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Economic and Social Commission for Western Asia (ESCWA)

Report

Building Capacity for Accessing Disruptive Technologies for Improved Water Resources Management under Climate Change Beirut, 14-15 January 2020

Summary

The World Bank and the Economic and Social Commission for Western Asia (ESCWA) jointly organized a workshop on Building Capacity for Accessing Disruptive Technologies for Improved Water Resources Management under Climate Change, which was convened at the United Nations House in Beirut from 14 to 15 January 2020. The workshop identified challenges, opportunities and innovative approaches for utilizing disruptive technologies and climate projections for improved water resources management in the Mashreq region, leveraging on current knowledge, information and data resources.

The meeting presented examples of disruptive technologies that have a potential to improve water resources management in national and transboundary settings in view of identifying opportunities for drawing upon innovative tools that can benefit water resource decision-makers in the Mashreq region. The meeting also explored available regional climate modelling, hydrological modelling and integrated vulnerability assessment tools and outputs that can inform hydrological and agricultural modelling applications in the region. Regional and global knowledge resources and data platforms available to inform decision-making were also introduced. The meeting concluded with a discussion of opportunities and challenges associated with accessing and using disruptive technologies for improving water resources management in the Mashreq region, as well as a roadmap for capacity development for different stakeholder groups.

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Introduction

1. The workshop on "Building Capacity for Accessing Disruptive Technologies for Improved Water Resources Management under Climate Change" was jointly organized by the World Bank and the Economic and Social Commission for Western Asia (ESCWA). The meeting was convened at the United Nations House in Beirut from 14 to 15 January 2020.

2. The overall objective of the workshop was to identify challenges, opportunities, and innovative approaches for utilizing disruptive technologies and regional climate projections for improved water resources management in the Mashreq region, leveraging knowledge, information and data resources.

3. The meeting consisted of five sessions. Section I of this meeting report highlights the main topics of discussion, while section II reviews the organization of work as well as information regarding the meeting agenda, participants and evaluation. The meeting documents, including the workshop agenda and delivered presentations, are available at the following website: www.unescwa.org/events/disruptive-technologies-water-management-climate-change.

I. TOPICS OF DISCUSSIONS

4. Presentations and main discussion outcomes are presented in the following sections according to the substantive sessions of the meeting.

A. Framing the Regional Context

5. ESCWA opened the session with an overview of shared surface and groundwater resources in the Mashreq region based on the findings of the ESCWA-BGR *Inventory of Shared Water Resources in Western Asia*.[1] The overview of transboundary surface water resources presented the Euphrates, Tigris, Jordan, Orontes, Nahr el Kabir and Qweik river basins. The characteristics of each basin was provided, including its riparian countries, river length, surface area, mean annual flow volume, as well as information on key concerns and history of riparian cooperation. The presentation noted the difficulty of securing good quality data due to availability and accessibility challenges.

6. The overview of shared groundwater resources in Western Asia described 14 transboundary aquifers that include Iran, Iraq, Jordan, Lebanon, Syrian Arab Republic and/or Turkey as a riparian country. The presentation reviewed the characteristics of each aquifer, key issues and riparian cooperation modalities. Among the main challenges identified was the difficulty of obtaining accurate data. The importance of mapping and improving the conjunctive management of surface and groundwater basins was also highlighted, particularly with surface waters linked to large regional transboundary aquifer systems. A brief on findings from a study using GRACE Satellite data to assess groundwater resources in the Middle East and North Africa region was offered as an example where disruptive technology is increasingly being used to assess changes in the extent and availability of groundwater resources.

7. During the ensuing discussion, it was reiterated that data is central to water resources management and that disruptive technologies can help to improve the collection and access to data that is needed to refine understanding of shared water resources. This is because new and emerging data tools are delivering more detailed outputs and time-series data that provide insights into water quantity and quality based on a standardized approach. These new data sources can improve management of connected groundwater and surface water basins in an informed manner based on common datasets. The challenges related to groundwater resources management were also highlighted as some think of the extraction of groundwater

[1] ESCWA and Federal Institute for Geosciences and Natural Resources (BGR), 2013. *Inventory of Shared Water Resources in Western Asia*. Beirut. Available from www.waterinventory.org.

resources as similar to extracting petroleum, i.e., it is better to use now rather than later, despite the inter-generational equity concerns associated with such an approach.

8. The World Bank pointed out that it is important to differentiate between the notion of "porous" groundwater with low flow velocities versus "fractured" groundwater with high flow velocities. They also highlighted the limited margin of use of non-renewable groundwater resources, even though countries might have significant stocks of non-renewable groundwater. The issue of double counting surface water and groundwater when calculating water balances was mentioned as well, noting that the linkages between both resources should be considered when pursuing or implementing cooperative frameworks. As final remarks, ESCWA stressed that the aim of any assessment is to improve the knowledge base and facilitate information access and use to foster awareness and informed dialogue among riparian countries, especially when data is incomplete or needs updating.

9. Following the discussion, ESCWA delivered a presentation on the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR). RICCAR assesses the impact of climate change on freshwater resources in the Arab Region through a consultative and scientifically grounded integrated vulnerability assessment methodology based on regional specificities. Selected results from the impact assessment and vulnerability assessment components were presented through maps showing the projected increase in temperature across the region through the end of the century, and associated changes that will affect precipitation, extreme events, evapotranspiration and water-related sectors. It was also noted that the bias-corrected projections from RICCAR's regional climate modelling and hydrological modelling ensembles generated at a 50 km^2 grid scale can be used to inform other hydrological models and agricultural productivity models. The presentation also noted that regional climate projections for the Mashreq region at a resolution of 10 km^2 were under preparation and would be available to support water-related analysis by early 2021.

10. This was followed by discussions that highlighted the importance of defining the problem that needs to be addressed before identifying which type of assessment tool or dataset to use. Representatives from the Syrian Arab Republic inquired about the downscaling process and the application of assessment tools in different sectors. Representatives from Iraq expressed their interest in assistance to conduct vulnerability assessments to inform adaptation strategies, as well as their concern about data availability to conduct such an assessment. Representatives from Turkey inquired about how to use ensemble outputs as inputs to other models, as well as the importance of model calibration against observed data. ESCWA expressed its readiness to assist countries conduct impact and vulnerability assessments through training and technical assistance at the national and sector levels. ESCWA also briefed on its support of the Arab Climate Outlook Forum (ArabCOF) and collaborative efforts to support farmers in the use of supplementary irrigation practices based on seasonal climate forecasts and longer-term regional climate projections.

11. The World Bank then presented its engagements in the Mashreq region. Several projects in the World Bank's Mashreq portfolio were presented including the Greater Beirut Water Supply project, the Lebanon Water Augmentation Project Bisri Dam construction, and the Baghdad Water and Sewerage Improvement project in Iraq. Stressed was the importance of ensuring water utilities have adequate water supplies and sufficient financial resources to continue their operations, as well as the need for dam safety considerations to be considered alongside operation and maintenance requirements. The overall approach of the World Bank in the Middle East and North Africa region was described in terms of the "4Rs": Renewing the social contract; Regional cooperation; Resilience; and Recovery and reconstruction. It was noted that both quantity and quality components of the water sector are important to consider, with civil society increasingly focusing on the latter. It was also shown that despite the considerable importance of the water sector in the region, the data to enable informed water resource management is limited, fragmented and contested across countries. As a result, in Middle East and North Africa water is under-valued, transboundary water management is threatened by fragility and climate change, and poor water management practices are increasing demand for expensive water desalination plants rather than more impactful investments in water

use efficiency and non-conventional water resources such as treated wastewater use for irrigation. Water recycling was also identified as an opportunity to consider.

12. During the discussion, it was highlighted that using the characteristics of past drought conditions and applying it to the current environment could assist countries identify risks, increase preparedness and reduce socio-economic repercussions. The World Bank shared its experience working with the National Remote Sensing Institute of Morocco to measure evapotranspiration and other water-related indicators in the country. Examples of digital disruption in the water sector were also presented, such as showing how a water balance can be generated easily and quickly given increasing computing capacities that can calculate the water balance in a basin daily rather than every one to two years. With respect to agricultural water use, the World Bank questioned whether investments in drip irrigation schemes result in water saving or increased water use productivity as more crops are cultivated. It was suggested that shifting to higher value crops was perhaps better to consider as well as a well-developed institutional framework to manage water use. A representative from Jordan asked the World Bank for its opinion on private sector involvement in the water sector, to which the World Bank responded that there are changing views about private sector engagement in the delivery of water supply and sanitation services. The example of Algiers and Oran were given as they now have their water services delivered by the private sector, but tailored to local circumstances, and how this demonstrates a change in mindset as such an approach would not have been well-received twenty years ago. In responding, the World Bank emphasized the need to clearly identify the problem affecting service delivery before pursuing a private sector engagement in the sector as involvement depends on local circumstances and needs to be tailored to national needs. Finally, it was emphasized that traditional management modalities are important to build upon when adopting disruptive technologies and that a balance is needed when transitioning to a new way of work.

B. Disruptive Technologies: Uses and Potential

13. The World Bank delivered a presentation on the potential roles of disruptive technologies for water resources planning and management. A series of tools, technologies and platforms were proposed to support institutions, analysis, policy formulation, investment and operations. The presentation highlighted that the reducing cost of disruptive technologies is making them more affordable and technically feasible to introduce in water resource management. The example of sensors attached to individual plants being provided for free by technology companies was offered, with the explanation that the collection and analysis of the data gathered from these sensors is what is deemed valuable by these companies. Such systems could be used to provide decision support; facilitate data collection and monitoring; and encourage knowledge transfer through learning platforms and social media that can inform better research and decision-making from a bottom-up approach. Cloud services were also presented with their increased ability to store and analyse input data, and provide analysis through online modelling platforms. Interactive online tools being developed at the World Bank through its new Spatial Agent platform (https://olc.worldbank.org/about-olc/spatial-agent-world-data-your-fingertips) were also presented, including an interactive technology explorer application (www.appsolutelydigital.com); a hydroinformatics database (www.spatialagent.org/hydroinformatics); as well as access to satellite data, earth observations and global databases such as G-REALM (www.ipad.fas.usda.gov/cropexplorer/global_reservoir) that provides data on water levels in lakes and reservoirs across the work and is maintained by the United States Department of Agriculture (USDA) Foreign Agricultural Service.

14. During the discussion, the World Bank clarified that the websites presented are freely accessible to all. A representative from Jordan expressed concern about putting confidential official data on the cloud and the resulting security implications. The World Bank explained that cloud services are more reliable than traditional information technologies and are less costly to manage and maintain; it is also assumed that cloud services will be widely used by institutions and governments throughout the world within five years. The World Bank also noted that with data sharing policies in place, data security becomes irrelevant. Publicly available data can be used as basis for discussion, and then countries can draw upon their own datasets to apply models internally to check if openly available datasets and analysis are in line with their own

observations and findings. Furthermore, once sensor data becomes more prevalent and freely available online, the quantity of data available for monitoring and analysis at smaller increments of time and over larger geographic areas will become considerable and it would not be feasible to store these large datasets in existing databases. That noted, ESCWA highlighted that internet connectivity and access to information technologies remains varied across the region in terms of data management, speed and storage and thus the adoption of disruptive technologies will need to consider those limitations or advance investments in information technology infrastructure as a first step.

C. Interactive Session: Accessing Data through Open Data Platforms

15. ESCWA delivered a regional overview on trends in Science, Technology and Innovation (STI) and the generation of scientific knowledge in the region based on a recent ESCWA report on the Fourth Industrial Revolution.[2] This presentation showed that investment in research and development in the Arab region is limited. More focus was placed on research rather than development, which contributed to the Arab region lagging global trends in biotechnology and artificial intelligence (AI). The region also tends to focus more on industrial technologies. However, some gains have been made with the World Intellectual Property Organisation (WIPO) recording 340,000 AI related patents in the region last year. Deep machine learning has also significantly advanced over the past five years, with almost half of all AI-related patents concentrated on computer vision applications. Over 70 per cent of AI applications also tackle convergences with other disciplines with virtual reality offering a significant opportunity for growth, particularly with the private sector. Nanotechnologies and biotechnologies are also gaining traction.

16. During the ensuing discussion, a representative from Jordan pointed out it seems that the Arab region follows global trends, and inquired whether this meant that there is no innovation in the Arab region. ESCWA indicated that being aligned with global trends does not necessarily mean that there is no innovation as there is potential to expand innovation in data science and AI in the region. However, this can be fostered by improving interactions between Arab and international scientists, and efforts to reduce brain drain. On the quality education needed to advance innovation, it was discussed that educational institutions should respond to the needs of society and local communities. The region needs research institutions that are connected and willing to incorporate disruptive technologies in curricula and other educational mechanisms to advance lifelong learning. It was noted that ESCWA signed an agreement with United Nations counterparts to increase the availability of webinars and technical content in Arabic language; and that the ESCWA Technology Centre examines internet governance and internet security in the region, which included ways to deploy AI tools in national strategies. A representative from Syria inquired about how to reengineer education for future generations. ESCWA recommended that focus should be shifted to building skills that can maximize the benefits of the Fourth Industrial Revolution. Such efforts should recognize the speed of change in the technology sector and thus the need to focus on soft skills such as leadership, teamwork, communication when looking at youth education as well as frontier technologies. More online educational content should also be used and made available in the Arabic language that responds to local needs and conditions.

17. The World Bank subsequently provided a detailed overview of a range of open access water data platforms available to support data access and analysis for decision support. The list of resources presented is provided in Annex I of this report. A draft Mashreq Data Portal developed by the Bank team for the workshop was presented to illustrate the growing world of open-access data and analytics of relevance to the region and this would be enhanced to include additional relevant open public domain data and knowledge resources as they become available. Included is the Global Agriculture and Disaster Assessment (GADAS) website maintained by the USDA Foreign Agricultural Service, which provides soil moisture data from ground truthing provide by universities that can be compared with data generated by the satellites. It was

[2] ESCWA, 2019. "Impact of the Fourth Industrial Revolution on Development in the Arab Region". Beirut. E/ESCWA/TDD/2019/3. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/impact-fourth-industrial-revolution-development-arab-region-english.pdf.

noted that with more observation data, it is possible to calibrate satellite images and models better to reflect what is happening on the ground. This also provides opportunities for university researchers to inform and benefit from Google Earth and Google Analytics tools that can be tailored to user needs with basic coding.

18. During the discussions, a representative from Turkey shared their experience using machine learning and AI to support hydropower generation analysis, which included using different models to optimize hydropower generation and identify flood risks. The Turkish Ministry of Agriculture and Forests also uses remote sensing tools to target incentives to cultivate certain crops and to determine whether the crop type and quantity is in line with what farmers report. Drones are used to monitor the water content of soils. Based on a question posed by a representative from Iraq, the World Bank explained the frequency and resolution of images generated by Sentinel satellites and the possibility to combine datasets to obtain the time period and resolution needed. Participants also discussed that "power workshops" could be organized to map hydrological structures in an area, such as dams; which could involve on-site, coherent meetings with geographic information system (GIS) experts to collectively map items as a group based on a common set of tools and to populate a common platform. Complementary efforts could be made to digitize observed datasets and maps otherwise only available in hard copy. ESCWA pointed out that region-specific knowledge needs to be drawn upon in the identification of suitable indicators and the calibration of Earth observations through ground-truthing. ESCWA also indicated that the computer power and storage space needed to access or use satellite data is an important limiting factor to consider in the absence of adequate access to cloud computing to political or technical constraints. It was also reiterated that the population of global knowledge and data platforms needs to be considered regional and national specificities.

19. The United Nations Economic Commission for Europe (UNECE) delivered a remote presentation on assessing the water-food-energy-ecosystems nexus in the North-Western Sahara Aquifer System (NWSAS). The intervention provided an overview of the NWSAS, the interlinked pressures it is facing, and how coordinated action across sectors and countries is being undertaken to address these challenges. Specifically, a nexus approach was applied to examine groundwater use through a collaborative project initiated in 2017 involving the UNECE, the Global Water Partnership-Mediterranean, and the Sahara and Sahel Observatory (OSS). The project resulted in an open source GIS-based model that informs integrated planning in the NWSAS through national dialogue and within the framework of the intergovernmental consultation mechanism of the NWSAS. The project found that GIS, remotely sensed data and integrated modelling are useful for understanding complex natural resource interactions, and that an integrated nexus approach can help to maximize benefits, but requires intersectoral dialogue to facilitate joint prioritization of issues and the elaboration of solutions and synergetic actions. It was also recognized that data availability and accessibility as well as data consistency across countries requires effort and ground truthing, as data validation is necessary. Finally, it was highlighted that capacity building is needed to support integrated planning and informed decision-making, particularly in the use of open source tools that encourage transparency, reproducibility and provide support researchers and policymakers.

20. During the discussion, a representative from the Syrian Arab Republic requested clarification on the relationship between water use efficiency and water savings. The UNECE explained that when water is saved through using the adoption of new technologies or more appropriate agricultural practices, farmers tend to expand the area under cultivation, which results in additional amounts of water used for irrigation. While this may benefit agricultural output and productivity, such technologies do not necessarily result in conserving water resources.

21. A representative from Jordan then delivered a presentation on how the Ministry of Water and Irrigation is using remote sensing for crop mapping and assessing groundwater abstraction. Groundwater depletion and the drilling of illegal wells have been reported in many locations in the irrigated highlands of Jordan, particularly in the last few years. The situation prompted the MWI to invest in groundwater monitoring tools to improve the management of these scarce freshwater resources. Remote sensing techniques were used to develop maps of irrigated crop areas and their water consumption in the irrigated highlands of Jordan. The maps helped to identify the spatial distribution of actual evapotranspiration (ETa)

over large areas, and could be easily integrated with other datasets and GIS maps to generate new analysis. An example of a map showing the distribution of irrigated crops and ETa in Yarmouk basin was shared, which has been used by the Ministry to identify hotspots in the basin where water consumption is much higher than the recorded abstraction level, which can indicate the presence of illegal wells.

22. During the discussion, it was highlighted that remote sensing can provide information about types of crops being cultivated that can be complemented with field data for improved accuracy. In a response to the questions about the measures taken in response of illegal well drilling, the representative of Jordan clarified that after suspecting the presence of an illegal well, field visits are undertaken to confirm the locations. The wells are then sealed if confirmed to be illegal. This process is undertaken in coordination with the environmental police. To date, remote sensing is being used to detect illegal works solely in the agricultural sector, although it could have other applications related to domestic use.

23. ESCWA subsequently delivered a presentation on the RICCAR Regional Knowledge Hub and Data Portal (www.riccar.org). The Regional Knowledge Hub provides an interactive, open access, online platform for accessing regional datasets, information and analysis related to climate change and water resources in the Arab region. An overview of the website contents was provided, highlighting its role as a repository for RICCAR-related knowledge products as well as theme-specific regional knowledge nodes. The functionalities of the data portal were then presented, including how to access datasets and maps stemming from the RICCAR regional climate modelling, hydrological modelling and vulnerability assessment outputs for specific climate change projections, scenarios, time periods and scales of analysis. Tools for generating customized maps, downloading geospatial datasets, and exporting outputs in different formats were also reviewed. Technical assistance and training are available to support access to and use of RICCAR-related products, datasets and applications.

24. During the discussion, ESCWA clarified that while Turkey was covered in the MENA/Arab Domain used to generate the regional climate projections, it was not included in the vulnerability assessment as that work was mandated by the Arab Ministerial Water Council of the League of Arab States and ESCWA member States. However, datasets and methodologies were openly available for use by Turkish institutions and others. ESCWA also offered to provide tailored support on the use of forthcoming finer resolution regional climate projections for the Mashreq region; this could potentially be pursued collectively by several countries based on a common set of projections, datasets and methodologies. A representative from the Syrian Arab Republic inquired about the availability of results for the number of summer days (SU) characterized by temperature between 35°C and 40°C (SU40-SU35). ESCWA clarified that these results can be obtained by downloading the datasets and doing the calculations or by requesting it directly from ESCWA. The representative from Iraq inquired on which climate scenario to use to inform climate sensitive and ESCWA explained that the selection of which scenario to use depends on the type of communication and audience targeted and that there were different policy implications to consider when engaged in mitigation and adaptation planning when making this decision.

D. Drawing upon Data and Technology for Decision-making

25. A first round of discussions reflected on the opportunities for using disruptive technologies for informing decision-making. Syrian representatives noted that there was a need to fill gaps in time series datasets, particularly given the damage and destruction of monitoring systems during the current conflict, and the opportunity to use artificial intelligence to this end. Concern was also expressed regarding the loss of qualified personnel in ministries to support water resources management and the need to build the technical capacity of younger staff who had not had the opportunity to visit water infrastructure in the field due to security concerns. Also noted was the benefits of harmonizing standards and parameters for improved water resource management in shared basins. Representatives from Jordan welcomed the use of disruptive technologies to enhance data collection, reliability and integrity. Similar concern was expressed regarding the need to standardize approaches and terminologies to benefit from new technological tools, while indicating support for the use of disruptive technologies to gather more accurate data to help in strategic

planning and benchmarking. Turkish representatives commented on the usefulness of disruptive technologies for filling data gaps in remote places. Also highlighted was the benefits of using new information technologies for enhanced communication on the sharing good practices, for capacity building and for raising public awareness on climate change. The representatives from Iraq emphasised the benefits of using disruptive technologies for supporting data collection and analytics for better informed transboundary water resources management and including mapping and monitoring of discharge. Opportunities to draw upon disruptive technologies to improve integrated water resources management (IWRM) was also noted.

26. The participants then identified the disruptive technologies that could be most helpful in their work. Representatives from Jordan highlighted the benefits of using cloud-based services to facilitate access to information; the use of supervisory control and data acquisition (SCADA) computer systems for gathering and analysing real time water data; and the use of instruments for locating leaks and damages to water networks. Representatives from Turkey identified artificial intelligence, machine learning and computerized algorithms for modelling as frontier technologies that can support improved water resources management. Syrian representatives highlighted the importance of technologies that can support real-time monitoring and analysis of water resources, particularly those that can zoom in on micro-sheds and micro-farming activities. Representatives from Iraq said that it was important to change the mindset in order to overcome resisting to adopting disruptive technologies and that this would involve training a new generations of water resource managements on these tools. The use of disruptive technologies to support smart agricultural practices was also identified.

27. Other suggestions included the use of web portals for data management, the dissemination of knowledge and the application of models, as well as the use of GIS tools and remote sensing to support the application of IWRM approaches in the agricultural sector. The need to adopting modern software and online tools was noted. ESCWA also raised the issue of ensuring that the researchers in the region be part of global efforts to populate global data platforms to ensure that regional specificities are reflected in global databases, for example, that the characteristics of native crop species and local knowledge are incorporated in algorithms applied in global data platforms that are mapping plant yields over time.

28. A second set of discussions then focused on capacity development needs for different stakeholder groups based on the aforementioned identified opportunities. Participants agreed that governmental experts needed training and that disruptive technology concepts and innovations should be introduced in university curricula. Moreover, the engagement of civil society organizations as well as non-governmental organizations and the private sector was found to be necessary. Considerable focus was also put on empowering youth as future water leaders, as well as providing technologies that can support end users, such as farmers. Finally, the crucial role of service providers such as United Nations related agencies was raised, given their role as important facilitators of access to disruptive technologies.

29. The participants then discussed a roadmap on how capacity on disruptive technologies could be best developed in the coming year or two. Three key avenues were identified: (a) the Mashreq Data Platform should be populated with publicly available data; (b) the issuance and use of interactive e-books that can easily and constantly be updated with information on new technologies and tools; and (c) the organization of intensive workshops and technical assistance on new and emerging technologies and applications. It was also emphasized that the proper selection of people to train is necessary, and that follow-up by trainers would be useful as well as the training of trainers. Such training should also aim to develop the practical "know how" of new staff in water-related ministries. On proposed needs for virtual learning or training, representatives from Iraq noted that data and methods to estimate the economic costings of loss, damage and degradation caused by climate change and to conduct impact assessment studies would be useful to support their policy processes and decision-making. In conclusion, the participants identified the following topics for further examination in subsequent workshops: using/validating data from satellites; means of accessing/extracting climate data; applying hydrological models and flood risk models; and benefiting from

climate change models. The provision technical assistance and easy access to *ad hoc* support on these and related topics was also mentioned.

30. ESCWA and the World Bank discussed collaborating on a series of UN-facilitated capacity-building events, starting with virtual workshops, on a range of technical themes associated with water resources management at national and transboundary levels.

II. ORGANIZATION OF THE SESSION

A. DATE AND VENUE

31. The workshop on Building Capacity for Accessing Disruptive Technologies for Improved Water Resources Management under Climate Change was held at the United Nations House in Beirut, Lebanon on 14 and 15 January 2020.

B. OPENING OF THE SESSION

32. ESCWA opened the meeting by welcoming the participants to Beirut and highlighted the water stress and water quality concerns facing the Mashreq region and its transboundary waters resources. Climate change and extreme climate events were identified as regional challenges affecting water resources management, with opportunities presented by scaling up the adoption of new technologies and accelerating innovation throughout the region. It was emphasized that achieving the 2030 Agenda for Sustainable Development was dependent upon accessing appropriate means of implementation including finance, capacity-building and technology. Disruptive technologies fall within these means of implementation and offer new ways to source data and information for improved water resources management. These technologies also enhance the science-policy interface by providing new tools and analysis to enrich decision-making processes. In closing, it was remarked that ESCWA's work on climate change and water is implemented within the framework of the Arab Centre for Climate Change Policies, which serves as the umbrella for work pursed through the RICCAR Regional Knowledge Hub and supports climate change activities implemented by the Arab Integrated Water Resources Management Network (AWARENET) housed at ESCWA.

33. The opening statement of the World Bank remarked on the numerous challenges and uncertainties affecting water resources management in a region and world where freshwater is becoming increasingly scarce, particularly in the context of climate change. The need for new ways of designing actions and activities that take advantage of new disruptive technologies was highlighted. The World Bank representative pointed out that the central aim of this meeting was to initiate a dialogue within the Mashreq region on the considerable potential that disruptive technologies present for improving water resources management under changing climate conditions. Finally, it was emphasized that achieving the Sustainable Development Goals not only requires securing financing for projects, but integrating new technological elements within projects, and engaging a broad range of stakeholders, including representatives from the private sector and civil society.

34. Following a tour de table, the World Bank presented the objectives of the workshop which aimed to identify challenges, opportunities, and mutually beneficial approaches for utilizing disruptive technologies and regional climate modelling to strengthen water resources management in the Mashreq region. Another key objective of the workshop was to foster peer-to-peer exchange and improved capacity to access a range of knowledge resources to support water resources management and climate change adaptation.

C. PARTICIPANTS

35. Participants from Iraq, Jordan, Syrian Arab Republic and Turkey attended the workshop. Experts from the World Bank and two United Nations Regional Commissions, namely ESCWA and UNECE, contributed to the meeting. The list of participants is provided in Annex II.

D. EVALUATION

36. An evaluation questionnaire was distributed to participants to assess the relevance, effectiveness and impact of the meeting. The form was made available in English language. The organizers received 18 filled questionnaires and information provided was compiled and analysed. The feedback received was positive with all respondents rating the overall quality of the meeting as good to excellent. The vast majority of the those who have participated in the survey found that the meeting achieved its objectives and all agreed that their expectations were met.

37. The meeting organization was rated as good to excellent by all respondents, most of whom (88 per cent) found that the issues discussed were relevant to their field of expertise. Most of those who have completed the questionnaires indicated that the meeting represented a very good forum to exchange information with other participating experts. Respondents also found that the written material were of good quality and appropriately covered the topics listed on the agenda. The need for follow-up activities to the meeting was recommended in all questionnaires. The nature of requested follow-up activities included capacity building on application of disruptive technologies for actual case studies, climate change and disaster and applications to transboundary groundwater basins.

ANNEX I

Useful list of knowledge resources provided by the World Bank

- Mashreq Platform (draft) http://spatialagent.org/Mashreq/ which includes a link to the RICCAR Regional Knowledge Hub (www.riccar.org)
- Disruptive KIDS (Knowledge, Information & Data Services) Helpdesk - Interactive Product Catalogue: http://spatialagent.org/KIDS/
- Spatial Agent App (iOS, Android beta, OLC resource page)
- E-Book Examples:
  - Disruptive Tech Primer (esp. see typology, tech examples and interactive library and case studies)
  - An in-situ hydromet monitoring interactive e-book
- Other Data Portal drafts (HydroInformatics, with automated translation tools Africa, Pakistan, Nigeria)
- Example Package - Congo Basin (data portal, knowledge portal, e-book)
- New WB Geospatial Platform from ITS Geospatial (external) – analytical functionality to be added shortly (currently on an internal platform)
- http://floodobservatory.colorado.edu/ uses satellite data to measure daily river flows
- Google dataset: www.developers.google.com/earth-engine/datasets/
- 3D-Printed Automatic Weather Station (3D-PAWS)
- www.nullschool.net – winds across the globe; desert winds, PMs and visualizing complex data
- www.watershedtool.org – online analytics decision-support tool with the support of the Nature Conservation Society and the World Bank. The data is external; the app is hosted by apple; Data analysis can be generated on demand on app even with limited computing power.
- Desert Research Institute: www.app.climate.org/climateEngine/ which has NDVI already calculated and thus equation use already there to generate for full area immediately
- Streamflow predication database - GEOGLOWS: Global River Forecasting Applications. GEOGIoWS Africa Streamflow Explorers with more than 50 models to streamflow for various catchments, based on historical streamflow. Works for independent catchments, but not as good with rivers with dams
- US Airforce open data – GADAS: USDA Foreign Agricultural Services: Global Assessment System, with analytics and data drawn from air force, soil moisture computed weekly across the world)

ANNEX II

List of Participants

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