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POSITION PAPER – Extended Summary

Bridging the Water and Food Gap: The Role of the Water-Energy-Food Nexus

Rabi H. Mohtar, Amjad T. Assi and Bassel T. Daher

Day 3 | Population Growth

Bridging the Water and Food Gap: The Role of the Water-Energy-Food Nexus

Rabi H. Mohtar[1*], Amjad T. Assi[2], Bassel T. Daher[2]

[1*] *Biological and Agricultural Engineering Department and Zachry Department of Civil Engineering, Texas A&M University, College Station, TX, USA*

[2] *Biological and Agricultural Engineering Department, Texas A&M University, College Station, TX, USA*

Summary

Food and water security are among the top global risks facing the future of our planet and our current way of life. Four out of the top 10 global risks highlighted in the 2014 World Economic Forum report "The 2014 Global Risks Report" are directly related to water and food security. The report also highlighted a major shift in the risks and the manner in which the global community sees these risks. For the first time, the big risks are seen as economic, environmental, and societal rather than geopolitical: this is a major change in the way in which the global community sees future risks and touches on the enabling conditions for good resource management, i.e. governance, political and social stability. The report also highlighted the manner in which global risks are interconnected and have large-scale impacts that ripple across the economies and societies. Managing global risks effectively, requires that we make the effort to understand, measure and foresee the evolution of the interdependencies between risks. Essentially, the report reaffirms previous calls for nexus thinking: looking not only at components in isolation, but at the broader system, focusing our efforts into a new reality of managing complexity.

In this paper we emphasize these findings. We start by introducing the global resources challenges, risks and shifts in what society defines as global securities. We then explore the grand challenges surrounding resources scarcity and the need for a holistic platform to quantify these interlinkages and tradeoff analyses. In order to implement such a holistic platform, we introduce the water – energy – food nexus [WEF Nexus] as a resource integration platform that can help with scenarios analysis. Moreover, we introduce various nexus hotspot applications around the world to highlight the use of such a holistic nexus platform to address the securities of water, energy, and food resources. One of the major hotspots highlighted is the water-food nexus challenge and sustainable agricultural intensification, mainly as relates to dryland. These agricultural systems are currently dominated by the land centric concept of producing more food from the same land without analytically defining sustainable production systems that take the resource nexus into consideration. We argue that sustainable agricultural intensification should also be based on the sustainable use of the pillars of the natural system: energy, soil, water, and atmosphere, which are key to facing the water and food crisis. However, managing these resources requires a quantifiable framework for characterization and modeling the hydro-functioning of the soil-plant-atmosphere system. The lack of such a framework prevents the scientific community from quantifying, managing and thus, sustainably utilizing other water resources, mainly green water and non-conventional waters, such as greywater, wastewater, and produced water.

To summarize, the paper introduces a WEF Nexus approach based on a theory of holistic systems. It is a hierarchal approach that begins with localizing the food security issue by taking into account issues of

policy, quantification and accounting for the water, land, and food issues from the perspectives of science, governance, finance, and local capacity building.

The paper concludes with four points to be explored for bridging the water-food gap from a WEF nexus point of view. These are:

(1) There is a need for holistic platform to determine interlinkages and tradeoffs for resource management and allocation. Such a platform will offer a systems view of the solution for each pillar, without infringing upon the others.

(2) Site specific accounting for the feasibility of alternative water for bridging the water food gap is essential. Such feasibility must be accompanied by long term impact studies on soil quality and human health.

(3) Green water is a precious resource that must be better defined, accounted for and represented in thermodynamic modeling and hydrologic scaling. Such a multi-scale hydrologic platform would enable us to quantify and map system resources at a regional scale, enabling local information of the soil thermodynamics to be easily scaled up to the policy scale and vice versa.

(4) A change is needed in the manner in which soil water medium understanding and characterization where soil and soil properties represent soil behavior.

Professor Rabi H. Mohtar is the holder of TEES Endowed Professor at Texas AM University, College Station, USA. He is the Founding Executive Director of Qatar Environment and Energy Research Institute (QEERI) a member of Qatar Foundation, Research and Development and the Founding Executive Director Strategic Projects at Qatar Foundation Research and Development. He was also the inaugural Director of the Global Engineering Programs at Purdue University, Indiana USA. He co-founded the Environmental and Ecological Engineering Division at Purdue University.

Professor Mohtar's research focused on conserving natural resources (including land, water, air, and biological resources) that face global challenges such as increasing food and water supplies for a growing population. He was a pioneer in developing a conceptual and modeling framework for the Water – Energy Food Nexus and linking science to policy. He developed environmental and natural resources conservation engineering programs that evaluate the environmental impacts of land use and water management; developed innovative soil and groundwater remediation technologies; applied numerical methods to biological engineering systems; characterized the soil water

medium at the pedon, field, and watershed scales. He also designed and evaluated international sustainable water management programs that deal with population growth and water shortage conditions in arid climates. His research has resulted in improved methods for environmental and natural resources engineering, many of which have been adopted by other professionals and agencies internationally.

He received numerous international research awards and honors including the Kishida International award for contributions to agricultural research and the distinguished alumni from the American University of Beirut, Faculty of Agriculture and Food Sciences. He served on the World Economic Forum Global Agenda Council on water security since 2009-11 (vice chair 2011), climate change agenda council 2011-present), board of governors of the World Water Council (2012-present), advisory board of the UNFCC momentum of change initiative (2012-present), advisory board of the President of the University of Alberta Water Initiative (2012-2014) among many other global leadership roles. Prof. Mohtar has published over 200 publications including peer-reviewed articles, refereed conference proceedings, books and book chapters.