard approach is to ask how much each individual is willing to pay (usually via increased local tax) to ensure the new development does not take place, water quality does not decrease and wild swimming can continue. Make sure that your survey is well researched and believable and it is crucial that your respondents provide the true amount they would be willing to pay. It's also useful to ask some questions about their background, income, age and usage of Loch Example. This will make the process of generating an average value a little easier.

Michael: Thanks. We will get started on this ASAP. So once what have generated economic values from our surveys, what do we do next?

Katie: Once you have estimated the economic value of Lake Example and all the services that it offers you should share these with the community council and include these in your planning objection. Your planning objection will be strengthened significantly by using established techniques to demonstrate the economic benefits of protecting Loch Example. But remember, we have only chatted about a handful of the services offered by the loch, you really want to know the total economic value so read up on some of the other benefits Loch Example offers and ask around (I've attached some example). Good Luck!!!

How to solve a problem involving the Brazilian drought and pesticide usage?

by: Indira Menezes, Robert Gordon University

Water is an essential resource for human survival; however, water supply is greatly affected by drought as well as by pollution caused by industry, large cities, and even smaller communities. I am originally from Brazil and my home city is in the North Eastern region of Brazil, which is known for experiencing periodic droughts. Recently, this region has faced one of the greatest periods of drought of all times lasting more than seven years. In the Northeast of Brazil, a great part of the human water supply is collected in surface freshwater reservoirs which are commonly polluted due to runoff, discharge of chemical products and nutrients and wastewater contamination.

Biocidal agents are chemicals used to eliminate or prevent the action of harmful organisms such as insects, fungi and weeds. Biocidal agents have many applications, including maintenance of hospital hygiene, household cleaning, disinfection and to a large extend in agriculture where they are also known as pesticides. However, a great concern regarding the pesticides application in agriculture is that they can be extremely toxic to non-target organisms, they can persist in the environment for several years and can accumulate in the food chain, representing a threat to human health.

During the application of pesticides in agriculture, these chemicals can be carried through the air or by rainfall runoff and wastewater disposal, finding their way to freshwater reservoirs. The problem is that conventional water treatment is not designed to remove dissolved compounds such as pesticides from water, therefore, they can eventually end up in drinking water. To overcome this contamination problem, it is necessary to develop and apply alternative and complementary water treatment processes that focus on removing dissolved pollutants.

One possible treatment for pesticide removal is known as heterogenous photocatalysis, which is based the use of a chemical that is activated by light energy of a specific wavelength. Many studies have focused on the development of optimal photocatalysts and the selection of the best illumination source, however, little is known about the practical application of this type of treatment. I believe that now is the time to take this promising technology forward and focus on the possible ways of application. I am currently working on the development of a treatment unit that will be used to treat pesticides before they arrive at the treatment plants, this way, there will not be subsequent contamination in drinking water. My plan is to engineer a treatment unit that will use recycled materials and will avoid the use of plastics. Also, the use of renewable energy sources will be evaluated for illumination and activation of the photocatalysts. After that, the reactor will be deployed in strategical places in farms across Scotland and will successfully treat pesticides!

Why water is the most important source

by: Hanna Peach, University of Edinburgh

Life began in an unlikely place. Around 3.8 billion years ago, a primordial cell was formed on the ocean floor, close to a deep sea hydrothermal vent. Pressure and temperature were extreme constraints, and the only sources of energy were volcanic gases seeping out of vents and minerals released from rocks. Nonetheless, it is hypothesised that the surface of the ocean floor acted as the catalyst for different chemical elements to react with each other, to make the first enzyme, which drove the formation of the earliest version of a microbial cell. This cell is known as LUCA, the Last Universal Common Ancestor to all life on Earth. Single-celled organisms began proliferating and diversifying, then the incorporation of organelles began to emerge; this became an entirely new branch of life, which over millions of years became all eukaryotic life in the oceans, land and mountains. At first, life only inhabited the vast ocean. Then, oxygenic photosynthetic organisms created an oxygen rich troposphere, known as the Great Oxygenation Event, which created entirely new weather patterns, allowing land to be hospitable to many plants and animals. These processes predate even the formation of our modern tectonic plates.

All living things require water, even the most extreme bacteria and archaea inhabiting the driest and coldest deserts on Earth. Many larger animals also use water as a source of protection, a source of well-being and a source of peace. Humans have created ways to travel across water, to clean water, to recreationally use water – and to exploit water. It is undeniable that water is the backbone of our civilisation, but remains a finite resource.

We have a populace split into countries, which each have varying access to resources, capital and expertise, differing regulations, and each place different connections and cultural values on water. How we allocate resources to the protection of natural and built water resources now greatly affects the outcomes for biological species. We now hold the keystone for the survival and protection of all species on Earth, which are in a precarious state. Industry relies on water, humans rely on water, and all biological entities rely on us to retain a healthy homeostasis between profits, pollution levels and the health of aquatic ecosystems for the survival of, literally. everything.

Alongside our regulated threats, there are many emerging threats to aquatic ecosystems. These include organic micropollutants such as pharmaceuticals and pesticides which are introduced through anthropogenic activity. These threats are shown to affect ecosystem health even in miniscule, micromolar concentrations. As a microbiologist, and a Hydro Nation Scholar, my research is centred around removing pharmaceuticals from water by exploiting the vast metabolic capability of microorganisms. My microorganisms work as a biofilter, gifting us one more source of protection against our own pollution. Microorganisms were the first biological entity on earth, are the backbone of every ecosystem, and now they are helping save life on Earth, with me as their arms and eyes. Collectively, we need to be proactive, responsive and in tune with protecting with our greatest resource, water. Without our efforts, the beautiful and wildly diverse array of biology will cease to exist as we know it. We must protect our water, as ecosystems across the globe depend on its quality and its health.

Microplastics: tiny particles, big problems

by: Diana Souza Moura, Robert Gordon University

The importance of water is undeniable and well established. However, many of human's acts are affecting its quality over the years. Plastic is one of the most pressing issues responsible for water pollution. In our current society, plastic is an essential material used in multiple important daily applications, health system and constructions. Nevertheless, plastic persistence in the environment is quite problematic.

Plastic derived materials can last for over 500 years in the environment. Since its invention, in 1907, it is estimated that every particle of plastic ever produced is, somehow, out there, especially being disposed in natural freshwater reservoirs. Even though plastics are hardly biodegradable, i.e. not normally decomposed by living organisms, it is susceptible to fragmentation by biological, chemical and physical degradation.

Plastic particles with all dimensions smaller than 5 mm are called microplastics. Such forms have been found in various environments, such as sediments, fresh and seawater, glassier, as well as inside the guts of wild animals of different sizes, from tiny zooplanktons to wales, and even on human organs. Till this day, very little is known about the real impact of microplastics on the water system, and the majority of the scientific studies are focused on the seawater environment.

The poor water quality of freshwater bodies is an increasing concern and far from a definitive solution. Microplastic is not the sole pollutant possible to found in freshwater reservoirs. Freshwater systems are often contaminated with untreated waste water, which is the main source of microplastic, and other contaminants such as pharmaceuticals, that have various negative impact to the wildlife. Another problematic of the disposal of untreated waste water in the water environment is the enhance of nutrients concentration that can lead to an over growth of a toxin producer organism, the cyanobacteria. Several incidents have been reported due cyanobacterial toxin in the water. Cyanotoxins are responsible for the death of hundreds of animals every year, and even humans have been affected. In 1996, in Brazil, 52 patients have died due the presence of a cyanotoxin in the water used in their haemodialysis treatment.

It is no news that these pollutants are capable of harm the biota of the water system. However, there is a lot left to understand about the interaction of pollutants that co-exist in the same environment, and how this interaction can affect their behaviour towards living organisms. This highlights the challenge of a deep understanding of all factors that can impact the water quality of freshwater reservoirs that will guide policy makers. That knowledge can also help us to comprehend that our routine actions have major and direct consequences on the water, hence on our health.

Water and equality – a sea of opportunities

by: Victoria Porley, University of Edinburgh

The irony of studying methods of water treatment is that it actually uses up a lot of clean water. I develop photocatalysts – materials that can initiate chemical reactions when light shines on them – and use them to remove pollutants from water. In order to do this, I need samples of water with known contaminants, so that I can track their removal over time by the photocatalyst. Over the course of my research, I have added many hazardous chemicals and pathogens to clean, de-ionised water, amounting to large volumes of contaminated aqueous waste.

This is a factor of all environmental remediation research – in order to see if you can fix a problem, you need to simulate it under controlled lab conditions. Sometimes, we make breakthroughs and the effort was all worth it, and sometimes we don't, and it's extremely frustrating. But it's all knowledge gained, and the sacrificial water that was contaminated for the experiment brought us one step closer to painting a fuller picture of the work that needs to be done, and how our skill sets can be used to address the problem.

In Scotland, it's hard to see this as a problem as we go about our day-to-day tasks. We can easily refill the de-ionised water bottles in our lab from a departmental water supply, tens of litres at a time. In our personal lives, we can grab a drink of water from the kitchen tap whenever we like, shower for as long as we want, brush our teeth with the tap running, and use fresh water from the taps to water our houseplants. With the convenience of our lives, it is easy to feel disconnected from where our water comes from, and the extent of cleaning it has to go through to get to our taps.

This is not a global phenomenon, and many people are not so fortunate as to be oblivious to the value of water. It is clear that we need water to survive, but the extent of the opportunities afforded to us by having easy access to clean, safe water is not so clear. As a woman in STEM, I have faced barriers my male colleagues have not, and there is a lot of work that still needs to be done to change this, but the fact that I have been able to access such an exceptional education and career opportunities is, in part, due to water.

In many communities, treated water is not freely flowing from taps in multiple rooms of every home, and people have to walk for miles to collect water and bring it home. This often falls to the women and girls to do, while the men work. This prevents young girls from receiving an education, and therefore limits their opportunities in life, due to something as basic as water – something we have freely flowing whenever we want. As well as exacerbating gender disparity, limited access to safe water contributes to socioeconomic inequality. For individuals living in areas without access to clean municipal water supplies, often the only available water is contaminated and can lead to illness, which many cannot afford to treat, or will lead to time off work and further financial difficulties.

Therefore, water has much more value than simply being something we need to quench our thirst. When the entire world has easy access to safe water, we are also one step closer to equality.

Clean drinking water – do we value it enough?

by: Carolin Vorstius, University of Dundee

Before starting this PhD journey as a Hydro Nation scholar, I didn't think too much about the water that comes out of our taps: cold, clean and convenient. Although I am from Germany, where you pay per unit of water you are using and I was brought up not to waste it, I never really felt an urgent need to save water, either – certainly not since coming to Scotland, where water always seems to be plentiful (and more than that, at times). In short, I, like many others, take healthy, clean, and ample drinking water for granted. But this is certainly not the case for everybody, and being on the Hydro Nation Scholars Programme and working with Scottish Water has also made me realise the enormous machinery behind keeping and making our water safe to drink, and conveying it into our homes. Yet, the effort and costs required for sourcing water from rivers, lakes, reservoirs, and boreholes, bringing it to the treatment works, treating it to the required standard in several steps, and then piping it to individual houses still do not reflect the true value of our drinking water. What is harder to measure in monetary terms, and hence often for us to value, is having a sufficient supply of water in the first place, and having it at a quality that takes treatment to a minimum – not only for our use, but for the environment, too. The landscapes providing our water are precious on so many levels, and we benefit from them in multiple ways. And while it may be harder to enjoy them in times of a pandemic, and the restriction it brings, we are connected to them every time we open the tap for a drink of water. That's a thought that makes me appreciate how wonderful clean water, and the nature that provides it, truly is.

A very personal dive in deep waters

by: Lucille Groult, University of Dundee

My first thoughts for writing this blog post turned into a rather academic and formal approach, not to say boring, trying to squeeze in some notions from my own research with the value of water theme.

And suddenly a flashback hit me: me at a job interview, stressfully trying to support a bold career move, and been asked why I chose a career in the water industry. At that time, a decade ago already, my answer focused on how water played a central role in my life. My South East Asian origins indeed made me aware from an early age of existing difficulties of having access to safe water and potentially shaped my study pathway. Still, the question remains, even years after: why do I value water so much that I chose to spend a major part of my life trying to preserve it? And what do I value so much in it? Since then, this background reflection got increasingly more elaborated.

My professional journey with water started at the very beginning of my studies. The discovery of the beauty of fluid mechanics equations (yes, there are such thing) led me to consider a career in hydraulics, hydrology, or even meteorology. Fate, and my not so exceptional results at the entrance competition for French engineering schools, made me embrace environmental chemistry and process engineering instead. Not totally off track then, but still a very scientific outlook at the water element. The most striking – and shocking – thing I retain from this period is that my childhood urban legend on gender-changing fish in the Seine River turns out to be true and results from exposure to endocrine disruptors. Kind of a revelation.

However, the wealth of water sciences, which I believe will be very well illustrated by my fellow bloggers, was not enough for me and, along my career, I realised that water could represent so much more for the society. The key role of water in geopolitical hotspots became my new fad. After an amateur investigation, I am ever more convinced that water plays multiple roles in world political organisation, alternating from a threat (natural disasters, fear of future water wars), to a driver for international collaboration (sharing a catchment encourages to work together for a fair share of this resource). No doubt that water will still be crucial in future environmental negotiations.

My arrival to Scotland and the discovery of its industrial past – New Lanark, Stanley Mills – has revived some other memories. I spent indeed my teen age in the Centre region of France, abundant of nineteenth century hydraulic infrastructures and local manufacturers. By the way, the aptly-named Rogny-les-sept-écluses village ("Rogny the seven locks") and the canal bridge over the Loire River in Briare incontestably worth the detour from major touristic roads. At this time, water transformed many decentralised water-wealthy areas and made possible their economic development beyond expectations. Industrial revolutions surely wouldn't have been the same without taming water to transport goods and power manufactures.

At the source of multiple scientific enigmas, geopolitical issues, economic activities, historical legacy, technological challenges, and even touristic attractions, water can represent a plethora of entities. Such versatility and inclusion into our activities are definitely worth spending a lifetime to preserve it for now and the future.

Oh and still, just before moving here, I have been diagnosed an 'allergy' to water. So far mostly a source of discomfort rather than a serious health condition, but it certainly limits my ability to simply have fun in waters. Life has a weird sense of humour, don't you think?

What if I just gulp this red pill for every ill? Eye-opener for sensible drug use and the role of water after having a wee

by: Manuel-Thomas Valdivia, University of Highlands and Islands

Health-care facilities have been invaluable institutions around the globe to ensure highly targeted, effective therapies. The very earliest interventions were often rudimentary, life prolonging measures e.g. for disinfection of serious flesh wounds caused by wild animals (or fellow humans), to help prevent life-threatening infection. Medication per se was limited to herbal infusions that earned reputations for benefit in both acute and chronic conditions.

In the modern era, more than 5000 different pharmaceutical products exist worldwide to ensure targeted treatment for a multitude of global diseases. These products include the diclofenac-containing topical cream you use on your skin to alleviate muscle ache. Tesco's 'everyday essentials'-multipack of paracetamol and ibuprofen, which you might store in your handy bedside cupboard to take at the merest hint of headache.

And – how do you dispose of expired drugs? Flush them away down the toilet? They'll surely be rendered harmless through dilution in the sewer system – Let me intervene here!
There is a reason why pills come in pre-sized blister packs and different colours!

Drugs are target-designed to assist the body to cope with specific diseases. Importantly, they are typically developed to work at very low doses. Early drug intervention for many diseases is essential to ensure effective treatment and consequently, improved wellbeing – no doubt!

However, worldwide prescribing rates are rapidly increasing, driven not only by the increase of modern-world disease incidence, such as diabetes, obesity, cancer and cardiovascular conditions, but also by an increasingly impatient audience for rapid and effective treatments, fuelling spiralling prescriptions and over-the-counter sales.

Every pill you swallow will release its active pharmaceutical ingredient, to carry out its purpose in your body to treat e.g. pain, fever, nausea or more specific disease symptoms. However, sooner or later, the content of the pill ends up in the toilet and each flush releases these active pharmaceutical substances into our water environment – rivers, lakes, ultimately the tap water you and I drink!

Yes, there are sewer systems, water treatment centres, accredited laboratories, and the drinking water quality regulator to ensure safe drinking water; tap water is clean of bugs and microorganisms that underpin those widespread, potentially fatal diseases that are still prevalent in many developing countries. So, surely the drugs are gone too?

Unfortunately, drugs are not among the components that our wastewater treatment systems remove reliably! Severe impacts on nature from remaining drug residues in our water system have been revealed by scientist over the past few decades. For example, antidepressants can impact fish migration – delicious salmon or trout might not reach their respective spawning grounds, ultimately threatening their populations and impacting our dinner plates!

Similarly, anti-cancer medications are highly toxic drug cocktails with as yet unknown effects on nature, despite their increasing release from hospitals worldwide. Even your 'harmless' painkiller, diclofenac, is known to generate toxic drug residues detected in domestic wastewater.

Direct effects on the aquatic environment and human health of the tons of drug residues released every day via household and hospital wastewater worldwide, require urgent research. The effects already seen in nature hint at the potential for future serious impacts on environmental and human health. Are drug quantities going to continue to accumulate in our water, ultimately crossing the threshold for toxicity in the environment or harmful effects in people, pets and livestock?

Maybe, think carefully reading over your drug instruction leaflet next time. There is no need to overfill your beside cupboard with painkillers!

Think about alternatives and think carefully before you flush out of date drugs down the toilet! A colourful pill is not necessarily always contributing to your wellbeing. Sometimes a simple walk outdoors (with friends) might do the job!

The value of water for the Scotch Whisky sector

by: Ilgaz Çakin, University of Highlands and Islands

Whisky is produced by the distillation of an aqueous extract made from malted barley (or other cereals) fermented with yeast (Saccharomyces cerevisiae). Despite the different aromatic flavours of each whisky brand, Scotch malt whisky requires just four main inputs: energy, yeast, water, and malted barley. This means that the quality of water is one of the main parameters to determine the taste of whisky. The flagship industry of Scotland benefits from the high-quality water resources of Scotland, and whisky production brings huge benefits to the economy of Scotland, and according to the Scotch Whisky Association, Scotland exports >1.3 billion bottles of whisky each year, with a net export value of £4.9 billion. In addition, the Scotch whisky sector provides the UK economy with £5.5 billion in total added value and employs >10,000 people directly, and 40,000 indirectly across the UK. Some 7,000 jobs are provided in the Highlands and Islands of Scotland alone, equating to 2.5% of the working population of the region. Since the industry also sources 90% of its barley from Scotland, business is created for farmers too; and from a tourism perspective, distilleries attract 2.2 million people per year to Scotland - making distilleries the third most popular tourist attraction in the country. This success is directly related to the water used in production. The pH and mineral equilibrium of water improves the efficiency of fermentation. The cleanliness of water prevents the formation of unwanted taste in the end product. High alcohol-containing spirit must be diluted with water to obtain the end product. Water is also used for some operational purposes such as cooling/cleaning/effluent diluting. That is why the quality and quantity of water is vital for the continuation of production. We should bear in mind that the whisky industry of Scotland needs to collaborate to protect the water resources. In a typical malt distillery, 100 tonnes of draff, 345 tonnes of pot ale, 388 tonnes of spent lees and washings are produced as by-products for every 100 tonnes of malt processed weekly. In other words, in a medium-sized distillery, 718 tonnes of waste needs to be treated for every 100 tonnes of malt processed weekly. This copper and organics rich waste must be treated before it can be disposed of to land, rivers or sea. To manage waste streams, different methods can be used such as anaerobic digestion, dead-end/cross-flow microfiltration, evaporation/combustion, direct long sea outfalls, and remote long sea outfalls. In addition to the current methods, distilleries should invest in the development of more sustainable and environmentally friendly treatment options requiring less energy input and chemicals.

Water values arise through water relations

by: Elliot Hurst, University of Stirling

I come from an island where rivers are cherished ancestors. As affirmed by recent legislation, the Whanganui river is not a 'water resource' but an 'indivisible and living whole'. What does this tell us about the value of water? Firstly, the Whanganui river clearly has a value that far exceeds any monetary valuation. But even more importantly, comparing this river to an icy asteroid, floating between Mars and Jupiter, I would argue that water does not have any intrinsic value. A river, or a pot of boiling water, is not the same thing as 'water in abstract'; it is water in a specific context. It is in relation with societies, landscapes and ecosystems that water co-produces value. In other words, value is created when people, other living beings and technologies interact with water.

How does this perspective shape my understanding of the value of water? Firstly, no living being can survive without water. These ecological relations are the most crucial value of water. Water is essential for the whole biosphere, not just the part of the biosphere that we call 'the economy'. I believe a shift in valuation is required: to focus on the living world that water sustains, rather than the value harnessed to water as a driver of planet-devouring growth.

Secondly, as water bodies, ecosystems and societies all change over time, the values created alongside water will also change. Compared to the approach of the Victorian engineers who began the construction of our drinking water network, current approaches to water governance are better at taking the ecological importance of water into account. But these approaches will continue to change. Future social, ecological and hydrological changes are unpredictable, especially changes in social priorities. Our priorities are also shaped by the relations with water that we have.

The combination of these two points means that the 'value of water' is not something that can be 'optimised' or 'maximised'. Determining the values of water is a political question of how the priorities of different species, communities and industries are accommodated. In other words, decisions about which social and ecological relations are important. Current economistic methods of valuing water relations are unfolding alongside a devastating loss of freshwater species and habitats, and alongside a huge global inequity in access to safe water and sanitation. To change this situation, social and political movements are needed, where new ways of relating to water are made possible, and new values emerge.

Recognising water and its value in Scotland: Looking beyond the provision of water services

by: Kirsty Holstead, University of St Andrews

I am a Hydro Nation PhD scholar. My research is about the involvement of communities in water management and governance in Scotland. I look at what happens when communities are asked to participate in decision-making, when they own or manage infrastructure, or when they are recognised as managers and consumers and asked to change their behaviour with respect to water. As part of my research I am fortunate enough to observe and interview people who work in the areas of flooding, drinking and waste water services.

Throughout my work I have observed the people who work in public organisations in Scotland related to water, care deeply about water and are dedicated to its provision. They show their care in different ways – some develop flood management schemes, some try to unblock drains, some make sure that bills are at an appropriate level, or ensure that water quality meets legal specification. These actions contribute towards providing safe and clean drinking water and ensuring the environmental water quality which Scotland prides itself on. These actions are all integral to society, but is this enough? What more is needed to support Scotland to recognise the value of water?

An area of increasingly importance is understanding how communities' value and relate to water. People enjoy and feel associated with mountains and lochs in Scotland, but when we are removed from that obvious beauty and primarily see water when we flush the toilet, or at home during the shower, some see mundane, everyday water. Our interactions with water tend to actually be very routine. And on top of that, most people are far removed from the management and organisation of water. Water is hidden; we made it this way. We as a nation, have spent over 100 years managing and developing expertise to hide water and its infrastructure – pipe it, tank it, make it always available, and hide the workings of how it got here. 'Flush and forget', 'use and not know' could be the mottos of our modern relations with water in the UK. However, this may be changing.

So, an unanswered question remains – what does it mean for a nation to value water? Some may say: use less water, turn the tap off when you are brushing your teeth, don't dispose of inappropriate waste down the toilet. These certainly are ways that one can contribute to the provision of public water services.

And, while these are important, and by no means a small feat, a more systematic and ambitious approach is also necessary. An approach where communities are involved and engaged in water management and governance. Where they have a say in how they are run and contribute to their functioning. When water is no longer something that we save in the house, but something that is ours, and we are proud of and that we see. We need an even more dynamic, forward thinking, outward facing, diverse water sector, that encourages and resources different kinds of engagements with communities, and fosters different relationships between people and water. Water needs to be made visible in every sense of the word.

My research shows that this kind of thinking comes with risks for those charged with public services. Such change can bring scrutiny, higher expectations and costs, and change is fraught with difficulty. The challenge is that these suggestions are challenging to measure and it is difficult to show their benefit. In hard pressed financial times, life reverts to 'business as usual', or tackling the most immediate challenge. Is it easier to just not to rock the boat, one may ask? After all, on the whole, Scotland does enjoy largely excellent water services. I would disagree – this is worth working for. I know from my own work that this is a vision that some people hold and are taking steps to try to realise. You could call this public water 2.0.

The Value of Water – Increasing resilience through nature based solutions

by: Martyn Roberts, University of Aberdeen

The Covid-19 pandemic has taught us that we take many things for granted – and that includes water. Living in Scotland, it is easy to look out the window and think "we do not have to worry about water, we have plenty of it". Although it may feel like it rains all the time, it does not always rain when we need it to; and when it does, it comes as intense rainfall events. This has led to increasing flood events and believe it or not … droughts in Scotland.

Growing up on a farm, we were reliant on our own natural spring. In summer, we would face water scarcity and having a shower would become an extremely efficient operation! Meanwhile, in winter, excess water would cause soil erosion and the fields would become mud baths.

Due to climatic uncertainties, a growing population and changes in land use we now face an increasing exposure to flood and drought risk. The UK Climate Projection 2018 report predicts that the UK will experience warmer, wetter winters and drier, hotter summers. Currently, flood damage costs in Scotland are estimated at ~£250m per year. Furthermore, the National Audit Office raised concerns that the UK's total available water supply will reduce by 7% by 2045.

Previously, hard engineering approaches have been used to deal with these environmental ills. However, has nature provided the solution all along?

On the 5th anniversary of the Paris Climate Agreement, Nature Based Solutions are now emerging as a key flood and drought risk management strategy … But what are Nature Based Solutions? They are interventions inspired by the processes and functioning of nature, which aim to resolve environmental ills (e.g. flooding). This can include flood storage ponds/areas or restoring/protecting forests. In the context of flooding, Nature Based Solutions aim to "slow the flow" allowing excess rainwater to be stored in the catchment and then soak into the ground. This minimises the volume of water travelling downstream before it reaches settlements. Therefore, both flood risk and the need for expensive hard engineering approaches is reduced. The UK government has identified Nature Based Solutions as a key strategy for flood mitigation, setting aside £15 million in investment. Although primarily used for flood mitigation in the UK (see Natural Flood Management Network Scotland for examples), Nature Based Solutions provide wider benefits such as drought management, improved water quality and habitat creation for wildlife.

Though a relatively new concept for environmental management in the UK, Nature Based Solutions have been utilised for many years in India. The Rajasthan region has a long history of rainwater harvesting, using Nature Based Solutions such as Johads (storage ponds). These features store runoff, which then soak into ground and replenish aquifers. This has been found to improve community resilience by increasing crop yields and accessibility to water (see The Flow Partnership).

As we already know, water is the most essential natural resource. The value of water is only going to become more significant as we face future water scarcity and flooding issues. Nature Based Solutions can provide a sustainable cure for many environmental ills, dealing with the issues at the source rather than fixing the symptoms.

In order to protect our most important natural resource, maybe we should look to nature for help.

A reliable water source – the essential ally to soap during a pandemic

by: Sughayshinie Samba Sibam, University of Aberdeen

In the last year thorough handwashing, social distancing and mask wearing have become a part of ordinary life. It was encouraging to see the educational role of good handwashing practices being widely promoted during the pandemic, an act that helps prevent the spread of disease-causing germs. While the ability to perform the act of handwashing is often not given much thought, something as simple as a consistent supply to clean water can be easily taken for granted, although in many parts of the world it is both a scarcity and a privilege.

I grew up in a government housing flat in Kuala Lumpur for hospital workers. Interruptions to our water supply were something we experienced multiple times in a year. On the fortunate occasions when the interruptions were planned, we were given notice about it and mum would round up all the pots and pails in the house to collect water for drinking, cooking, and showers. It might be hard to imagine a country with an abundance of water that is known for its rainforests to have water cuts, but these were not isolated incidents. Last year my parents along with 5 million others in the most populated region of Malaysia were affected by two major unscheduled water cuts which resulted in no water from the tap for at least four days.

Even when a reliable water source is available in an area, other factors such as social deprivation can also play a role. For most countries in Europe, it is illegal to disconnect water to a household due to unpaid water bills. In contrast, households in the United States face cut-offs from water utilities for non-payments of bills. Deprived regions with the highest rates of water cut-offs have been linked to higher levels of COVID transmission.

In North eastern Syria, locals have struggled with repeated water cuts due to the disruption of water supplies by armed forces. These supplies provided water to a number of nearby Refugee camps which impacted the ability of some of the most vulnerable people to protect themselves from disease transmission.

Water is a key requirement for people's ability to follow recommended handwashing practices and during a pandemic it plays a crucial role for governments to achieve their health targets.

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