Panel 1:
Water-Energy-Food Nexus: A fundamental resource challenge in an evolving world

Dr. Rabi Mohtat, Texas A&M University, Department of Biological and Agricultural Engineering, TEES Endowed Professor

10:30 a.m. – 12:00 noon (90 minutes)
Panel 1: Food-Energy-Water Nexus – A Fundamental Resource Challenge in an Evolving World

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<th>Panel 1</th>
<th>Food-Energy-Water Nexus – A Fundamental Resource Challenge in an Evolving World</th>
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<tr>
<td>Dr. Rabi Mohtar</td>
<td>Texas A&amp;M University</td>
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<td>Dr. Bruce McCarrl</td>
<td>Texas A&amp;M University</td>
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<td>Dr. Patricia Romero-Lankao</td>
<td>National Center for Atmospheric Research (NCAR)</td>
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<td>Dr. Gabriela Muñoz Meléndez</td>
<td>El Colegio de la Frontera Norte</td>
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<td>Dr. Lucy Mar Camacho</td>
<td>Texas A&amp;M University</td>
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Consolidated Panel 1 Presentations

Dr. Rabi Mohttar
Moderator
Binational Perspectives on Gulf of Mexico Sustainability

Water – Energy – Food Nexus Panel
Panel 1: Water Energy Food Nexus: A fundamental resource challenge in an evolving world

Moderator: Rabi H. Mohtar, TAMU Water Energy Food Nexus Initiative

Panelists:

- **Bruce McCarl**, Agricultural Economics, Texas A&M
- **Patricia Romero-Lankao**, Senior Research Scientist, Urban Futures, CSAP-RAL, National Center for Atmospheric Research (NCAR)
- **Gabriela Muñoz Meléndez**, Profesora investigadora en Cambio Climático, Energía y Calidad del Aire, Departamento de Estudios Urbanos y Medio Ambiente El Colegio de la Frontera Norte
- **Lucy Mar Camacho**, Professor at the Department of Environmental Engineering, Texas A&M University Kingsville
### Session Organization

<table>
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<th>Time</th>
<th>Session</th>
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<tr>
<td>10:30 – 10:40</td>
<td>Why the Nexus? What its role for resilience to water – energy - food resources? What is the role of the global community of science with reference to TAMU workshop (Rabi Mohtar)</td>
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<tr>
<td>10:40 – 11:00</td>
<td>Panelist perspectives on Urban and Rural issues related to the Nexus and sustainability</td>
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<td>11:00 – 11:30</td>
<td>Moderator Questions to the panel</td>
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<td>1. What are the trends in Water-Energy-Food resources and how can the nexus be useful to managing future trends?</td>
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<td>2. What role can US - Mexico partnership play towards resource resilience? What are there incentives for both partners to work together? What resources exist/lack?</td>
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<td>11:30- 12:00</td>
<td>Open Q/A and dialogue to the floor</td>
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1. Why the Nexus and role it plays in resilience to water - energy - food resources?

2. What is the role of the global community of science in reference to TAMU workshop?
Integrated Science, Engineering, and Policy: A Multi Stakeholder Dialogue Towards Building FEW Nexus Community of Science

College Station | January 26-27, 2017
10 Big Ideas

Data and modeling
Governance, policy, and financing
Governing resources in future cities
Tradeoffs and decision support tools
Energy for water
Water for food
Water for energy production
Food processing and waste
Soil – Food – Climate Nexus
Engagement and outreach: Community Building
Timeline

- **JAN 2017**
  - FEW Workshop

- **FEB 2017**
  - INFEWS Proposals

- **MAR 2017**
  - NSF-RCN

- **AUG 2017**
  - NSF Report

- **OCT 2017**
  - CISE Open 2017

- **JAN 2018**
  - Science Technology Center (STC)

- **AUG 2018**
  - Engineering Research Center (ERC) Preparation
Panelist Perspectives

Bruce McCull, Agricultural Economics, Texas A&M
Patricia Romero-Lankao, Senior Research Scientist, Urban Futures, CSAP-RAL, National Center for Atmospheric Research (NCAR)
Gabriela Muñoz Meléndez, Profesora investigadora en Cambio Climático, Energía y Calidad del Aire, Departamento de Estudios Urbanos y Medio Ambiente El Colegio de la Frontera Norte
Lucy Mar Camacho, Professor at the Department of Environmental Engineering, Texas A&M University Kingsville
WEF Nexus in the Climate Change Squeeze

Distinguished Professor of Agricultural Economics
Texas A&M University  mccarl@tamu.edu

Energy
Climate Change Adaptation

Climate Change Mitigation
Climate Change Effects

Presented at Binational Perspectives on Gulf of Mexico Sustainability Workshop
March 8-10, 2017, San Miguel de Allende, Mexico
• 2016 was the warmest year in NOAA's 137-year series.
• Third consecutive year with new high in global temperature.
• 40th consecutive year (since 1977) annual temperature is above 20th century average.
• All 16 years of 21st century rank in seventeen warmest on record (1998 is eighth)
• Five warmest years have all occurred since 2010
• Last 3 have been successively the warmest.
• Temperatures in 2016 were majorly influenced by strong El Niño
• Increased 0.07°C (0.13°F) per decade since 1880 and 0.17°C
Human influences. Dramatic changes in runoff volume from ice-free land are projected in many parts of the world by the middle of the 21st century (relative to historical conditions from the 1900 to 1970 period). Color denotes percentage change (median value from 12 climate models). Where a country or smaller political unit is colored, 8 or more of 12 models agreed on the direction (increase versus decrease) of runoff change under the Intergovernmental Panel on Climate Change’s “SRES A1B” emissions scenario.

What you see is nonstationarity: the future is not like the past. Less water in rivers in sub tropical regions.

Mean summer (JJA) PDSI (drought index) and standardized soil moisture (SM-30cm and SM-2m) for 2050–2099 from 17 CMIP5 projections using RCP 8.5.

Summer moisture in Central Plains and Southwest. Brown line represents the variation in dryness since year 1000;

The lower the line, the drier. Colored lines represent what climate models see ahead:

Much less water in some regions.
In the Nexus

- Climate change has multidimensional implications
- Energy and cooling water and hydro
- Food and soil moisture and crop mix change
- Water and possible diminished supplies and intensity increases and increased demand and more evaporation
- Nexus will become even more complex in dry areas
- At same time Population and FEW demands growing
The Food-Energy-Water Nexus
III. Urban FEW Security: Operationalization Challenges

**Knowledge/policy integration:** disciplines use disparate concepts, methods & data, & highlight contrasting interactions among key causal mechanisms

**Path dependency of infrastructure & governance make them difficult to change**

E.g., depending on definition of urban, estimates of energy use by urban buildings and industry range between 37% and 86%

Source: Romero-Lankao, McPhearson, Davidson (2017)
Urban FEW Security: Operationalization Challenges

1. Equity and scale - nature of the FEW security to be achieved

- When and where is FEW security pursued?
- What interacting FEW systems are included?
- By and for whom are these systems being secured?

E.g., push toward photovoltaics

Source: Romero-Lankao, McPhearson, Davidson (2017)
The water-energy-food nexus in Baja California

Gabriela Muñoz Meléndez

March 9, 2017
Context
Water consumption in Mexico, 2012
The water-energy nexus in Baja California

Irrigation
The water-energy nexus in Baja California

DISTRITO DE RIEGO 014, RIO COLORADO
Niveles Operativos para la entrega de agua rodada

CILA Sección Americana pedido de agua del Río Colorado a la Sección Mexicana y esta a la C.N.A. (1,850.2 millones de m³).

C.N.A. recibe agua en Presa Morelos

C.N.A. recibe agua en Canal Sánchez Mejorada

Distribución a Red Mayor

Canal Reforma
Canal Independencia
Canal Revolución

Volumen Resultante: 1,595.8 millones de m³

Recepción de Agua en bloque por módulos de riego en puntos de control 1,595.8 millones de m³

Volumen de agua Superficial para uso público urbano a poblaciones rurales 6.1 millones de m³

1,259.0 millones de m³

Volumen susceptible de entregar a los módulos de usuarios en sus tomas de granjas parcelarias con agua del Río Colorado 1,259.0 millones de m³

Volumen de agua de pozos federales y particulares susceptibles de entregar a los usuarios a nivel parcelario 700.000 millones de m³

Volumen total susceptible de entregar a los usuarios a nivel parcelario 1,959.0 millones de m³

Volumen de agua efectivamente requerido para cultivo: 1,459.0 millones de m³
1. What trends do you see in Water Energy Food resources and how can the nexus be useful in managing future trends?

2. What role can the US - Mexico partnership play towards resource resilience; are there incentives on both sides of the border for working together (available resources or lack thereof)
Climate Change can be disruptive

Lots of effects

Source: 2001 US National Assessment