Wisconsin Fertilizer, Aglime, & Pest Management Conference
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Overview of Soil Quality *for* *Sustaining Earth & Its People*

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Technological Revolutions in 20th Century Agriculture

- Mechanization, turn of the Century
- Chemical & Energy Intensification

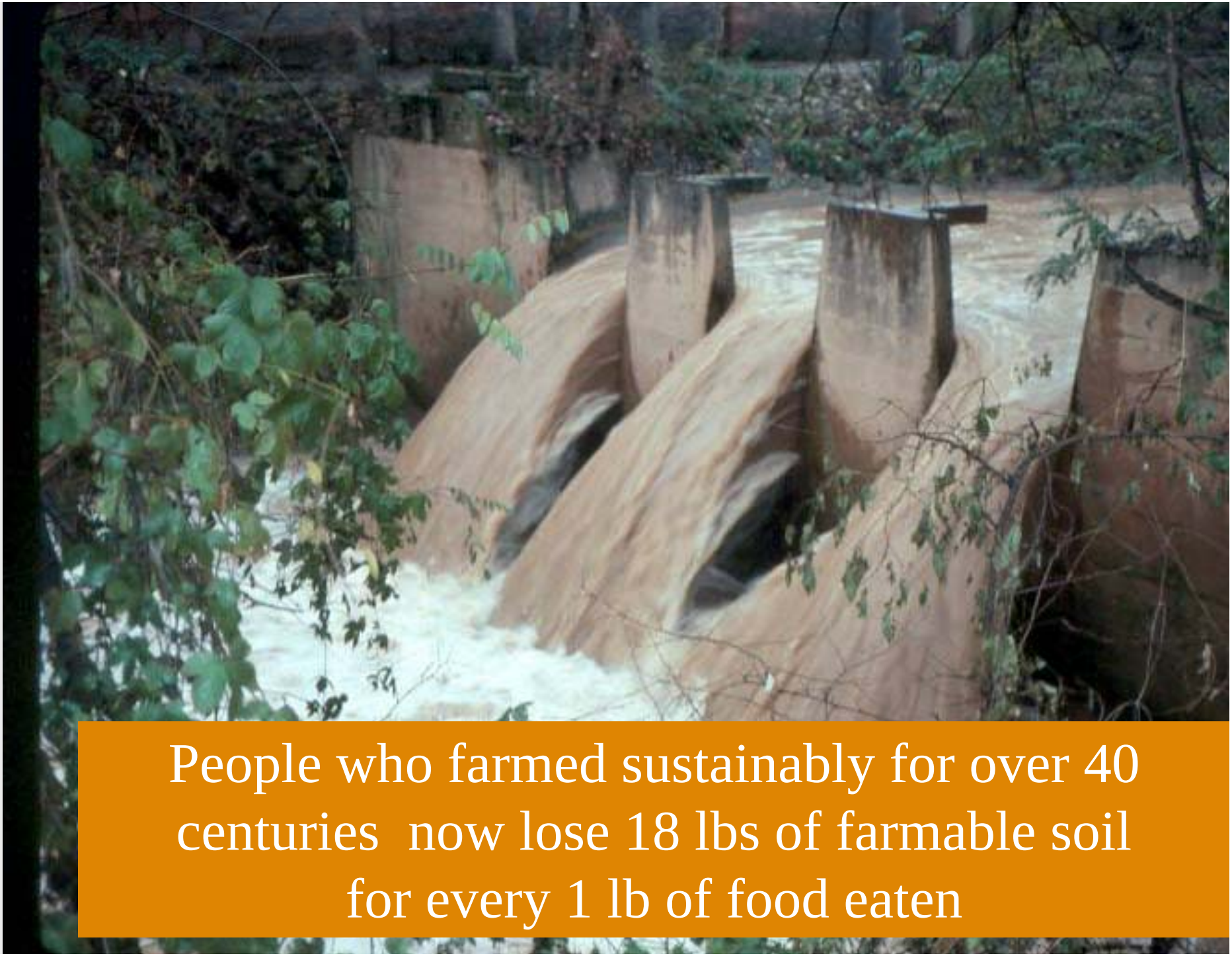
  1940's to 1950's
- Information Technologies Develop
- Return to Biological basics, last

2-3 fold grain yield increases from industrial agriculture have come at a fairly high cost and always subsidized by oil

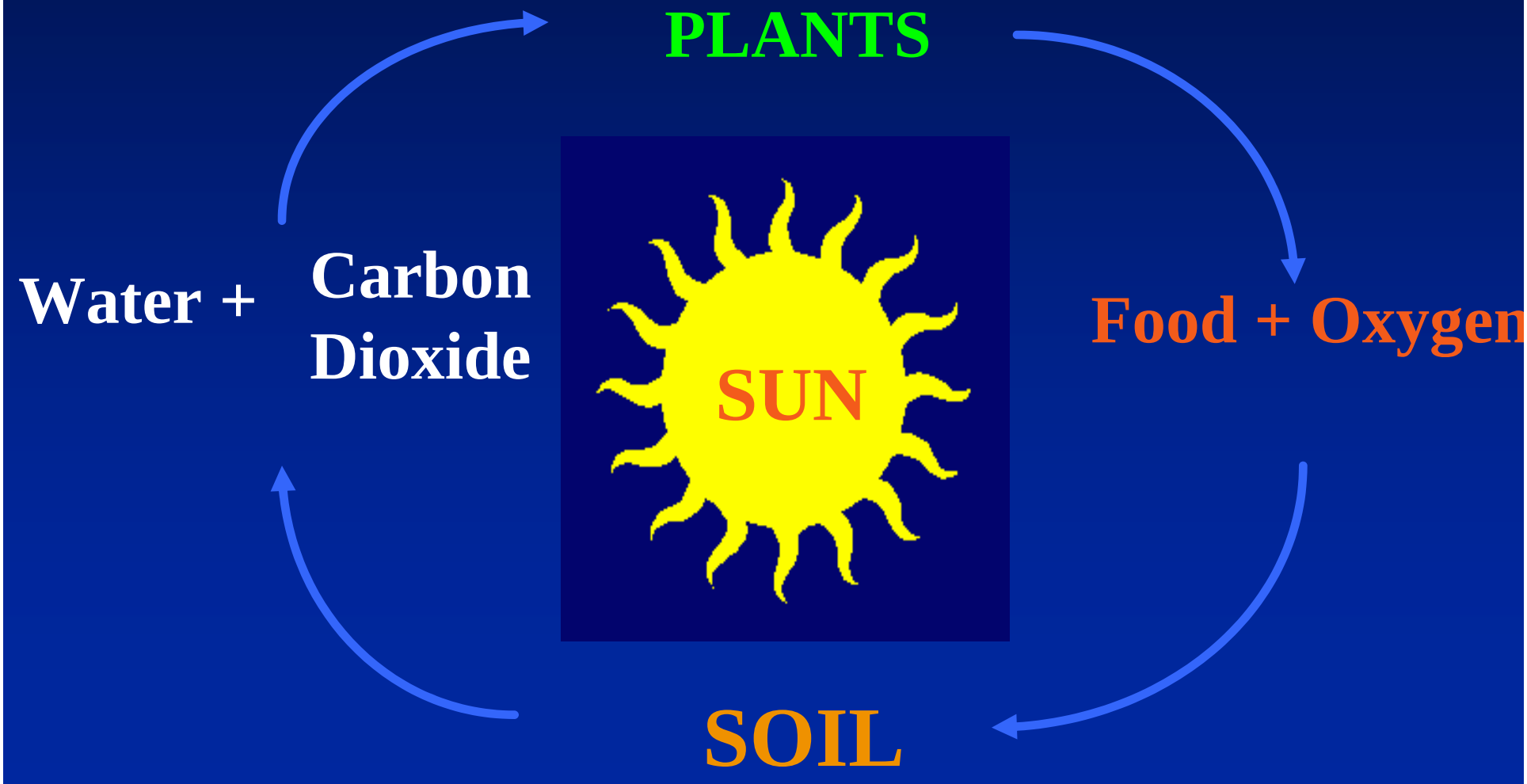
Green revolution scientists shocked to discover that feeding the world could impair the environment

For the first time since the dawn of civilization we now have the technological capacity to change the global environment

Sustaining Earth and Its People


People who farmed sustainably for over 40 centuries now lose 18 lbs of farmable soil for every 1 lb of food eaten

SOIL : An Essential Link in the Cycle of Life



SOIL HEALTH
is the FITNESS to SUSTAIN LIFE
through ***soil function*** as a

- *Medium* for plant growth & biological activity
- *Regulator of Water* flow and storage in biosphere
- *Living Reactor* to filter, buffer, and recycle nutrients & chemicals
- *Primary Interface* with the global environment

THREATS to SUSTAINING EARTH & ITS PEOPLE

POVERTY- - - - - of Affluence - - - - - WAR

- **Population Growth**

Adequate *Food* and *Standard of Living*

- **Fossil Fuel Dependence**

$ and environmental *Costs*

ENVIRONMENT ***HEALTH/AIDS***

“Worldwide changes are transforming American agriculture into an endeavor focused not only on *efficient food and fiber production* but also on delivering

improved public health, social well-being, and a sound environment”

(FRONTIERS IN AGRICULTURAL RESEARCH: Food, Health, Environment, and Community, NRC, NAS, Washington, D.C.2002)

SUSTAINABLE AGRICULTURE

An agriculture that can EVOLVE toward:

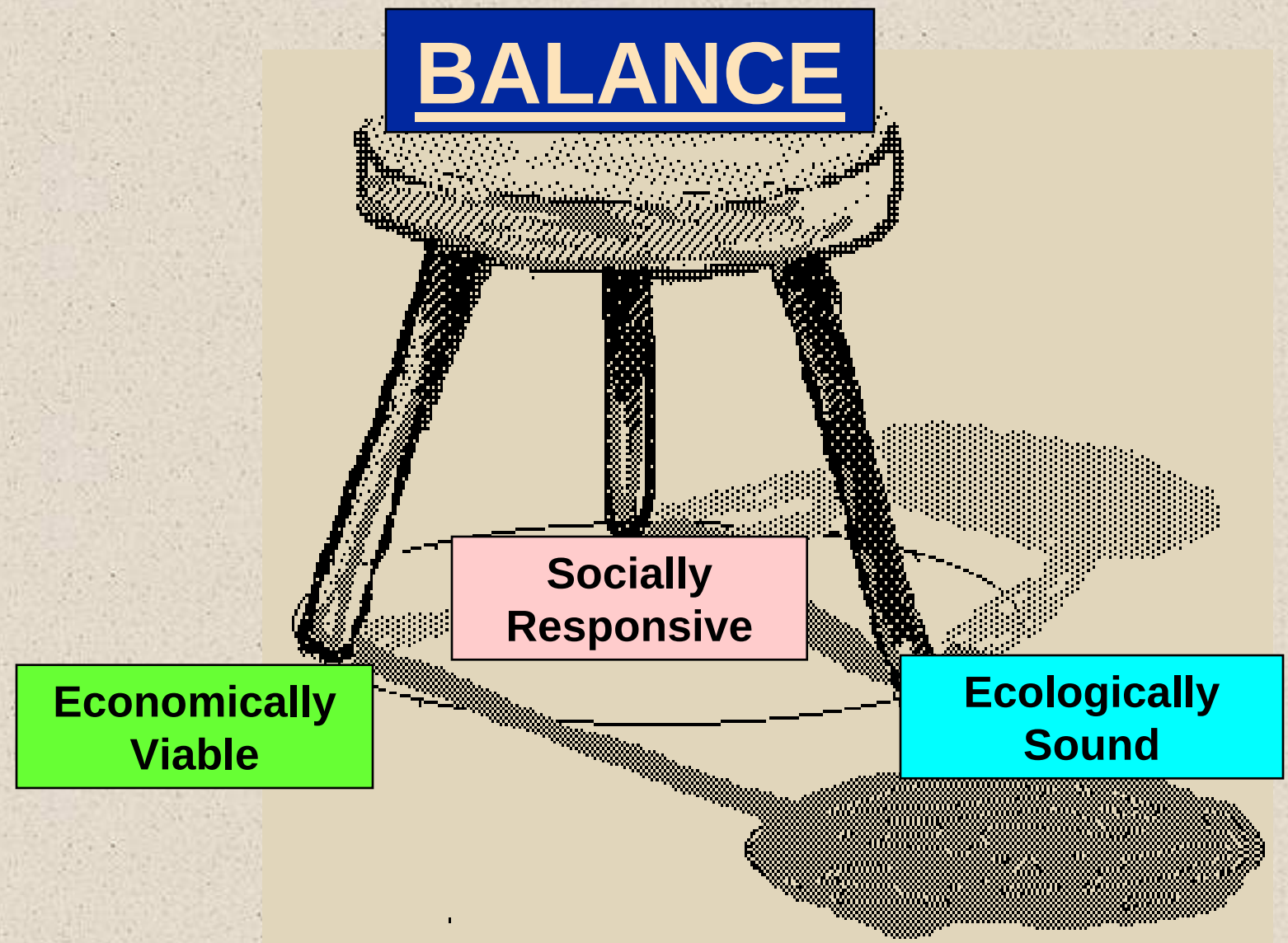
- Greater human UTILITY
- Greater EFFICIENCY of RESOURCE use
- Favorable BALANCE with the ENVIRONMENT

(Richard Harwood, MSU, 1990)

“Sustainable Agriculture -
Sustains the People
& Preserves the Land”

(Tom Frantzen - Iowa Farmer)

Agricultural Sustainability, A Three-legged Stool



Renewable Agriculture & Food Systems

Agroecology – Biological Basics

Approaches to Sustainability

- Giving Value to Soil Health
- Using SQ as a Sustainability Indicator
  NOT an End in Itself

Soil Quality as an Indicator of Sustainable Agriculture

STRATEGY

Conservation Farming

- Crop rotations
- Residue management
- Conservation tillage
- Erosion control
- Permanent cover
- Reduced fallow
- Organic recycling
- Integrated pest mgt.
- Water management

SOIL QUALITY

GOAL

Sustainable Agriculture

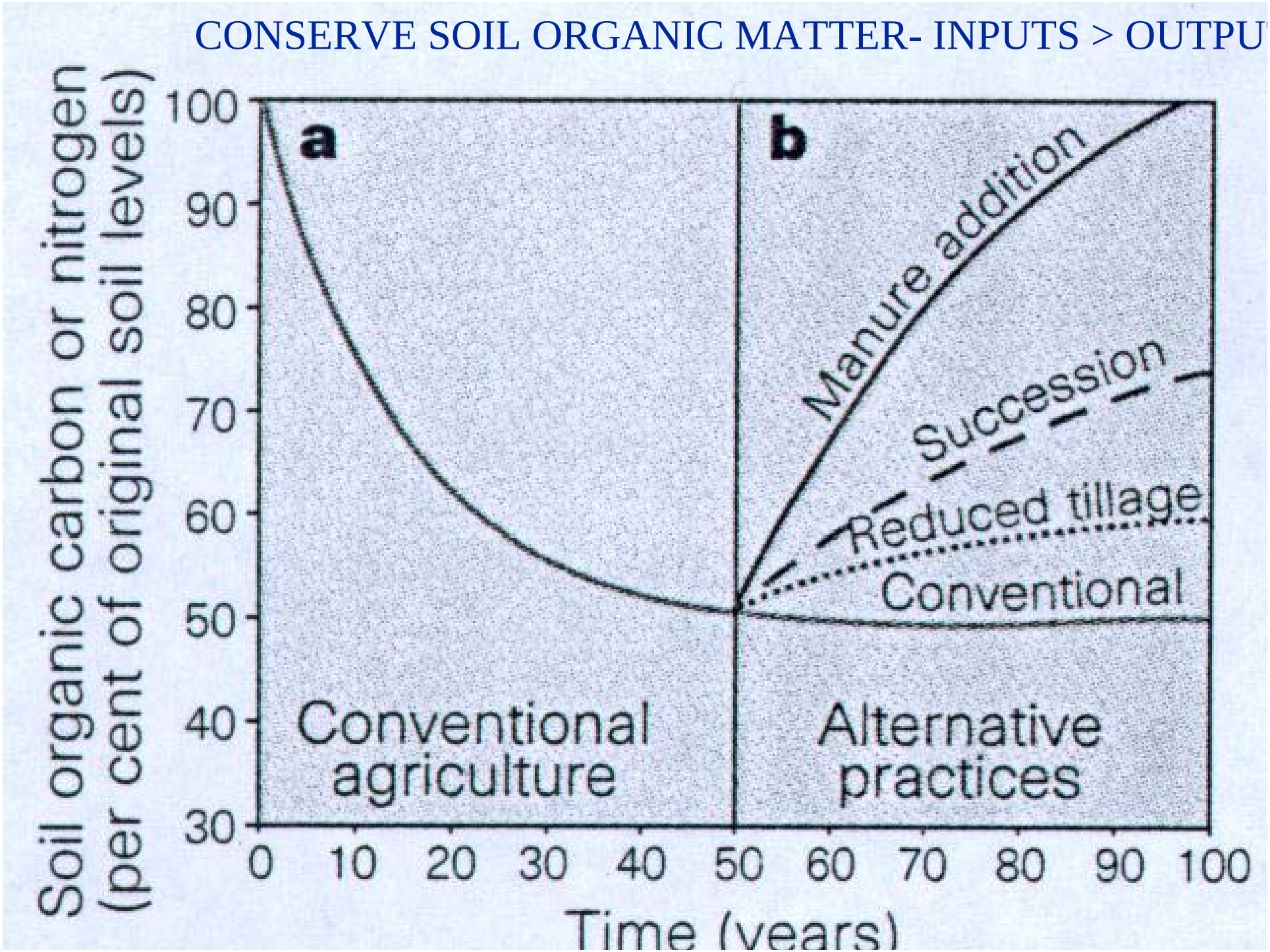
- Good-quality food
- Realistic crop yields
- Environmental health
- Energy conservation
- Natural res. conservation
- Economic viability
- Safety
- Modifying climate change

(After Parr et al. 1992)

Strategies for Sustainability

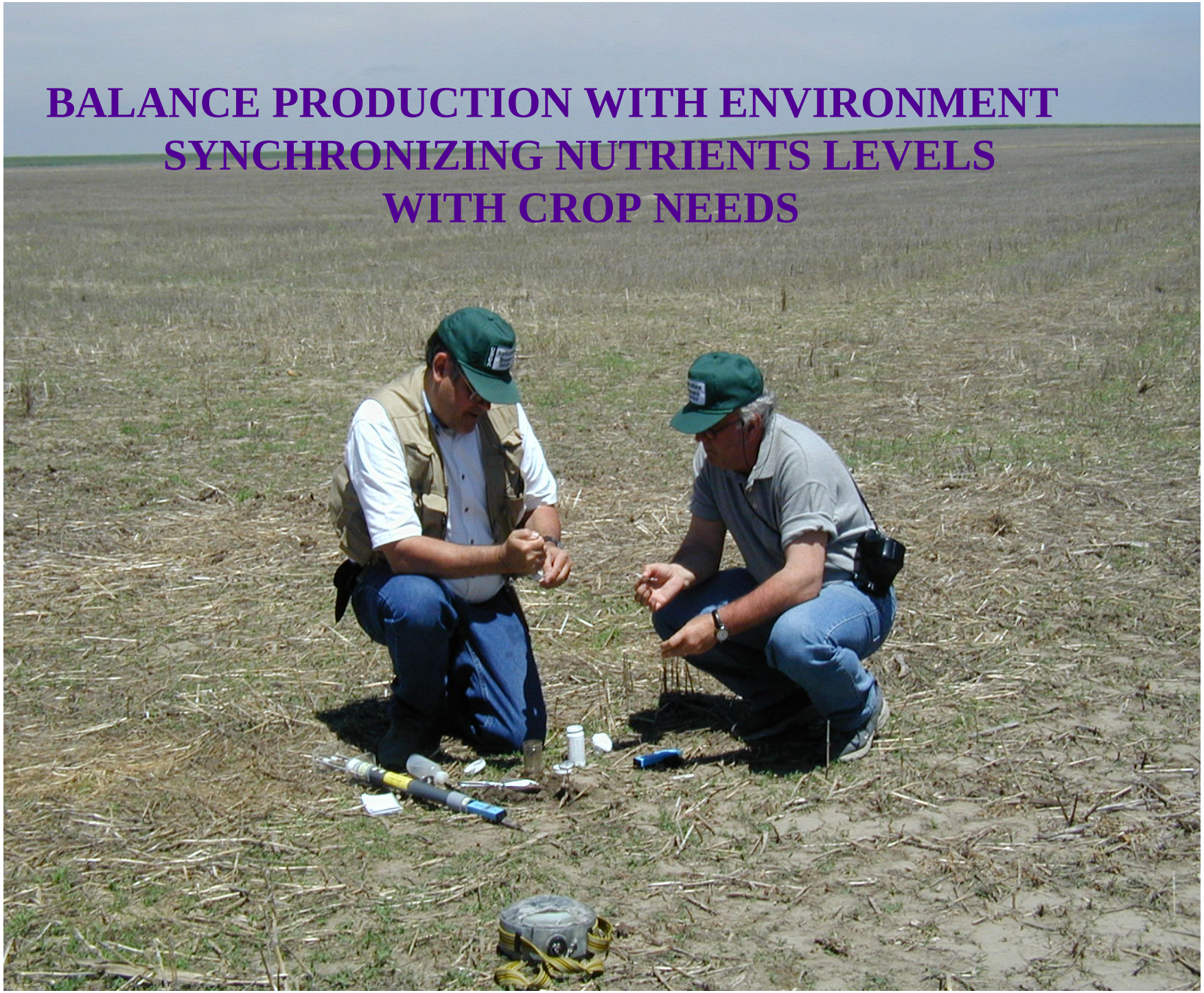
- Conserve soil organic matter
  C & N balance, inputs > outputs
- Minimize soil erosion
  Conservation tillage & vegetative cover
- Balance production with environment
  Synchronize nutrients (N) with crop needs
- Better use of renewable resources
  rely less on fossil fuels and petrochemicals
  & more on renewables and plant diversity

CONSERVE SOIL ORGANIC MATTER- INPUTS > OUTPU



CONSERVATION TILLGE
VEGETATIVE SOIL COVER

BALANCE PRODUCTION WITH ENVIRONMENT
SYNCHRONIZING NUTRIENTS LEVELS WITH CROP NEEDS



BETTER USE RENEWABLE RESOURCES

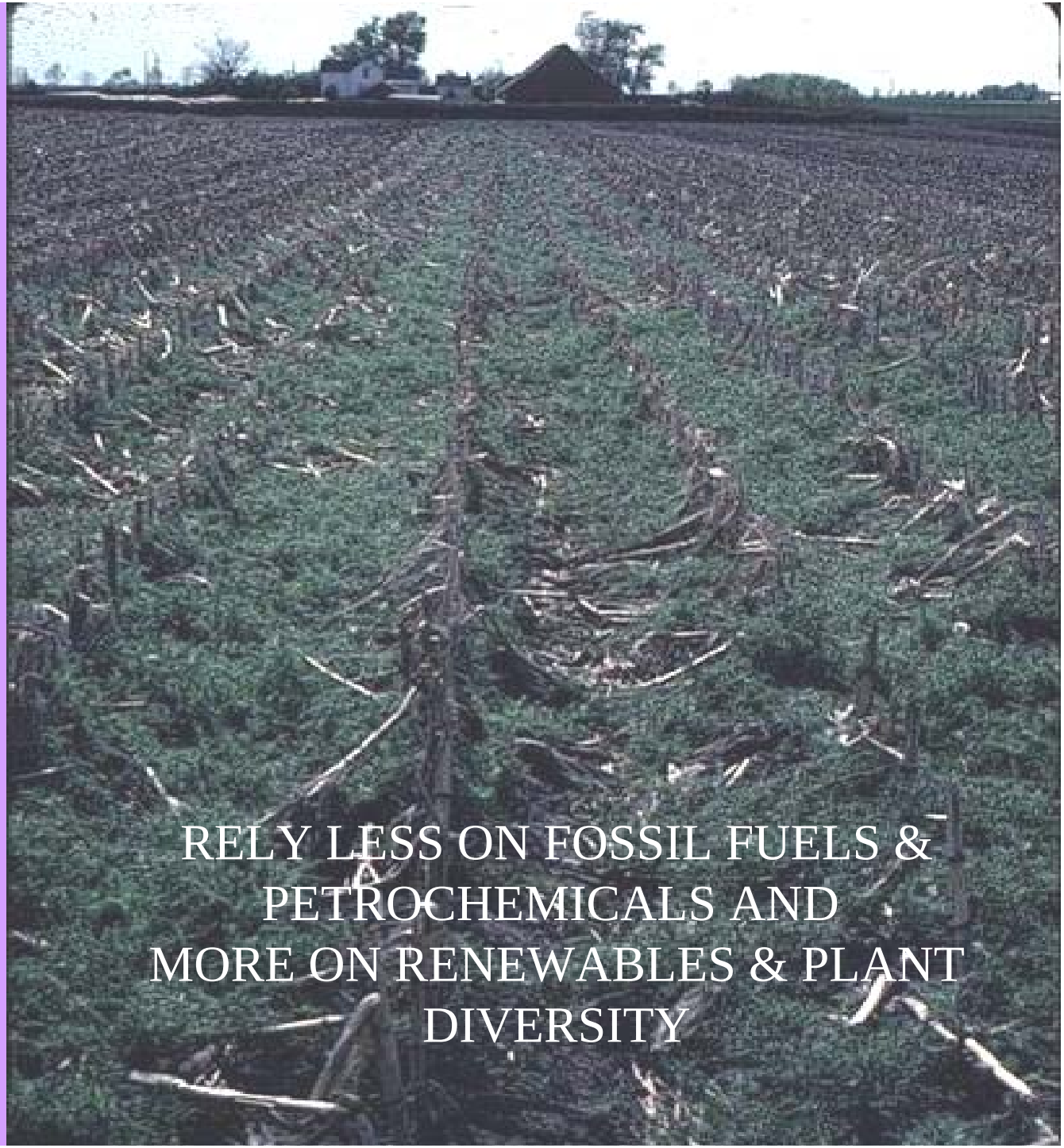
Partnering with Farmers

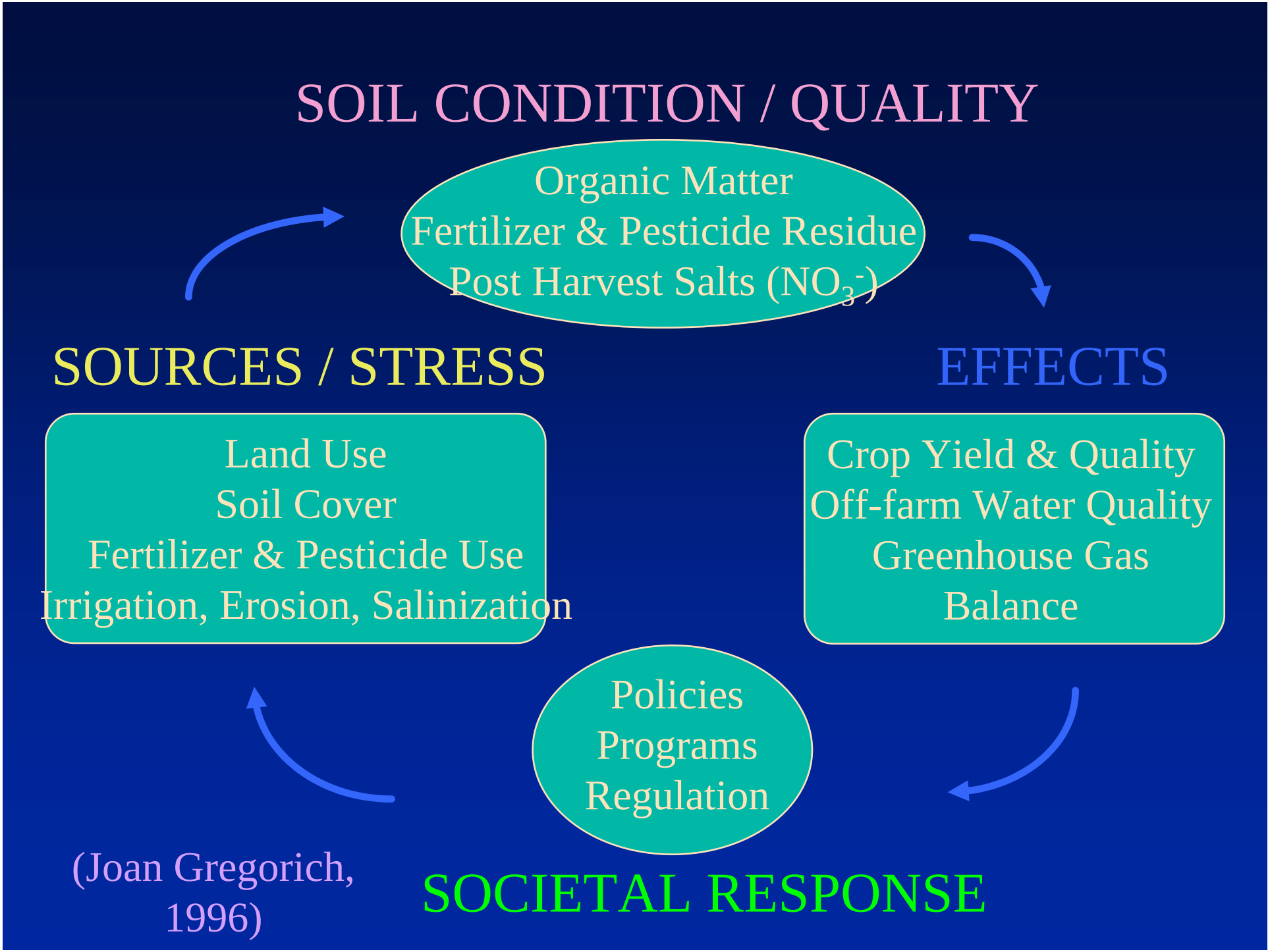
Dick & Sharon
THOMPSON'S
Iowa Farm
300 acres

Diverse Crops &
Livestock

Reduced Input:
No pesticides
Ridge Tillage
Legumes for N
Reduced Fertilizer
Manure & Sludge
Crop rotations

Net Income
$138/A




SOIL CONDITION / QUALITY
Organic Matter
Fertilizer & Pesticide Residue
Post Harvest Salts (NO_3^-)
SOURCES / STRESS
EFFECTS
Land Use
Soil Cover
Fertilizer & Pesticide Use
Irrigation, Erosion, Salinization
Crop Yield & Quality
Off-farm Water Quality
Greenhouse Gas
Balance
Policies
Programs
Regulation
SOCIETAL RESPONSE
(Joan Gregorich, 1996)

OUR CHALLENGE

Charting a course
towards *Sustainability*
by
Translating Science into
Practice

“Soil quality is in the Hands of the
Land Manager”

(Theme -Advances in Soil Quality Symposium, Ballarat, Australia 4/96)

(Harvey Gaynor- Australian Cotton Producer)

"I need help from *Scientists* with

TOOLS for MANAGEMENT

more than

INDICATORS of SOIL QUALITY"

We need PARTNERSHIPS to get

KNOWERS working with DOERS

“It is hard to be Green
when you are in the Red!”

(Ann Hamblin, Ballarat, Australia
4/96)

USDA Soil Quality Test Kit

"Helped translate science into practice."


“Test kit has facilitated partnerships between farmers and ag specialists”

SQ INDICATORS for PRODUCERS

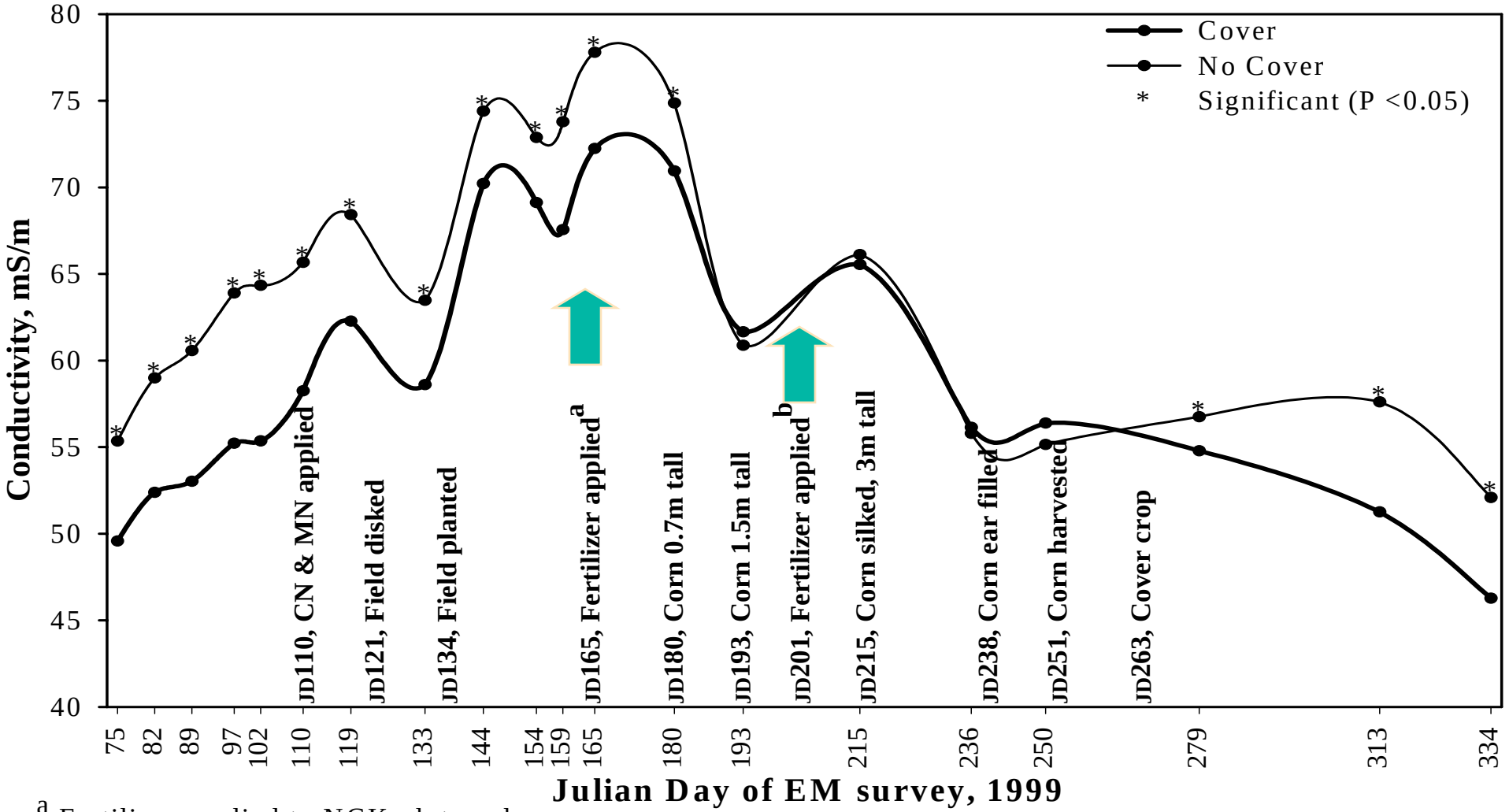
- **Direction of CHANGE in SOIL OM with TIME**
  - **Visual or Remote Sensing of Soil Color, Soil Analysis**
- **Visual : DUST, RUNOFF, RILLS, SEDIMENT**
  - **Surface Soil Properties: Depth, OM, Texture, % Cover, Infiltration**
- **CROP and VEGETATION Characteristics**
  - **Yields, Color, N content, Rooting (Visual/Remote Sensing)**
  - **Soil Physical State / Compaction (Dig a Hole)**
- **Input / Output Ratios of COSTS and ENERGY**
  - **Soil & Water Nitrate Levels to indicate Efficient N Use**
  - **Soil Acidification (leaching with inefficient N fertilizer use)**

Measuring Agricultural Sustainability at the Farm Level

Farmer/Society Needs	Resource/Environmental Conservation
Acceptable	Adequate/Acceptable
• Yields	• Soil organic matter
• Profits	• Soil depth
• Risk	• Soil cover
• Energy($) Ratio Output/Input	• Leachable Salts (NO_3) Electrical Conductivity

(After Gomez et al., 1996)

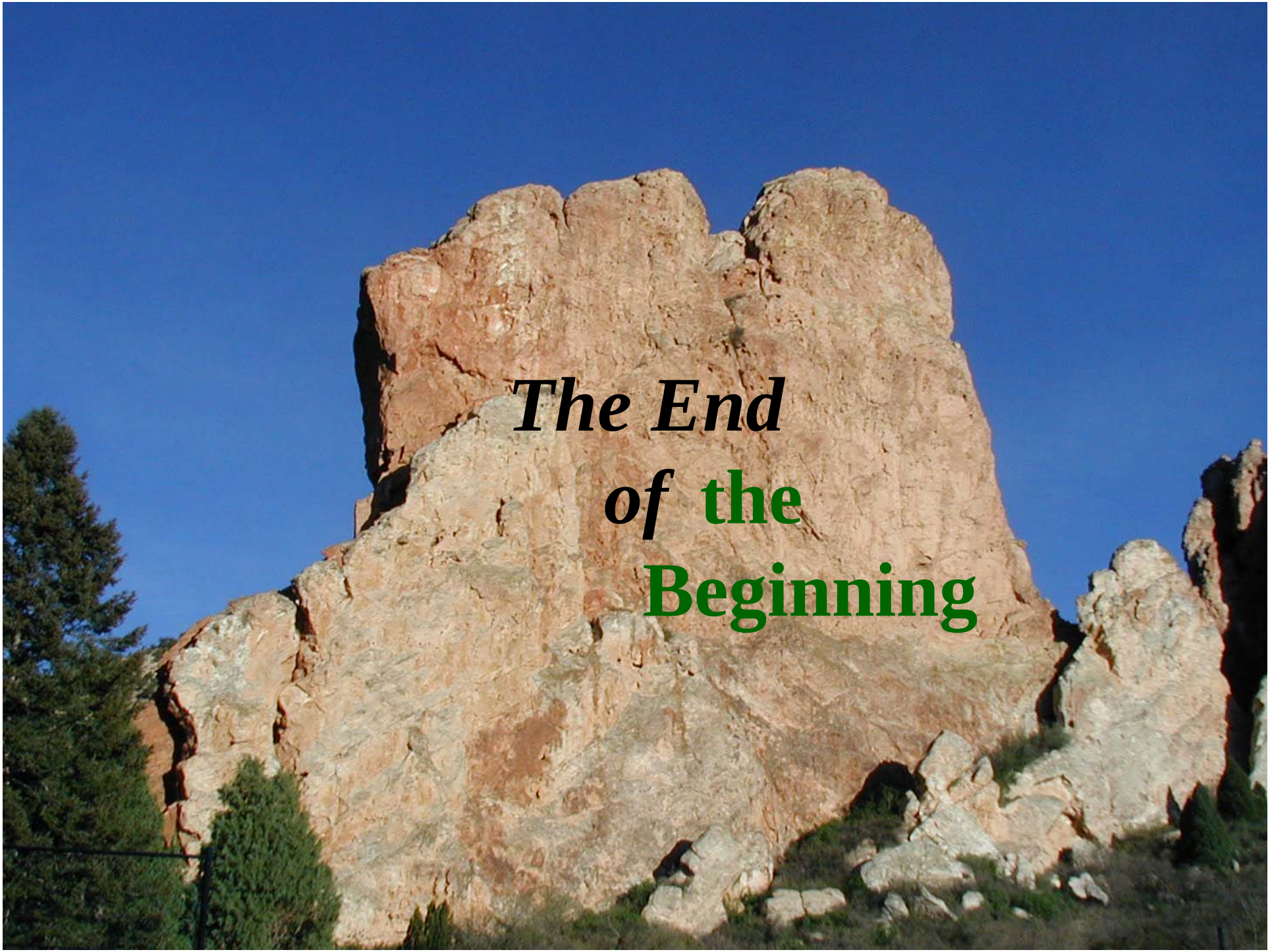
Electrical Conductivity



[a] Fertilizer applied to NCK plots only

[b] Fertilizer applied to NCK, CP and MP plots

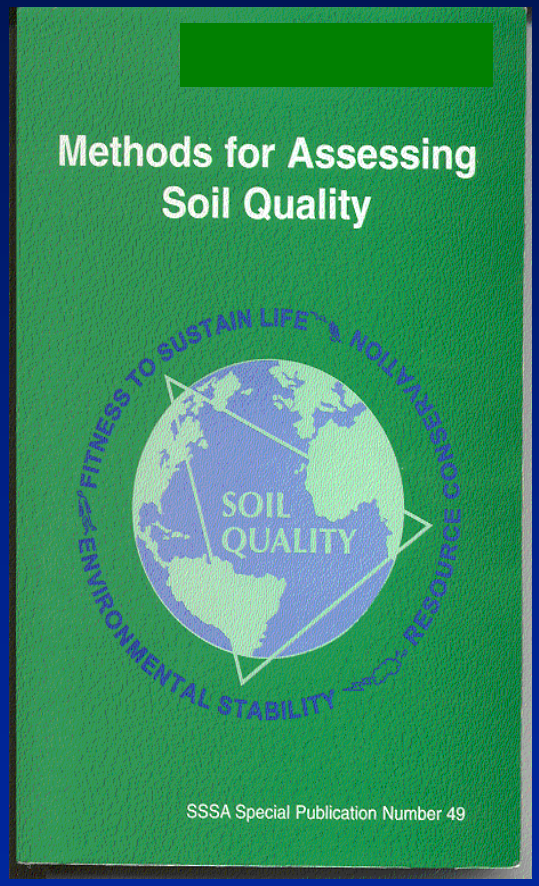
Single Most Valuable Soil Quality Indicator


The End
of **the**
Beginning


Thank
You!

Methods for Assessing Soil Quality

Edited by: J.W. Doran and A.J. Jones



Soil Science Society of America, Special Pub. No. 49, $30

“RULES IN THE REAL WORLD”

- Water Runs Downhill
- Everything is Related to everything else
- There is no Free Lunch
- Nature always Bats Last

Consequences of ignoring rules: “Today's Solutions often become tomorrow's Problems”

(Tom Frantzen, Iowa Farmer)