

# **THE FUTURE OF WATER AND HUMANITY<sup>1</sup>**

## **Framework and Way Forward**

**In Preparation of International Conference, October 18-20, 2022,  
Muscat, Oman**

### **Introduction and Context**

1. Water is of central importance to life on Earth, and thus inevitably to the existence and well-being of all people who ever lived, and who will ever see the light of day. Some 79 percent of the world's surface is covered by water and some two thirds of the human body consists of water. The water cycle and the atmosphere, propelling the water we drink and the air we breathe, are inherently intertwined with the living ecosystems of our world.

2. Reflecting the crucial importance of water as a precious resource, humans learned many years ago how to harvest and make the most productive use of water. While this was the case all over the world, the civilisations that dawned in the Middle East belonged to those that managed this task the best. Following in the footsteps of Mesopotamia and Egypt, Oman and its neighbouring countries in the Middle East, as well as large parts of Northern Africa and South Asia, have thousands of years of experience at the forefront of water management, referring to technical solutions as well as social organisation.

3. In the last few centuries, the era of industrialisation and modernisation, which began in Europe, brought economic restructuring and growth as well as a population explosion and a massive increase in resource exploitation and consumption. Gradually, increased material living standards have brought high regard for quality of service and appreciation of the environment and sustainability as well, but the overall impact on our world – which includes global warming as one of its most conspicuous manifestations – is devastating. The physical consequences, meanwhile, are interrelated with cultural and societal transformation.

4. The ingenuity and organisation that supported sustainable water management are now all but forgotten and foregone. Wasteful behaviours have taken hold, applying to water much the same as to food and energy. Overexploitation of the riches of the sea is paralleled by the degradation and pollution of groundwater and other freshwater sources. The result is a combination of severe drought, salination due to the invasion of sea water, lack of access to clean water for large numbers of people, erosion and dust storms, coupled with severe flooding at other times.

5. The water cycles of our world are one, a common resource for all humanity, and so water is the victim of the “tragedy of the commons”. On the other hand, the need of collaboration may turn water from a source of conflict into a unifying factor. Learning how to manage water, together, as a source of value, calls for improved organisation, locally and nationally as well as when it comes to cross-border relations.

6. Accelerating climate change and associated issues bring a massive need of new solutions as well as of applying existing ones effectively. It is not that opportunities are lacking. Examples abound in, e.g., recycling, drainage systems, circular agriculture, saline agriculture, restoring wetlands and mangrove forests, and so forth. Other strands of progress are at hand in utilising solar, wind and hydro power, or in the form

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<sup>1</sup>The “Future of Water and Humanity” shapes an inclusive partnership of individuals and organisations engaged in propelling new solutions to sustainable management of water and related resources of key importance to the future of humanity. The main secretariat is hosted by the Organisation for Quality and Innovation Strategies (Qualies), Muscat, Oman. For further information, visit [waterandhumanity.com](http://waterandhumanity.com).

of simple but radically transformative ways of planting native trees without use of irrigation, generating eco-friendly soil generation and restoring eco-systems backed by monitoring using smart sensors and IoT (Internet of Things). For such possibilities to take hold, however, people on the ground cannot act as by-standards; they need to be agents who engage actively, with solutions shaped *by* them, not *for* them. This calls for a shift of focus in governance, management and capacity building.

7. Governance was never just about government policy making. In today's world, however, given the complexity and cross-border nature of the sustainability challenge, much more is required by way of coordinated efforts, spanning a range of stakeholders and interest groups. When it comes to managing water, we may distinguish between core stakeholders (governments, service providers, river basin organisations, business, civil society, farmers, legislators, and trade unions); "newcomers" or "visiting interests" in the water sector, such as property developers and long-term institutional investors; and "under-represented" groups (consumers and users generally, the elderly, youth, poor, indigenous, nature and non-consumptive users). Further, there is the need of managing issues that arise at different levels. Depending on the cultural and socio-economic context, for instance, women are often burdened with the bulk of operational work to secure water but may have little say in investment decisions. Geographically the spectrum ranges from local to global, reflecting that the water issues are, on the one hand, decentralised and fragmented, while on the other hand, intrinsically inter-related across wide areas.

8. While it is common that vested interests taking advantage of privileged positions act to block collaborative effort, opposing interests may be observed for many reasons. The costs and benefits of particular action may be unevenly shared, while also the access to information is skewed. Increased awareness and transparency may go a long way to improve chances of sound governance and help gain the backing of the general public for reforms that underpin the common good for the long term. Overcoming states of friction and conflict may require further action, however, in order to heal discord and mistrust, bridge between divergent perspective, and realize inclusion in participatory processes capable of opening up for search of mutually acceptable solutions to joint problems.

9. The impact and approach to water management varies hugely among businesses as well. For increasing numbers of firms, supporting secure access to quality water for workers, consumers and stakeholders is seen as inherent to business success. Good water stewards understand their own use, catchment context and shared risk in terms of water governance, balance, quality and important related aspects; and engage in meaningful individual and collective actions that benefit people and nature. For others, meanwhile, water resources are taken for granted and pollution is seen as somebody else's problem.

## **An Inclusive Action-Oriented Platform and Agenda**

10. The issues at hand call for broadened means of engagement and action, enhanced awareness, and the realisation of existing and new solutions. *The Future of Water and Humanity* (W&H) represents an inclusive platform for networking and collaboration. It pulls together a number of organisations and experts with a focus on realizing untapped opportunities. Besides inventions and various technical and organisational solutions, cross-border collaboration and sound governance are in the limelight, along with their linking to culture and human behaviours. This is of high importance, as the issues and challenges referred to are intrinsically related to the ability of people to interact across natural and social systems.

11. The W&H agenda has been initiated in the Sultanate of Oman, a country that has long experience of managing water as a critical resource. Additionally, Oman has a unique history serving as a bridge-builder in forging common understanding as a means of peaceful co-existence. The initiative in part builds on already developed, initiated and deployed solutions to outstanding issues, in support of greater awareness, synergies flowing from linking diverse competencies, and attention to means of removing unproductive hindrances. On this basis, the scheme has been able to draw on existing project budgets, coupled with add-on earmarked sponsorship, to muster the required resource base. Going forward, it will have to build new, unique combinations capable of drawing in increased support, sponsorship and project funding.

12. The launching event was held in Muscat on November 13-15, 2019. It was attended by 60 participants, from Oman, other countries in the Middle East, Europe, and other parts of the world. While the emphasis was on expert workshops, decision makers and practitioners along with stakeholders, including from industry, civil society and youth organisations, took active part along with researchers and specialists. A novel workshop format was applied, engaging children in reflections on the value of water, in the past, today, and for the future. In thematic workshops, related projects were brought together under the themes of “Heritage, Lessons and Diplomacy”, “Solutions Inventory and Ways Forward”, and “The Value of Ecosystems and People Engagement”.<sup>2</sup>

13. In connection with the launching event, side-activities featured two tree-planting exercises using water-saving technology, one on the premises of the Dutch Embassy in Muscat on November 12th, and the other on the last day, Friday the 15<sup>th</sup>, on the seashore behind the Crowne Plaza hotel, where naturally preserved land resides between the cliffs. On the latter occasion, participants from 10 countries and 3 continents (Asia, Europe, and the Americas) joined forces in the plantation.

14. Following from the launch of W&H mid-November 2019, the ensuing steps unfolded:

- Participation in MEDRC “Cutting-Age Water Technologies Showcase”, December 2-4, 2019, in Muscat, Oman, with W&H represented in the exhibition, along with demonstration by Qualies of water-saving plantation technology, and by Planet from Brescia, Italy, of decentralised solar energy powered desalination, resulting in locally produced water suitable for land regeneration/reforestation projects as well as household use growing own fruits and vegetables.<sup>3</sup>
- Exploring by Hydrousa, the Horizon 2020 project with 27 partner organisations that participated in the W&H launch, the opportunity for establishing an “early adopter” project in Oman. The process has been awarded provision of funding by MEDRC. Work on identifying a suitable hosting site and local partner organisation is ongoing.
- A series of informal workshops, including consultative meetings with Omani NGOs, universities, factories and private equity organisations, investigating the outlook for kick-starting a “circular economy”, and also a video conference taking stock of the youth agenda and how to scale it, were hosted by W&H in Muscat, February 3-6, 2020.
- A coordinated advancement of workshops for children and youth, diffused and also adapted for fit in various countries, drawing on a common methodology conducive to inspiration from cultural heritage and/or other local roots related to water, as a basis for reflection on the value of water and how to stimulate its sound development in the future. Undertakings have been taken forward in Hamburg, Germany, Kerman, Iran, Bologna, Italy, and Soweto, South Africa, providing valuable further experience how to frame the arrangements.
- W&H partners have prepared a major project connecting hubs at different waterbodies in joint research and innovation on the water-food-energy nexus, accompanied by an extended proposal focused on climate change mitigation and adaptation. These activities thus far contributed to the Agenda 2040 organised by partners of Water and Humanity in Africa, and to several project initiatives in Punjab, Pakistan.
- The initialisation of a W&H Working Paper series, with 19 reports in place or under way thus far, elaborating priority themes, potential solutions and planned future work.
- As of 2020, W&H assumed responsibility of acting as the Omani hub for Earth Day and undertook water-centric activities in support of climate mitigation on the 22<sup>nd</sup> of April over the past years.
- Activities of W&H carried out at the Dubai Expo, in the United Arab Emirates, in collaboration with the Dutch Embassy, February 2022.
- Collaboration with the Global Environment Policy Programme (GEPP), Geneva, on an Executive Training pilot, related to the W&H framework, was prepared for 2020 but has had to

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<sup>2</sup>See <https://waterandhumanity.com/>.

<sup>3</sup>See [https://www.medrc.org/wp-content/uploads/2019/12/Final\\_ProceedingBook.pdf](https://www.medrc.org/wp-content/uploads/2019/12/Final_ProceedingBook.pdf)

be postponed due to the pandemic. Plans for its eventual undertaking will resume in the near future.

- Cooperation with researchers from Wetland International has been initiated in particular to the wetland restoration and conservation of Barr Al Hikman in Oman.
- Preparations in regard to a student competition to be organised in connection with the upcoming event in October 2022 are under way in collaboration with Wetskills, <https://wetskills.com/>
- The holding, by W&H, of the next major International Conference in Muscat Oman, October 18-20<sup>th</sup>, 2022, with experts, decision makers, and stakeholders, to further the substantive agenda and the identified priority projects, and also issue recommendations for policy along with other strands of action, to appear as the *Muscat Call 2022*.
- The 29<sup>th</sup> edition of the Global Forum, for the first time to be held in the Middle East, to be co-arranged with W&H in Muscat, on October 17-18<sup>th</sup>, 2022, linking issues of technology and sustainability, <https://globalforum.items-int.com/>

## Framework for Collaborative Activities

15. The priorities of the W&H agenda have been shaped with a view to where:

- i) Untapped opportunities in the shape of solutions to outstanding common water-related challenges are at hand, or could be made readily available, by linking up and aligning interests between relevant actors that are presently non-communicating
- ii) Attention to common challenges can help create awareness, spark interest among those uninformed or who typically lack voice, such as children and youth, and/or enable cross-border collaboration in supporting, developing or executing joint solutions
- iii) Similar issues are at play in different locations and/or communities while, at the same time, weakly recognised, understood or acted upon, with sharing of experience building awareness and enabling the diffusion and uptake of solutions
- iv) Collaboration can help realize capacity building and engineer the ability to overcome obstacles and hurdles that prevent progress
- v) Cross-fertilisation between scientific disciplines, different knowledge fields and competences can help generate collaboration where most potent and relevant, whether between cities, regions, countries, or regions, and/or enable involvement by more actors of importance to realize success, such as private sector, civil society, deprived areas, or disadvantaged groups based on, e.g., gender, belonging to an ethnic minority, or age
- vi) Joint efforts to connect with multilateral frameworks, such as those associated with the SDG:s, or regional cooperation mechanisms, as in the case of Horizon 2020, can help strengthen access to required competences, resources and partners.
- vii) Activities in order to enable entrepreneurial activities for students so as generate inspiration and tangible facilitation for innovation and start-ups in regard to novel water management solutions

16. The activities progressed through W&H aim to be locally relevant, strengthening regional receptiveness and adaptation, on the one hand, while on the other hand also support an international outlook, trust, and joint effort. Cross-border collaboration, which refers to reaching across artificial boundaries, whether in terms of scientific disciplines and lines of thought, sectoral, institutional, ethnical, or geographical, is seen as a tool to overcoming obstacles and realizing untapped opportunities. In order to achieve success, the value of shared benefits must outweigh what privilege vested interests have to give up. Actions can generally be taken most expeditiously at local or city level, where broad stakeholder engagement or co-creation by citizens meet with less practical issues. Likewise, “small” countries may be better placed than large ones to identify shared interests, thereby involving citizens and stakeholders more effectively around sustainability as a unifying purpose. At the same time, common purpose and the importance of overcoming prejudice and battling sources of inequality and exclusion, may be highlighted from linkages to international

frameworks. The prime force in this respect, the 17 Sustainable Development Goals (SDGs)<sup>4</sup>, or 2030 agenda, was developed by the United Nations through an interactive process that involved large numbers of people around the world.

17. Through shared insight and the ability to communicate, crossing boundaries, the potential for progress grows through joint action. On this basis, the substantive directions for W&H activities have been arranged by pulling together related specific project agendas, clustering within the scope of four complementary focus areas. Each focus area includes three tracks of substantive concrete activities, making up 12 (4 x 3) in total. Neither the focus areas nor the individual activities are mutually exclusive but rather overlapping, and of complementary nature. See Figure 1 for a schematic illustration of this framework.

## Project Activities Going Forward

18. In this section, we present each of the 12 activity “tracks”, again, grouped 3 at the time underneath the headings of each focus area. The included areas have been devised so as to be relevant for a number of actors and reflect genuine opportunities for collaboration. Together, they embody the holistic nature of the water and humanity agenda. In some places, we indicate where specific actors play a key role, along with envisaged ways forward. More information on specific activities is available in the W&H Working Paper series.

19. The project agenda and networks are naturally set to grow and evolve over time. A core subject, linked to and converging with others, is that of Water diplomacy, at the top of the imaginary clock visualised in Figure 1. Moving anti-clockwise, three activity tracks form part of the focus area “*Heritage, Diplomacy and the Future*”. This is followed, at the lower left, by three activities within the realm of “*Quality of Life, Health and Leadership*”. Moving forward bottom-right, we enter the sphere of “*Industry, Produced Water and Treatment Solutions*”, finally followed by “*Climate Change, Water Cycles and Ecosystems*” on the upper right, leading back to water diplomacy at the top.

20. People and communities knew for thousands of years how to manage water, especially in the Middle East where some of the world’s oldest and most sophisticated systems for managing water evolved. Specific practices unfolded in Africa, initially along the Nile, later along the Mediterranean, stretching to Morocco in the west, and also in West, South and Central Asia. Each country tends to highlight its own historical practice. In Oman specifically, the *falaj* refers to water that runs through a channel dug in the earth, while supplied at different stages and levels according to best use, level of cleanliness required depending on the use (e.g., for human consumption, bathing and washing, animal consumption, irrigation, etc.). As late as at the turn of the last millennium, some 3000 were still operational. Although the ongoing trend means they are becoming deserted and dysfunctional, Oman is probably the country in the world with the largest share of its original traditional water management still operational.

21. The *falaj* centred on collaboration, through shared investments, responsibilities, and principles for usage of water, taking seasonal variation into account and also individual needs and capabilities. These practices were devised so as to last over long periods of time and to help fostering solidarity and tolerance, values that have become a hallmark of Omani society to this day. Each other country display their own lessons from the past. In Yemen, the heritage is represented by the Qanat, in Sri Lanka the Cascade, and so it goes in India, Iran, Morocco, Pakistan, Uzbekistan, and so forth. Yet virtually all of these countries face severe contemporary challenges in regard to water, while general awareness is lacking and tools for engagement by the public are largely absent. This begs the question how to compare situations of the past with those of the present, and what lessons to draw.

22. In the following, three specific activity tracks pick up on these themes, with a view to overcoming fragmentation in regard to heritage as a basis for realizing water diplomacy today.

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<sup>4</sup> The SDGs explicitly addressed in this document are nr. 3, Good Health and Well-being, nr. 6 Clean Water and Sanitation, nr. 7 Affordable and Clean Energy, nr. 8 Decent Work and Economic Growth, nr. 10, Reduced Inequalities, nr. 11 Sustainable Cities and Communities, nr. 14 Life below Water, nr. 15 Life on Land, and nr. 17, Partnerships for the Goals.

Figure 1: Thematic Landscape and Activities



Focus Area I: Heritage, Diplomacy and the Future

I.1. Linking water management of the past with water diplomacy today:

23. The present project sets out to build on and extend initial efforts to compare and share lessons from various part of the world, arranging with structured reviews and comparative analysis. While water insecurity has been a predominant cause of social distress through the ages, human history offers a wealth of experience of solutions having been worked out. Here, the objective is to enable sources of past success to inspire action today, with potential avenues coming in various shapes. This includes practically useful insight how to approach uncertainty and ambiguity in human relations.<sup>5</sup> The key to understanding win-win between decision makers as well as ordinary people on the ground, is not merely about facts and codified information, but resides in tacit knowledge, embedded in preferences and attitudes of opposing interests in relation to each other and pertinent to a specific situation. Such aspects are generally not explicitly expressed but manifested in practices. Knowledge co-production, on terms that enable the active and constructive engagement by diverse interests and perspectives, can serve as a way to instigate dialogue and joint learning in support of fruitful negotiation and alignment of interests.

24. Going beyond exchanges between historians in such respects, the project aims to explicitly link comparative research work to contemporary policy- and decision making. Bridging between lessons of heritage and water diplomacy requires opening up for cross-disciplinary, cross-cultural and cross-sectoral interfaces, with two-way exchanges between science and research on the one hand, and relevant policy spheres on the other. Considerations of economic incentive, science diplomacy, peace research, and also the role of culture, have to connect. The purpose is to build a common and practically useful understanding of the issues, driving forces and solutions in regard to water management over the years. Lessons learned may apply to ways of enabling resolution of conflict between different countries but also between policy fields, as in the areas of agriculture and water management, sectors, communities, or individuals.

<sup>5</sup>See <file:///C:/Users/thoma/Downloads/Ambiguity%202012%20-BrugnachAn%20Ingram.pdf>

25. The project may operate through city networks, regional networks, or exchanges between likeminded institutions in different countries, brought about by W&H or related partner bodies. At the upcoming international conference, October 2022, specific plenaries will be devoted to sharing of experience among policymakers and experts on sources of failure as well as success in managing water resources shared between nation states. Subsequent in-depth parallel sessions are set to examine how constructive methods, tools and practices can be further diffused and implemented.

26. The objective is to open for improved collaborative processes, through shared understanding how constructive solutions could be enacted, of relevance to each situation. The partly untapped potential of “women in tech – women in water”, will be scrutinised in a conference session that calls attention to the gender dimension. A special challenge has arisen due to the huge onset of refugees, individuals often in a desperate situation lacking access to basic utilities, leading to a worsened water crisis while also sapping resources out of the countries and regions receiving them, notably in the Middle East.

27. Tracks of activity are under development, addressing such high-friction and vicious circles where the challenges of water management may either be high-jacked by or worsen other conflict situations, or act as a bridge-builder (the Nile, African Great Lakes, hot-spots in the Middle East, Central and South Asia, but also between nation states and regions in Europe. A bid to address issues in the water-food-energy nexus, taking cultural factors into account, was already made by W&H partners located at different water bodies, in response to a Horizon 2020 call. A related but expanded international project is in formation, with focus on climate change mitigation and adaptation.

## **I.2 Inspiration and Co-creation drawing on Cultural Assets (incl. Museums):**

28. People engagement is fundamentally important for sustainability. Inspiration is key for any real difference in behaviours to occur. Heritage offers a vast source of information and inspiration which can be useful but is often passively observed rather than approached actively. This tends to be emblematic also of Museums, which carry the mission to collect, structure and communicate aspects of the past to the citizen of today. Today, museums face a challenge to adapt and innovate in order to remain relevant, attractive and able to make a difference for visitors. As new means of experiencing cultural phenomena have become available, museums are in the process of evolving into more potent informal educational platforms, and to serve as important sources of inspiration and co-creation, enabling citizens to be active as shapers rather than merely receivers of communication and content.

29. This way, museums may help realize community development goals while also emphasising access to knowledge and aesthetic experience. Modern Information and Communication Technology (ICT), by way of digitalisation and visualisation, creates new possibilities to achieve visitor-museum interaction through which the museum environment can foster specific expression and dynamics of learning. Museums as educational platforms therefore offer more substantial forms of involvement, and can be used to develop basic cognitive skills, including awareness and motivation to resolve problems of today. As they are left to evolve in relative isolation, however, progress and new initiative is highly uneven.

30. Recognising the potential of museums to inspire and catalyse knowledge and inspiration, drawing on practices of the past and linking to today, we propose developing an ecology within the existing museum environment, involving interested Middle Eastern institutions, and engaging them with international partners. The first step will be an evaluation of their typology of exhibitions, the degree of auratic/non-auratic experience, and with consideration to ways in which the themes of the different museums may be coordinated in support of synergetic effects. This includes collecting information about visitors attending the different museums, and their experience, all handled with due privacy concerns in mind. Through the creation of links between relevant stakeholders, we thus propose synergetic learning about the role of museums, with common water heritage at the epicentre but also reaching into broader themes. The objective is the emergence of an ecosystem embedding likeminded museums, facilitating creating alternating exhibitions attracting increased number of visitors, and linking to society and citizens initiatives in search of avenues to collect and lessons from the past and transform them into practice of the present.

### I.3. Workshops Valuing Water: Engaging Children and Youth:

31. “A series of workshops is undertaken with children and youth in selected countries, building on an initial workshop held on November 13, 2019, in conjunction with the launch of W&H, at the National Museum of Oman. On that occasion, established methodology rooted in motivational interviewing, was applied to capture the interest of 7-8-year-olds in regard to traditional water solutions, the *Falaj*, from there extending to personal positive associations with water, to open up for reflection by the children individually and in groups on the value of water, and from there on issues with regard to water management today and in the future. The children were intensively inspired by presentation material that many 20-year-olds – even those specialising in the field - find boring. Using art, the Omani children produced presentation material to illustrate important relationships and suggested steps of action.

32. Following the launch, similar but locally adapted workshops were arranged in three other countries as a result of local, personal initiatives within the network, in Iran, Germany and Italy. The age groups varied from 3 up to 15 years’ old, entailing the following common elements: i) Reflection on the unique value of water; ii) linking water to personal aspects, such as family or their immediate surroundings; iii) opening for reflection on the role of water today and how it is handled; iv) considering where we are heading in the future, and; v) creative work, including in teams, using art for expression. In each country, a slightly varied version of the workshop was offered to age groups, with lessons of what worked well or less well recorded. The relationship to the teachers, specific school, school administration, etc., was handled with care. Both preparation and follow-up were planned for.

33. The outcomes were reviewed and compared at a joint Video conference, held on February 6<sup>th</sup>, 2020. Apart from participation by the mentors who had masterminded the different workshops, the discussion incorporated external experts and entry points to relevant international networks. These included the coordinator for the Middle East, based in the Netherlands, of the World Youth Parliament for Water, the World Youth Summit, South Africa, and the founder of Move Green, Oman. The deliberations demonstrated the breath of positive impact, in regard to the children themselves but also in regard to teachers, principals and institutions involved, which can be of great importance for scaling the model. The case for adaptation to reflect the special features of age groups, local conditions and cultures. Practicalities, such as the duration of the workshops, facility or equipment used, and what is key to achieve interactivity and creativity, were reflected on. The invited organisations presented their views, ideas and recommendations on avenues ahead.

34. A key consideration for the next step is that of formulating a “protocol” that builds on the lessons of the workshops held thus far, while also taking account of other relevant experience, literature and sound judgement. The protocol should reflect what has proven to work well under different circumstances, including how to adapt the setup. It should lay the basis for a sort of “certification” based on “guidelines”. Certain requirements should be determined for pre-workshop preparations, execution, and follow-up, and also what key actors to involve, mentors, teachers, and other resource persons. Rules when it comes to reporting and evaluation, so that the lessons are documented in ways fully respectful of the participating children, while also effectively shared and built upon in the further development of the W&H agenda. The objective, after some additional experimental workshops, is for the protocol to be developed, reviewed and accepted through a process that entails collaboration and acceptance by other existing relevant organisations and networks. This will include mechanisms for channelling ideas and outcomes flowing from the youth workshops into real-world action. A Steering Group is in formation to guide the strategy.



### Focus Area II: Health, Quality of Life, and Leadership

35. Water is essential to human health, as to all life on earth. Multiple uses cannot be forgone, such as drinking water, water for food production, oxygen generation, heat control, sanitation and waste. Other usage attains great value too, such as recreational waters and means of transport. Today, waters all over the world are impacted by human activity. Some 2 billion people worldwide are estimated to rely on drinking-water sources contaminated with faeces, and water has been seen to instigate conflict, as well as to be used



as a means of suppression. Meanwhile, water issues are closely interwoven with food security, which in turn impacts on quality of life through a multitude of channels.

36. How water management translates into health and quality of life more broadly is critically about governance, and how decisions are formed. An important element has to do with the scope for research, and notably interdisciplinary collaboration, spanning natural science, social science, and the humanities, which has a bearing on the way researchers engage both in the scientific process and in societal and political affairs. At the same time, there is the critical question to what degree a society hires and promotes experts on the basis of appreciation for – and the relevance of - their skills, or whether personal contact, loyalty and vested interest take upper hand. The role of the media, mechanisms for communication and for building trust, whether diversity is appreciated or differences in view are suppressed or obliterated, and whether citizens are genuinely heard and engaged in decision-making processes, are further inter-related with the quality of leadership. Having said that, various initiatives can be taken, and activities be developed in support of sound leadership, in both public, private and other spheres of society, with enhanced capacity to understand, value, develop strategy and act in support of sustainability.

## **II.1 Chemicals, Food Security and Health Hazards:**

37. Analysis of water for tracing potentially harmful compounds is very important. A salient development is the excessive use of plastics which degenerate slowly, have implications for living organisms, including humans, and which now spread in waters all over the world. One particular category of disturbing chemicals, endocrine disruptive compounds (EDCs), generate biological activity at a very low level of concentration which may increase risks for chronic disorders. The impacts of EDCs in water, their potential effect on human health, as well as how EDCs should be reduced, have been insufficiently researched. The lack of scientific knowledge is paralleled by lack of awareness among the general public.

38. Enabling change requires enhanced transparency, increased awareness and adjustment by water suppliers, communities, and households. Concrete measures of high interest include the development of tools for measurement of water quality, a dip water developed with IoT, to be available at home. A procurement process has been proposed to make this a reality. More broadly, behaviour change methodology coupled with innovation using IoT can be mobilised to bring about inspiration for prevention and remedial action on a number of fronts. To promote progress, a new institute for holistic integrated perspective on Water and Health is under consideration.

39. Insufficient knowledge about the health effects of water quality generally, and produced water specifically, creates potential health hazards. Conversely, the lack of scientific knowledge translates into swaggering public perceptions and general uncertainty, serving as a drag on technical progress and new solutions. While already existing technologies can go a long distance towards enabling current drinking standards for produced water, for instance, concerns of unknown toxic compounds and effects prevent further development, impeding scaling and thereby leaving new solutions exclusive and expensive. Much enhanced knowledge of human health hazard of chemical mixtures is thus required, both to ensure that genuine health issues are addressed and in support of technical and industrial development. For instance, toxicity assays are necessary in regard to the potential synergy between toxic compounds and the possibility of undetected toxic compounds in produced water treatment.

40. Health standards, in this case for drinking water, basically reflect a time when health risks could be determined through measurement of concentration in regard to individual contaminants. Today, maximum safe contaminant concentrations must consider the combined impact (and risk) of much broader mixtures of contaminants. The potential formation of disinfection by-products (DBPs) also requires attention. In the case of DBP formation, the studies underlying current regulations concerned surface water, groundwater, or reclaimed domestic wastewater. In the case of produced water, the potential DBP formation is virtually unknown. While RO-treated produced water features a low level of organic carbon concentration, high iodide and bromide content opens for risks of forming DBPs, whose gradual concentration becomes much more toxic than chlorinated DBPs.

41. Water quality and health relate closely to food security and hygiene. Poor soil management practices, animal mistreatment, use of pesticides/fertilizers/chemical disruptors, under-investment in infrastructure and neglect of sanitation in the food logistics chain all add up to threaten human health.<sup>6</sup> To achieve significant change to current practices and the associated risks, regulations, standards and credible certification need to go together with enhanced citizen awareness. Local communities along with entrepreneurs and social innovators must be drawn upon as important change agents, where local empowerment can be accompanied by behavioural change. On this basis, customer engagement is critical for realising improved practices through the value-chain, resulting in improved hygiene and enhanced food quality and nutrition status. Transparency and reliable information need to be mirrored in responsible policies and corporate management. The call is on for cross-sectoral and cross-disciplinary competences to come together in highlighting the issues as well as address them<sup>7</sup> (see also Activities II.2 and III.2).

## II.2 NBS, IOT and Quality of Life in the Urban Environment:

42. The urban environment exerts an overwhelming influence on sustainability in the modern world. Cities almost always display much higher productivity than surrounding areas. In recent decades, cities entered a phase of accelerating expansion, with demographic shifts accompanied by imbalances and environmental degradation. Cities have thus come to consume excessive resources, including water and energy, as well as producing equally excessive waste. At the same time, their internal dynamic tends to be marred by processes leading to fragmentation and polarisation. It is commonplace that people, depending on where in cities they reside, experience huge internal variation in the quality of infrastructure, in access to public and private services, in their level of income, in what security or amenities they enjoy, and so forth. In this context, a sense of alienation gains traction, along with worsening conflict, crime, and insecurity, fuelling populism while further eroding public investment in sustainable infrastructure and resource use.

43. Within the special model of “Blue Urbanism”, advanced by Gulf cities, new flagships help craft national identity through city development taking advantages of innovation around the riches of the sea. Leverage using foreign brands and capabilities blend with own traditions, local culture and environmental assets in achieving transformative change. Limitless attraction of resources, technology, and has enabled reclamation of the ocean with landfills and artificial islands. Achieving sustainability and liveability for their citizens, however, requires going further. Most fundamentally, there is the critical need of breaking the dependence on rents flowing from the petrol economy by achieving genuine payoff from investment in environmental and social assets, translating into massive challenges ahead.

44. In order to divert from the patterns and trends of the past, urban planning must be placed on a new track of embracing wellness and quality of life. Around the world, a revival of Nature-Based Solutions (NBS) is viewed as a means to create and transform public space in support of urban regeneration, including deprived areas. While access to green space is commonly quantified, however, cultural access, a sense of belonging, and roll back forces of exclusion and discrimination, may be evasive. A key element is for citizens and stakeholders to take active part in co-design, co-development and co-implementation of such space. In URBiNAT, this has been extended further, to encompass the notion of “healthy corridors” devised to increase well-being by combining different kinds of NBS (territorial, technological, economic, and social) as larger constructs, the success of which crucially hinges on genuine participation and co-creation by citizens, including from disadvantaged groups.

45. As physical meetings are not always practical, or even possible, on-line communication is increasingly important. Practical and user-friendly arrangements are key to effective participation. Smart sensors, IoT platforms and machine learning using big data further open up for broad-based diffusion of information, including for information using open source. Smart metering coupled with simple means of measuring

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<sup>6</sup>See <https://en.unesco.org/themes/water-security/wwap/wwdr/2020#download>

<sup>7</sup>See <http://www.fao.org/3/a-av046e.pdf>

water quality, may greatly facilitate amending sources of contamination and allow separation of water based on quality at household level. As another example, sources of waste and water losses can be identified and be made available to people where and when they need it and are able to act on it. Beyond adequate deployment of digital tools, the key for success resides in applying methodology and content relevant in the specific context. Through interactivity and tailored messaging that responds to individual attributes, such as gender, age, ethnicity, level of education, digital literacy, and so forth, the rate of precision and relevance can be greatly enhanced. At the same time, it is of critical importance to protect privacy, putting citizens in the position to exert adequate influence, including over who has access to personal data and how it is used. The choice appears in many situations, between using central command backed by close surveillance, or embrace ways and means of enabling local communities to engage and take part in crafting solutions<sup>8</sup>.

46. There is a need of improved means and opportunities for those engaged with sustainability at local and city level, to exchange information and engage in shared learning around the value-enhancing potential as well as outstanding risks of new tools and methods. Stronger networks are required to link emerging innovation institutes in joint capacity-building and work to identify best practice, encompassing environment and water-related SDGs and their implications for future policies. Euromed Cities Network, which connects 150 cities in the Mediterranean, offers examples of such exchange and collaboration, developing Green and Blue Infrastructures, as NBS, with the purpose of adapting urban and peri-urban areas to climate change, and fighting biodiversity loss. In particular, considering cities' vulnerability to climate change, storm water risk has to be assessed and managed. An initiated pilot project has been devised for this purpose; Urban Flooding, Risk and Resilience in Cities. Through collaboration with W&H, this agenda is opening for sharing experience with cities in the Middle East, to be furthered in preparation of the next international W&H conference in October 2022.

### **II.3 Innovation, Entrepreneurship and Training in Sustainability:**

47. Sustainability ultimately hinges on governance and leadership. In the absence of prosperity, however, demand will be lacking for quality services and environmental protection. In countries that rely on rents from natural resource extraction, a shift to creating value based on skills and knowledge-based services is essential. The scope for “economic freedom” and managing risks is critical, and partly relates to access to diverse sources of finance (public seed funding, private equity, angel and venture capital). In order to breed innovation, entrepreneurship and business growth along with new jobs on terms in sync with sustainability, however, an ecosystem needs to evolve including regulations, standards and a demand-side that places value on natural capital.

48. “Top-down” strategy and “Bottom-up” initiative must come together in enabling this to happen. Rather than pursuing introvert organisational change, innovation needs to be spurred by attention to an external customer base and relevant stakeholders. International entrepreneurship, and the avenue to more radical and impactful innovation through “Grown Global”, while at the same time building localised, connected hubs, can serve as a source of such impetus. There is the need as well of appreciating diverse experiences and the point of view of others, often requiring a conscientious strategy to recognize competency in different forms, make appointment on the basis of merit, while also identifying qualified women as well as men for board positions and among senior management.

49. A biomimicry track inspires a new model approach to innovation and the solutions inventory. Biomimicry/Biomimetics or Bio-inspiration is a new integrated discipline which aims at solving problems looking at how living systems operate. The emulation of natural forms, processes and entire ecosystems can inspire innovators and leaders at all levels and background to design more sustainable innovative solutions; not only at technical level but also with impetus on policymaking with the ultimate goal to set up circular economies and more sustainable/regenerative cultures. For this track is foreseen the identification and implementation of a series of activities, in the form of interactive seminars, workshops, training courses

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<sup>8</sup>See Y. N. Harari, The world after coronavirus <https://www.ft.com/content/19d90308-6858-11ea-a3c9-1fe6fedcca75>

as well as concrete activities that get to involve strong elements of co-creation. Biomimicry, as a problem-solving approach, may serve as a horizontal resource that helps underpin other focus areas and activity tracks, as well as connecting them based on a holistic approach.

50. The Global Environment Policy Programme (GEPP) has been planning to run a pilot Executive Training for young leaders on strategy and leadership for Sustainable Development, co-organised with W&H in Oman. The partners behind that programme include the University of Geneva and the Zonoff Institute at Harvard University. Partners of W&H collaborate with GEPP on the preparations. Based on a successful outcome, a recurrent executive training programme may be established, in synergy with other means of capacity building. An important objective is to enable fruitful linkages in training and propelling leadership across the Middle East, with a view to turning the challenges in sustainability into a source of opportunity for innovation, new market growth and value-creation.



### **Focus Area III: Industry, Produced Water and Treatment Solutions**

51. Although agriculture stands out as the main consumer of water in many countries, industry exerts a major influence too. As countries industrialise and keep expanding their resource base, a conflict between alternative strands of water use, e.g., for agriculture, drinking water, and industrial purposes, tends to intensify. On the other hand, technological and organisational capabilities are on rise, along with better provision of information and increased public demand for environmental protection and sustainability.

52. Aside from water consumption by the agricultural sector and households, the treatment and release of wastewater into the environment is heavily influenced by industrial activity. In the oil producing countries of the Middle East, petrochemical wastewaters raise particular challenges. In recent years, enhanced resources have flowed into achieving better practices and enable produced waters that can be used for productive purposes, as witnessed by demo sites featuring impressive plantations using such water. Yet, established standards and means for evaluating information to guide such ventures are weakly developed.

53. Meanwhile, new technologies and industrial processes offer new vehicles for cleaning water, and also separating water of varying quality. Nanotechnology, advanced membrane science and circular economy applications offer pioneering methods for addressing various kinds of water issues, ranging from industrial purposes to the household sector. Further, beside the scope of modernised large-scale infrastructure development, the opportunities following from new technologies operating in tandem with regulatory reforms and revised procurement practices, need to open up for decentralised and locally adapted solutions for improved water management.

#### **III.1 Sustainable Infrastructure, Logistics and Recycling:**

54. Infrastructure plays a fundamental role in framing economic and social development in a broad sense. Public purposes along with industry and private sector development come together in the planning, design, implementation and operation of infrastructure. Challenging trade-offs have to be dealt with, as between different kinds of functionality, costs and quality aspects. Regrettably, much of the infrastructure devised for water management lacks proper consideration to maintenance and commonly there is under-investment in planning and strategy to account for long-term viability. Further, infrastructure development tends to be fragmented and compartmentalised, with little consideration to natural capital and the necessities of sustainability.

55. Today, infrastructure for water management is ageing in many parts of the world, with fixes tilted towards temporary, low-cost solutions and an absence of contingency plans for the future. The problems are exacerbated by the weight of vested interests and corruption commonly surrounding large-scale projects. There is a need of opening up for innovation in niche development and services, as exemplified by smart metering for detecting sources of waste and spills, coupled with simple means of measuring water quality (see Activity II2). Also, it is necessary to apply a systems perspective, ensuring synergies

and optimisation of investment and resources spanning inter-related aspects, including with regard to transport, logistics, and supply chain management.

56. The sustainability of logistics and supply chain operations are often seen as associated with solving organisational issues confronting (large firms), while improving expertise within smaller size suppliers and contractors. For actors in the industry, a core concern is how to introduce practices resulting in improved environmental outcomes in ways that go hand-in-hand with enhanced efficiency and profitability. It is not a given what opportunities are at hand. Apart from company strategy, ingenuity and initiative, regulations, standardisation and customer awareness are of high importance for the benefits to outweigh the costs for forerunners in this respect. More wide-ranging collaboration, including public-private partnership and in some cases social innovation, may importantly shift the boundaries for what can be achieved. A transition to solar-powered transport or more effective multimodal transport solutions, entailing shifting interfaces between seaports, airports, railway terminals, may require a combination of citizen engagement, public infrastructure investment, and more stringent environmental protection, resulting in sustainable business development and growth.

57. Lifecycle analysis and implementation represent an essential element in this context. Opportunities for recycling and reuse generally represent a grossly under-exploited source of enhanced systems-efficiency. Some low-hanging fruits illustrate the gravity of the situation. Used batteries represent an abundant and continuously provided source or potentially viable materials. In most countries, however, they keep being shipped to and thrown away in landfills, and this despite growing risks of leakage of hazardous materials, such as cadmium, lead, mercury, nickel, and lithium, to the world's water cycles. Yet, recovery and reuse are generally economically beneficial, applying innovative processing and separation stages, given that reliable battery collection can be arranged, which in turn requires an organisation effort coupled with the engagement of people in waste separation.

58. On this basis, W&H has initiatives consultative meetings between lead researchers, practitioners, NGOs, and private equity organisations with the objective of kick-starting a “circular economy” Resource Recovery and Circular Economy Centre (R2CEC). A number of applications for re-use would be incorporated, including recuperation of plastic from the ocean, for which multiple viable and yet unrealized solutions are at hand. The idea is to create a platform for demonstration effects coupled with skills development, enabling new methods and social organisation to come together in making solutions feasible and sustainable. The impetus needs to incorporate a change in attitudes along with capacity building.

### **III.2 Addressing Produced Water Issues:**

59. Chemical processes deployed across diverse sectors exert an increasing impact on water resources. Produced water is inherent to the hydrocarbon recovery processes, making up the by far largest waste stream. Oil industry is using growing amounts of water to pump into wells, blended with chemicals and salt. In the aftermath, produced water is obtained in huge volume, featuring dissolved gases and oils, salt, precipitated solids, and so forth. High costs and limitations in managing separation, along with the absence of adequate standards how produced water can be used, contribute to waste and pollution.

60. The exact composition of produced water varies between each field and production zone. Failure to control the environmental impact may cause damage to ecosystems, as well as lead to fines, lost or deferred production, and civil penalties for the industry. On shore facilities are more strictly monitored and limited compared to offshore facilities, with oilfield brines prone to kill freshwater fish and vegetation, doing great damage to oceans and coastal areas.

61. Adequate reuse would naturally decrease the pressure on existing water resources. At the same time, no available methods achieve a full separation of hydrocarbons and water. New innovative solutions are under development however, drawing on, e.g., nanotechnology and advanced membrane science. Realizing untapped opportunities will require stronger cross-sectoral collaboration, linking to enhanced knowledge of the scope for safe and economical usage of purified waters under varying circumstances (see activity

II1). This applies to the feasibility of using produced water for, e.g., waterflooding [produced water re-injection (PWRI)], tree plantations, crop irrigation, wildlife and livestock consumption, aquaculture and hydroponic vegetable culture, industrial processes, dust control, vehicle and equipment washing, power generation, fire control, and so forth.

62. Produced waters are marked by a number of elements which are interwoven under the influence of various enabling/limiting factors. The magnitude of the challenges at hand calls for:

- Better mapping the complexity of the system of produced waters and connections among its elements, as well as the key stakeholders that have a bearing on what results can be achieved.
- Identifying gaps and bottlenecks jeopardising the development of sustainable solutions for treating/reusing/disposing produced water.
- Determining which specific actions (basic-applied research, standards definition, policy drafting, pilot testing, etc.) could be taken to remove gaps and bottleneck. Programme and prioritise these actions with a view to securing the organisation and resources to implement them.

63. Progress in regard to the above will require that stakeholders and experts with diverse needs and competencies work in synergy, confronting themselves with conflicting purposes, and carefully examine which are the gaps and bottlenecks in different parts of the overall system around produced waters, so as to identify practical actions at different levels to remove blockages and turn the overall system into a sustainable one. For this purpose, an activity is in preparation to link the issues of high treatment cost, potential chronic toxicity of the treated produced water, and public acceptance. Given the diversity of solutions required, diverse competences are called upon. Meanwhile, the physical and chemical characteristics of produced water vary widely and change over time, depending on the characteristics of fields, the regulatory environment, and technologies used, calling for customised approaches.

### **III.3 Decentralised Solutions for Water Treatment and Desalination:**

64. The exploitation of water by agriculture and other industrial usage, coupled with rising sea levels lead to increasing problems with salination of coastal lands. Conversely, land degradation and water scarcity contribute to major losses in agricultural food production. In order to address these global challenges, low-cost, nature-inspired multi-functional solutions are under development, using a systemic approach to combine utilisation of solar energy for desalinating or purifying presently useless but locally available water resources for productive purposes.

65. A particular solution in this respect, mangrove, mimics nature in regenerating degraded soil whilst producing high-value crops. Combining cost-effective desalination techniques with organic restorative methods and state of the art information technology, the objective is to arrive at a method that is scalable, adaptable and cost-effective, offering a robust, sustainable and economically viable solution to regenerate soil in dry regions bestowed notably with saline water.

66. Various traditional and upgraded solutions smartened with the help of IoT or other new technologies, may be combined in new ways and integrated in the local context. Low-cost desalination systems such as Mangrove Still may cover the daily water needs of a household using a decentralised devise run with solar energy. The Groasis Waterboxx allows for planting trees using minimal water while instead rooting themselves naturally in the ground. Hydroponics, through which plants may be grown without soil and diffused in containers, opens for providing quality food locally, including eco-food in the form of fruits and vegetables. Factory of the future may be applied to allow for local production, at much reduced cost.

67. Strengthened synergies and new applications can arise from integration with related activities in the water-food-energy nexus which, along with cost reductions, is key to help leverage funding and diffusing such solutions. Arranging with testing activity and demonstration of opportunities on-the-ground, in relevant locations, is a vital step. The Hydrousa Horizon 2020 project is examining possibilities to co-invest in “early adopters”, in Oman or other countries in the Middle East. Such adopters could serve as inspiration for local research and help achieve customer appreciation and market up-take.



## Focus Area IV: Climate Change, Water Cycles and Ecosystems

68. The water cycles of the world form a powerful planetary resource which is inevitably subjected to a myriad of influences, natural and man-made. An ongoing massive impetus from climate change and associated disruptions is now beyond doubt, however. Living eco-systems are under pressure from multiple ends. Heated waters cause the decay of coral reefs and other havens of marine life. Overfishing and pollution have a bearing on all oceans while the construction of dams intercept more and more rivers, putting an end to the revitalisation of fish stocks. The discharges of expanding large-scale desalination plants bring stark side-effects. With rising sea levels, soils in coastal areas are damaged by salination. Deforestation, modern agriculture and land use practices remove protective natural vegetation and destroy the capacity of soil to retain water and regenerate life. Shifting climate zones subject local plants and animal species to stress, forcing them to relocate or be wiped out.

69. There are no single panacea or piecemeal solutions to tackle this vast realm of issues at stake, and no way for individual countries or communities to stay clear of the consequences, nor to work out a solution on their own. While comprehensive responses are required, and fast, nation states are proving unable to respond, individually as well as in the context of regional and multilateral organisations. This begs the question how to initiate processes to highlight the need of countermeasures and enable their realization. Paradoxically, the massive shutdown on economic activity and abrupt change in human behaviours following from the onset of the corona virus in 2019, has had some positive environmental effects, such as a temporary reduction in CO<sub>2</sub> emissions. Such developments occurred as a side-effect of undesirable dangers to human health, however, were of *ad hoc* nature and inherently unsustainable.

70. While the gains of depletion are mostly short-term and concentrated on few hands, the damage cuts widely and stretches far into the future. Human existence and life on earth more generally depend on the outputs and benefits from healthy and functioning ecosystems. Coming to grips with the task at hand will require multiple actions, undertaken by different kinds of actors, propelled by the engagement of and collaboration between complementary competences and realms of responsibility. Gaining momentum will hinge on the provision of adequate information, effective communication and constructive alignment of conflicting interests. In this focus area, we identify ways to move when it comes to identifying, furthering and scaling specific opportunities related to climate change water cycles and ecosystems.

### IV.1 Value of Ecosystems: Oceans, Wetlands, and Eco-tourism:

71. How do we gauge the impact of disrupted water cycles and ecosystems? Much needs to be done with regard to measurement and evaluation, as well as in working out ways of translating what gets measured into action. There is a need of stretching beyond analysis of purely technical aspects, and of what is piecemeal, in favour of cross-disciplinary approaches that span both nature and society, taking account of synergies and the risks that emanate from aggregate and also irreversible, or threshold, effects. Meanwhile, in order to enact societal change, people need to be on board and be able to collaborate. Skills upgrading, mindset change, and behavioural adjustment are essential.

72. Systematic conservation methods (or optimal site selection or reserve design methods) identify optimal conservation areas based on ecological and economic constraints and resources. Conservation efforts need to be broad-based, however, taking account of economic and spatial considerations, e.g., in regard to competitive land use options. There is a continued challenge though, to value, in monetary terms, many of the goods and services provided by the natural environment, as they may take the shape of non-marketable goods, and/or because their impact is so far-reaching and emanates through indirect or aggregate effects.

73. The functionality and benefits of living ecosystems are at work across many dimensions, resulting in direct as well as indirect benefits. Quantifiable and qualitative impacts must both weigh in. Evaluations need to be undertaken at a level where critically endangered synergies, or strategic complementarities, between different assets, and thus also between different disturbances and impacts, are taken into account.

Irreversible outcomes, which will serve to erase our options for the future, must be given due attention. Theoretically derived non-market valuation methods, devised to value the goods and services provided by the environment by estimating people's willingness to pay (WTP) for protecting and restoring nature, can be used to increase the visibility of nature in some situations. However, preferences, traditionally used as the point of departure for measuring how people value various assets, are subject to change. Meanwhile, there is the task of coming to grips with the fluid role of culture, human interface and social capital.

74. Oceans are the source of enormous, yet often disregarded benefits. They produce roughly two thirds of the oxygen that propels life as we know it. Despite enormous depletion in recent decades, its stock of animal and plant species harbours tremendous diversity and opportunities for sourcing food, medicines, precious materials, and a wealth of other products. Its intertwined ecosystems possess enormous resilience, thus far serving as a mighty buffer to mitigate the global impact of human exploitation and over-consumption. Its resources can, at the same time, be furthered in a sustainable manner, by human ingenuity and innovation. Commercially valuable species can, for instance, be bred by introducing safe zones for fish, or cultivating "marine agriculture" in open seas (in contrast to highly interventionist aquaculture, where fish is trapped, vulnerable to disease and requiring heavy use of antibiotics). Meanwhile, destructive large-scale industrial fishing needs to be banned and replaced by ecologically friendly practices which allow for capture of fish with higher value added and generate more local jobs. Yet, many countries have sold out their waters for limitless and senseless exploitation, not for generating means for development, but to stack money aside for a few.

75. "Blue carbon" has become a nickname for growing value out of coastal ecosystems, which play a prominent role in sequestering atmospheric carbon. Wetlands, mangroves, seagrass, corals, etc., act as a green shield protecting coastal communities against cyclones, tsunamis, etc., while serving as well as a breeding ground for fish and other aquatic life forms. In fact, due to the many benefits, including greening using sea water and very little land use, especially favourable regulation is now in place for the sequestration of carbon by mangrove forests. In the meantime, however, huge damage is being inflicted on wetlands around the world. In Oman, Bar Al Hickman represents a precious remaining natural haven for migrating birds, now protected by Royal Decree, but how extensive, and for how long? What kind of tourism - ecotourism, linking to culture, mindset, including planning and governance? This case and the issues it brings are highlighted in W&H. Ways of operationalising solutions are furthered and tested. It is critical to accelerate and communicate tangible progress on the issues at hand, linking to and using the common platform of the SDGs to approach cross-border collaboration on the aggregate task of bridging to action on the way water cycles are managed in our world as a whole.

76. Improved governance hinges on multiple relevant actors and competencies coming together to realize and stand up for broad-based benefits and long-term sustainability. Digital communication can help diffuse information and about "good practices" and inspire curiosity and creativity what to do and how to create valuable results together. Further, packaging the use of digital tools with the help of appropriate methods and content, can help realize participatory practices and thus support a shift from top-down command to community driven action. While small steps will not suffice, they are critically needed along the way. This applies to securing safe breeding ground for turtles on the ancient but precious beaches they depend on, or for protecting dolphins, sharks or whales from short-term exploitation, must be orchestrated through coordination between the different policy spheres which have a bearing on the outcome, including tourism, transport, construction, fishery, agriculture, waste management, and regulations for materials industry.

77. As already discussed, other models for water stewardship have flourished in the past, throughout the Middle East, North Africa and South Asia. Based on a particular cultural and societal context, using systemic, transdisciplinary and multi-stakeholder consultations, citizens and stakeholders have collaborated closely in devising and implementing management schemes resulting in high social, environmental and economic benefits. The heritage created and example set by those models can be built upon to help resolve issues today (cf. activity I1). Applying today as much as in the past, solutions at community level generally have to find a way of engaging and harmonising with water usage downstream. Water *trading*, based on transferable water rights, may serve as an operational element to help equalize the marginal prices faced by various water users, providing information about the value of water in alternative uses and creating compatible incentives. It may thereby be used also to help reconcile a broader set of competing interests,



e.g., of industries versus communities, which may help resolve conflict in border regions and other areas burdened by water stress. Devised properly it can also serve as an instrument for restoration, by instituting compensation for the water consumed by a defined organisation and entity.

78. As is further elaborated in W&H reporting, water trading is a voluntary exchange or transfer of a quantifiable water allocation between a buyer and seller. In a water trading market, the seller holds a right or entitlement that is a surplus to its current water demand, and the buyer faces a water deficit and is willing to pay to meet its water demand. Given the greater complexity of contemporary water issues, however, with a greater number of influencing and disrupting factors, water trading generally won't work out in the same way as in the past. Ownership reform, training, and innovation in crafting effective brokerage mechanisms, may be critical for success. Also, again, digital enablers can be used to enhance transparency, secure complementary support - as through broader policy coordination – and for orderly exchanges. New opportunities are on the rise as well, such as building on the trading concept to measure and incentivise systems efficiency in the water, food and energy nexus.

## **IV.2 Plantation with Water-Saving Technologies and Carbon Credit Projects:**

79. Tree plantations in arid landscapes are usually very challenging, often undertaken using drip irrigation, which may appear practical when water is abundantly available and fast tree growth is an industrial necessity. Under conditions of severe water stress and dwindling vegetation, however, such tree planting primarily promotes root development near the surface. This is in dependency of the daily dose of water handed out by humans, of which these roots can then only collect some small amount. As in the way agricultural practices are applied in many parts of the Arabic Peninsula, water is continuously extracted out of the ground and then used for artificial irrigation. Meanwhile, water tables are shrinking, with sea water intrusion becoming a problem near coastal regions, resulting in salination of water tables. Some planting areas near the source of desalination plants may have abundance of water, yet the practice presents other issues as noted under point III.3.

80. A number of tree planting activities were recently introduced in Middle East countries, however, based on the observation that multiple benefits occur when trees are planted mimicking mother nature. The aim is notably about restoration of ecosystems though, not about industrial forests. A multitude of benefits arise, including requirements of less water for irrigation, less evaporation, hence less energy used for that process, no dependency on water pumps and lesser maintenance cost, and less plastic pipes placed in the ground. Further, the naturally rooted trees attract more water, biodiversity and life to the area, while also providing better stability and resistance against natural or manmade disasters.

81. As a step towards further addressing these issues, a pilot testing new avenues to enable ecosystems restoration was initiated in 2018, applying so-called Groasis technology, including the Waterboxx. Created in the Netherlands, the Waterboxx represents a unique method to plant trees, using minimal water resources in a self-contained enclosure that houses a young seedling/sapling, making it perfect for planting on eroded and deserted lands. Relatively, fertile areas in the Dhofar region, which benefits from seasonally enhanced humidity levels through the Khareef, have been the main focus to date.<sup>9</sup> In connection with the W&H launching event, November 2019, demo plantations were undertaken in two locations: i) outside the Dutch Embassy, and; ii) at the Crowne Plaza Hotel, both in Muscat, Oman.

82. The aim for the next stage of these research-based experiments is to produce a scalable, holistic model capable of championing ecosystem restoration in dry regions and in those that are under the risk of becoming depleted. Work is proceeding to enable a larger experimentation scheme spanning several countries in the Middle East/South Asia/Africa. Plantations of trees in carefully devised corridors are under preparation to achieve multiple objectives, including cutting off dry regions, preventing dust storms (see further below), and inspiring communities to learn about nature and engage in plantations and preservation of ecosystems. Some pilots integrate the Waterboxx with complementary methods, such as eco-friendly bio stimulants, production technologies from non-conventional water resources (e.g., the Mangrove Still), or

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<sup>9</sup>See [www.serc.om](http://www.serc.om)

other water preserving solutions such as planet bags around tree roots. Other locally invented solutions may be co-designed with citizens, for instance, to protect saplings against grazing animals.

83. Full restoration of arid and semi-arid lands in the Middle East and elsewhere can hardly be achieved, due to major constraints including the basic availability of water. As a consequence, other factors need to be considered, such as height, water evaporation, wind and lack of nutrients in the soils. Tree species selection needs to be done carefully and research-based experiments to develop the growth models and measure carbon sequestration are important steps to consider. The Waterboxx as well as other solutions can grow trees with less water consumption, but require skill, care and commitment from the local population, to support their appropriate usage.

84. Adding to the conventional benefits expected from tree planting, the global framework for Climate Change mitigation opened for acquiring Carbon Credits. The prime mechanism is the United Nations Clean Development Mechanism (CDM), defined in the Kyoto Protocol (IPCC, 2007), adherence to which generates Certified Emission Reduction units (CERs). Since February 2019, the noted pilot plantation project has been pre-registered with this scheme. The plan is to complete the carbon credit registration as soon as the final scale of the project can be determined, with a view to resources available and the capacity of the organisation. Further, the ambition is to carbon credit registration to other markets in the region, to help underpin sustainable plantation projects on the best possible terms. Pricing of carbon credits is not just framed with a view to climate mitigation in a narrow sense but the fulfilment of various SDG:s (e.g., poverty reduction, job creation, water savings, etc.) opens for add-on compensation. Based on current trends, growing international awareness and search for solid contributions to sustainability are anticipated to push up the evaluation of projects that apply nature-based solutions in a comprehensive and fully accountable manner, enabling more favourable compensation where most warranted.

85. The provision of offset for carbon emissions through forestry projects, not least in the tropics, is currently subjected to some criticism in developed markets. A point made is that real mitigation this way might be hard to verify with credibility. The Clean Development Mechanism (CDM) sets up far-reaching requirements in this regard, however, as a condition for emissions trading. As a downside, however, entering the scheme is associated with substantive administrative costs, and may also be hindered by government bureaucracy. Partly as a consequence, voluntary markets are on the rise, offering advantages of flexibility and meeting with fewer legal barriers. It is a mistake to reject this development and associated opportunities to strengthen the incentives and attracting enhanced investment in support for reforestation, especially in the tropics. Rather, efforts should be made to increase awareness, applying to both ends of the market, to facilitate knowledge exchange and the build-up of management skills and monitoring tools required for quality projects. Continued weak support for build-up of capacity underlines the importance of improved collaboration, including on a bi-regional basis, to realize the opportunities at hand.

86. Key building blocks for success include; i) best-matches between tree species and soil-conditions; ii) the support and direct engagement of local communities, including through awareness creation and incentive schemes that can create local ownership, co-creation and also underpin patience before obtaining results; iii) training (including engagement of school children) that is inspirational; iv) a model for sustainable funding, e.g., related to carbon reduction, and; v) the development of smart monitoring, e.g., by way of:

- a) Site-Specific Measurement (SSM) – Geographic Information Systems (GIS) –Variable Rate Technology (VRT);
- b) Remote Sensing (RS) – Internet of Things (IoT) – using appropriate indices, Land Topography, Plant numbers & properties, Nutrition Index, Pests, Weed mass, Biomass, Livestock Control, and;
- c) Crop Health Monitoring, Area Mapping, Fertiliser Recommendation, Harvest Supervision, Crop Tension Analysis, Drought Distribution, Crop Classification, Tree Classification, etc.

### **IV.3 Combatting Global Warming, Desertification and Dust Storms:**

87. The SDG:s represent a coherent agenda to combat global warming and the associated overriding challenges to sustainability, resulting from an ambitious consultation process involving huge numbers of

people around the world. Major efforts are being made at multilateral negotiations and by some countries to deliver. Disparities are enormous, however, both in terms of willingness and the means to do so. Out of the 10 countries that have been judged most severely affected by global warming, 8 are developing countries, several of them small (island) states and with few resources to take action.

88. Water issues are strongly represented within the SDG framework. Meanwhile, the World Economic Forum has identified water as the single biggest risk factor globally in the years ahead. The threats at hand are only exacerbated by increasing temperatures and changing weather patterns. The consequences are evolving at multiple levels, including extreme pressure on the world's water cycles, as manifested in extreme weather events, drought, desertification and dust storms, and so forth.

89. The flipside of dwindling vegetation in hot and dry regions is desertification, leaving lands barren, without ability to retain water and so, also, with the soil losing fixture and letting go. While soil erosion has been observed since many years, the recent dramatic increase in sandstorms represents a more recent phenomenon. While air turbulence in regard to particular source areas is of high importance, the decline in water tables, unsustainable land use practices and soil salinity can be seen to increase both the prevalence of reduced green cover, more dam constructions, unsustainable land use practices and soil salinity, can be seen to increase both the prevalence and the damage of sandstorms. They are further accompanied by a steady rise in the number of "dusty days" and a generally enhanced level of dust in the air, diminishing air quality (especially as many of the source areas have been the scene of Middle East wars and the soil still carries traces of chemical bomb substances, now travelling with the dust and ending up in the lungs of people who breath them, resulting in major respiration illnesses) and sunlight at surface level, damaging human health, vegetation, marine productivity, and so forth. The impacts are increasingly felt in much of Northern Africa and the Middle East, the Gulf States, Iraq, Iran, Central Asia, and so forth.

90. The spread of desertification, dust storms and related developments are fundamentally associated with the dramatic disturbance to water cycles and the associated loss of vegetation. Rolling back these developments require measurement along with candid communication on causes and what is required by way of countermeasures. A comprehensive response will have to include many measures, such as the establishment of green corridors, planting with water-saving technologies, soil improvement, a removal of subsidies for unsustainable water and energy use, a sea-change in waste management, and supporting natural water tables in defence of salination. Joint efforts are required to promote innovation and the diffusion and implementation of best practices. W&H has set out to champion untapped opportunities, to contribute with increased awareness, and a shift from mere analysis to action.

91. It is imperative to work with those that are capable and willing to move. In many cases, this means working with cities and communities, rather than nation states. There are also many organisations, spanning educational institutions, including universities, as well as public bodies, private companies, NGOs, and so forth, that can and do take action. There are also the citizens, spanning different generations, genders, ethnic groups, professions, and so on, some of whom crave action, and others who must come on board. And, coming back to the nation states, some are on the move, oftentimes smaller countries which, similar to cities, are closer to their citizens compared to alienated national administrations in mega-states. Also, in that case, embracing an "ecological" or "sustainability" model with quality management and value-enhancing co-creation, is facilitated by organised collaboration and synergies with others that are likeminded. Real solutions need to be realised and diffused on the ground. We need to work together to grow a generation of frontrunners, not a world of laggards and dinosaurs.