



**THE OHIO STATE UNIVERSITY**

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**THE SOIL-PEACE NEXUS:  
OUR COMMON FUTURE**

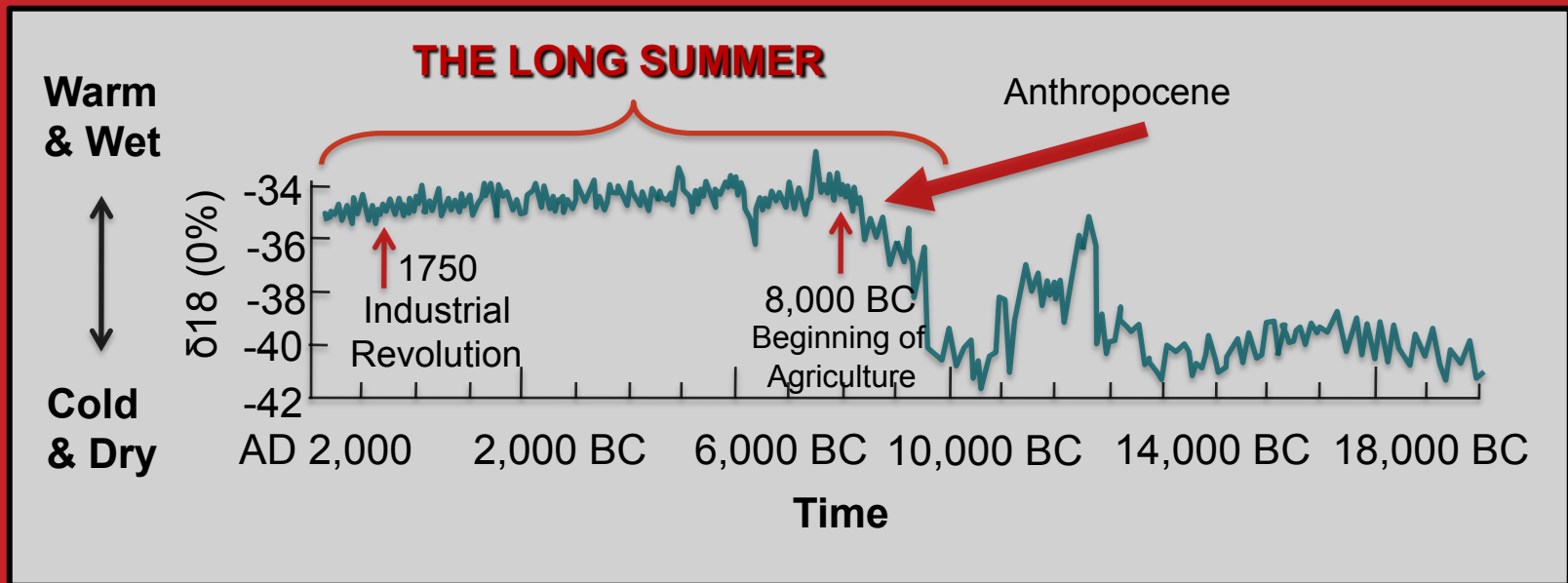
Carbon Management and Sequestration Center

Dr. Rattan Lal



# EARTH'S HISTORIC TEMPERATURE AND THE EVOLUTION OF AGRICULTURE

(Fagan, 2004)





# EVOLUTION OF HUMAN SYSTEMS

Stage	Species	Society	Tools	Era (Ma)	Population
<b>1. Paleolithic</b>	<i>Homo erectus</i>	Tribes, hunter/ gatherer	Stone, Fire	2.5	2-20 million
<b>2. Neolithic</b>	<i>Homo sapiens</i>	Agricultural	Powerful tools	0.01	900 million
<b>3. Carbon Civilization</b>	<i>Homo carbonapiens</i>	Fossil fuel	Scientific methods	0.003	7.3-11 billion

**AS A FORCE IN TRANSFORMING THE BIOSPHERE**



# SOILS AND ECOSYSTEM FUNCTIONS

**300,000 Soil Series**

Forest/Biodiversity

Water Resources

Animal Biodiversity

Energy /Biofuels

Aquaculture

Climate Regulation

Food Production

Ecosystem Restoration





## SPIRITUAL BELIEFS IN SOIL AND ENVIRONMENT

- Judaism** : The word “homo” (man) is derived from the Latin word “humus” or the decomposed organic matter in soil, which is the essence of all terrestrial life. The Hebrew phrase “Tikkun Olam” means “repairing restoring the world”.
- Hinduism** : Human body is made of “Kshiti (soil), Jal (water), Pawak (energy), Gagan (sky/space), Sameere (air)” (Prasna Upanishad)
- Sikhism** : Pa uᅇ gurū pānī piᅇā māᅇā ᅇharatᅇ mahaᅇ. ᅇinas rātᅇ ᅇu é ᅇā ī ᅇā i ā khᅇlai sagal jagatᅇ. (Gurbani)
- Buddhism** : “One should not break even the branch of a tree that has given one shelter” (Petavatthu II, 9, 3)
- Christianity** : The word “Adam” (man) is derived from the Hebrew word “adama” meaning “earth” or “soil”
- Greek** : The daughter of Earth goddess “Gaea” named Themis (goddess of Law), and her descendent Demeter was the goddess of agriculture and fertility
- Romans** : The Earth goddess (Tellus) was related to the goddess of fertility and harvest (Ceres), and named “Mater Terra”
- Islam** : “He created the man of clay like the potters” (Suhrah Al-Rhman, verse 14)  
“We made from water every living thing” (Qurān 25:54)  
“Do not overuse water even if you are on a running river” (Prophet Mohammad)
- Khalil Gibran** : Trees are poems (rubbiat) that earth writes upon the sky. We fell them down and then turned them into paper, so that we may record our emptiness.



# COLLAPSE OF HISTORIC CIVILIZATIONS

Civilization	Region	Era	Cause of Collapse
Sumerian	Mesopotamia	10,000 BCE	Salinization
Harappan	Indus Valley	2,000-2,000 BCE	Desiccation
Inca	Andean Region	750-900 CE	Soil Erosion
Maya	Central America	750-900 CE	Soil Erosion
Axum	Northern Ethiopia	100-600 CE	Ecological Degradation
Roman	Mediterranean	27BC – 395 AD	Exhaustion of soil



## CAUSE OF INSECURITY

**Poverty and subsistence agriculture  
are root causes of national food  
insecurity in developing countries.**

*...Defra, Food security and the U.K. (2006)*



- **Extractive Farming/Subsistence**

- **Depletion of SOC and Nutrients**
- **Decline in Soil Structure**

- **Loss of Soil Resilience**

- **Decline in Ecosystem Functions and Services**

- **Loss of Soil biodiversity**
- **Disruption of Key Processes**

- **Hunger**
- **Malnutrition**
- **Political Unrest**
- **Civil Strife**
- **War and insecurity**

**Severe Degradation**







## PEACE AND AGRICULTURE

**“If you desire peace, cultivate justice; but at the same time cultivate the fields (soil) to produce more bread; otherwise there will be no peace.”**

*... Norman Borlaug*





## **BREAD AND PEACE**

**There are not many troubles in the world more alarming than those caused by the fire in the pit of an empty stomach.**



## HUNGER AND STEWARDSHIP

**“Love and business and family  
and religion and art and patriotism  
are nothing but shadows of words  
when a man’s starving.”**

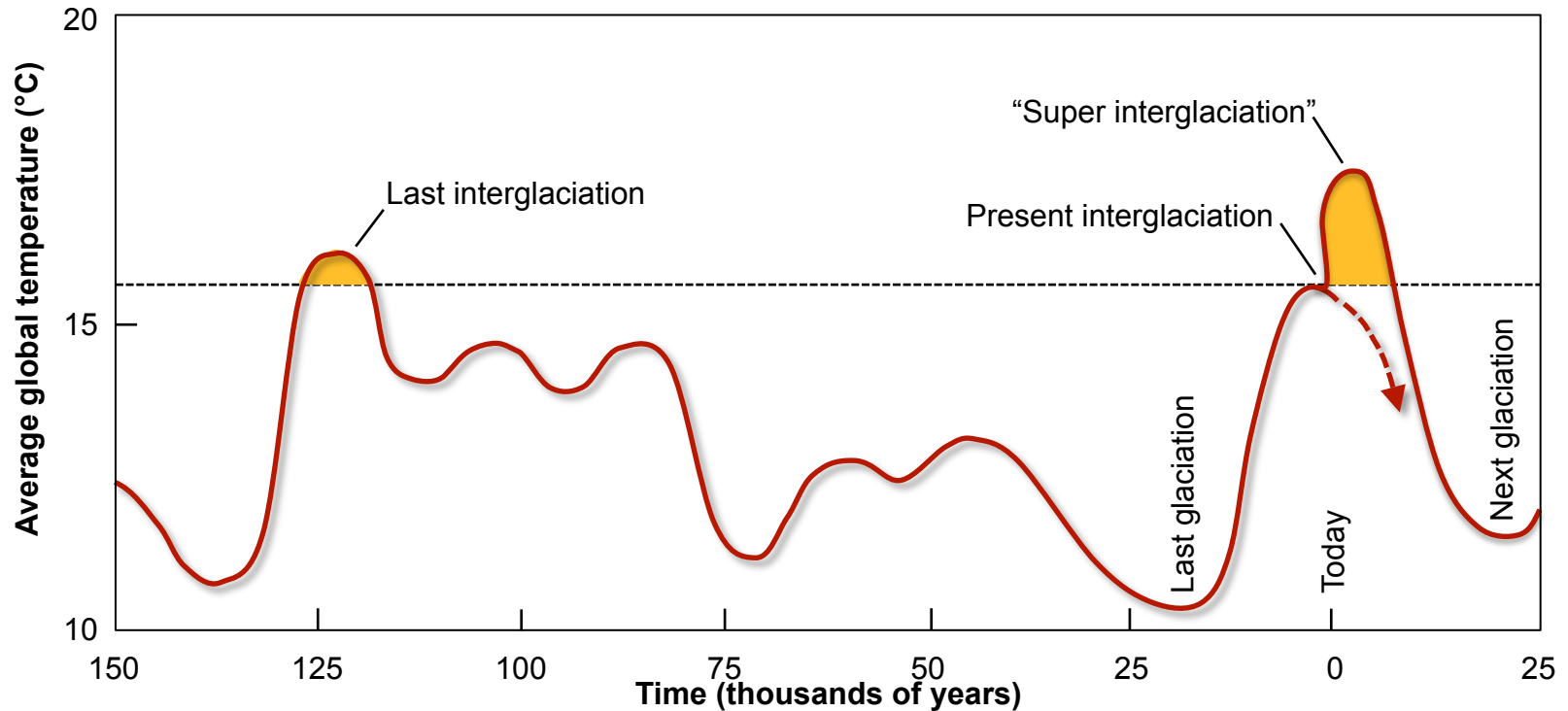
... ‘O Henry  
“Heart of the West” 1907

# SECURITIZATION OF FOOD AND THE ENVIRONMENT THROUGH SOIL SUSTAINABILITY



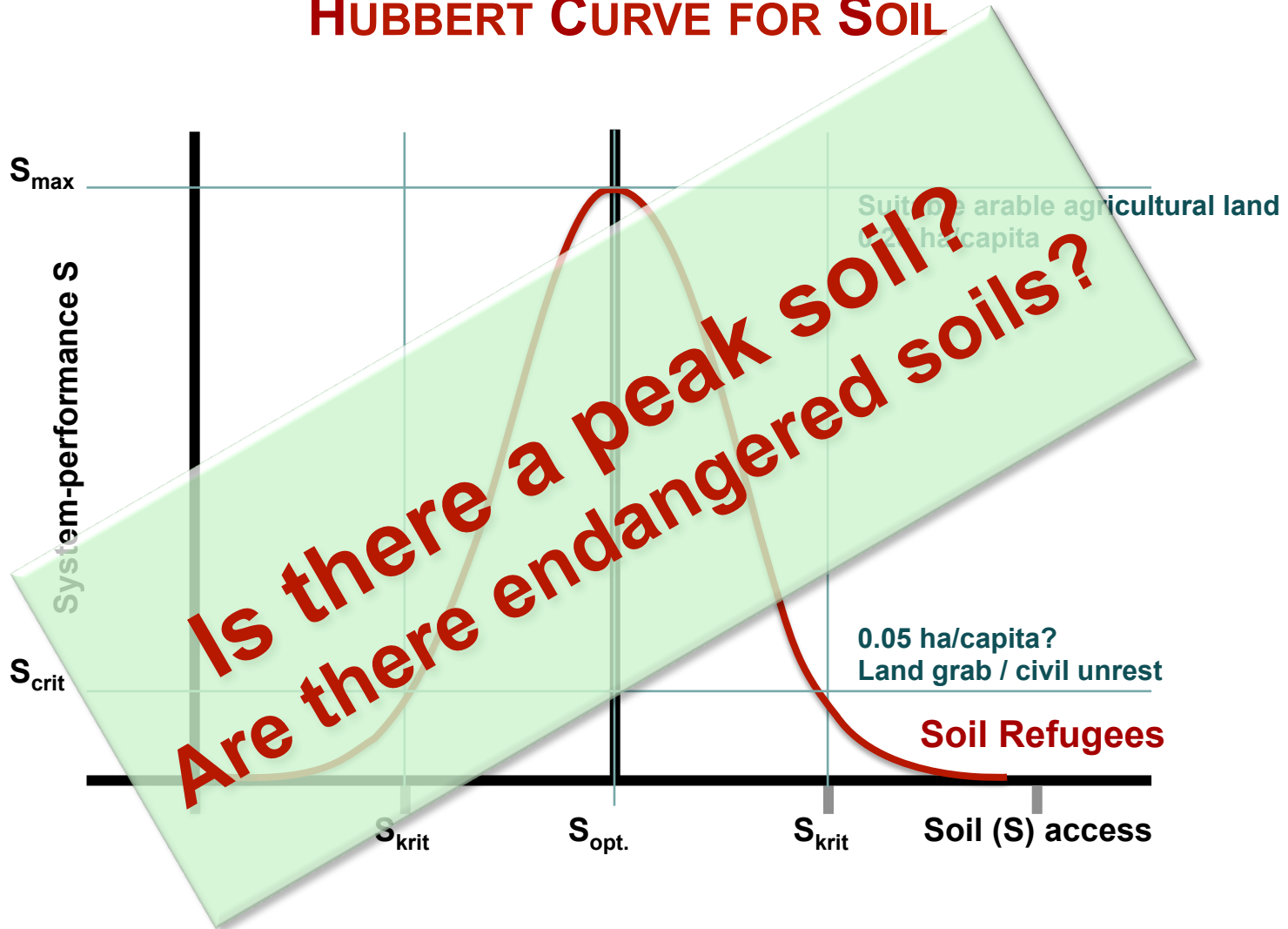


## EARTH'S CLIMATE DURING THE LAST 150,000 YEARS AND AN INTERPRETATION OF ITS FUTURE





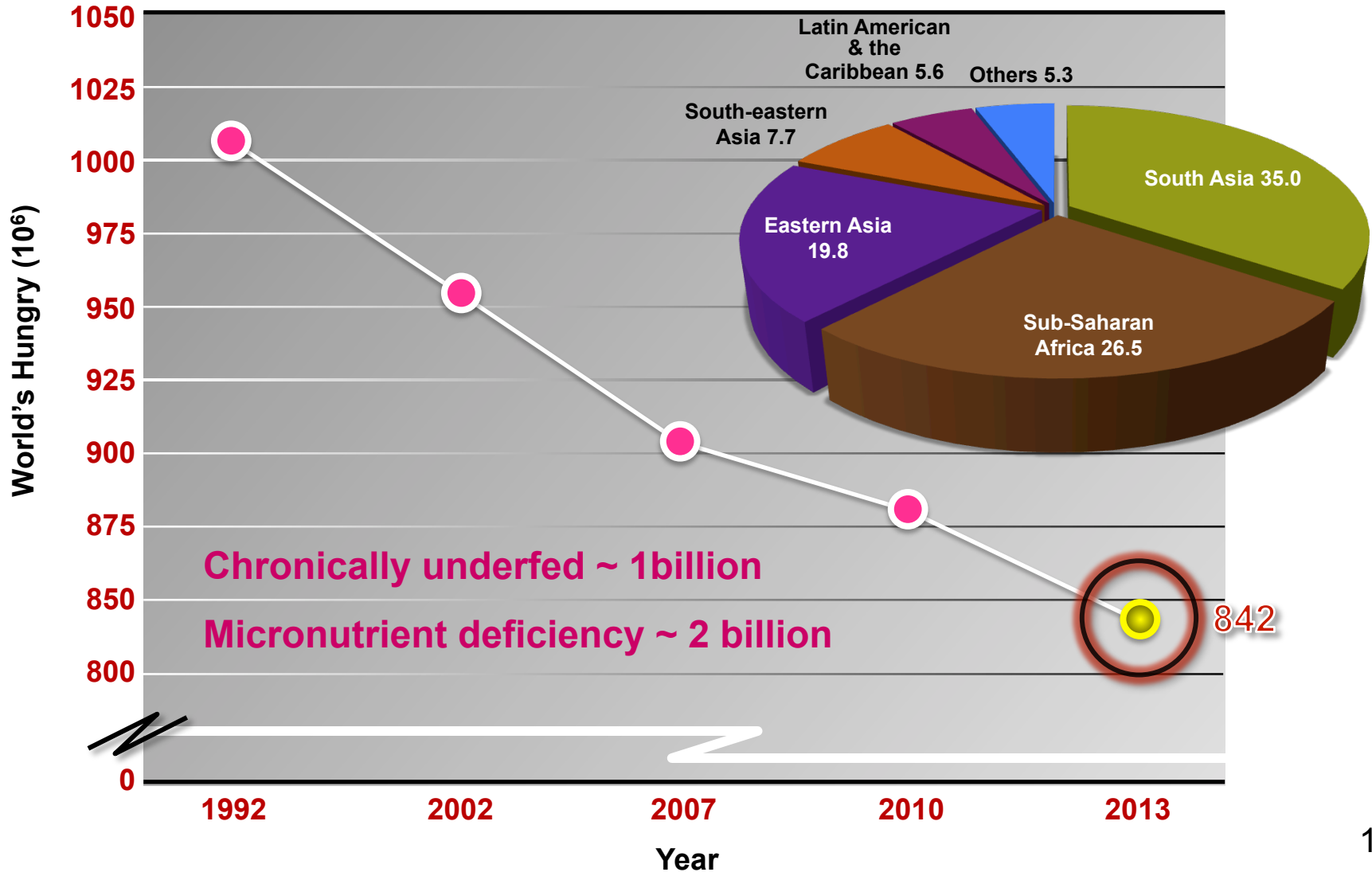
## HUBBERT CURVE FOR SOIL





# GLOBAL FOOD INSECURITY

(FAO, 2013)





# SOIL AND CIVILIZATION

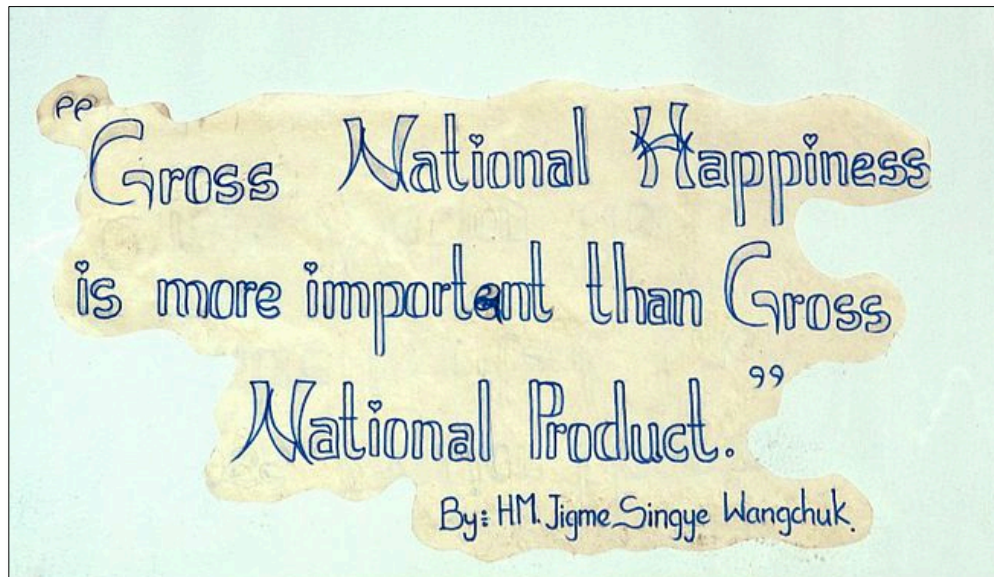
- **True democracy cannot survive in a country where a large part of the people are hungry.**
- **It was the superlative productivity and durability of the soils which made the first Egyptian civilization possible.**
- **The fall of the past civilizations was due in large part to bad management of the landscape.**

Vernon Carter and Tom Dale (1973)



# THE QUEST FOR VICTUALS

- Historically, major migrations and revolutions were driven by the never-ending quest for victuals, which have been a major justification for invasions and revolution. Then, agriculture was the foundation of power.
- In modern times (since 1980s), economic development and GDP have become the major source of power and global influence.



- Yet the need for food, a common thread in both eras, has led to proclivity, tensions, political instability, and social/ethnic conflicts.



# SOIL AND NATIONAL SECURITY

- **Soil is not just an economic development or an environmental/health concern, it is also a peace and security issue.**
- **Densely populated regions (China, India, etc.) have low and shrinking per capita arable land area.**
- **Scarcity of good quality soil/land can increase the risk of instability, land-grabbing, state failure, and exacerbate regional and international tensions.**
- **Land grab, presently estimated at ~200 Mha between 2000 and 2010, can be a future threat to peace and stability.**



# FOOD AND NATIONAL SECURITY

**Presently, China continues to consider  
agriculture as a matter of “national security”**



<http://resiliency-rising.blogspot.com/2013/10/nanjing-permaculture-to-pdc-or-not-to.html>



# HUNGER AND STEWARDSHIP

**The national food security act (NFSA) legally binds the Federal Government of India to guarantee access to subsidized food to 70% of the 1.2 billion people (840 million), the combined population of USA and EU.**

**According to NFSA, food is now a basic right. During 2011-12, > 500 million Indians received 51.3 million tons of subsidized food or more than 10 times the direct food aid delivered by the World Food Program in 2011.**

*... NFSA (2013)*



# U.K. GOVERNMENT POLICY

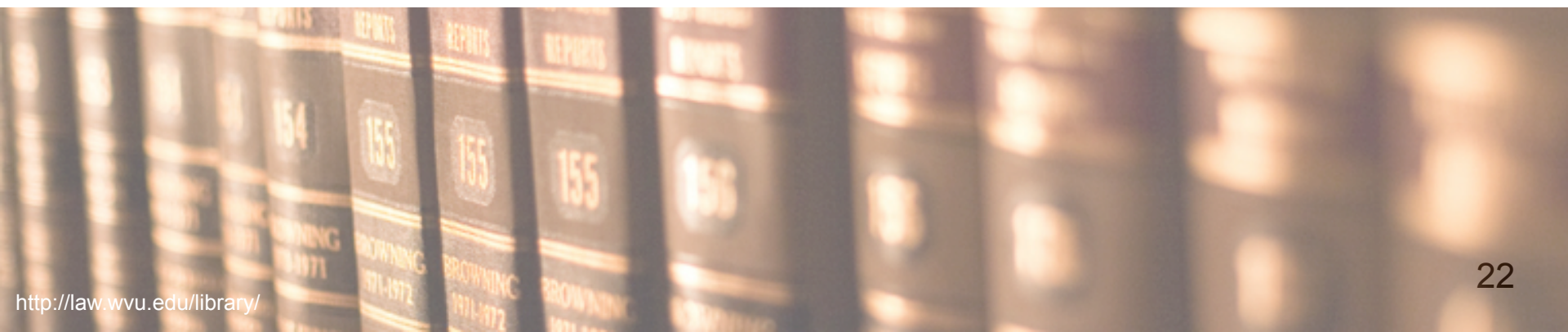
**Food matters: towards a strategy  
for the 21<sup>st</sup> century**

*...PMSU (2008)*



# FOOD AND NATIONAL SECURITY

- The Public Law 480 (10<sup>th</sup> July 1954, Eisenhower) renamed “Food for Peace” (1961, Kennedy), and Global Food Security Act (Sen. Lugar, 2009) recognized the food-peace nexus.
- On 24<sup>th</sup> Sept. 2009, Secretary of State Hillary Clinton made “food security” a key component of the U.S. foreign policy and recognized that hunger threatens the stability of governments, societies and borders.
- VP Biden stated on 28 Oct. 2011 that “Investments made to ward off food insecurity and prevent its recurrence can prevent the vicious cycles of rising extremism, armed conflict and state failure...”





# UNDERSTANDING SOIL-HUMAN INTERACTION

- **How can we double food production between 2005 and 2050 while restoring soil, mitigating climate change, improving the environment and maintaining peace and stability?**
- **This is a much larger challenge than was faced by Norman Borlaug, M.S. Swaminathan, and other Green Revolutionaries of the 1960s and 1970s.**
- **Soil scientists have a crucial role to play in meeting this challenge through close cooperation with other disciplines, including natural sciences and humanities.**



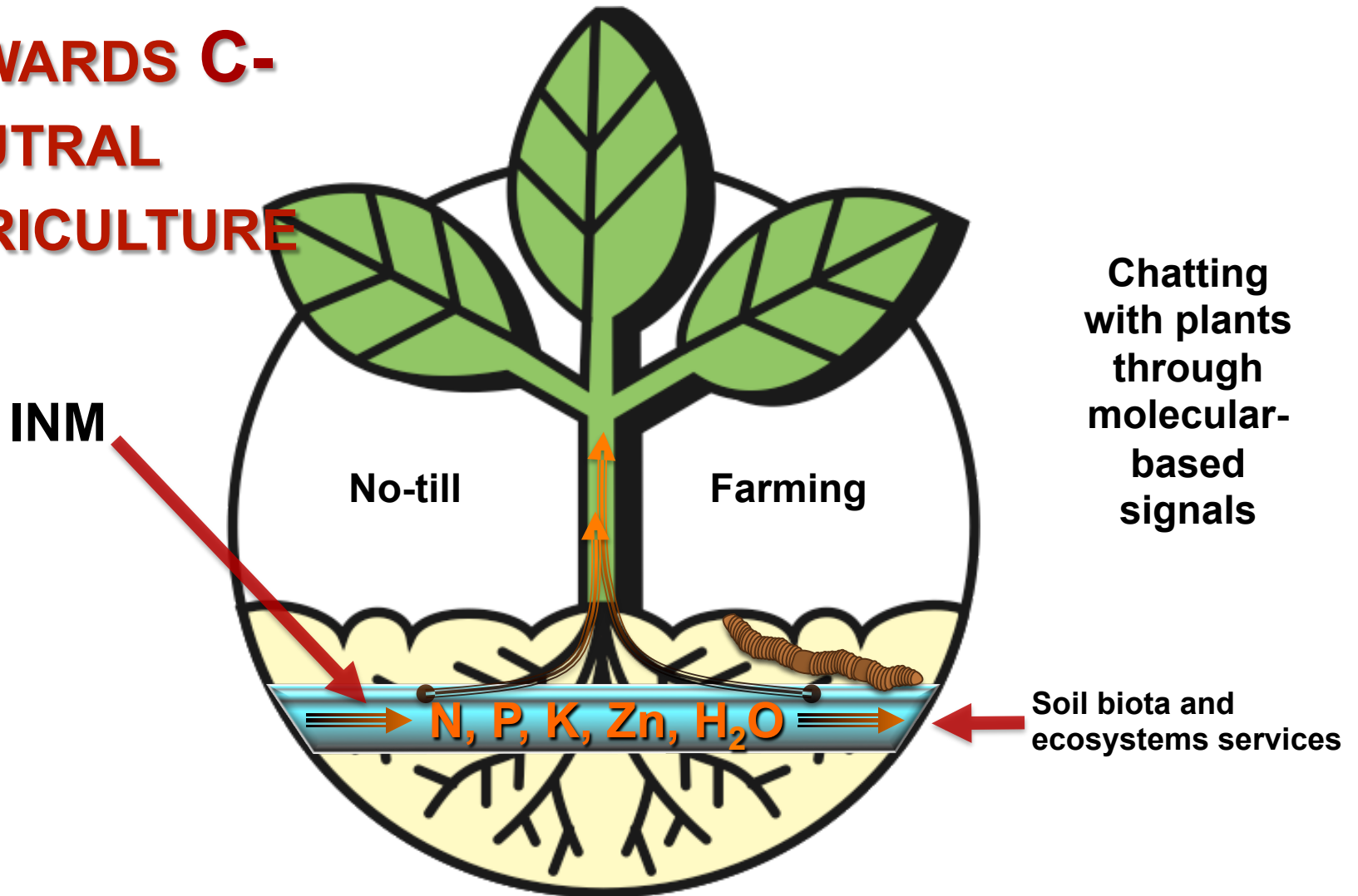
# ACTION FROM MULTIPLE FRONTS TO FEED 11 BILLION

1. Increase production from existing land & restoring soils: : Sustainable Intensification (SI)
2. Reduce post-harvest losses : 10-40% (Developing countries)
3. Minimize food waste (farm → fork → landfill) : 20-40% (Developed countries)
4. Reduce diversion of food to biofuels : ~1/3 of corn in U.S.
5. Prefer plant-based diet : 6-8 kg grain/kg of meat on grain-fed livestock
6. Per capita grain consumption : India= 170 kg/yr  
USA = 635 kg/yr } Diet





# TOWARDS C-NEUTRAL AGRICULTURE



Delivering nutrients and water directly to plant's roots



## EX NIHILO NIHIL FIT (*Nothing Comes From Nothing*)

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Law or Concept	Implications
1. <b>Nothing is appropriated:</b>	There are always trade offs (give and take).
2. <b>Nothing is permanent:</b>	Everything is in a dynamic equilibrium and a transient state.
3. <b>Nothing is absolute:</b>	All processes, properties and values are relative to a baseline.
4. <b>Nothing is a panacea:</b>	There is no silver bullet, there is a multitude/menu of options.
5. <b>Nothing is universal:</b>	Soil/site/region specificity is an important consideration which cannot be overlooked.
6. <b>Nothing tangible is free:</b>	Under valuing a commodity leads to “Tragedy of the Commons”.
7. <b>Nothing is empty (vacuum) in nature:</b>	All space is occupied, pores in solid rock contain water or air and injecting something (liquid CO <sub>2</sub> ), fracking solutions can create shock waves.
8. <b>Nothing is given or for granted:</b>	It is the judicious use and management which produce goods and services.
9. <b>Nothing is a waste:</b>	Everything in nature has a use.
10. <b>Nothing is nothing:</b>	There is no such thing as nothing.

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## NOT TAKING SOILS FOR GRANTED

If soils are not restored, crops will fail even if rains do not; hunger will perpetuate even with emphasis on biotechnology and genetically modified crops; civil strife and political instability will plague the developing world even with sermons on human rights and democratic ideals; and humanity will suffer even with great scientific strides. Political stability and global peace are threatened because of soil degradation, food insecurity, and desperateness.

*... Lal (Science, 2008)*

**This is the time for the soil scientists to act and address issues of global significance because you have the capacity , knowledge and motivation to do so.**