Geophysical survey for groundwater prospecting, Teknaf, Bangladesh © IOM 2021

GROUNDWATER: A RESILIENT RESOURCE FOR CLIMATE CHANGE ADAPTATION IN DISPLACEMENT AND MIGRATION SITUATIONS

IOM WASH POSITION PAPER

PURPOSE AND TARGET AUDIENCE

The global WASH Support Unit and Environmental Sustainability Unit, in collaboration with International Groundwater Resources Assessment Center (IGRAC) and Groundwater Relief (GWR), have prepared this position paper[1] with the objective of supporting IOM staff at all levels to understand the importance and use of groundwater, and providing guidance to decision-makers, including WASH programme managers, WASH practitioners engaged in projects reliant on groundwater for domestic consumption livelihood, and social cohesion, Emergency Coordinators, and Chiefs of Mission. The paper endeavors to facilitate effective WASH programming that optimizes groundwater usage, minimizes adverse impacts on natural resources, and fosters adaptation to climate change.

[1] *This position paper is complemented by IOM´s Position Paper on Climate resilient WASH (2024), WASH and the Environment (2022), Climate Change and Future Human Mobility (2022) and by the IOM´s Guidance Note groundwater development, monitoring and data management (2024).*

Figure 1: Groundwater Monitoring activities in IOM Borehole Camp 12 - Kutupalong Mega-Camp, Cox's Bazar, Bangladesh

BACKGROUND

Groundwater is a unique resource that accounts for approximately 99% of all liquid freshwater on Earth[2], and has the potential to provide societies with social, economic, and environmental benefits and opportunities. It supplies 50% of all drinking water worldwide, about 40% of water for irrigated agriculture and 30% of water required for industry[3]. Due to the large water storage and natural treatment processes of aquifers, groundwater can act as a buffer to seasonal changes in rainfall patterns that are predicted by climate change models. Therefore, it can support climate change adaptation when managed effectively as part of an integrated water resource management (IWRM)[4] plan to optimize its potential and ensure its sustainability. Groundwater can contribute to the Sustainable Development Goals (SDGs): it enables the provision of clean water and sanitation for all (SDG 6); it contributes to climate change adaptation (SDG13) by providing a reliable alternative resource less impacted by pollution and environmental shocks than surface water; it also sustains terrestrial and underwater ecosystems (SDG 15), by maintaining the baseflow of rivers and preventing land subsidence and seawater intrusion.

However, groundwater is often poorly understood, and consequently undervalued and mismanaged[5]. Indeed, as not directly visible, it is difficult to understand its nature and state, and detect possible issues such as depletion and pollution. This is why assessing groundwater resources, identifying groundwater impacts and interlinkages with the socio-economic and ecological systems, and adopting sustainable practices when exploiting groundwater resources are essential to meeting water needs while preserving the environment.

In the context of displacement, migration is shown to be increasing over time and are caused in part by natural resources scarcity, such as water. Lack of drinking water supply and limited resources for the agricultural sector are the main underlying water-related cause for population to move[6], creating a strong incentive for governments to integrate migration concerns into water governance and policy. Furthermore, water-related migration is expected to be exacerbated with climate change and population growth if no urgent climate action is taken[7]. Climate change increases the risk of natural hazards and their impact on infrastructure and communities. In 2022, an estimated 31.9 million people were internally displaced by climate-related hazards worldwide[8]. Climate change is impacting the hydrological cycle through unpredictable precipitation patterns, causing unreliable water sources and/or water quality degradation. Extreme weather events can lead to soil erosion, increased runoff, and the transportation of pollutants into water bodies. In the case of sea level rise, or groundwater depletion, intrusion of saltwater can contaminate freshwater resources in coastal areas. 44–113 million people are projected to internally migrate by 2050 as the result of these slow-onset climate impacts linked to

2 UNESCO. (2022). Groundwater Making the invisible visible.
3 UN-Water. (2022). UN-Water Joint Message and Call for Action.
4 IWRM ACTION HUB. (n.d). IWRM Explained.
5 UNESCO. (2022). Groundwater Making the invisible visible.
6 UNESCO. (2017). Migration and its interdependencies with water scarcity, gender and youth employment.
7 Clement Viviane et al. (2021). Groundswell Part 2: Acting on Internal Climate Migration. Washington, DC: The World Bank.
8 IDMC. (2023). GRID 2023 Internal displacement and Food security.

water (water stress, crop failure, sea level rise) under a climate-friendly scenario, increasing to 125–216 million people under a pessimistic scenario[9].

216 MILLION people maybe forced to move by 2050, if no decisive climate action is taken, with such up to 80% of these movements could be prevented. These movements will be in their majority within country borders in the form of migration or displacement (WorldBank/Groundswell).

Around 4 BILLION people are estimated to experience severe water scarcity for at least one month per year due to climatic and nonclimatic factors (IPCC).

FRAMEWORK

As part of IOM's global commitment to the 2030 Agenda for Sustainable Development and the Water Action Agenda[10], sustainable water resource practices and climate-resilient water supply solutions need to be identified and promoted to ensure displaced population's and migrants' human right to water, sanitation and hygiene and contribute the achievement of SDG 6 in all contexts, including fragile, displacement and migration situations. IOM's Strategic Plan 2024-2028 also recognizes the importance of environmental sustainability as a cross-cutting priority for the whole organization, including its implications for water resource management.

It is under these global frameworks that IOM advocates for the sustainable use of groundwater as a climate-resilient resource that also needs to be protected through integrated groundwater assessment, monitoring and management. Such work requires the engagement of key stakeholders responsible for water supply, management and governance within the country of intervention. IOM's programmes should engage these stakeholders to ensure that water supply interventions fit within the framework of catchment scale Integrated Water Resource Management (IWRM) Plans. This engagement also enables IOM to benefit from the country's knowledge and experience, while strengthening the resources and capacities of government agencies. WASH interventions will need to consider the investigation and management of groundwater resources depending on the volume of water required to be supplied, the vulnerability of the source that the water will be abstracted from, the potential impacts an abstraction might have on existing water users and sensitive ecosystems, and the cost of developing the water supply.

GROUNDWATER DEVELOPMENT INTRODUCTION

When developing a groundwater source, several factors need to be considered before tendering out drilling works.

Figure 2: Airlifting in IOM Borehole Camp 12 - Kutupalong Mega-Camp, Cox's Bazar, Bangladesh

The location where the well is to be constructed needs to be decided. The location is constrained by the geology and hydrogeology of the area, where the water needs to be supplied to, disaster risk (e.g floods), land permissions and agreements, groundwater quality constraints and by accessibility for well construction machinery such as drilling rigs.

9 IOM. (2022). Climate Change And Future Human Mobility.

10 IOM UN Migration. (n.d.). International Organization for Migration Commitments to the Water Action Agenda.

In addition to location, the well design needs to be defined including the drill depth, diameter, and type of consumables required to construct the well. These variables are determined by geology, water quality and water demand.

It is necessary to carry out a preliminary desk study to help determine what type of field investigation work might be required to better define the technical specifications of a drilling contract. If more information is required to understand the subsurface water resources, then field investigation work maybe required following completion of the desk study. Such field investigation includes both intrusive and non-intrusive investigation. Non-intrusive field investigation is generally lower cost and includes activities such as: water point mapping, community surveys and interviews, water quality testing and environmental impact assessments. It may also include geophysical investigation and geological mapping. Intrusive investigation works consist of drilling exploratory boreholes, pump testing in existing boreholes.

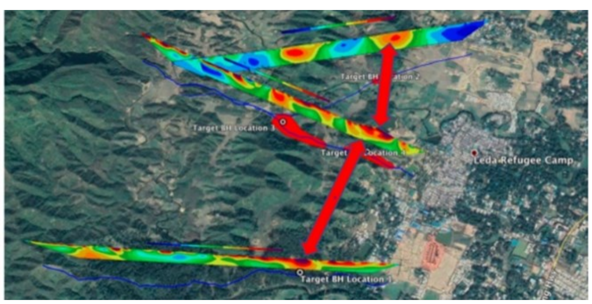

Figure 3: Electrical resistivity tomography in Leda, Bangladesh

GROUNDWATER MONITORING & MANAGEMENT

The buffer capacity of groundwater to mitigate the impacts of climate change on communities and livelihoods relies upon the availability of reliable groundwater resources at times in need, and this can only be known through monitoring. Once groundwater developments have been done, it is necessary to assess this resource's evolution over time in quality and quantity. Only then can groundwater be used as a resilient resource for climate change adaptation.

Aquifer systems are always in flux, with water entering, being stored, and being discharged out of the aquifer system which can be modelled through a water balance where: Inputs = Outputs + Change in Storage.

Inputs into the system are predominantly associated with groundwater recharge that is largely dependent on geology, precipitation, soil moisture, topography, and land use. Outputs from an aquifer system might include spring discharges, discharge to rivers (base flow) and groundwater abstractions.

Monitoring includes the measurement of water levels, water quality testing and pumping rates. Such monitoring data helps identify the response of the aquifer system to different pressures. It helps to estimate short and long-term trends and can provide early warning of potential problems that might occur with extraction. The data collected can also be used to better understand the aquifer systems being abstracted and help authorities to improve the sustainable management of these resources. It is important to note that only long-term monitoring of the aquifer can help determine long term sustainability of the supply.

As such, IOM's WASH services should include the development of data management, monitoring systems and other decision-making tools such as modelling to support governments to integrate them in their water decision-making processes. Modelling of water resources is a tool essential to understanding long term consequences of any changes made to groundwater abstractions or climate. Groundwater models are used for both scientific research and for regulation of water use. However, groundwater models need long and good quality monitoring data series to be accurate because they are calibrated and checked through groundwater monitoring data. Without long series of monitoring data, it is not possible to build models with any certainty or accuracy.

Figure 4: Groundwater monitoring in Bentiu POC, South Sudan with the support of Groundwater Relief (GWR).

The potential environmental impact on groundwater associated with large-scale displacement and migration is frequently highlighted as a justification to provide alternative solutions or to deny the right to access safe water for this often-marginalized population. In these contexts, IOM should support and promote good practices for groundwater developments and long-term monitoring systems of the aquifer that can help determine long term sustainability of the supply, advocate and ensure that the right to water is always fulfilled.

KNOWLEDGE SHARING & CAPACITY BUILDING

An integrated groundwater assessment and groundwater monitoring dataset outline groundwater-dependent systems and needs. By compiling such data and sharing them, including groundwater models, with relevant authorities, groundwater information can feed into IWRM plans, support equitable water resources allocations, and be used for the development of water supply systems to mitigate the impacts of climate change.

IOM WASH interventions in this context should ensure that relevant authorities are involved from the start of the operations, that they understand the information provided and, if necessary, IOM must provide adequate training to ensure the tools provided will be used in the long-term. As crises become increasingly protracted, it is essential that measures consider future needs and capacities. It is therefore the role of IOM to help strengthen local capacities to improve the resilience of WASH services in the face of climate change and improve the sustainability of WASH services for all. The assessment, monitoring and management should also be supported through an online collaborative environment, with guidelines, templates, exemplary cases, apps, and a structured archive with a geographic user interface. Thanks to rapid development of Information and Communication Technologies (ICT) and availability of open-source software, the costs of required infrastructure for storage, processing and sharing of data and information are nowadays low, especially considering an added value for informed water resources management.

PARTNERSHIPS

Global and local partnerships can support IOM WASH programmes to fill gaps in knowledge and expertise in the sector. They foster innovation, engagement and capacity strengthening of different stakeholders, enabling collaborative problem solving and collective action for effective groundwater management. IGRAC and GWR are two examples of partners with unique expertise in the field.

THE INTERNATIONAL GROUNDWATER RESOURCES ASSESSMENT CENTRE (IGRAC)

IGRAC's mission is to provide evidence-based knowledge and information on groundwater worldwide to support decision-making for a sustainable planet. IGRAC is focusing particularly on regional/international aquifer assessment, groundwater monitoring and information & knowledge management. IGRAC is working under the auspice of UNESCO, as a category 2 UNESCO center, and of the World Meteorological

Organization (WMO) as the global groundwater data center. It is supported by the Government of The Netherlands.

IGRAC can support regional/national organizations in groundwater assessment, monitoring, and data management. IGRAC provides necessary guidelines, content, and technical support, including experience and lessons learned.

IGRAC always work in partnership and close cooperation with institutions at national and subnational level and local actors. Their approach is to support, assist, co-produce and share knowledge on groundwater to ensure sustainable groundwater management.

GROUNWATER RELIEF (GWR)

Groundwater Relief (GWR) is a charity, providing technical support to organizations engaged in supplying water to people who lack access to a sustainable supply. GWR services include groundwater exploration and groundwater resource management, groundwater modelling, geological mapping, geophysical investigations, supervising the construction of groundwater infrastructure, setting up groundwater monitoring programmes, developing data management systems, capacity building and delivering training programmes to local water providers.

Via the membership of over 500 technical experts, GWR helps organizations and water providers to construct and manage groundwater infrastructure in a professional, responsible, cost effective and sustainable way, engaging local authorities, companies, non-governmental organizations (NGOs) and institutions. GWR's members come from 58 different countries, speak over 33 different languages, and have expertise and proficiency across a broad range of groundwater specializations including hydrogeology; geophysics; geochemistry; groundwater modelling; drilling; remote sensing; GIS; environmental regulation; geotechnical engineering; and water resource regulation. GWR draws upon the expertise of the membership, ensuring that the unique challenge at hand is met with the appropriate and proficient skillsets required.

Central to GWR's mission is the engagement and active involvement with local water authorities and institutions. GWR is committed to building local technical capacity through comprehensive training initiatives, secondments, and academic partnerships to ensure sustainable solutions, enabling local stakeholders to confidently manage their water resources, contributing to long-term environmental and community well-being and resilience.

ANNEX - CASE STUDIES

IOM Yemen: Building a monitoring programme in Mar'ib to lead to modelling of a vulnerable groundwater system that has been minded for 30+ years.

IOM has been working to ensure that the water resources in locations of displacement is well understood in order to adopt appropriate adaptation strategies before and after a disaster or crisis. For example, in Yemen, IOM responded to severe water scarcity in 2020 and 2021 by engaging Groundwater Relief to conduct a comprehensive groundwater analysis in the Marib basin, in coordination with the local water authority. This analysis not only guided IOM's WASH intervention but also included capacity building for local authorities, providing a roadmap of recommendations for comprehensive and sustainable management of the resource, while ensuring access to water for host communities and internally displaced populations.

IOM Bangladesh: Development of a groundwater model to determine sustainable supply of water to the Cox Bazar Mega Camp and its impact on surrounding host community water supplies.

In 2020, IOM, with funding from the Government of Japan and in partnership with the Department of Geology of Dhaka University and Groundwater Relief carried out a hydrogeological assessment of the main aquifers supporting water supply to the Mega Camp within Cox's Bazar District. The mapping and the model gave a better understanding of the available aquifer, depth, thickness, abstraction volume, recharge rate with an estimated impact on groundwater drawdown over time in different geographical locations within the mega camp and surrounding host communities. IOM continue to monitor groundwater following the mapping and model development in 2022.

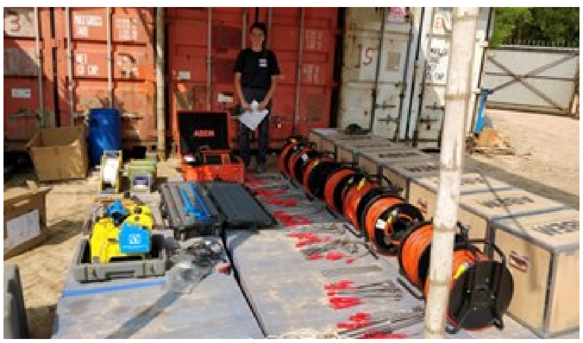

Figure 5: Geophysical survey equipment for groundwater prospection at Teknaf, Bangladesh - with support from Groundwater Relief (GWR).

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