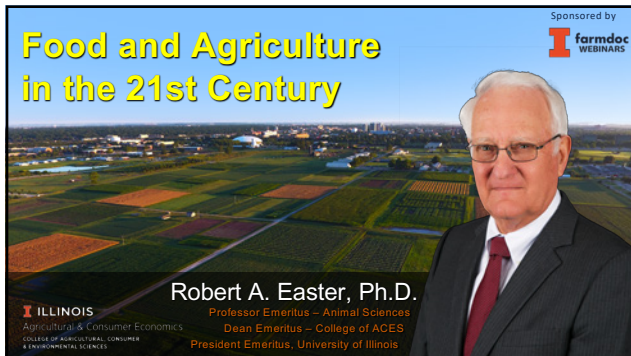


# Food and Agriculture in the 21st Century

Presented by Robert A. Easter, PhD., President Emeritus and Dr. Scott Irwin University of Illinois.

Date: Wednesday, April 17, 2019



**POLL: Can we produce enough food for the extra two billion people who will join the world's population by 2050?**

- Yes
- No
- Yes, but only with significant use of new technologies
- Yes, but only with expansion of cultivated acreage
- May not be possible

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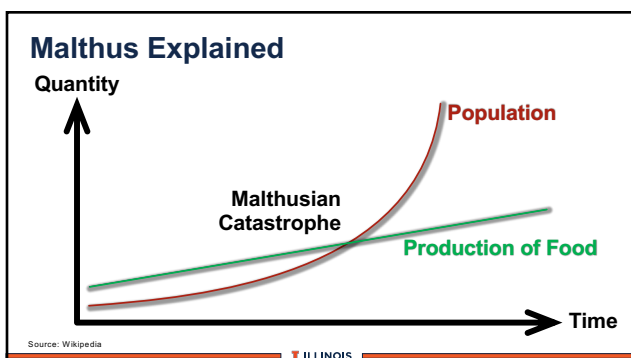
**This is not a new question!**

Thomas Malthus 1798  
*An essay on the principle of population.*

"Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will show the immensity of the first power in comparison with the second."

Thomas Robert Malthus  
Mezzotint by John Linnell, 1834. Credit: Wellcome Collection

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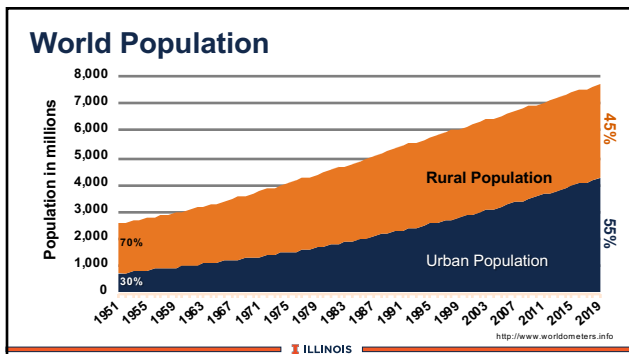
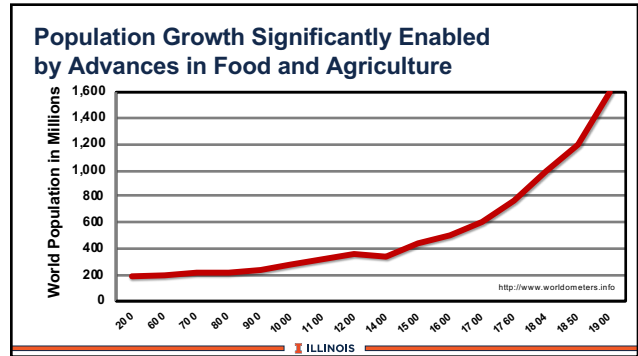
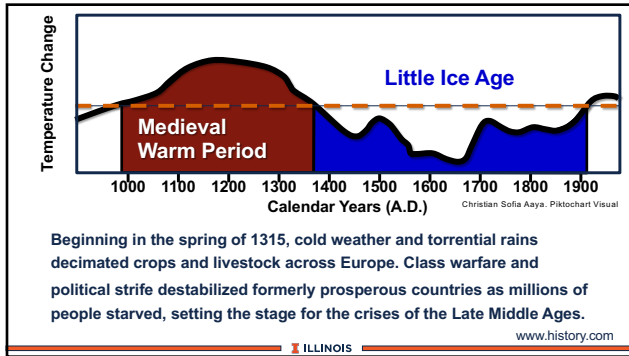
**Causes**

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## Around WWII Starvation Became a Global Issue

- The atrocities of WWII had increased public sensitivity to humanitarian issues
  - Many in developed countries had experienced real privation during the great depression and had very personal understanding of the lack of adequate food
  - Many who had fought in WWII understood the role of food in provoking political instability and committed to eradicating lack of food as a precursor to war.
  - There was a sense of shared obligation among western democracies.
  - Combating hunger was an instrument of "soft power" in the cold war.
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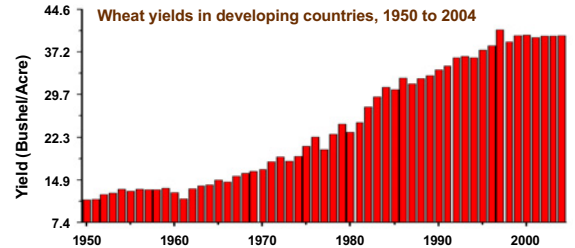
## Several Factors Dramatically Increased Food Production

- Improved crop genetics
- Fertilizer – especially nitrogen ★
- Irrigation ★
- Mechanization and improved farming practices ★
- Increase in cultivated land
- Research and Education



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## Resulted in Great Increases in Food Production



Source: FAO

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## The Green Revolution



### Norman Borlaug

In 1970 Norman E. Borlaug was awarded the Nobel Peace Prize for a lifetime of work to feed a hungry world. Although a scientist with outstanding contributions, perhaps Dr. Borlaug's greatest achievement has been his unending struggle to integrate the various streams of agricultural research into viable technologies and to convince political leaders to bring these advances to fruition.

[https://www.worldfoodprize.org/en/dr\\_norman\\_e\\_borlaug/about\\_norman\\_borlaug/](https://www.worldfoodprize.org/en/dr_norman_e_borlaug/about_norman_borlaug/)

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## Global Food Price Protests and Riots in 2007 and 2008



Algeria slashes food prices amid riots January 7, 2011

Photo by Maghreb

<https://www.flickr.com/photos/maghreb/5352296368>

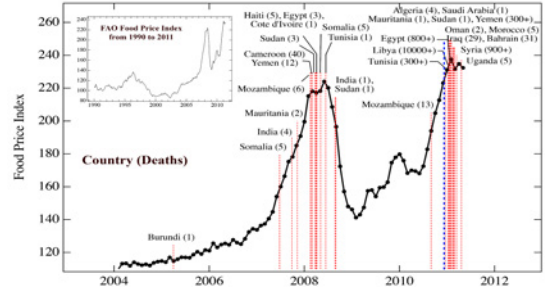
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## The "Food" Crisis of 2008

- No question – it was real
- Many factors contributed:
  - Drought
  - Population increase
  - Economic growth and dietary change
  - Lack of investment in science and development
  - Government export policies
  - Biofuel usage

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## Increases in Food Price Index Correlates with Social Unrest



M. Lagi, K. Z. Bertrand and V. Bar-Yam, 2011, *The Food Crisis and Political Instability in North Africa and the Middle East*, New England Complex Systems Institute

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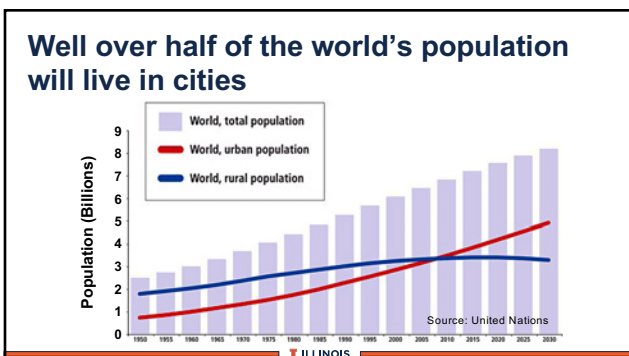
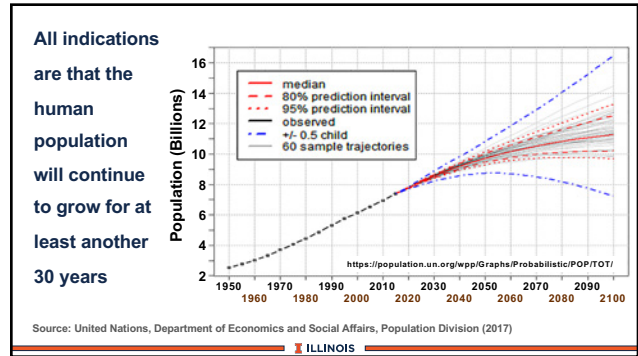




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Ten Largest Cities in the World

Rank	City	Country	Population (Metro)
1	Tokyo	Japan	38,001,000
2	Delhi	India	25,703,168
3	Shanghai	China	23,740,778
4	Sao Paulo	Brazil	21,066,245
5	Mumbai	India	21,042,538
6	Mexico City	Mexico	20,998,543
7	Beijing	China	20,237,645
8	Osaka	Japan	18,771,769
9	Cairo	Egypt	18,771,769
10	New York	United States	18,593,220
38	Chicago	United States	8,744,835

Source: www.worldatlas.com/citytops.htm (Oct. 2018)

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## Globalization of Food Systems

"In 1950 food production, for most of the world, was a local activity, today it is a global enterprise"



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It is estimated that about 50% of fresh fruit and 20% of our vegetables are imported

[www.foodsafety.gov](http://www.foodsafety.gov)

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## Four things that must be done:

- Produce more

And, this is the focus of most conversations.....



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## Four things that must be done:

- Produce more
- Prevent loss of that which is produced

It is estimated that 30% of all food produced is lost between harvest and the consumer



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Source: Personal Photo – Central China



Source: North India Post



Personal Photo  
Heilongzhang Prov.

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## UI-ADM Institute for the Prevention of Post-Harvest Loss – Bihar Province, India



Bihar Province, India



Grain dryer

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## Food Storage



Specialized Bags



Family Food Storage

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## Four things that must be done:

- Produce more
- Prevent loss of that which is produced
- Increase efficiency animal production



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## There will be more people

Year	Population
2014	7.2 b
2050	9.1 b

26%

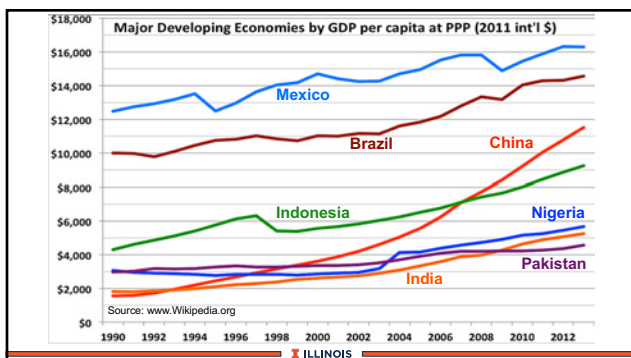
Source: United Nations

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## ....Around the world food consumption patterns are changing

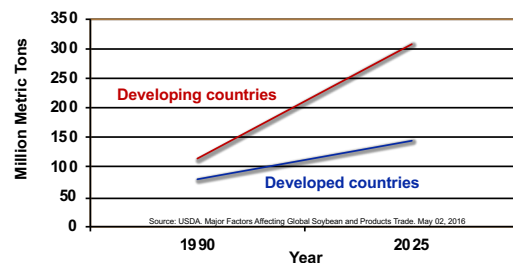


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## Global Expansion of Animal-based Food Production



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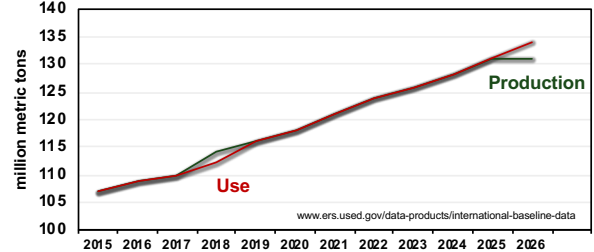
## Percentage Change in Food Consumption 1990 to 2005

Type	India	China	Brazil
Cereals	0	-20	120
Oil crops	70	140	10
Meat	20	140	70
Milk	20	200	20
Fish	20	130	-10
Fruits	30	250	-20
Vegetables	30	190	30

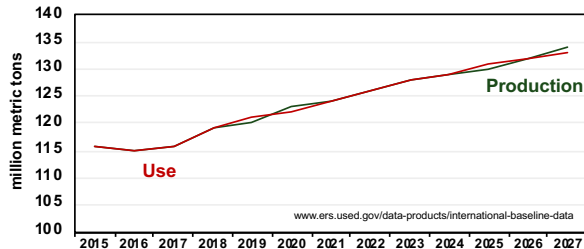
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(FAO, 2007)

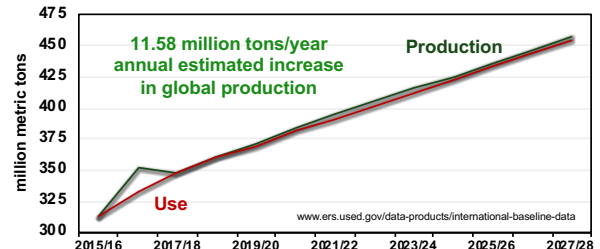
## World Poultry Global Supply and Use (Base Year 2018)



## World Pork Global Supply and Use (Base Year 2018)



## World Soybean Crop Global Supply and Use (Base Year 2018)



## “Planetary boundaries

- a concept involving earth system processes which contain environmental boundaries....” Wikipedia

Realistically, can the earth sustainably produce twice the current tonnage of soybeans?

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## Alternative Proteins (plant-based)



Ingredients: Water, Mung Bean Protein Isolate, Expeller-Pressed Canola Oil, Contains less than 2% of Calcium Citrate, Enzyme, Gellan Gum, Natural Carrot Extractives (color), Natural Flavors, Natural Turmeric Extractives (color), Onion Puree, Salt, Soy Lecithin, Sugar, Tetrasodium Pyrophosphate, Preservatives (Nisin, Potassium Sorbate).

www.justforall.com

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# Food and Agriculture in the 21st Century

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Date: Wednesday, April 17, 2019

## Four things that must be done:

- Produce more
- Prevent loss of that which is produced
- Increase efficiency of animal production
- Protect the capacity to produce



## Resource Conservation Why?



## Water

- Water is a transparent, tasteless, odorless and nearly colorless chemical substance...
- It is vital to all forms of life
- Water covers 71% of the earth's surface
- 96.5% of the earth's water is in the oceans and seas
- Only **2.5%** of this is fresh water

Source: Wikipedia



Please allow a  
personal story....



## About 1910

The Winter Garden  
Crystal City  
Artesia Wells  
Big Wells  
Carrizo Springs



Life was good!



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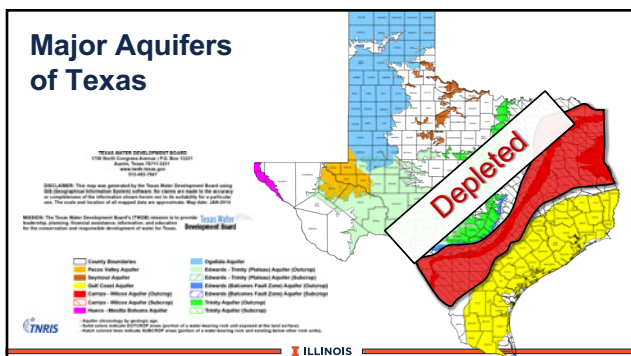




# Food and Agriculture in the 21st Century

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## Status of Underground Water Resources In India

- If current trends continue, in 20 years about 60% of all India's aquifers will be in a critical condition.
- India is the largest user of groundwater in the world - over a quarter of the global total.
- More than 60% of irrigated agriculture and 85% of drinking water supplies are dependent on groundwater.

Source: World Bank, 2012

# Food and Agriculture in the 21st Century

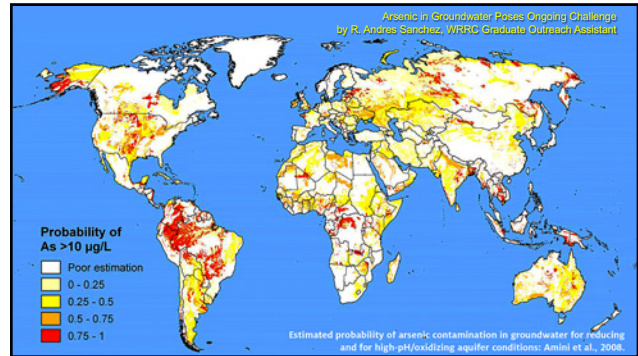
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## Water could become the most limiting factor

- Competition between cities and food production for available water
- Depletion of underground aquifers through pumping
- Loss of reservoir storage capacity through siltation
- Contamination of water through various means
- Need to expand crop production into arid lands

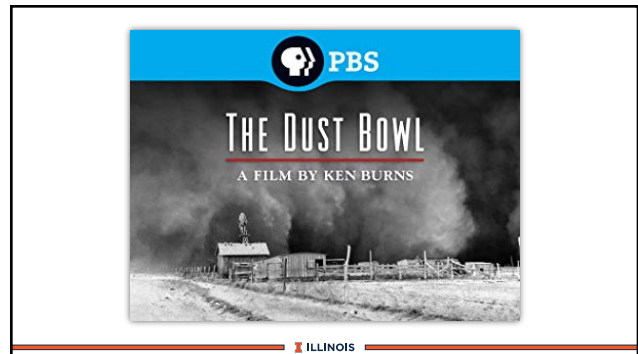
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## Conserve the Soil



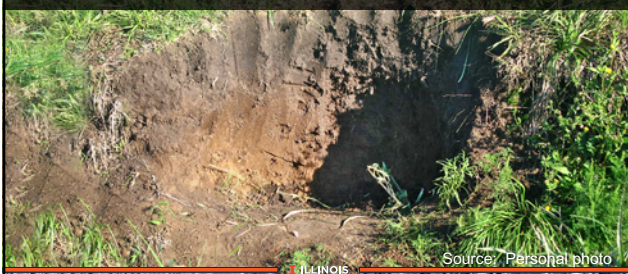
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"Soil health - the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans."

Source: [www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/](http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/)



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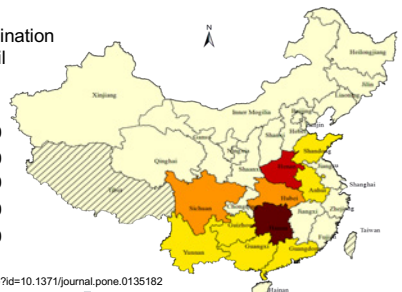
Source: Personal photo

## Soil Contamination is a Growing Problem Worldwide

Heavy Metal Contamination of Chinese Soil

Affected Grain Production %

- 0.00 to 0.50
- 0.51 to 1.00
- 1.01 to 1.50
- 1.51 to 2.00
- 2.01 to 3.00
- No Data



<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0135182>

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## Potential Challenges

- Lack of innovation
- Political/financial instability/social license
- National policies that impact land use, employment of technology or good infrastructure
- Biological limitations
- Unanticipated plant disease
- Climate change

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I'm Optimistic!

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Oh, to be 30 again!

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Thank You!

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farmdocdaily.illinois.edu

Robert A. Easter, Ph.D.

## QUICKPOLL

Can we produce enough food for the extra two billion people who will join the world's population by 2050?

Poll Results:

Yes	31%
No	2%
Yes, but only with significant use of new technologies	60%
Yes, but only with expansion of cultivated acreage	5%
May not be possible	2%

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