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Economic and Social Commission for Western Asia (ESCWA)

Report

Mashreq Waters Knowledge Series: Workshop on Economic Implications of Climate Change and Water Scarcity in the Mashreq Region

Beirut, 1-3 December 2020

Summary

The World Bank and the Economic and Social Commission for Western Asia (ESCWA) jointly organized a workshop on Economic Implications of Climate Change and Water Scarcity in the Mashreq Region which was convened virtually through online platform from 1 to 3 December 2020.

The World Bank findings on climate change impacts in the Mashreq region on agricultural productivity and the ensuing cascading effects on food security and Mashreq economies at large, were presented. Challenges faced in mobilizing climate funding by countries of the Mashreq countries, particularly for adaptation and approaches to improve access to global financial mechanisms, particularly in the context transboundary settings were presented by ESCWA. The meeting also included demonstrations on how RICCAR regional climate and hydrological modelling in combination with crop productivity modelling tools and outputs were built upon to provide science-based evidence to inform national policy and decision making, particularly in the agricultural sector. The meeting also included demonstrations on how to access regional platforms and how knowledge resources and geospatial data layers from various sources hosted on these platforms can be used in combination to support water and climate related analysis for specified geographical locations. In that respect, the application of analytical tools and information extracted from the Mashreq Data Portal to identified river basin from the Mashreq region were discussed. Also access and use of data and information available on the RICCAR Regional Knowledge Hub was demonstrated.

It was agreed that the way forward in organizing follow-up workshops within the framework of the Mashreq Waters Knowledge Series need to focus on more in-depth learning. The meeting concluded with a conversation on specific Mashreq country needs towards enhanced integration of disruptive technologies for water resources management, particularly groundwater resources.

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Introduction

1. The workshop on "Economic Implications of Climate Change and Water Scarcity in the Mashreq Region" was jointly organized by the World Bank and the Economic and Social Commission for Western Asia (ESCWA), and constitutes the second workshop within the framework of the Mashreq Water Knowledge series. The first workshop of which (Beirut, January 2020) focused on how regional knowledge platforms, joint scientific assessments and regional climate projections can provide a common knowledge base for strengthening water resources management in the Mashreq region.

2. This second workshop examines the Economic Implications of Climate Change and Water Scarcity in the Mashreq Region and expands the discussion to include consideration of economic and productivity assessment tools related to the agricultural sector.

3. The meeting consisted of five sessions. The main meeting deliberations and discussions are depicted in this report: 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 and participants. The meeting documents, including the workshop agenda and delivered presentations, are available at the following website: https://www.unescwa.org/Economic-Implications-Climate-Change-Water-Scarcity-Mashreq.

II. TOPICS OF DISCUSSIONS

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

A. Economic Impacts of Climate Change and Water Scarcity: An Assessment

5. The World Bank opened the session with a series of interventions presenting the outcomes generated from work published in the report "Water In the Balance"[1] whose goal was to assess the economic impacts of water scarcity for 6 selected countries of the Mashreq region and examine how water-use efficiency improvements and trade can mitigate these impacts.

6. The first presentation highlighted the water security policy implications in addressing the economic impacts of climate change and water scarcity in the middle east. The long-standing issue of water scarcity in the Mashreq region is further exacerbated by increasingly uncertain conditions, brought about mainly by the impacts of climate change and rapid population growth. The report examined climate-driven water scarcity implications on the economy whereby decreasing water availability by 20 per cent would result in up to 10 per cent decrease in GDP in some countries. Also, improvements in water-use efficiency can reduce the pressure on water resources only when accompanied by appropriate regulation for water withdrawals, including through water accounting and measurement. The consequences of water scarcity are experienced through cascading and interactive effects on various economic sectors and the environment. The need for a multisectoral approach was emphasized including through aligning water, trade and agriculture policies accompanied with complementary actions and investments. The role of joint regional collaboration mechanisms presents a promising avenue to support climate change adaptation in the water sector, reap economic gains and advance regional cooperation.

7. The first session provided an overview of the impact assessment methodology. It was highlighted that the analysis in the report is based on the Global Trade Analysis Project (GTAP) computable general equilibrium (GTAP-BIO-Water) model. It was emphasized that computable general equilibrium (CGE) models can capture economy wide impacts, including changes in prices, quantities and incomes engendered by fluctuations in goods and services using water as an input. The model captures the cascading impacts of water shortages across various sectors. The main features of the model were emphasized in that information on economic performance is disaggregated by isolating the role of water as a production input. Furthermore, interrelations and interactions among the various economic agents are factored in by tracing demand and supply of goods and services that are produced, consumed, and traded. The impacts of climate change are integrated by linking biophysical conditions

[1] "Taheripour, Farzad; Tyner, Wallace E.; Sajedinia, Ehsanreza; Aguiar, Angel; Chepeliev, Maksym; Corong, Erwin; de Lima, Cicero Z.; Haqiqi, Iman. 2020. Water in the Balance: The Economic Impacts of Climate Change and Water Scarcity in the Middle East. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/34498.

to economic performance. The model is based on projections generated under *what-if* scenarios depicting how shocks in one sector echo throughout the entire economy. Therefore, the model supports policy makers by providing a broad overview of what might happen to economies under different scenarios of increasing water scarcity.

8. The last of the series of WB presentations reviewed the key economic findings. An overview of the extended version of the Global Trade Analysis Project (GTAP) economic model was presented. The extended GTAP-BIO-W model is a type of CGE model that has frequently been used to assess the economy-wide impacts of changes in water scarcity. To project future changes in crop yields, climate change models under medium and high emission scenarios are examined. A schematic representation of the research methodology demonstrated how climate change and socio-economic factors were linked to drivers of crop yields and determinants of water scarcity to support modeling of the impact of crop yield changes and water scarcity on the economy. It was highlighted that the impacts of climate change induced water scarcity were found to have an idling effect on the entire economy that goes beyond food security and poverty. Increasing water-use efficiency is a key option to deal with water scarcity. Water use efficiency (WUE) was defined as economic output per unit water used, in line with the SDG monitoring framework definition. In that respect, GTAP-BIO-W model was used to simulate the impact of 10% and 20% increases in WUE across all economic sectors on GDP, land conversion and employment. It was found that improvements in water use efficiency would alleviate impacts on agriculture jobs, particularly unskilled labor in that sector. Similarly, WUE improvements would contribute to reduced economic loss in many countries. An example from the Syrian Arab Republic showed that 10 and 20 per cent increased WUE were associated with 1.9 and 4 per cent gains in GDP, respectively, compared to a no policy scenario. Similar trends were observed for countries where the model was applied, i.e., Iraq, Iran, Jordan, Lebanon, Syria, and Turkey. Improving water use efficiency by 10 and 20 per cent was also found to lessen the conversion of irrigated areas to rainfed cropland, thereby lowering the risk of cropland expansion and associated loss in forest coverage and natural habitats.

9. Turkey's delegation raised their concerns regarding the report preparation process, particularly with respect to insufficient consultation with country representatives. Also, analysis outcomes were not circulated to concerned countries prior to report issuance and hence data generated cannot be confirmed. In response to the issues raised, World Bank representatives clarified that the scope of the report was limited to the generation of projections based on *what if* models elucidating the impacts of climate driven water scarcity on agriculture sector and its reverberations for the economy at large under specified hypothetical circumstances. Hence it was re-emphasized that data and information generated are not predictions or forecasts of what would most likely happen but are intended to link alternative policy options to water scarcity and agricultural productivity under identified climate change scenarios with their associated implications to the economy at large. Other issues were raised regarding the impacts of changes in national trading policies prioritizing national food security objectives in response to the global pandemic. It was clarified that the applied GTAP-BIO-W model does not consider changes in trading patterns brought about by the recent global pandemic. Nevertheless, future runs of the model can integrate pandemic related implications specially since GCE models are flexible and can be easily customized to various contexts.

10. In response to inquiries raised regarding whether the region had developed comprehensive mapping of groundwater aquifers to support evidence on the nature, reserves and level of groundwater exploitation, it was clarified that ESCWA with support from BGR have prepared an *Inventory of shared water resources in Western Asia* which details hydrological and hydrogeological characteristics, agreements and cross border management efforts as well as water resources development and use patterns in 17 identified transboundary aquifer system in the Mashreq region. It was also highlighted that ESCWA is currently engaged in work on the generation of assessments for climate change impacts on groundwater resources.

B. Assessing Climate Change implications for agriculture and Finance

11. ACSAD presented outcomes of the project on "Promoting food and water security through cooperation and capacity development in the Arab region" implemented in partnership with ESCWA and the FAO and funded by Sida, to support regional capacities for the assessment of the impacts of changing water availability on agricultural production. Analysis was based on running the AquaCrop model integrating input data from the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic

Vulnerability in the Arab Region (RICCAR)[2] projections under two different climate change scenarios (RCP 4.5 and 8.5). The AquaCrop model was selected for this study as it presents a crop growth model with easy accessibility and limited data requirements. National and sub-regional trainings workshops were conducted to strengthen national capacities on AquaCrop model applications for the assessment of projected climate change impacts on crop yields. This has resulted in the preparation of nine (9) national assessment reports including for Iraq, Jordan, Lebanon and Palestine to detect the impacts of changes in water availability on agricultural crop productivity. Analysis presented in the assessment reports indicated a declining trend in crop yields and food production, specifically for rainfed crops. Furthermore, raising temperatures are likely to shorten crop growth cycles which would negatively impact the quality of grain yield. In light of those challenges, a series of adaptation interventions were proposed, and which include measures such as changes in sowing dates, crop varieties, cultivation approaches and irrigation schemes.

12. Discussants suggested to further differentiate in upcoming runs of the model between various sources of irrigation water whether groundwater or surface water as crop yield vulnerability to climate change is largely linked to sources of water used. In response to inquiries about the measures taken to ensure accuracy of results, it was clarified that the model was calibrated by comparing simulated and observed outcomes for controlled factors such as fertilizer use and soil management. Furthermore, the average for 3 projections conducted for each application was considered to reduce uncertainty. Also, it was clarified that future AquaCrop runs will integrate RICCAR projections undertaken at higher resolution based on 10 km^2 grids which will be drawn upon to refine assessment outcomes for agricultural climate vulnerability at the Mashreq region level.

13. A presentation by ESCWA followed on international financial flows for climate change adaptation in the region. Analysis of global trends in climate financial flows from developed to developing countries over the period from 2013 to 2018, indicate that most of these flows are focused on mitigation while adaptation has only attracted 21 per cent of the total amounts. Nevertheless, over the period 2016 to 2018, growth rate in adaptation finance has exceeded financial flows dedicated to mitigation. The presentation emphasized that public climate finance flow to the Mashreq region largely echoes global trends in that they are mainly directed towards mitigation action. A closer look at the types of funds revealed that debt is largely driving the resources needed to advance climate action. Furthermore, public financial flows are uneven across the Mashreq region, with cumulative climate flows granted to Iraq, Jordan and Turkey representing more than 90 percent of all financing to the Mashreq region. With regards to sources of climate finance targeting countries of the Mashreq region, most financial commitments are channelled through multilateral, bilateral and other channels, the World Bank and EU governments notably, France, Germany and Japan. Hence, the financing mechanisms established under global climate agreements only supply a fraction of all climate finance flows to the region, this is despite the doubling of GCF commitments alone in 2018 compared to previous year levels. The flow of climate financing committed to the water and Sanitation sector (WATSAN) and the Agriculture, Forestry and other land uses (AFOLU) sectors to countries of the Mashreq region was examined. It was highlighted that Iraq, Jordan and Lebanon have been able to attract most of the funds committed to the water sector, whereas Turkey has mobilized the largest share of flows dedicated to AFOLU. An overview of examples for climate financing support to countries of the region has revealed Adaptation Fund[3] commitments to Iraq and Lebanon towards enhancing climate resilience of the agricultural sector and towards enhancing sustainability of wastewater reuse in Jordan. Climate Technology Centre and Network (CTCN)[4] has also dedicated funds to support 5 technical assistance activities in Iran one of which covers the water sector. The presentation concluded with highlighting the importance of open data platforms for information sharing and collaborative work. Also planning constitutes a crucial step for the development of projects based on which financing is mobilized. The role of science-based evidence together with region wide impact assessments supporting direct adaptation finance was re-iterated.

[2] www.riccar.org

[3] Adaptation Fund: The Adaptation Fund was established under the Kyoto Protocol of the UN Framework Convention on Climate Change, and since 2010 has committed funds to climate adaptation and resilience activities (https://www.adaptation-fund.org/).

[4] The Climate Technology Centre and Network (CTCN) promotes the accelerated transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries (https://www.ctc-n.org/).

14. The following presentation in this session was delivered by a representative of the secretariat of the UNECE Water Convention[5] on financing transboundary climate change adaptation in shared basins[6]. One of the benefits of transboundary cooperation for climate change adaptation is that it supports more efficient adaptation through better data sharing and more accurate identification of priority areas of intervention. The water convention can present an effective avenue to advance adaptation work in transboundary basins since it provides a unique global legal and intergovernmental UN framework on transboundary cooperation and includes components supporting capacity building, knowledge and experience sharing and guidance on real life situations. In its efforts to support financing climate change adaptation in transboundary basins, the World Bank has issued a paper[7] delivering effective guidance for those working on climate change adaptation in transboundary river basins for the preparation of bankable project proposals that would attract public and private financing partners. Experience from cooperation on adaptation in the context of transboundary waterbodies demonstrates how strategic planning for adaptation supports successful resource mobilization. The presentation concluded by stressing the importance of developing joint vulnerability assessments and adaptation strategies and the existence of strong transboundary cooperation mechanisms to mobilize funds for climate change adaptation in shared basin settings. Recommendations focused on the importance of the development of technically sound but also financially viable (bankable) projects that are adapted to the mix of funding sources available.

15. In response to inquiries regarding the applicability of the knowledge included in the manual on financing adaptation in transboundary settings, it was clarified that the water convention presents a global framework and capacity building guidance that is currently piloted in various transboundary basins, such as the Dniester Basin. The possibility of piloting the framework in the context of the Tigris and Euphrates needs to be discussed based on a clear work plan shared with the UNECE Water Convention by the river basin stakeholders. Jordan representative exposed obstacles facing access to GCF funds whereby the global finance mechanism funds are conditional to securing funds from other sources. Discussions highlighted that grants and debts are the dominant type of funds allocated by global finance mechanisms and concessional loans represent only a fraction of the totality of granted funds. This constitutes a main obstacle to access to GCF funds by countries of the Mashreq region, specially that some countries could not satisfy the co-financing conditionality imposed by donors, specially that adaptation in the water sector involves large investment-intensive infrastructure works. Ensuing discussions focused on the need to prioritize water related adaptation projects on the climate finance portfolio by mainly highlighting the cost of inaction and underscoring interlinkages of the water to major productive sectors and the economy at large. It was also mentioned that global climate negotiation platforms are considering a proposition to integrate global adaptation metrics with their associated goals, and which would enhance access to funds for adaptation to ensure that the national priorities are addressed.

C. INTERACTIVE SEGMENTS

16. The interactive session provided an opportunity for participants to explore in greater depth topics discussed on the previous day and engage with the experts in related discussion.

1. Q&A: MODELLING CLIMATE CHANGE IMPACTS ON AGRICULTURAL PRODUCTIVITY USING RICCAR DATASETS AND AQUACROP TOOLS

17. ESCWA and ACSAD presented on the way RICCAR data set were integrated in AquaCrop tools to project agricultural productivity under changing climate conditions. In order to better understand the impacts of climate change as they relate to crop productivity, the model was run for both increased atmosperic carbon and restricted irrigation scenarios. The outcomes have shown increased productivity of tomato, wheat and potato under increased atmospheric carbon levels. On the other hand, restricted irrigation has resulted in consistent yield reduction for most crops studied. Also, experience with formulating scientific knowledge into policy recommendations have highlighted how channels and avenues available for that purpose, remain to a large extent

[5] The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) (https://unece.org/environment-policy/water/about-the-convention/introduction)

[6] Countries were invited to fill questionnaires by accessing the following link: https://www.surveymonkey.com/r/devpowwaterconventionen. to provide views on national priorities towards the finalization of the Water Convention Work Plan 2022-2024 by 11 December 2021.

[7] Financing Climate Change adaptation in Transboundary basins: *Preparing Bankable Projects* (https://openknowledge.worldbank.org/handle/10986/31224?CID=WAT_TT_Water_EN_EXT&locale-attribute=en

discontinued. The presentation concluded with agriculture strategy and policy recommendations in the Mashreq region towards a more resilient agriculture sector. These focused on cross sectoral coordination for better stakeholder engagement and partnerships, use of innovative technologies, resources mobilization and the formulation of adaptation measures, among others.

18. Ensuing discussions raised concerns regarding AquaCrop methodology mainly in relation to the large number of assumptions involved, and the quality of data entered. Particularly, the issue of whether irrigation efficiency is considered in net irrigation water requirements. In reply to these concerns, it was clarified that the scope of AquaCrop aplications does not cover irrigation efficiency calculations and hence only *net irrigation efficiencies* are entered in model simulations processes. Questions were raised regarding the selection of crops identified for model simulations, it was highlighted that the assessments were conducted to explore prelimnary impacts of climate change on one identified irrigated crop and another rainfed. In that context, the generation of higher resolution (10 km^2) climate change projections under RICCAR for the Mashreq region is crucial to generate more accurate information for better policy guidance. Such information would also suport expansion of the scope of assessments to include additional crop varieties and all water resources available hence would provide more accurate information on changes in irrigated crop yields. It was clarified that some countries such as Egypt, Jordan and Morocco have started incorporating outcomes from assessment reports into their national agricultural plans. The discussion then focused on how to better understand simulation outcomes which have forecasted enhanced crop productivity under increased atmospheric carbon concentrations. It was noted that caution needs to be exercised when interpreting these results as atmospheric carbon can only support increased productivity when sufficient water quantities are available, which in turn are expected to decrease under simulated climate change scenarios.

2. Q&A: Economic Impacts of Climate Change on Water Scarcity in the Middle East

19. The World Bank delivered a brief overview of the previous day's presentations. In this summary, the WB stressed that the model presented a framework linking different economic agents to better understand how water shortage and the associated impacts on crop yield will impact not only the sectors that use water for production but also other important economic sectors.

20. The methodological approach for the selection of climate change factors into modelling projections was discussed and it was clarified, that similar to other exogenous factors, climate change was integrated as a shock to the system and the outcomes generated were identified at the sectoral level and at macro level as well. It was explained that water scarcity will slow the economy at large since infrastructure (dams, roads linking rural to urban areas) and production capacities (tractors, farms…etc) will, to some extent, be kept out of operation under water shortage conditions. The effects at the household level will be double folded as the increase in food prices will be accompanied with lower income and hence less potential for households to purchase food. Furthermore, scarcity impacts will extend beyond food security and poverty and will be associated with high social, environmental and economic costs. Iraq's representative highlighted the need to expand the scope of the model application beyond quantity assessments to incorporate quality aspects into future runs of the model as dealing with salinity has been a major challenge for Iraq.

3. Accessing the RICCAR Knowledge Hub and Data Portal: Demonstration and Q&A

21. 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. It was clarified that ESCWA is ready to provide technical assistance and training to support access to and use of RICCAR-related products, datasets and applications. The presentation also noted that regional climate projections for the Mashreq region at a resolution of 10 km^2 will be available to support water-related analysis by June 2021. It was also mentioned that

the platform will migrate to the latest generation geospatial platform for easier navigation and comparability with other geospatial datasets.

22. On the selection of types of weather indicators, it was clarified that total precipitation volumes are not revealing since absolute changes in precipitation are small compared to other regions of the world. Therefore, indicators such as number of days where precipitation or temperature exceed a predetermined threshold is more indicative of the likelihood of floods and /or delays in crop growing seasons. In response to queries regarding methodology applied for bias correction, it was mentioned that bias-correction attempts to reduce systemic inaccuracies in GCM and RCM modelling outputs were based on incorporating reanalysis data computed based on historical meteorological observations for a control period identified from 1980-2009. Following discussions highlighted the advantages of this approach compared to bias correction based on station data collection which are often sparsely distributed and hence generate discontinuous data whereas reanalysis data provides an alternative for a more homogeneous and encompassing results. In the end, ESCWA expressed its readiness to assist countries conduct impact and vulnerability assessments through training and technical assistance at the national and sector levels.

4. Accessing the Mashreq Water Resources Portal: Demonstration and Q&A

23. The World Bank subsequently presented the main challenges and issues in applying disruptive technologies to data generation and analysis, particularly for the water sector. The challenge mainly resides in applying a data value chain approach starting with the decisions to be supported. The application of value chain approaches to flood preparedness highlighted the role of disruptive technologies in each step of the process. This starts with data collection through the use of technological tools and approaches which are then translated into relevant information through the application of hydrological modelling which leads up to the generation and dissemination of knowledge products and services which are consequently built upon to inform decision making for better disaster risk preparedness. The World Bank presented ongoing updates to the Mashreq Data Portal (https://spatialagent.org/Mashreq/)) which is built upon public-domain open source data. The portal hosts a myriad of water-related open-access data and analytics and is being expanded to include relevant public knowledge resources (e.g. articles, reports, videos, websites) of relevance to the region. The WB representative then performed a demonstration on how to combine geospatial water, climate, social, environmental and economic related data layers from various sources hosted at the platform to generate insights across the Mashreq region. It was highlighted that the platform integrates responsive design to visualize and interact with data, allow spatial and temporal data visualization through interactive maps and graphs, supports spatial analytics for defined areas and locations with the possibility to conduct scenario visualization and export analysis generated for subsequent dissemination and to inform policy making. The presentation also indicated additional advances in disruptive technologies that are expected to be included – including integration of additional free cloud computing analytics (e.g. leveraging the Google Earth Engine API), Artificial Intelligence (AI) and Machine learning in support of enhanced real-life representation including tangible landscape and immersive virtual reality. The presentation concluded that expanding modern disruptive technologies presents great potential for hydro-informatics and, in that respect, there is a great potential to leverage global, regional and national data and analytics for local benefits.

24. The Mashreq Region could help contribute to, and learn from, rapidly evolving global good practice in hydroinformatics. The World Bank has expressed their willingness to organize additional workshops to provide technical support on the use of the data portal. Country representatives were asked to present their particular needs and requests in this regard. The need for improved public access to in-situ monitored data was highlighted to help improve the bias correction, calibration, or training of increasingly powerful earth observation or global model estimates. An increasing number of countries in other parts of the world are serving national data on open access platforms which would further expand the use of novel technologies that are set to soon "disrupt" what was perceived as "normal practice". These include the automation of manual, labour-intensive tasks through the use of technologies for creating modern dashboards and applications to support basin planning, water infrastructure systems operations, ecosystem monitoring, irrigation planning and benchmarking. In addition, the risks that needed to be managed were also indicated – including cybersecurity, privacy, and need for skills upgradation and institutional infrastructure to bridge the digital divide. Additional effort would also be needed to complement the analytical advances with meaningful participation of stakeholders, whose involvement was recognized as central to support better insights on decision making priorities.

D. PERSPECTIVES FROM THE REGION

25. A panel discussion followed whereby Mashreq region country representatives were invited to provide their insights on the way forward with regards to the use of disruptive technologies for food security and economic concerns in the context of climate change.

26. The representative from Jordan clarified that more than 50 percent of water resources are used for irrigation and conveyed for the most part in aging network system characterized by high losses. Agriculture is experiencing climate change impacts through shifts in cropping cycles and dwindling water resources for crop irrigation. Groundwater resources, which represent a major source of irrigation water, are under pressure and their exploitation requires increasingly deeper wells and energy requirements for pumping to the surface. As a result, enhancing water use efficiency in the agriculture sector particularly under changing climate conditions has been at the centre of public policy planning. To monitor groundwater use for irrigation, authorities have integrated technology solutions namely, remote sensing to assess actual groundwater used for irrigation versus quantities reported by famers. Elaboration on how technological advancements can support better water use efficiencies in municipal and irrigation conveyance systems was discussed. Jordan representatives emphasized the role of renewable energy technologies, particularly biogas in addressing the water-energy nexus concerns. Improved efficiency of renewable energy technologies would alleviate the burden of energy expenditure in the water sector.

27. The Lebanon Ministry of Energy and Water representative highlighted major issues for water management across the Arab region and discussed how technology could provide solutions to these longstanding vital problems particularly under worsening current climate conditions. The Arab region, mainly the GCC countries, host more than half the global water desalination capacity and the major share of unconventional water volumes is directed towards irrigation. Furthermore, it was highlighted that irrigation efficiency in the Arab region is well below the global averages. Similarly, efficiency in municipal water conveyance and distribution networks is very low compared to global figures. In that perspective, desalination is key to water security in the region and technological solutions can support innovation and efficiency in that domain. The role of hydrodiplomacy and better WEF nexus management for improved water security was emphasized.

28. The representative from the Syrian Arab Republic clarified that climate change impacts are hurdling the planning process as a consequence of delayed rain season, decreased precipitation and shrinking snow cover specially during seasons where most of spring recharging takes place. Also, observed temperatures are on the rise with accompanying longer drought cycles. Technological solutions are needed to inform policy makers regarding the vulnerability of crops and adaptation towards climate smart crop production systems. Syria representative also brough to the front the challenges faced in accessing open source platforms such as the Mashreq Data Portal in Syria as a result to limited access to infrastructure and services brought by conflict.

29. Turkey representative presented the findings of a national study investigating climate change impacts on water resources, snowmelt and streamflow under various emission pathways at 10 km^2 grid resolution. The findings have shown clear trends in increasing temperature reaching up to 6 degrees under RCP 8.5. While a decrease in precipitation volumes is expected across the country, the black Sea coast is likely to be most impacted by reduced precipitation. Also, snow cover areas are expected to shrink significantly by up to 50 per cent in some parts of the country. Another concerning finding is the temporal redistribution in precipitation whereby rainfall historically received in the hot season, that is when it is most needed, shifts to the early spring. The climate and hydrological projections generated under the discussed project are stored in the ClimaHydro database which would soon be accessible through a dedicated electronic platform.

30. A roundtable discussion ensued to formulate a roadmap for follow-up action. During this session, participants highlighted specific requests of highest relevance to their national context. Jordan representatives expressed interest in learning more about applications of the presented model(s) and inquired about the possibility to adapt the scenarios to cover relevant issues such as land use for agriculture, urban encroachment,etc. Jordan was also interested in model application to the energy sector, particularly on biofuels. The Jordan Ministry of Water Resources representative also expressed interest in engaging in downscaling future RICCAR projections for more reliable outcomes. Representative of the Syrian Arab Republic expressed interest in capacity building particularly for young researchers and practionners since they are the ones who would most use disruptive technologies in performing their work. Turkey delegation was interested in exploring channels and avenues to

support access to climate adaptation funding and asked for greater involvement in the preparation phases of following workshops.

31. The WB summarized that the meeting outcomes and discussion shed light on the impacts of climate change on water availability and crop yields but also the cascading effects to food security and the economies at large. The importance of joint regional modelling to project the impacts of climate change across water dependant sectors was also highlighted to support better decision making. It was suggested that future workshops on disruptive technology to fill gaps in data scarcity would need to be more focused to allow for in-depth analysis.

E. Closing Reflections

32. The closing remarks delivered by the World Bank presented the Water Global Practice vision in working towards a water secure world for all, pursued through three pillars, namely: sustaining water resources, delivery of water related services and building resilience to climate fragility. The current climate change related language should be replaced by more positive tone focusing on the potential for transboundary cooperation to address the common global issues that have cross sectoral impacts. Action tracks include mobilizing finance as well as infrastructure and nature-based solutions, among others. Pathways which result in the simultaneous achievement of multiple benefits should be favoured and given highest priority, such as those actions with mitigation and adaption co-benefits, among others. In conclusion, the interest of the Water Global Practice in sustaining partnership and collaboration with ESCWA was reiterated.

33. ESCWA closed the meeting by reiterating that work on climate change and natural resources sustainability is being pursued within the context of the Arab Centre for Climate Change Policy (ACCCP) through an integrated Water, Energy, and Food security Nexus lens. The centre also created a platform for dialogue on water related issues working with member countries and beyond and provides scientific evidence base on priority climate issues and concerns for countries of the Arab region. The shortfall in adaptation work at the global level was underscored and hence the need for focused efforts perhaps through the formulation of global adaptation goals was raised. It was also mentioned that the scientific base generated under the ACCCP is also supporting Arab negotiators at the COP process. The ESCWA and World Bank informed the participants that the next workshop would focus on the use of modern “disruptive” technology for groundwater management bringing together a range of global resource persons on this subject.

III. ORGANIZATION OF THE SESSION

A. Date and venue

34. The workshop on Economic Implications of Climate Change and Water Scarcity in the Mashreq Region was held virtually, from 1 to 3 December 2020.

B. Opening of the session

35. ESCWA opened the meeting by welcoming participants to this second workshop of the Water Mashreq Waters Knowledge Series organized in collaboration with the World Bank. ESCWA representative highlighted the water stress and water quality concerns facing the Mashreq region and its transboundary waters resources and hence the importance of transboundary water cooperation for ensuring water security and sustainable development for all. ESCWA contribution to scientific basis for informing policy dialogue and fostering regional exchange among riparian states was highlighted. In that respect, the *Inventory of Shared Water Resources in Western Asia* was prepared to provide a common knowledge base to support dialogue among riparian states. ESCWA is also building the regional knowledge base on climate change for the MENA domain through RICCAR. Furthermore, the climate modelling projections generated for the newly established Mashreq Domain under RICCAR will inform more in-depth analysis on climate change across water-dependent sectors at the Mashreq regional scale. The importance of the science-based assessments that are openly accessible through the RICCAR Regional Knowledge Hub in informing policies and plans towards the achievement of improved water use efficiency, agricultural productivity under climate change was underscored. In closing, ESCWA representative thanked participants for their engagement and expressed interests in the meeting outcomes, recommendations and proposed next steps.

36. The World Bank representative reflected on the WB's engagement in supporting countries of the Mashreq region in their endeavour to enhance the regional water resources management efficiency. In that perspective, the importance of the Mashreq Waters knowledge Series to the region was highlighted, particularly under conditions of increasing climate variability which is exacerbating challenges in managing the already scarce water resources. The launch of the Mashreq Data Portal was emphasized in that it provides an effective accessible platform to draw upon novel technological tools and services for the generation of scientific evidence and hence better inform decision and policy making.

37. The Minister of Energy and Water (MoEW) of Lebanon delivered a speech during which he clarified that despite the abundant water resources characterizing the country, longstanding poor management of these resources have exacerbated water supply shortages, particularly during dry seasons. Lebanon still lacks a National Water Use Efficiency Strategy to coordinate rationalized water resources use and consumption across various water-dependent sectors. The experience of the MoEW in the development and operationalization of a national water strategy was exposed and highlighted reiterated efforts that have not yet succeeded in achieving the set objectives. A main impediment facing the implementation of this strategy was pinpointed as limited available funds.

38. Following a tour de table, the World Bank presented the objectives of the workshop which aimed to examine the implications of climate change and water scarcity on agricultural productivity and potential impacts on Mashreq region economies. It was explained that discussion will build on findings from a WB report that examine the extent to which water scarcity and losses in crop yields due to climate change could affect economies of the region.

C. PARTICIPANTS

39. Participants gathered senior officials and technical experts from government institutions responsible for water resources management in the Mashreq region from Iraq, Jordan, Lebanon, the Syrian Arab Republic and Turkey. Experts from the World Bank and United Nations organizations supported the meeting as well as resource persons from expert institutions. The list of participants is provided in Annex I.

ANNEX I

List of Participants

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