



FEWSTERN



US-China **F**ood-**E**nergy-**W**ater **S**ystems

Transdisciplinary **E**nvironmental **R**esearch **N**etwork

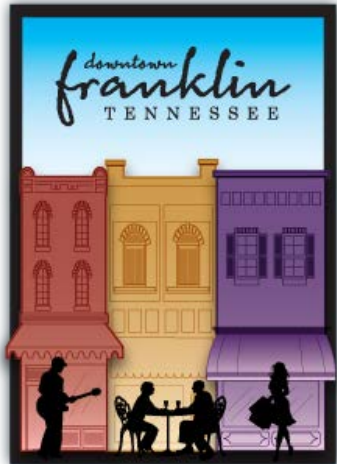
1st FEWSTERN Symposium and Workshop

December 7-9, 2017

Franklin Marriott Cool Springs, Franklin, TN

欢迎来自中国的客人

Welcome our Guests from China





Sherry Redus



- UT's Vice President for Research, Outreach and Economic Development
- Office of Research & Engagement
- Institute for a Secure & Sustainable Environment
- The Bredesen Center
- Center for Environmental Biotechnology
- UT Institute of Agriculture
- Biosystems Engineering and Soil Science



- Chinese Academy of Sciences
- China Agricultural University
- Nanjing Agricultural University
- Tsinghua University
- etc.



China-U.S. Joint Research Center for Ecosystem and Environmental Change

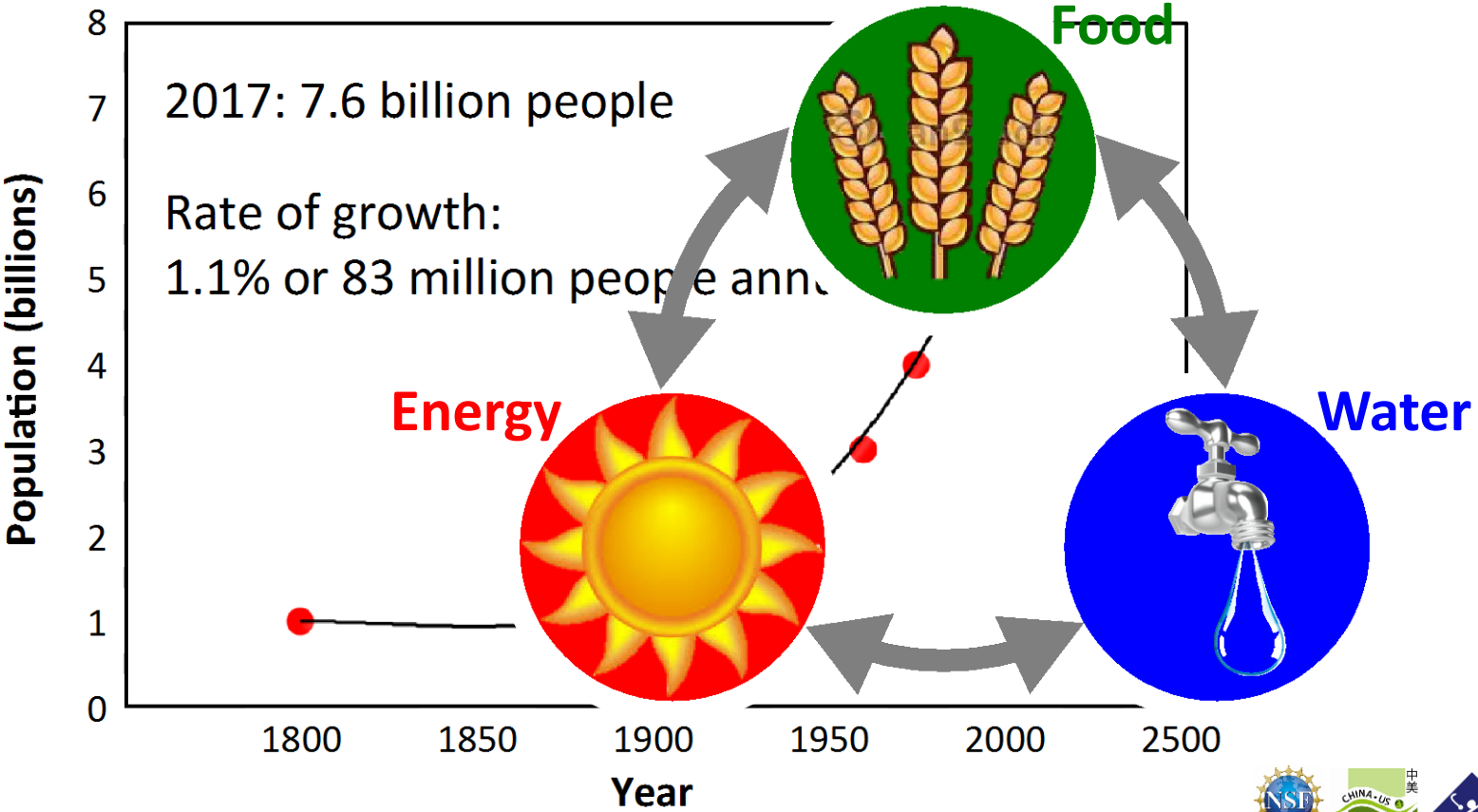
jrceec.utk.edu



The Signature Ceremony of Framework Agreement for "China-US Joint Research Center for Ecosystem and Environmental Changes" July 20, 2006
“中美生态系统与环境变化联合研究中心”框架协议签字仪式



The Global Human Population



The **Food-Energy-Water** Systems (FEWS) Nexus

Nexus:

A connection or series of connections linking two or more things

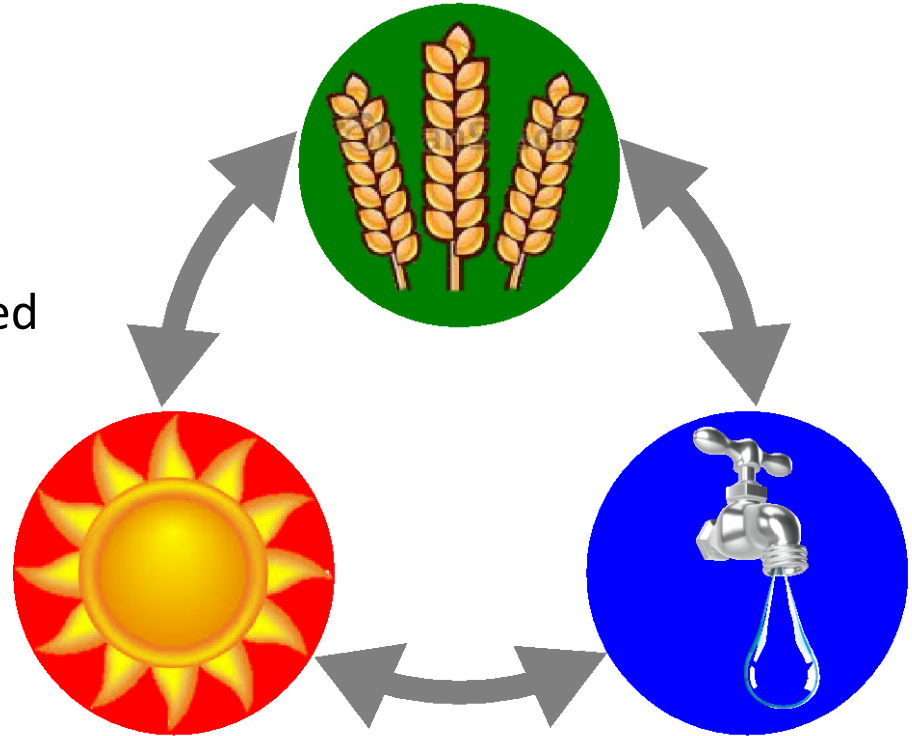
Food, **Energy** & **Water** are inextricably linked

FEWS Nexus:

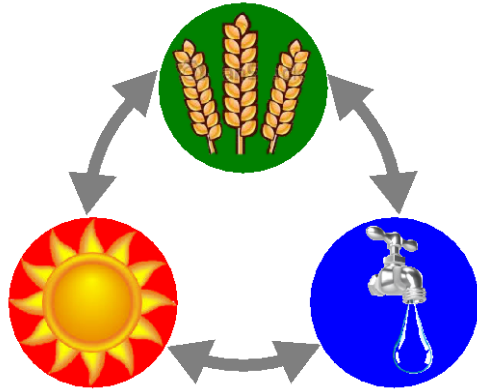
Promoted as a global research agenda

➡ Complicated system

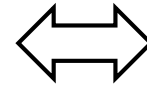
➡ Complex system ?



The **Food**-**Energy**-**Water** Systems (FEWS) Nexus



Policy

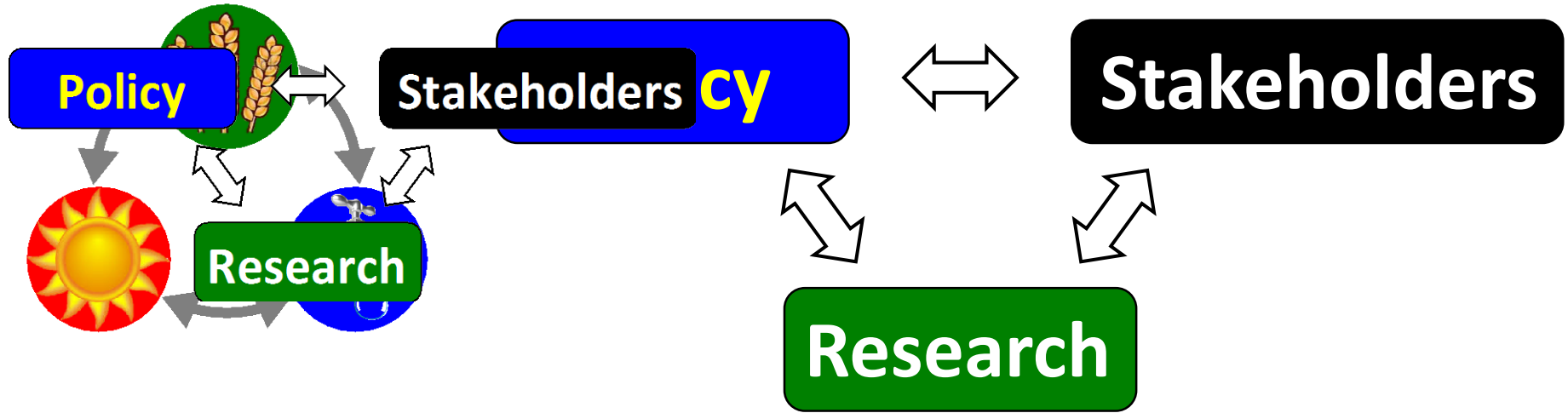


Stakeholders

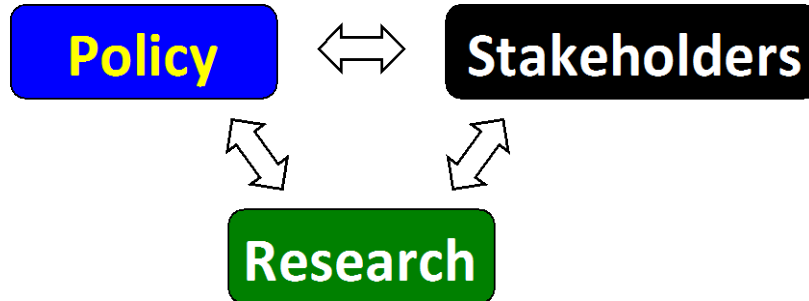


Research

The Food-Energy-Water Systems (FEWS) Nexus



The Food-Energy-Water Systems (FEWS) Nexus



“A lot of talk without concrete outcomes”
Broad-scale, top-down approaches without considering the nexus’ central importance at the local level

Leck et al. 2015, Geography Compass 9/8

What advances are needed?

- Identify nexus grand challenges
- Implement nexus research
- Deliver real world solutions at multiple scales

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N₂-Fixation



- Haber-Bosch process $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$
- Most important man-made reaction (>100 Tg per year)
- 3% of the world's CO₂ emissions
- Consumes 5% of natural gas production
- 15% efficient yield

N-Utilization

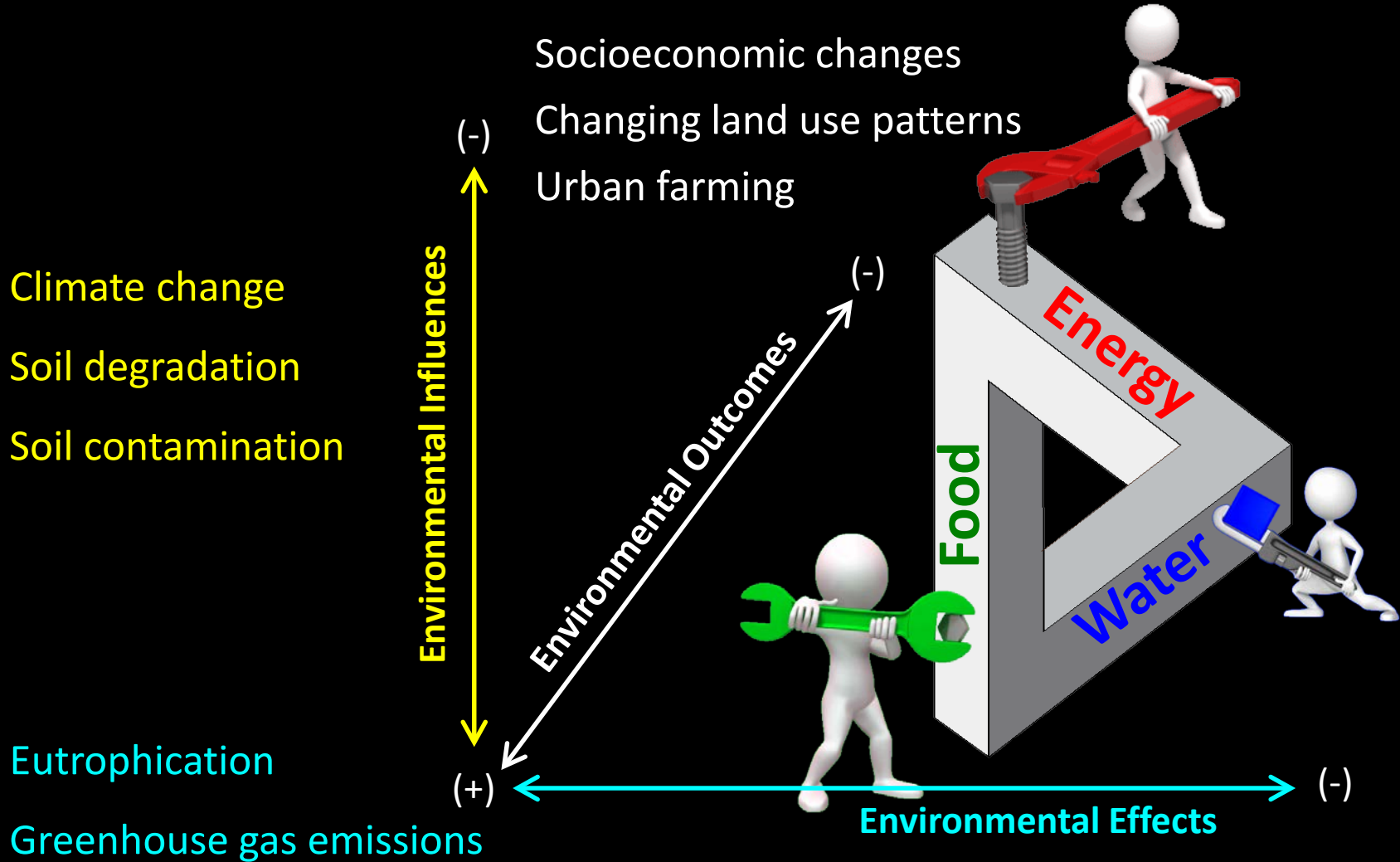


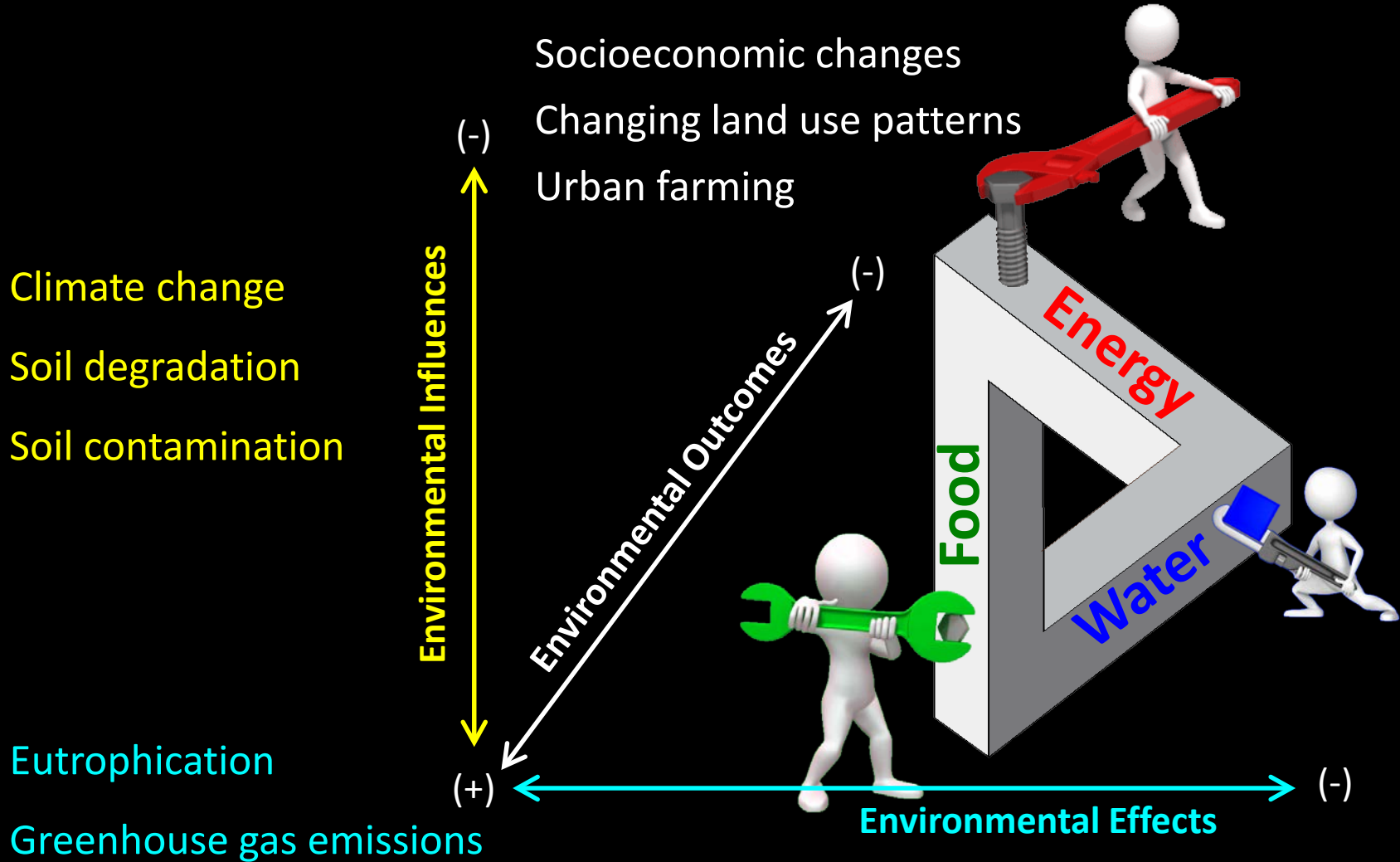
- <20% of fertilizer used by plants (\$200B waste/year)
- Massive pollution for water and air
- Supports 50% of world population
- Major Life Cycle cost of biofuels

Climate Change

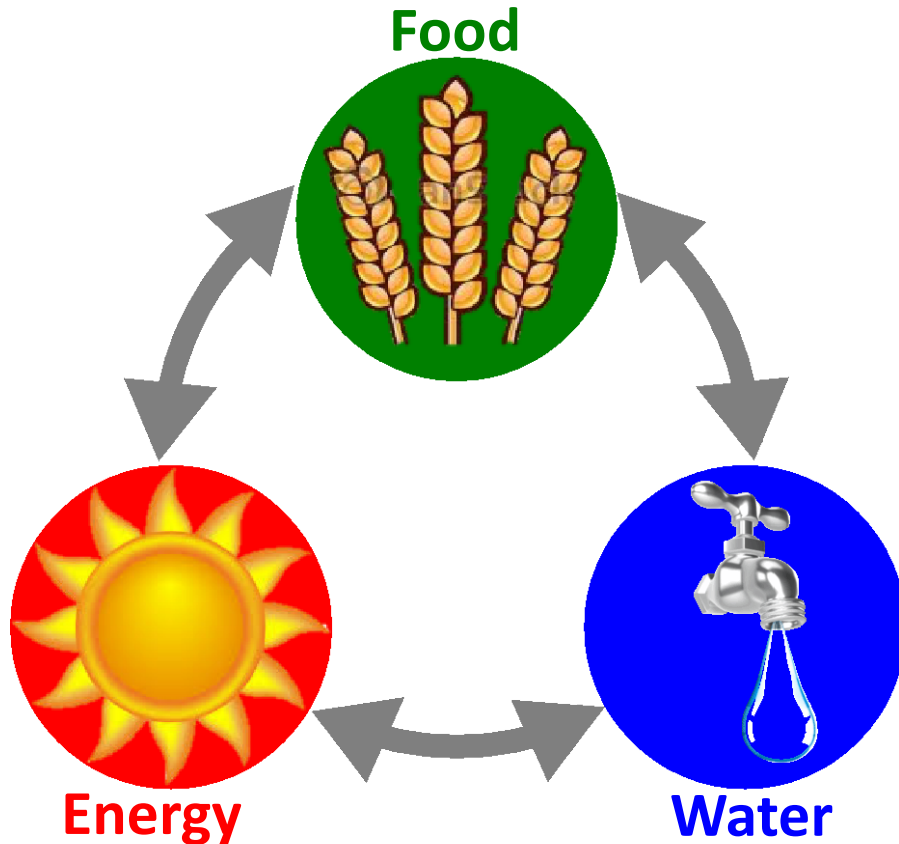


- N₂O emissions are increasing
- Ozone depletion
- Global warming
- Large uncertainty
- Better climate predictions from coupled C-N models





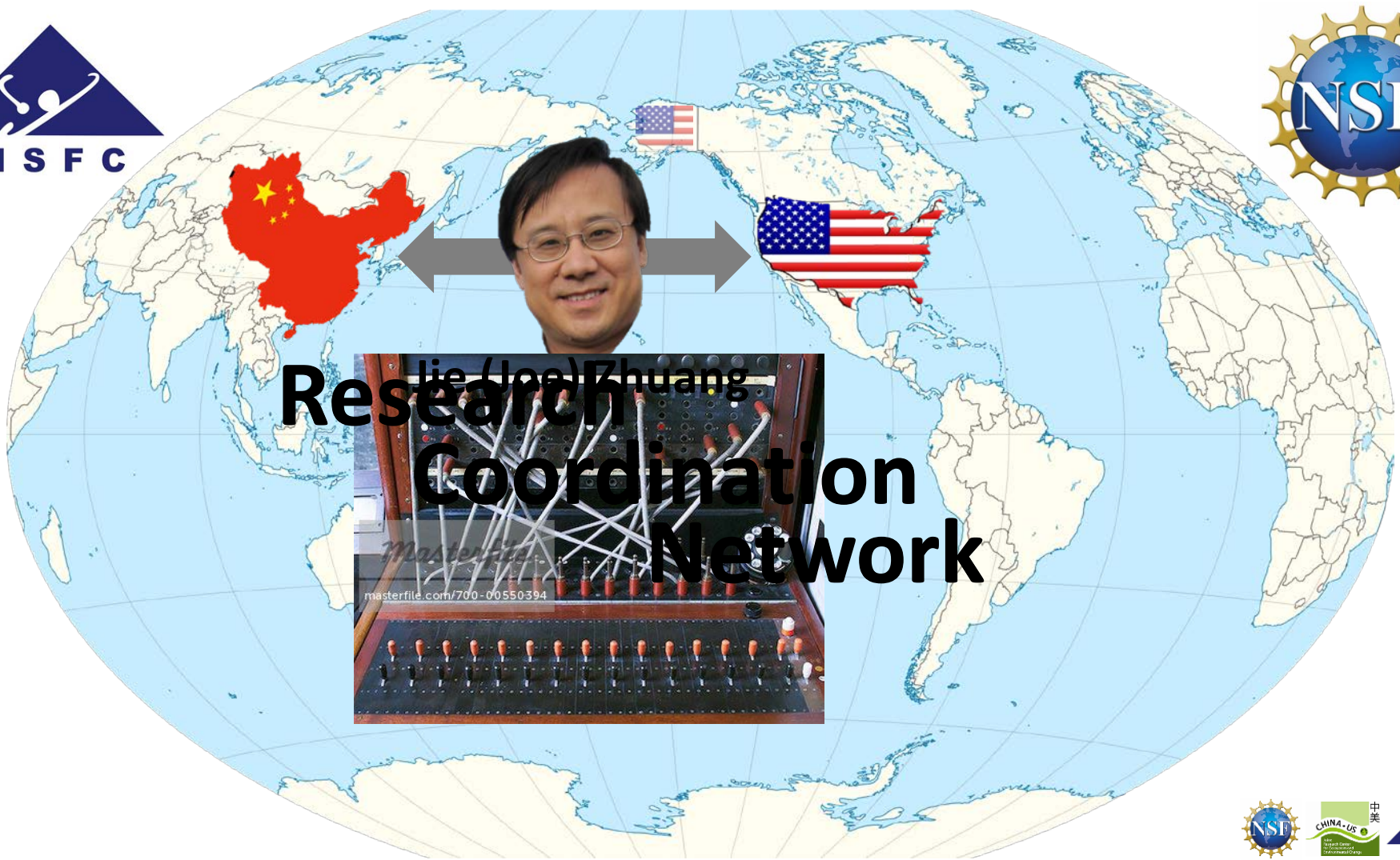
Tackling the FEWS Nexus Grand Challenges



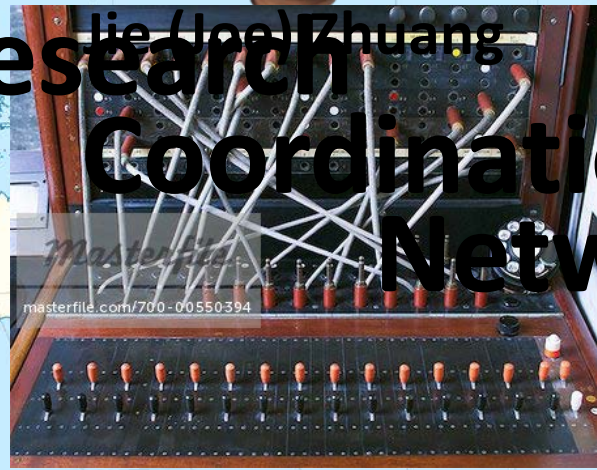
Any approach that focuses narrowly on one part of the FEWS nexus without paying attention to its interconnections risks major unintended consequences.

World Economic Forum (2011)

Integration is critical for productive solutions



Research Coordination Network



masterfile.com/700-00550394



Challenges & Opportunities

Transdisciplinary collaborations

International collaborations

Incompatibility of current institutional structures
(effects on research, student education)

Multiple interdependencies across three sectors (“silos”),
across disciplines and across scales

 **Conduct fundamental research and deliver
engineering solutions**

FEWS

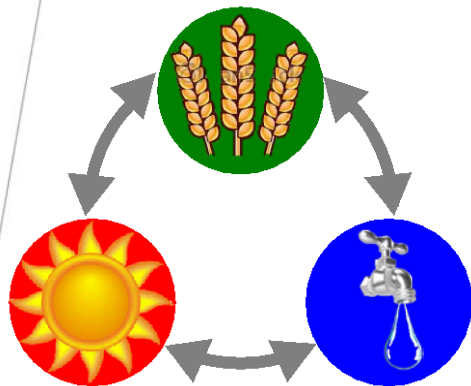
Research Network

US-China Joint
Symposium of the
Nexus of Food, Energy,
and Water Systems

December 6 - 9, 2017

Franklin Marriott Cool Springs,
Nashville, Tennessee, USA

The Food-Energy-Water Systems (FEWS) Research Network is a joint project between the United States and China focused on bringing together transdisciplinary environmental areas to identify and solve future challenges.





FEWESTERN



US-China Food-Energy-Water Systems

Transdisciplinary Environmental Research Network

思想的交流

Exchange of Ideas

合作

Collaborations

合作项目

Joint Projects

革新的方法

Transformative
Solutions

可持续性

Sustainability

健康的环境

Healthy
Environment

满足人们的需
求

Meet the Needs
of the People

持久的合作

Lasting
Collaborations

友好的关系

Friendships

文化交流

Cultural Exchange

Complicated system: The system components are known and interactions between them are understood.

Characteristics: Deterministic, behave in a predictable way, don't have a mind of their own



Boeing 737, which is made up of 367,000 parts

A complex system is a system composed of many components which may interact with each other.

Characteristics: Non-linearity (the change of the output is not proportional to the change of the input), emergent behavior

