Soil and Water Conservation Society (SWCS) is a nonprofit scientific and educational organization -- founded in 1943 -- that serves as an advocate for conservation professionals and for science-based conservation practice, programs, and policy. SWCS has over 5,000 members around the world. They include researchers, administrators, planners, policymakers, technical advisors, teachers, students, farmers, and ranchers. Our members come from nearly every academic discipline and many different public, private, and nonprofit institutions.

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“Conservation Practices to Mitigate and Adapt to Climate Change ”

Soil and Water Conservation Society

Photo NASA


The Soil and Water Conservation Society invited a group of scientists to review the science of conservation practices and their potential for climate change mitigation and adaptation.
Photo USDA
Slide # 3

The 20th century's Green Revolution showed that science-based solutions can provide answers to major global challenges.

Our planet in the 21st century faces a new threat that is among the most severe that civilization has ever faced. Science must again provide solutions (USDA NRCS 2010).

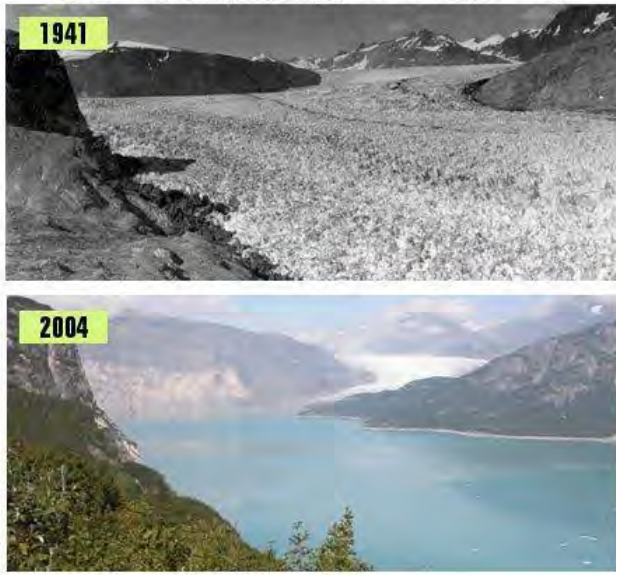
SOIL AND WATER CONSERVATION SOCIETY

Healthy Land
Clean Water
For Life

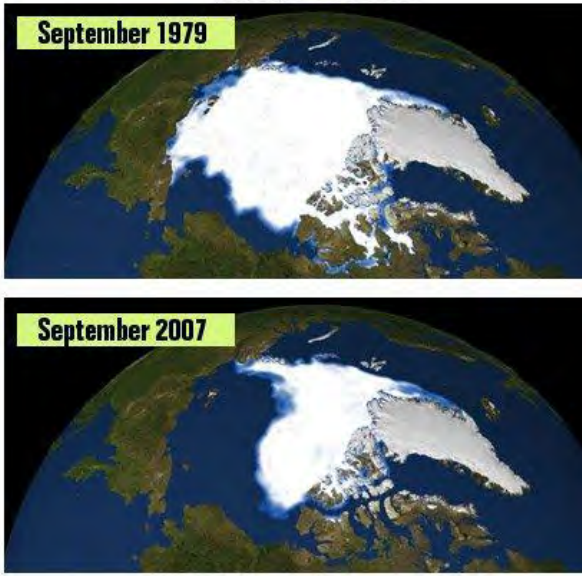
A Major Global Challenge for Soil and Water Conservation

Climate change is real and here now. We must implement sound conservation practices to protect public health, social stability, and security.

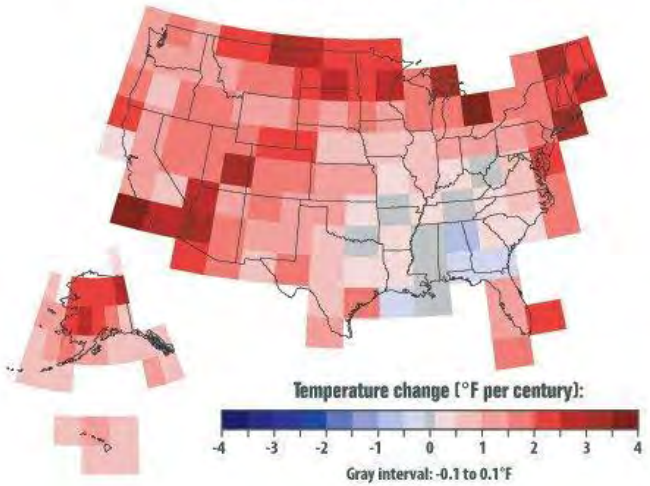
Muir Glacier, Alaska, 1941 and 2004



Arctic Sea Ice



Rate of Temperature Change, 1901–2008



Photos EPA

Extreme weather events, which may become more common, create environmental problems, accelerate the rate of erosion, and threaten agricultural production essential for food security and social stability.

Photo EPA

Photo ARS

Photo NRCS

Climate change increases the potential for higher erosion rates. Erosion can lower agricultural productivity.

Source:

Iowa

NRCS

At risk are key world agroecosystems that rely on irrigation water. Using water faster than it can be replaced, we deplete water resources.

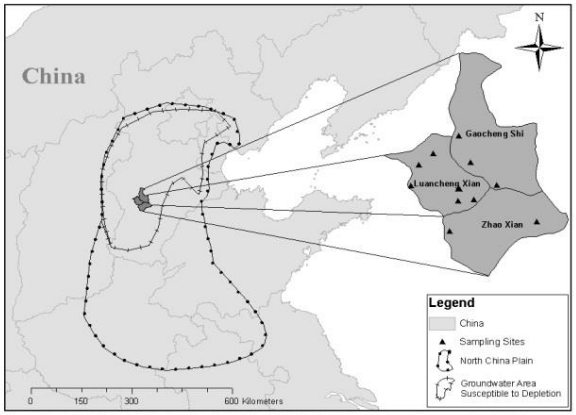
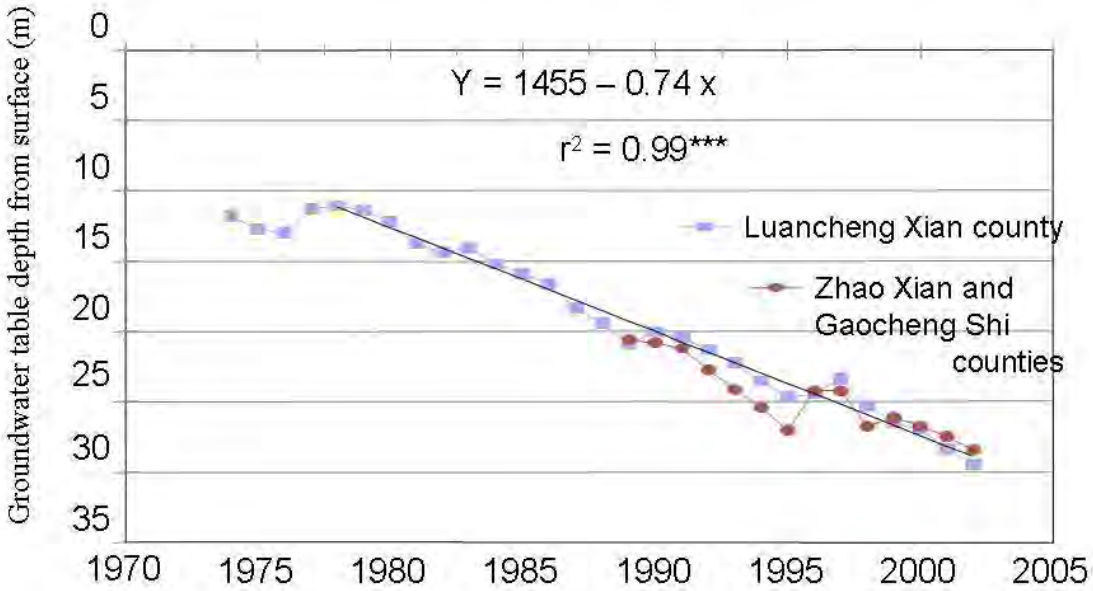
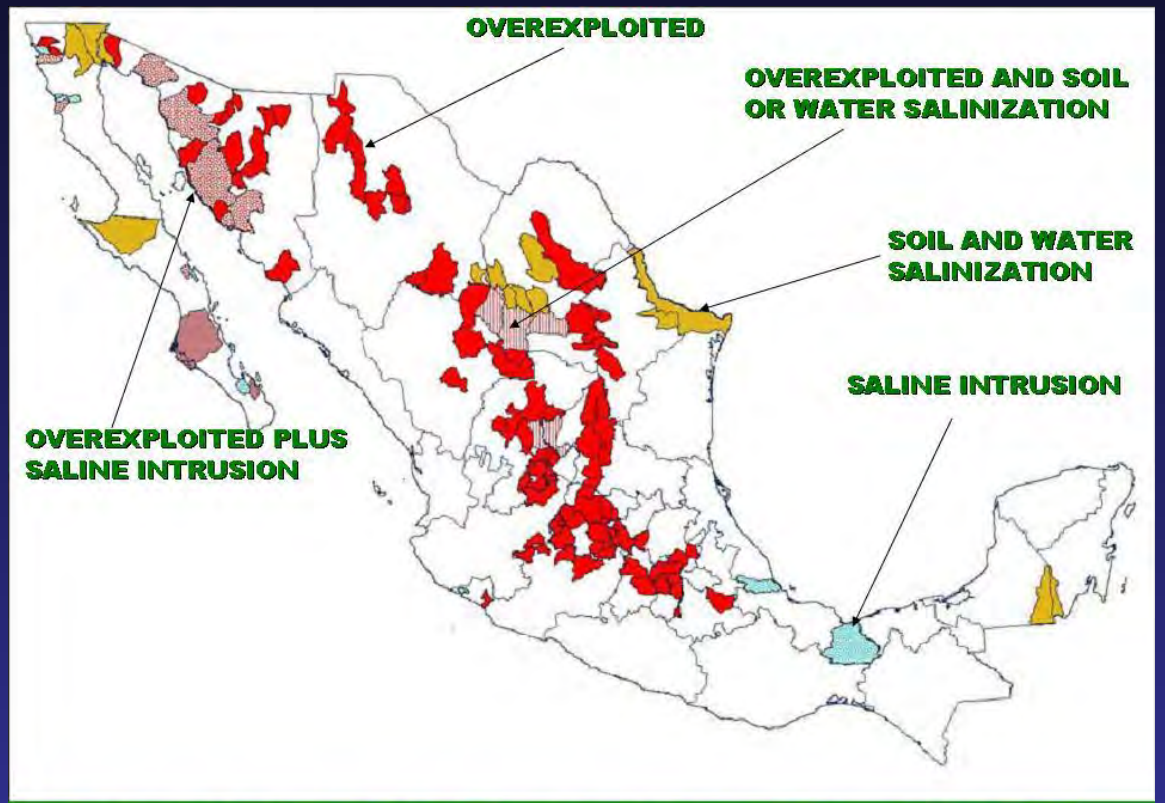


Figure 1. Map layout indicating the location of the North China Plain (NCP) (approximate area); northwestern region of the NCP susceptible to underground water depletion (approximate area); and locations of village study sites within Luancheng Xian, Gao Cheng Shi and Zhao Xian counties. Scale bar not relative to blownup image.



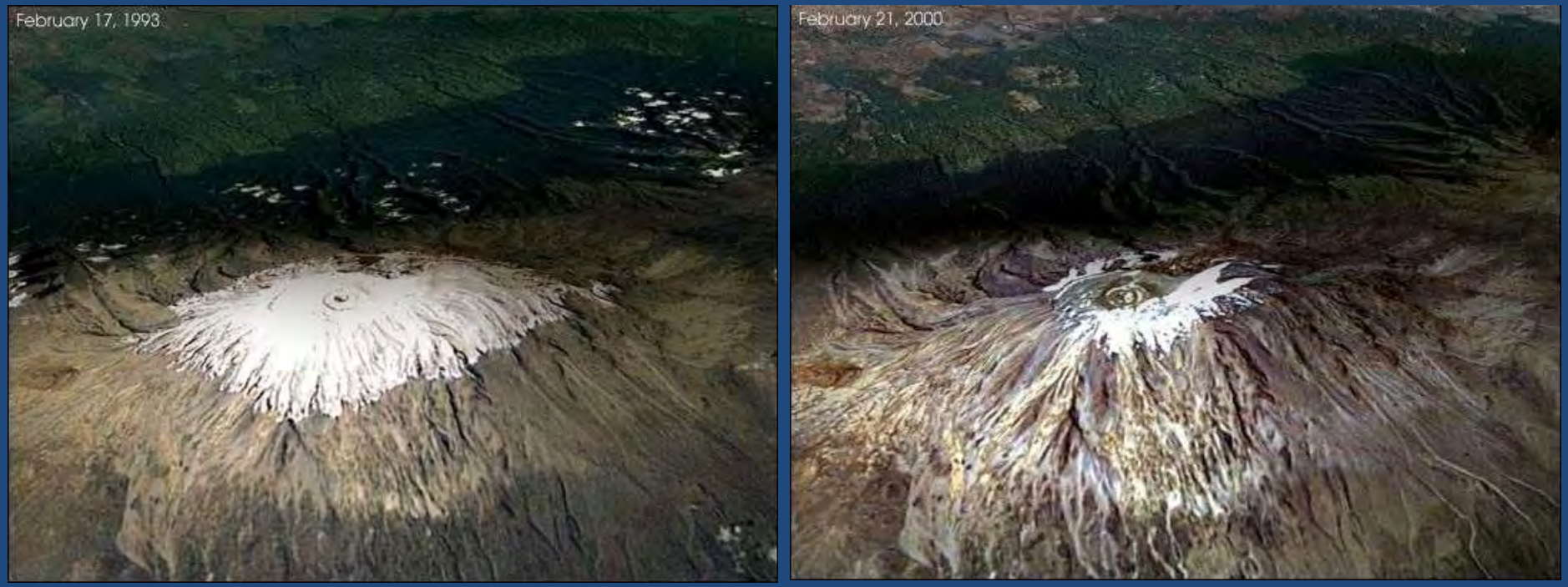
If we deplete and salinize these key world resources, we lose our highest yielding agricultural systems. Irrigated systems have, on average, double the yields of non-irrigated systems. Any yield loss has to be made up elsewhere, further straining agricultural productivity.



Overexploited aquifers, with saline intrusion and/or water salinization (CNA, 2004).

CNA 2004

The melting of glaciers can affect the availability of water for cities and/or irrigated lands.



Kilimanjaro, 1993 - 2000

(Jim Williams, NASA GSFC)

http://earthobservatory.nasa.gov/IOTD/view.php?id=3054

Yields in rainfed systems can also decline. **For every increase in temperature of 1°C** (1.8°F), agricultural yield can decline. **Grain yield falls by 10%**. Not only heat, but also drought stresses crops.

http://www.scientificamerican.com/article.cfm?id=climate-change-impacts-staple-crop-yields

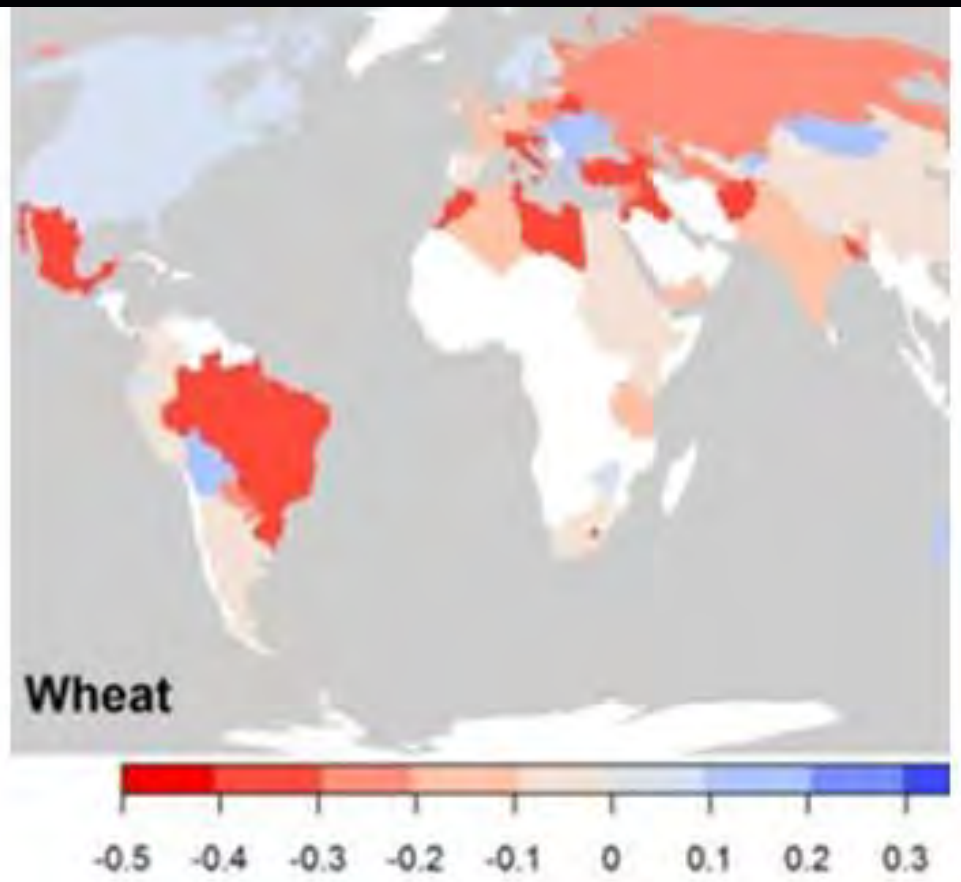
Cereal Killer: Climate Change Stunts Growth of Global Crop Yields

A crop-yield analysis reveals that warming temperatures have already diminished the rate of production growth for major cereal crop harvests during the past three decades

By David Biello | May 5, 2011 | 41

- Across Africa, an increase in temperature of 1°C under drought conditions can affect 100% of the corn crop. Yields can fall by 20% and more.

- Wheat yields are affected around the globe, see figure on right.



HEAT ON WHEAT: Rising temperatures are depressing yields of wheat, as pictured here, offsetting gains from improved farming practices
Image: Courtesy of AAAS/Science

http://www.scientificamerican.com/article.cfm?id=climate-change-impacts-staple-crop-yields

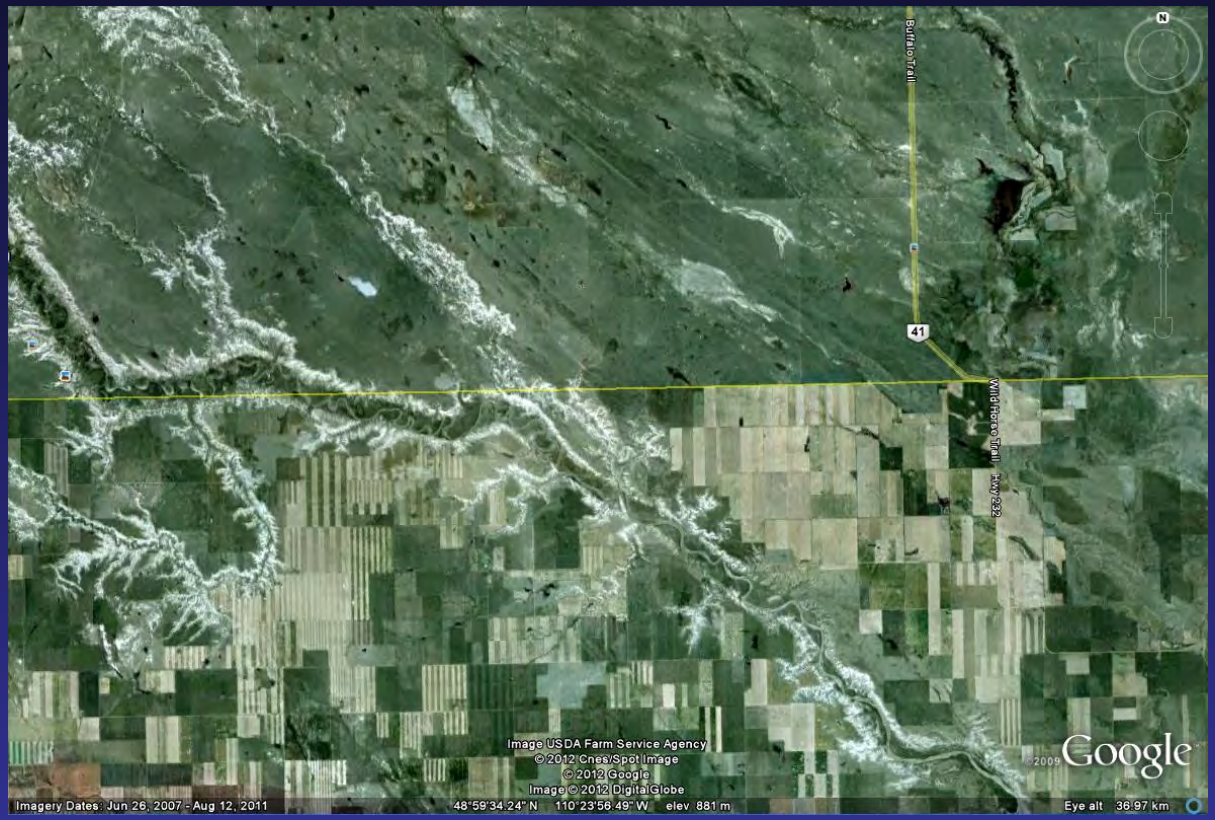
By 2050, the world will add 2.4 billion people. Widespread growth in developing economies puts more pressure on the world's agricultural systems. The combined impact of climate change and increased demand on resources threatens food security.

Photo credits – T. Goddard, SWCS Canada

Rising energy costs adversely affect higher yields by raising the cost to farmers of key fertilizer and agrochemical inputs.

Photo credits – T. Goddard, SWCS Canada

Deforestation, soil erosion, depletion of water resources, and other environmental problems threaten both agricultural productivity and the ecosystem services upon which people depend.



Slide # 16

Satellite image of contrasting land use along Canada-USA border (Alberta/Montana)

Extreme events, such as droughts, floods, or even extreme pest or disease outbreaks (e.g., blight, a potato disease that contributed to the infamous potato famine in Ireland) will test the resilience of our systems.

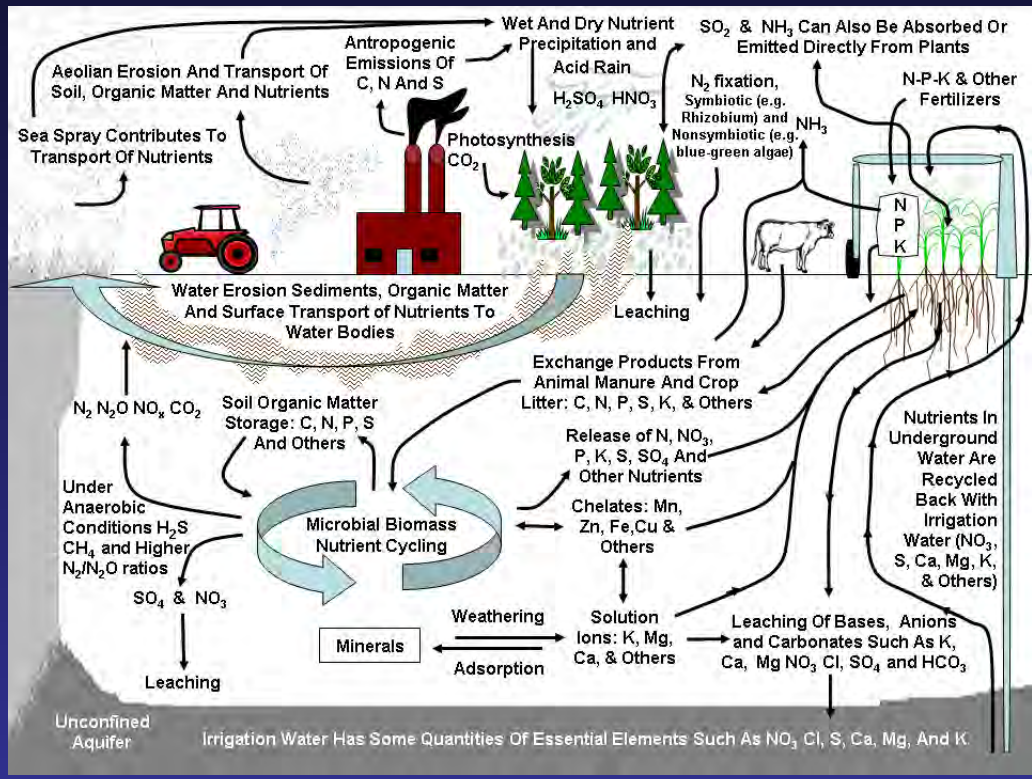
Source - UNEP

http://calclimateag.org/crop-insurance-reform-must-reflect-climate-realities/

The Carbon and Nitrogen Cycles and Agricultural Contribution to Greenhouse Gases

Greenhouse Gases Contributed by Agriculture are an Important Factor in Climate Change.

Agriculture plays an important role in the GHG fluxes of carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4), contributing 6% of total United States GHG emissions (USEPA 2010b).



Soil and Water Conservation Principles Applied to Climate Change Mitigation and Adaptation

Principles for Communication of Soil and Water Conservation Programs

- Teach the Value of Soil Carbon.

Increasing soil carbon (C) benefits soil and water quality.

Conservationists, farmers, policy advisors, K-12 and university students—in short, the general public—should understand how soil carbon helps mitigate climate change and adapt to climate change.

http://www2.ed.gov/programs/green-ribbon-schools/index.html

Source US Department of Education – Add Value of Carbon to Green Ribbon School Overview

PILLAR ONE: Net zero environmental impact

Element 1A: **Reduced or eliminated greenhouse gas (GHG) emissions**

Element 1B: Improved water quality, efficiency, and conservation

Element 1C: Reduced waste production

Element 1D: Use of alternative transportation to, during, and from school

- Develop Communication that Connects Science to Land Managers

-Better communication with farmers and farmers' groups is key.

http://www.ctic.org/Partners%20Magazine/2011/October/57/

- Develop Communication that Connects Science to the Public

-Better communication with the general public is essential to increasing awareness of the benefits of soil and water conservation

ARS

- Improve Historical Context

-Long-term data records, programs, and studies are important for developing conservation programs that contribute to climate change mitigation and adaptation.

http://www.illinoishistory.gov/TOC1203IH.htm

http://www.agclassroom.org/gan/timeline/ag_edu.htm

- Ongoing Training Essential

-Education programs and the mentoring of new personnel are important for maintaining an educated workforce.

Slide # 25

http://polycentric.csupomona.edu/news_stories/2011/04/history-symposium-agriculture-environment-relationships.html

- Enhance Exchange

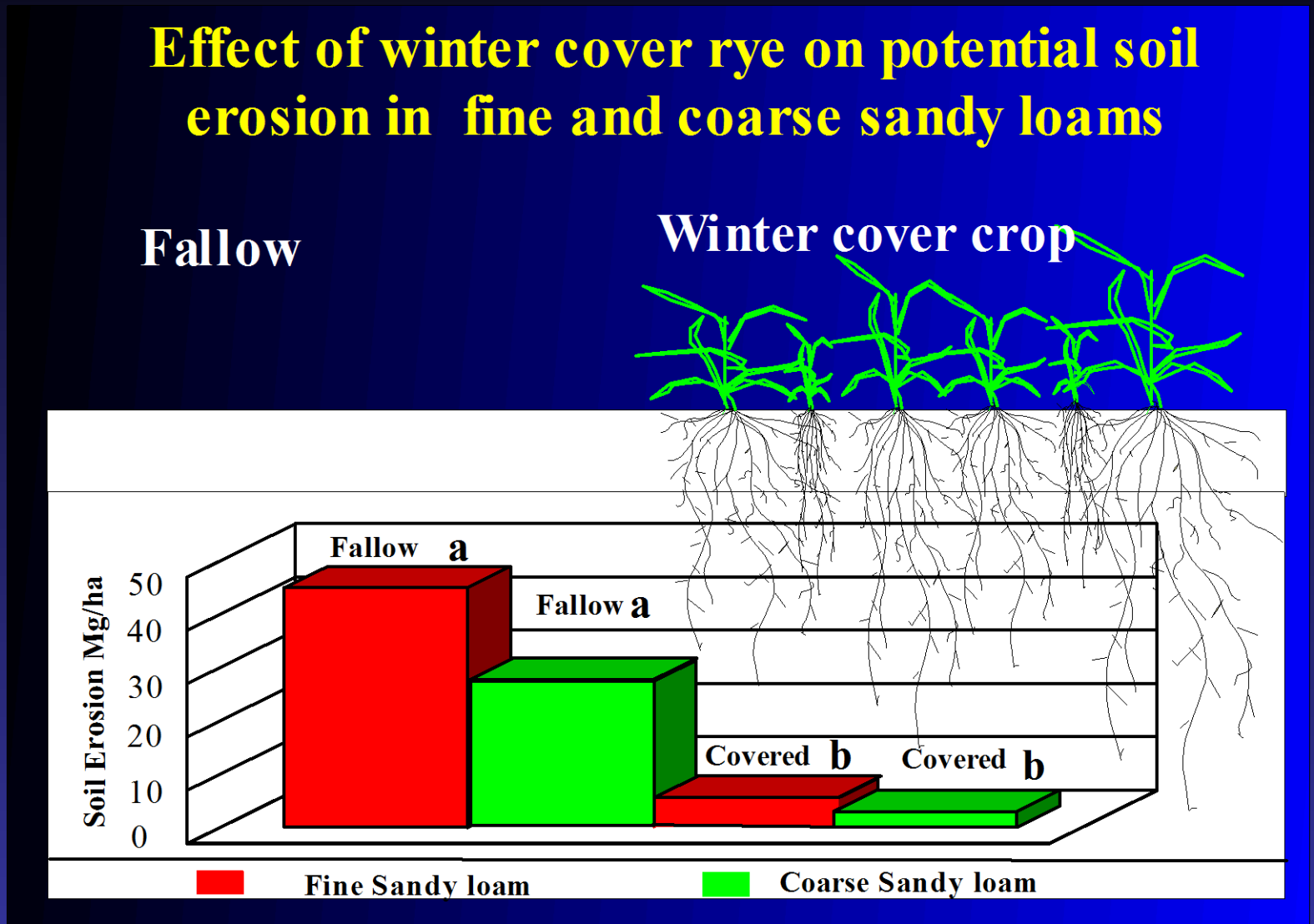
  -We need forums for exchanging information among farmers, professional societies, scientists, conservation practitioners, and the general public and for discussing the advantages and disadvantages of recent advances to continue advancing the field of soil and water conservation. Through information exchanges, we learn what works for mitigation of and adaptation to climate change.

Soil and Water Conservation Principles Applied to Climate Change Mitigation and Adaptation

Principles for Soil and Water Conservation Practices for Climate Change Mitigation and Adaptation

- Cover the Surface

  -Harvesting of plant residues should be avoided if soil function will be compromised.



- Soil Function Improves with Soil Carbon (Organic Matter)
  -Soil C sequestration is beneficial for the environment.

- **Potential Use of Cover Crops for potato systems**
- **Rotations with deeper rooted crops**

- Surface Residue Protects

-Conservation agriculture increases sustainability.

- Value Perennial Crops

  -Perennial bioenergy crops (e.g., switchgrass) can contribute to C sequestration and protect the environment better than the growing of grain crops used for energy.

http://www.ars.usda.gov/Research/docs.htm?docid=16619

- Off-Field Remediation Practices Help

-Off-the-field conservation practices can contribute to climate change mitigation and adaptation (e.g., riparian forest buffer, wetland).

- Improve Landscape Diversity with Agroforestry

  -Agroforestry can contribute to landscape diversity, benefiting the environment.

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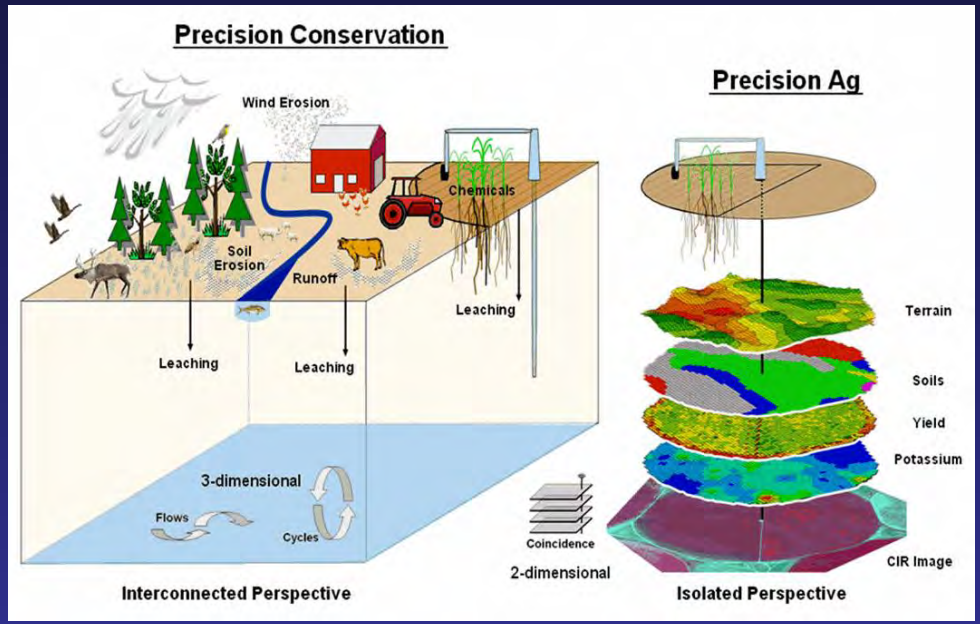
- Enhance Effectiveness with Landscape-Targeting Precision Conservation

  -We need to account for spatial and temporal variability and avoid a one-size-fits-all approach if we are to maximize conservation.



- Value Water Appropriately

-Water-use efficiency needs to be increased, and water quality needs to be protected.

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- Diversify Crops and Crop Varieties

-Diverse cropping systems will be key to mitigating and adapting to climate change. We need to develop new varieties that can be used for tolerance of drought, temperature stress, and other effects of climate change.

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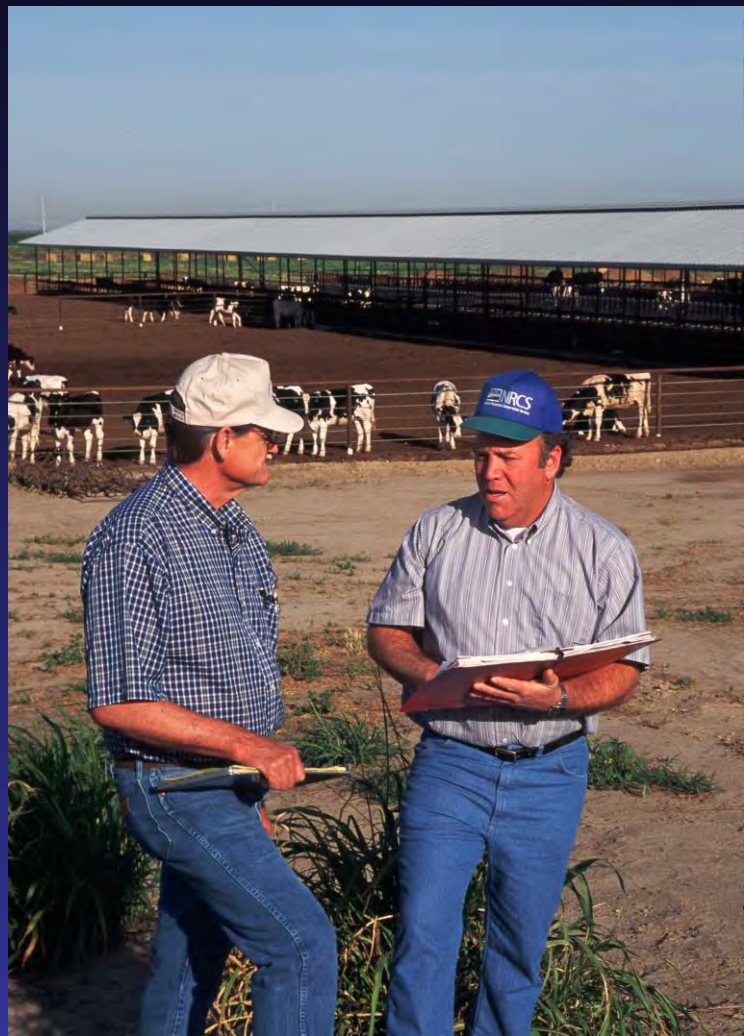
- Reduce Greenhouse Gas Losses

  -Practices that can reduce emissions of carbon dioxide (CO_2), nitrous oxide (N_2O), and other greenhouse gases at the farm contribute to sustainability.

- “Tighten” Nutrient Cycles

-Practices that can capture nutrients and energy from manure contribute to conservation. Cycling of crop residues, use of cover crops, and increasing fertilizer-use efficiencies are some examples of ways to contribute to tighter nutrient cycles.



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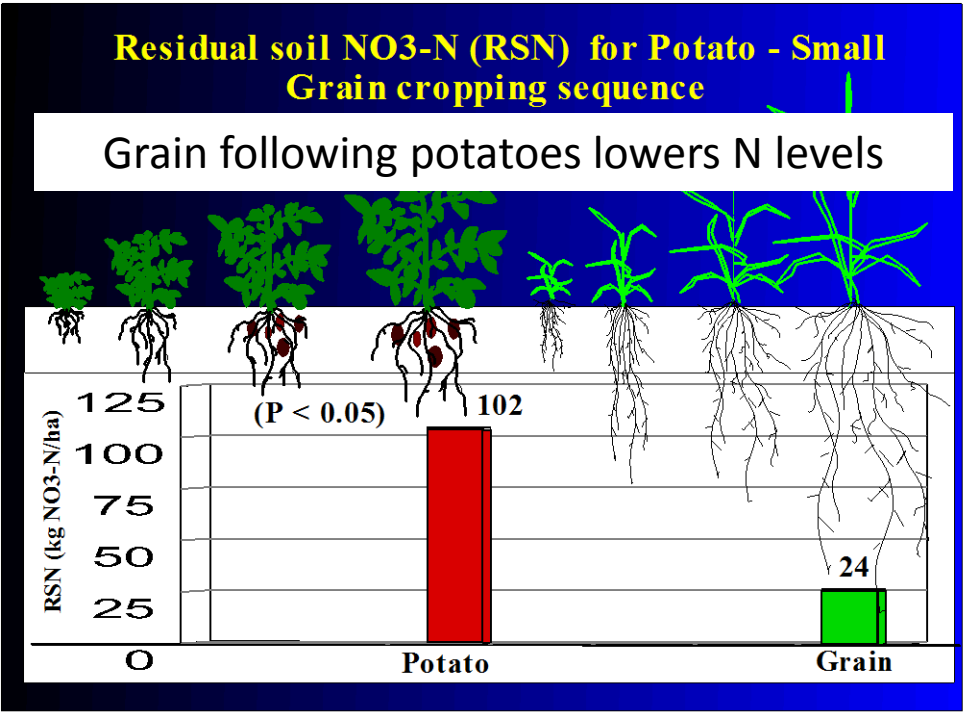
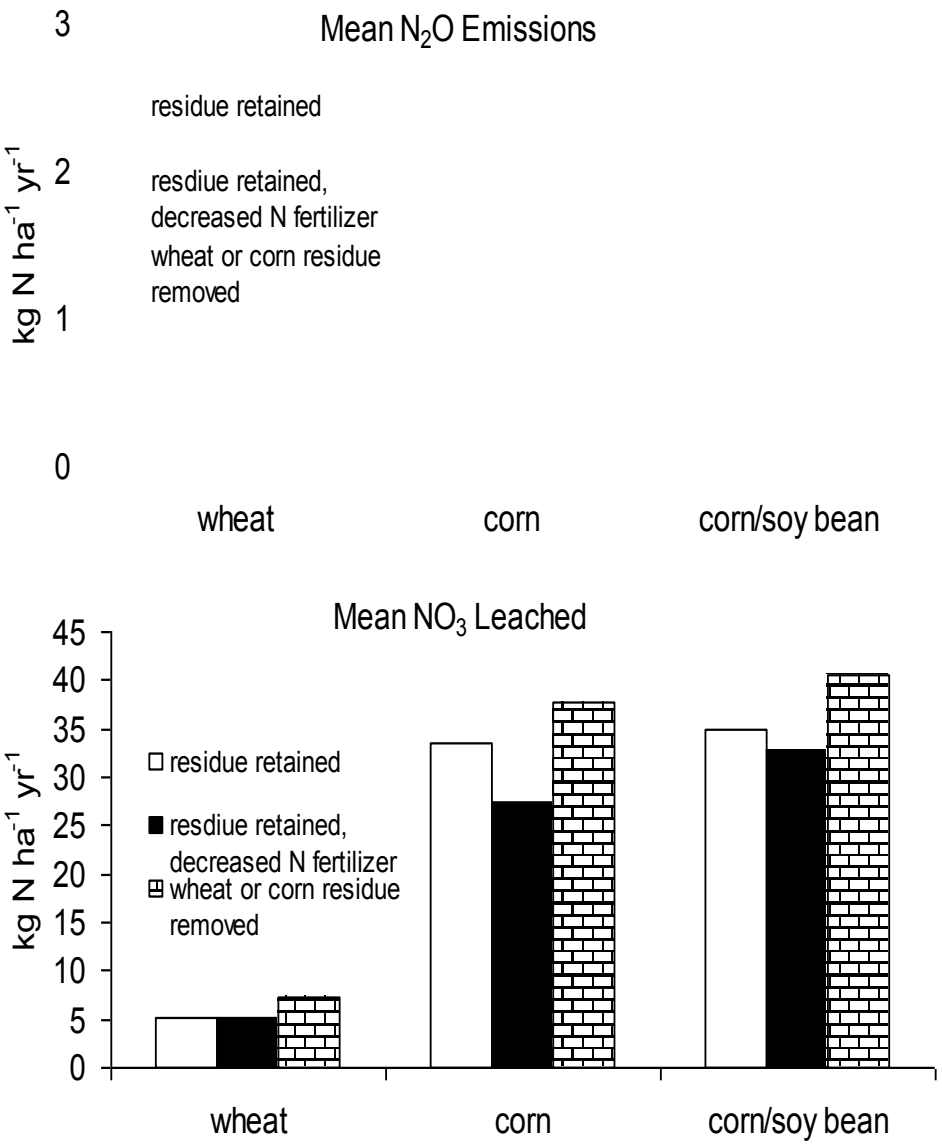
Need for agronomic expe systems can reduce soil nutrier





Soil and Water Conservation Principles Applied to Climate Change Mitigation and Adaptation

Principles for Developing New Science and Technologies

- Research Pays Dividends over the Long Term.

  -Research programs greatly contribute to soil and water conservation, making them important for both mitigating climate change and adapting to it.

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Current Mitigation and Adaptation Efforts and Findings From Research

❖ More needs to be done to prepare for climate change, i.e., adaptation.

Agriculture may be the most resilient or adaptable sector to climate change as crops, livestock, and fish have relatively short life spans. This short cycle allows farmers to try new types, genetics, or management practices of crops to suit changing conditions.

Some work has already been done towards developing drought-tolerant crops and increasing water-use efficiency and nutrient cycle efficiency.

We need research that follows both climate and natural resource trends (monitoring) over a longer term as well as research in conservation practices for mitigating and adapting.

Examples of Mitigation Strategies for Agricultural Production

1. Increasing soil C to improve soil functions.
2. Capturing nutrients and energy from manure, crop residue, and cover crop management (close the nutrient cycles).
3. Using more efficient power sources and renewable energy (more efficient tractors, green power).

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4. Reducing methane emissions from ruminants with feeding management, use of edible oils, and other practices.
5. Using slow-release N fertilizers with proper timing, placement, and rates to minimize N2O emissions.
6. Increasing N-use efficiencies for cropping systems.

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Examples of Soil and Water Adaptation Needs for Climate Change

1. Erosion prevention and protection from extreme weather events, which may become more damaging in the future.

2. Irrigation infrastructure to reduce water losses and increase irrigation efficiencies.

3. More diverse cropping systems to adapt to variable climates and new pest and disease pressures.

4. Development of crop varieties that are drought-tolerant and more resistant to heat stress, with higher N-use efficiencies.

5. Improvements in the synchronizing of planting and harvesting operations with shifts in the hydrologic cycle (rainy season).

6. Management of soil and crops to increase water-use efficiencies.

7. Valuating agricultural commodities for their water footprint or environmental traits.

8. Increasing soil C sequestration to improve soil functions.

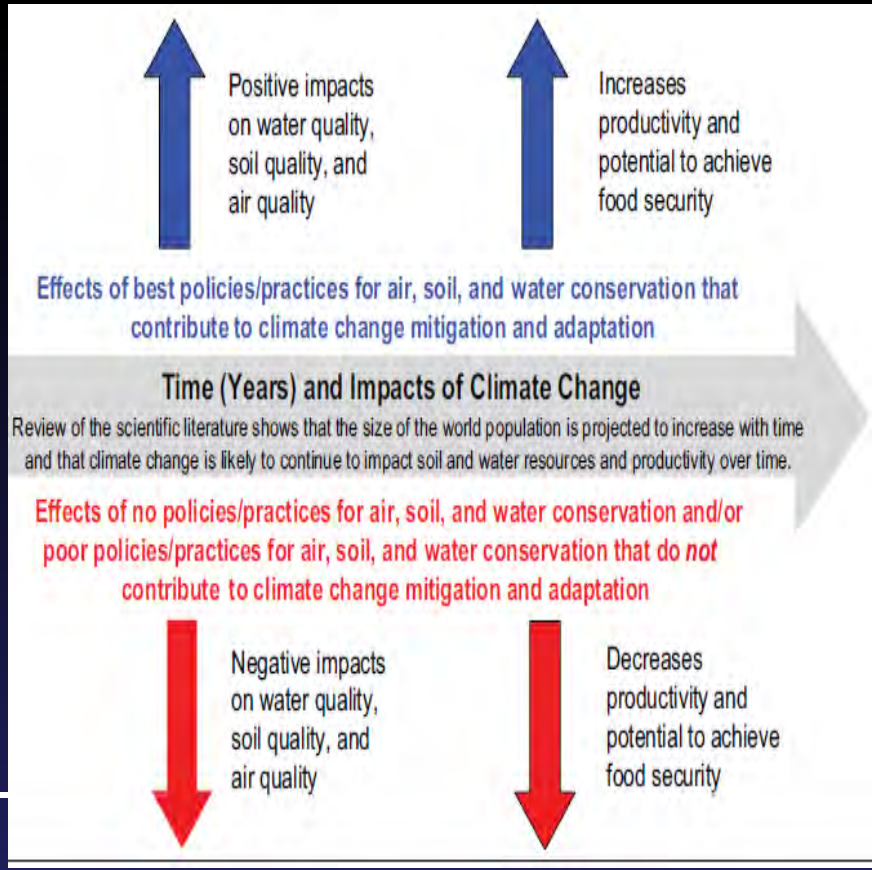
9. Increasing N-use efficiencies for cropping systems.

10. Applying the concepts of precision/target conservation to increase conservation effectiveness across spatial and temporal variability.

Conclusion

In this presentation, we reviewed the science of conservation and climate change. Although there is no silver bullet to address every site-specific situation, the scientific literature tells us that there are practices/systems that will help in many situations. We need more research. We need to do better transferring/disseminating information. And we need to implement conservation programs that integrate systems that maximize agricultural productivity with conservation systems that help us mitigate climate change and/or adapt to it.

The scientific literature argues that, with good policies, conservation programs, and practices, we can achieve food security (good air, soil and water quality). The alternative--business as usual--is lower air, soil, and water quality and ever greater food insecurity and associated social instability.



A Few Points on the Link between Climate Change and National Security:

The Department of Defense has identified Climate Change as an important security topic. See quote below and link

"Climate change and energy are two key issues that will play a significant role in shaping the future security environment."

http://www.defense.gov/qdr/QDR%20as%20of%2029JAN10%201600.pdf

USA Central Intelligence Agency (**CIA**)
https://www.cia.gov/news-information/press-releases-statements/center-on-climate-change-and-national-security.html

Among several other additional readings see the following links

- http://www.ens-newswire.com/ens/apr2007/2007-04-16-05.asp
- http://image.guardian.co.uk/sys-files/Environment/documents/2011/03/10/PrepubAllClimateChange110218.pdf

Conclusion – an additional thought

Hugh Hammond Bennett stated, “From every conceivable angle—economic, social, cultural, public health, national defense—conservation of natural resources is an objective on which all should agree.”

This statement applies, too, to the implementation of practices that conserve our soil and water while mitigating and adapting to climate change.

"Conservation Practices to Mitigate and Adapt to Climate Change "

Additional information about this slide show is available at the SWCS website (http://www.swcs.org/) and also published in the *Journal of Soil and Water (JSWC) Conservation* (http://www.jswconline.org/).

Photo NASA

Go to the following links by right clicking and opening the hyperlink at:

- SWCS Press Release
- SWCS Position Statement
- JSWC Viewpoint article
- JSWC Feature
- JSWC Research Editorial

Additional Information/Final Comments

All of this information is available at the SWCS website (http://www.swcs.org/) and also published in the *Journal of Soil and Water Conservation* (http://www.jswconline.org/).

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