



www.landinstitute.org



Rockwell's County Agent - 1948



What Followed?







Causes?





**Energy and Fertility
Management System -
Obsolete**

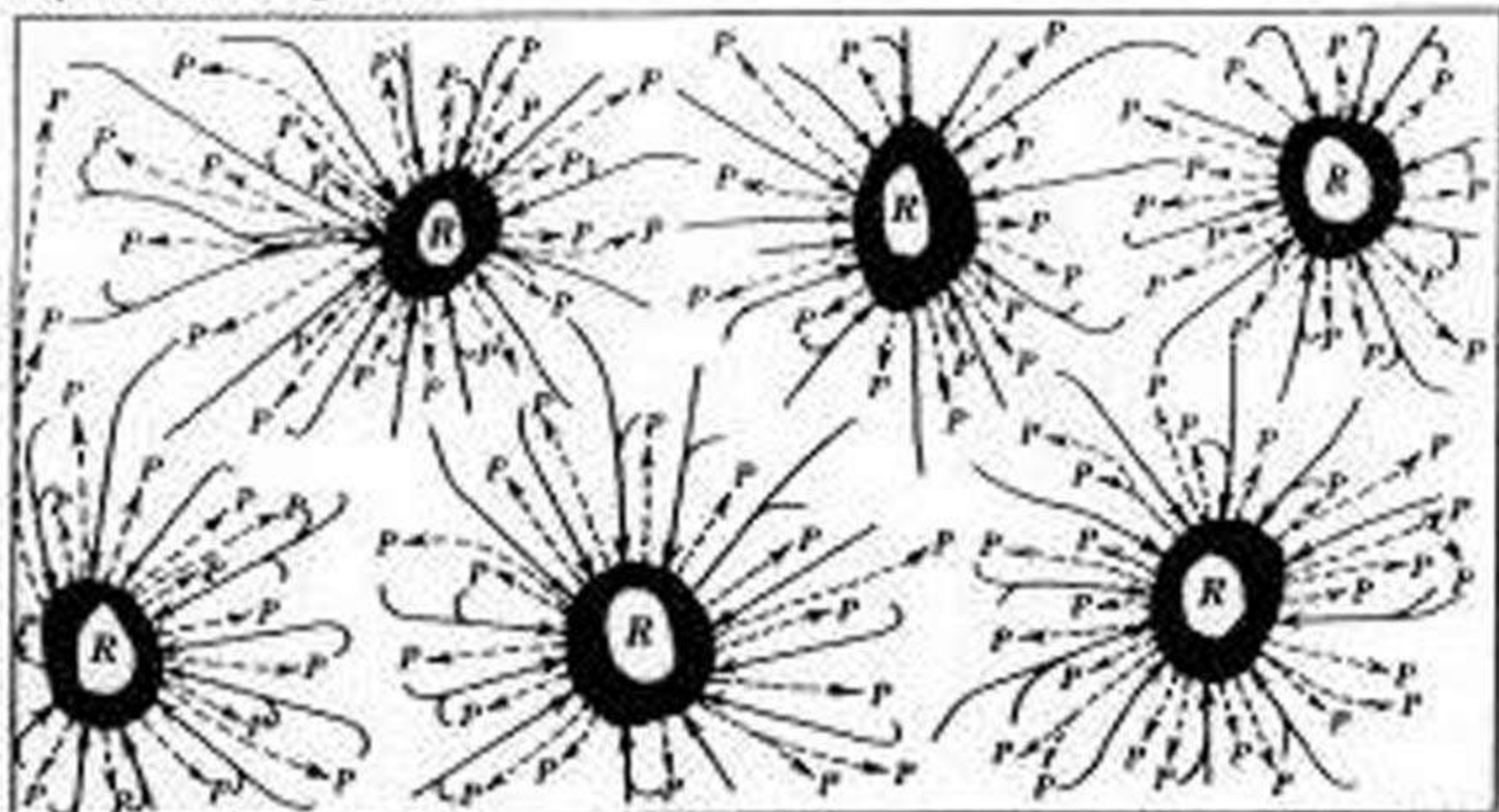


**Where
Are These People
Today?**



A Deeper Level Explanation

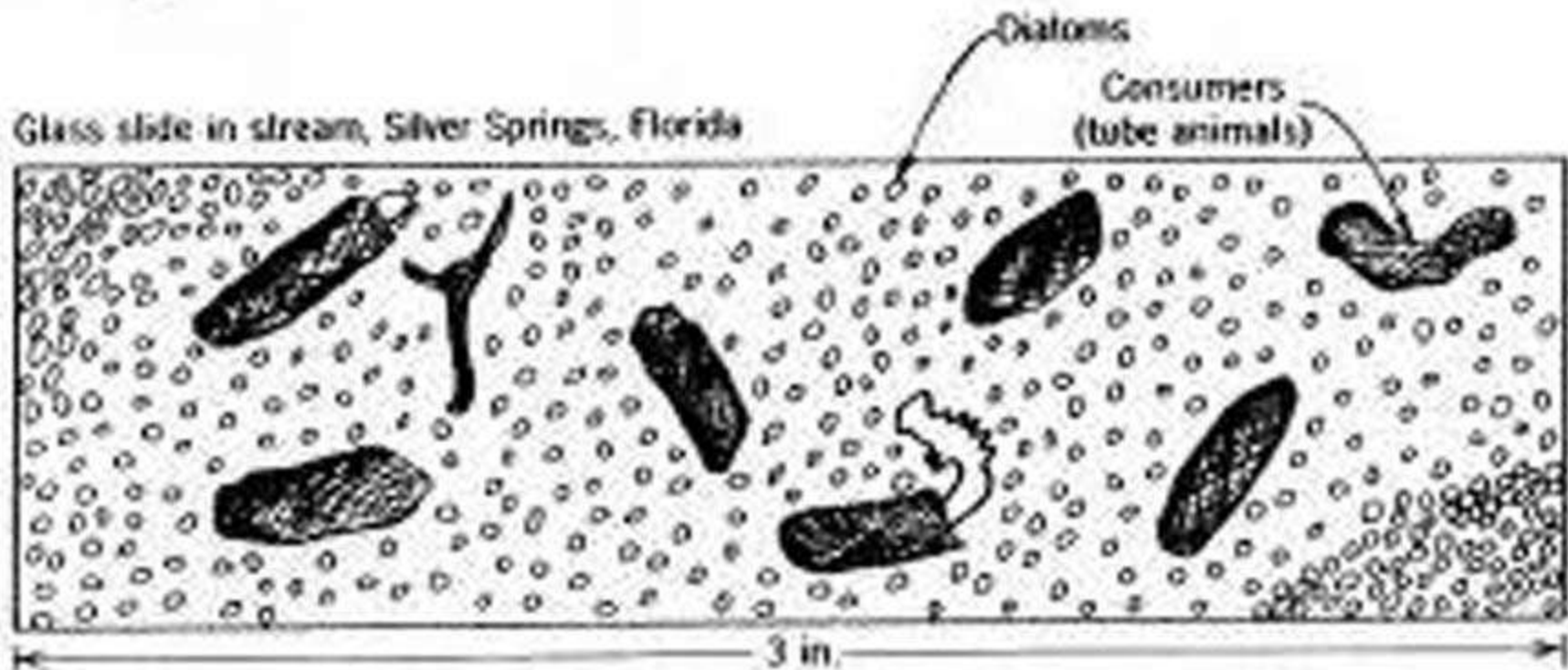
Top view of P-R systems



- - -> $\text{CO}_2 + \text{H}_2\text{O} + \text{minerals (waste, fertilizer)}$
—> $\text{O}_2 + \text{fuel}$

P is photosynthesis
R is respiration

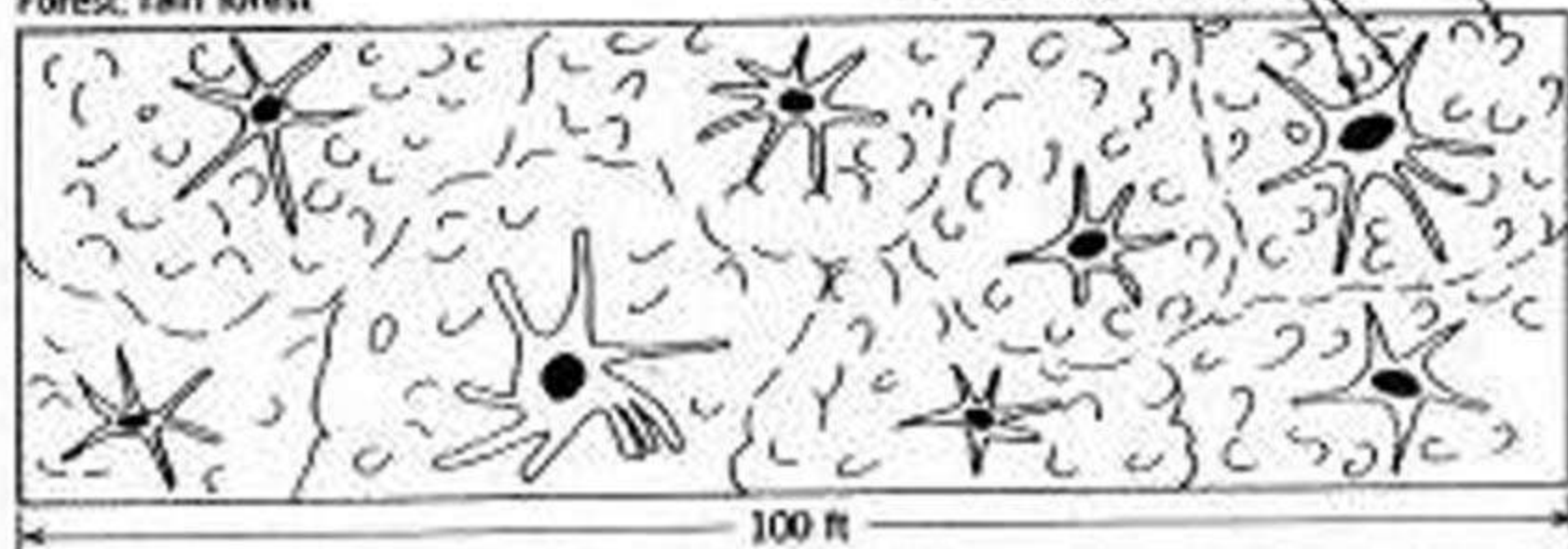
Glass slide in stream, Silver Springs, Florida



Forest, rain forest

Trunks, roots, branches

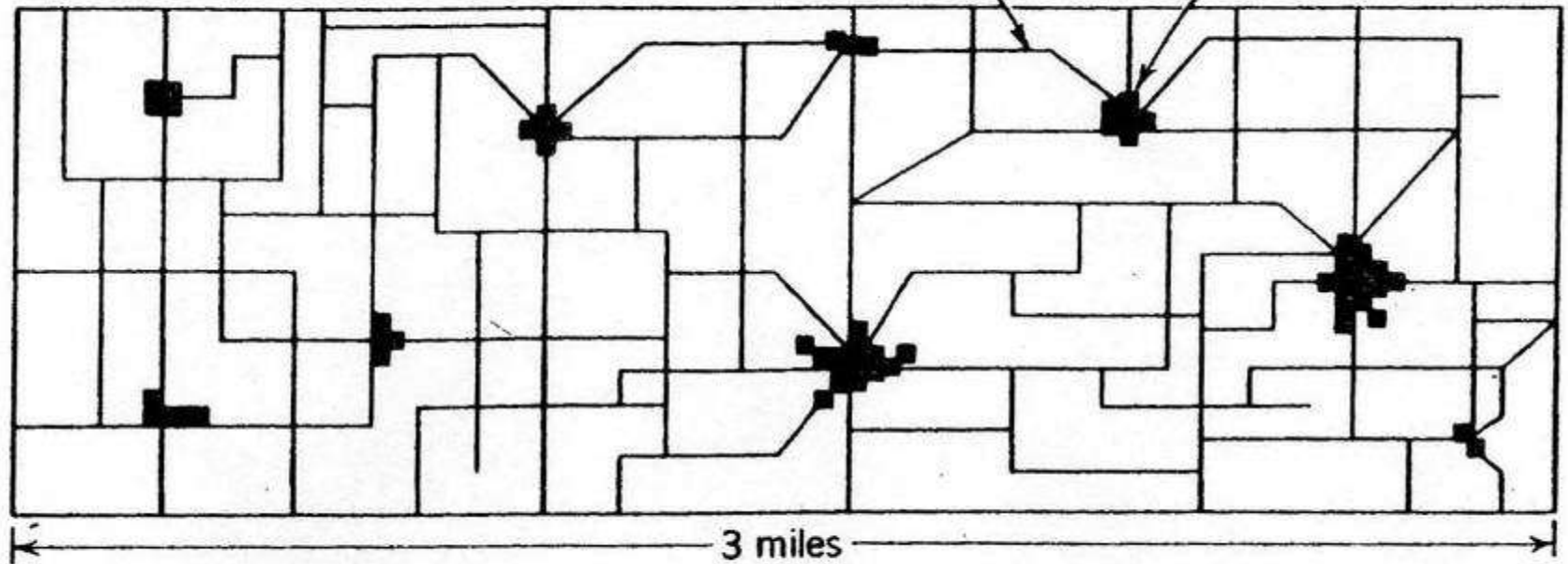
Leaves



Agricultural system, Kansas

Country roads

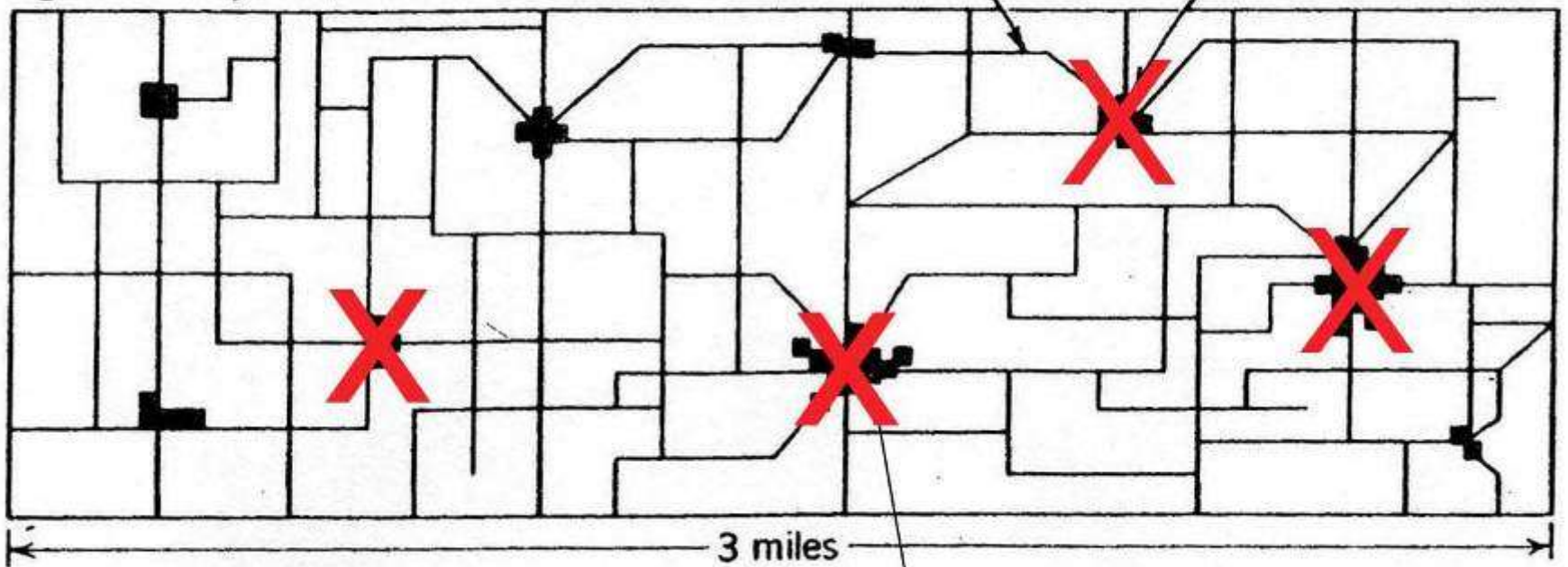
Houses



Agricultural system, Kansas

Country roads

Houses



3 miles

Small towns and villages

**Does contemporary sunlight
for food production and
harvest require a sufficiency
of people?**



Since 1948:

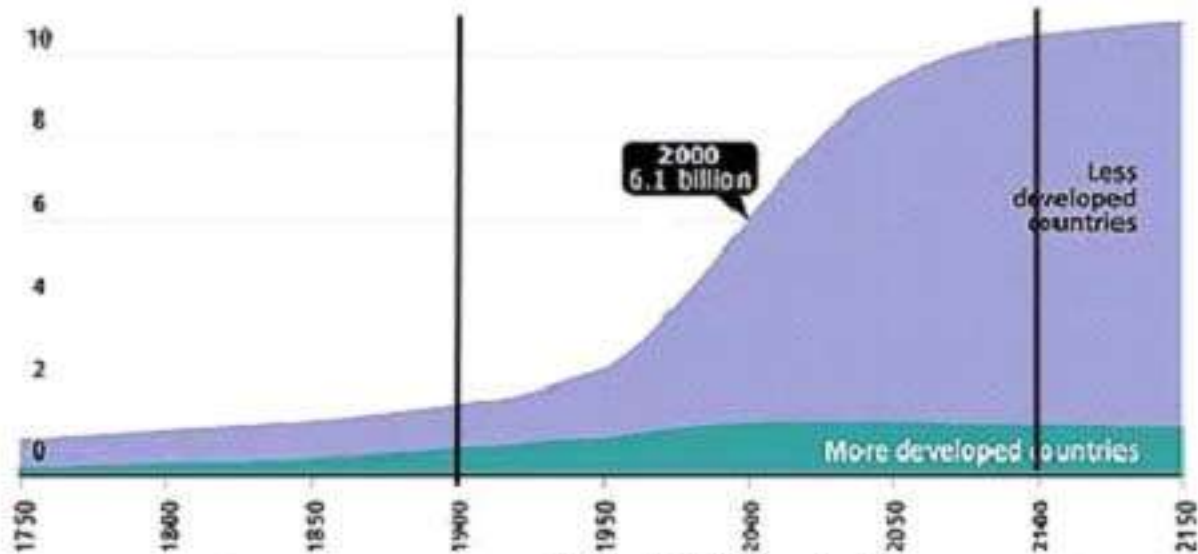
More people

More in cities

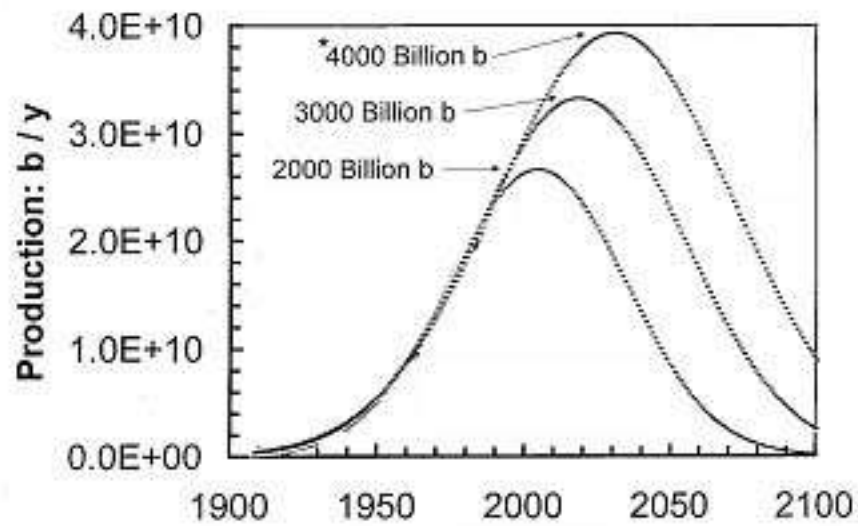
Fewer on the land

World Population Growth, 1750–2150

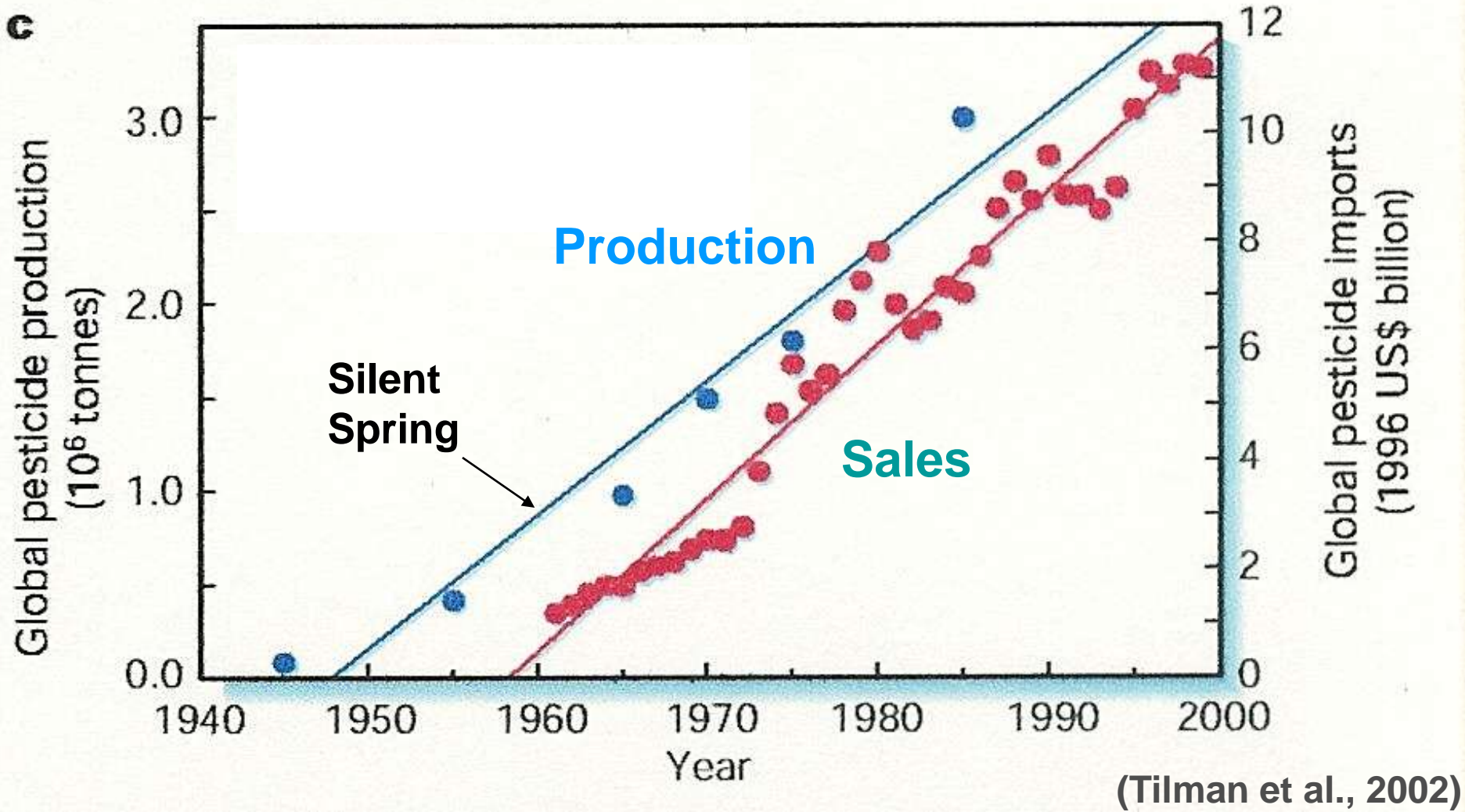
Population (in billions)



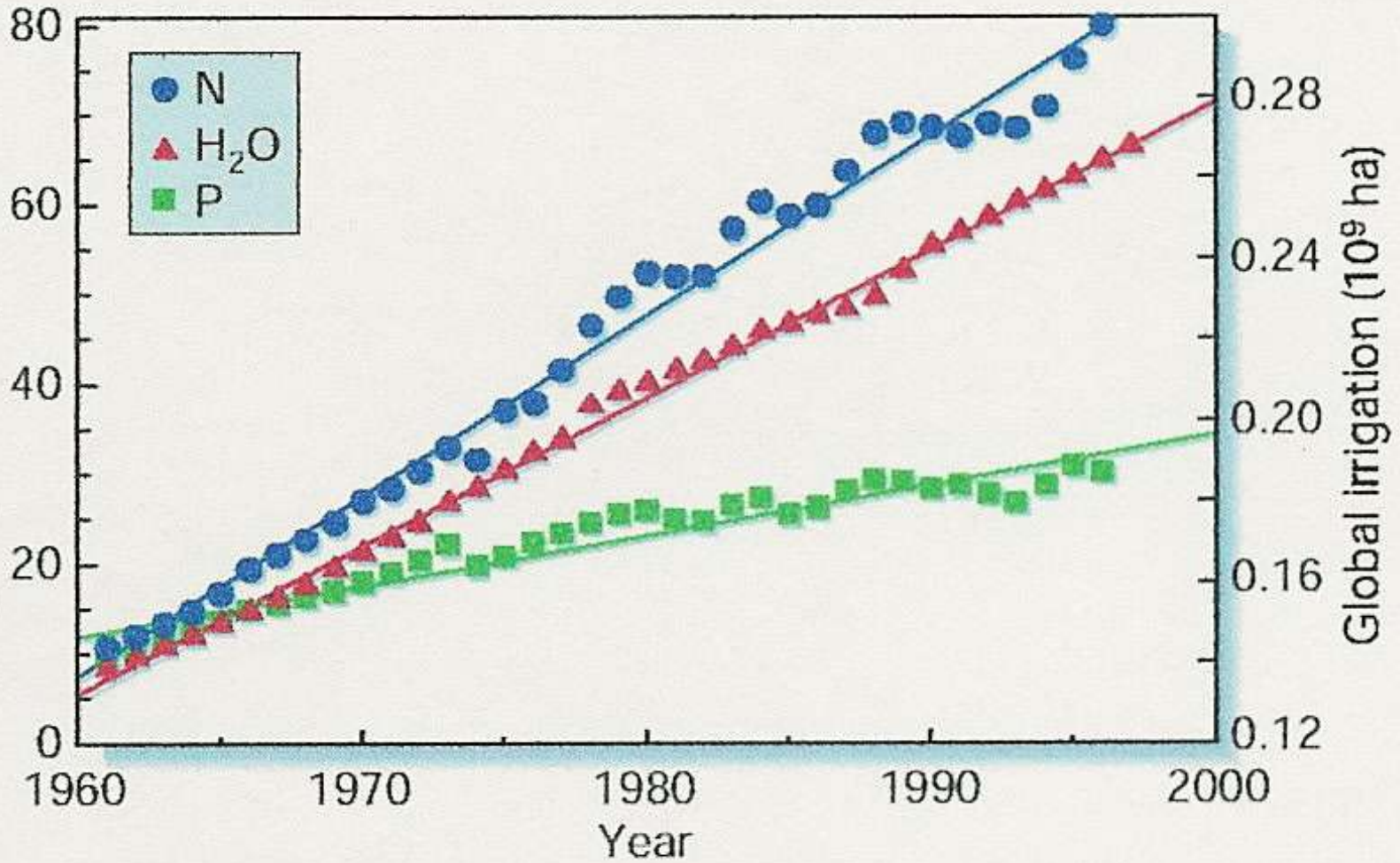
Global Oil Production



**What has been the
change on the
land?**



b
Nitrogen and phosphorus fertilizer
(10^6 tonnes; World-USSR)



(Tilman et al., 2002)





Agriculture: primarily monocultures of annuals

Satellite image of plant activity in the Corn Belt



April 6 – April 19

- 40% of US waters unfit
..for swimming & fishing
- 70% of US water ..
...contamination due to ag
- At least one pesticide ..
.. found in nearly every ..
.. water & fish sample in ..
...agricultural areas
- Pesticides increase ..
.. vulnerability to pathogens
.. at sub-lethal levels
- Atrazine: most commonly
.. used—most commonly ..
...detected
- Atrazine: inhibits normal
.. sexual development in..
..amphibians <0.1 ppb
- Pesticide levels associated
..with annual cropping

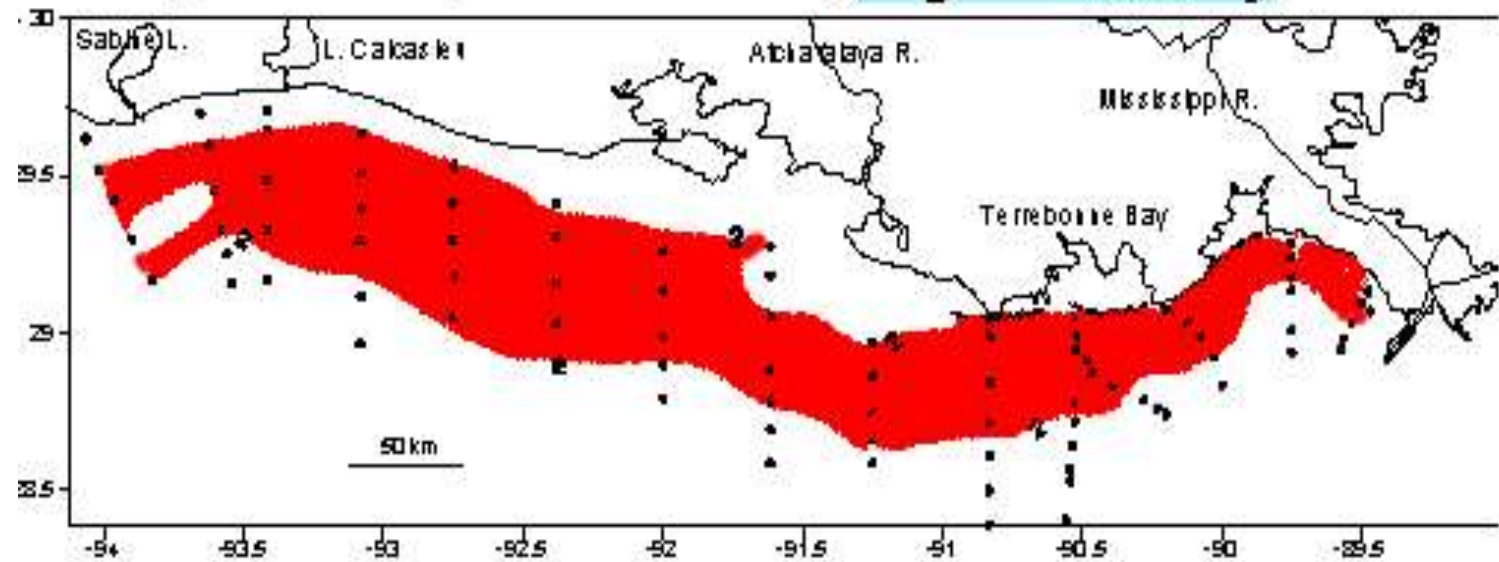


**Changes
in the
sea?**

Mississippi River Basin with Gulf of Mexico Hypoxia



Hypoxia Area - July 20-25, 2001



Loss of Cultural Capacity



**What
the experts say**

A Different Planet

“In most parts of the world, human activities, and agriculture in particular, have resulted in decreases in net primary productivity from the levels that likely existed prior to human management.”

(Field, 2001, Science)

“Confronting the Human Dilemma”

Millennium

Ecosystem

Assessment (MEA)

– a U.N. sponsored
assessment of the
state of the planet

Agriculture: the “largest
threat to biodiversity and
ecosystem function of any
single human activity.”

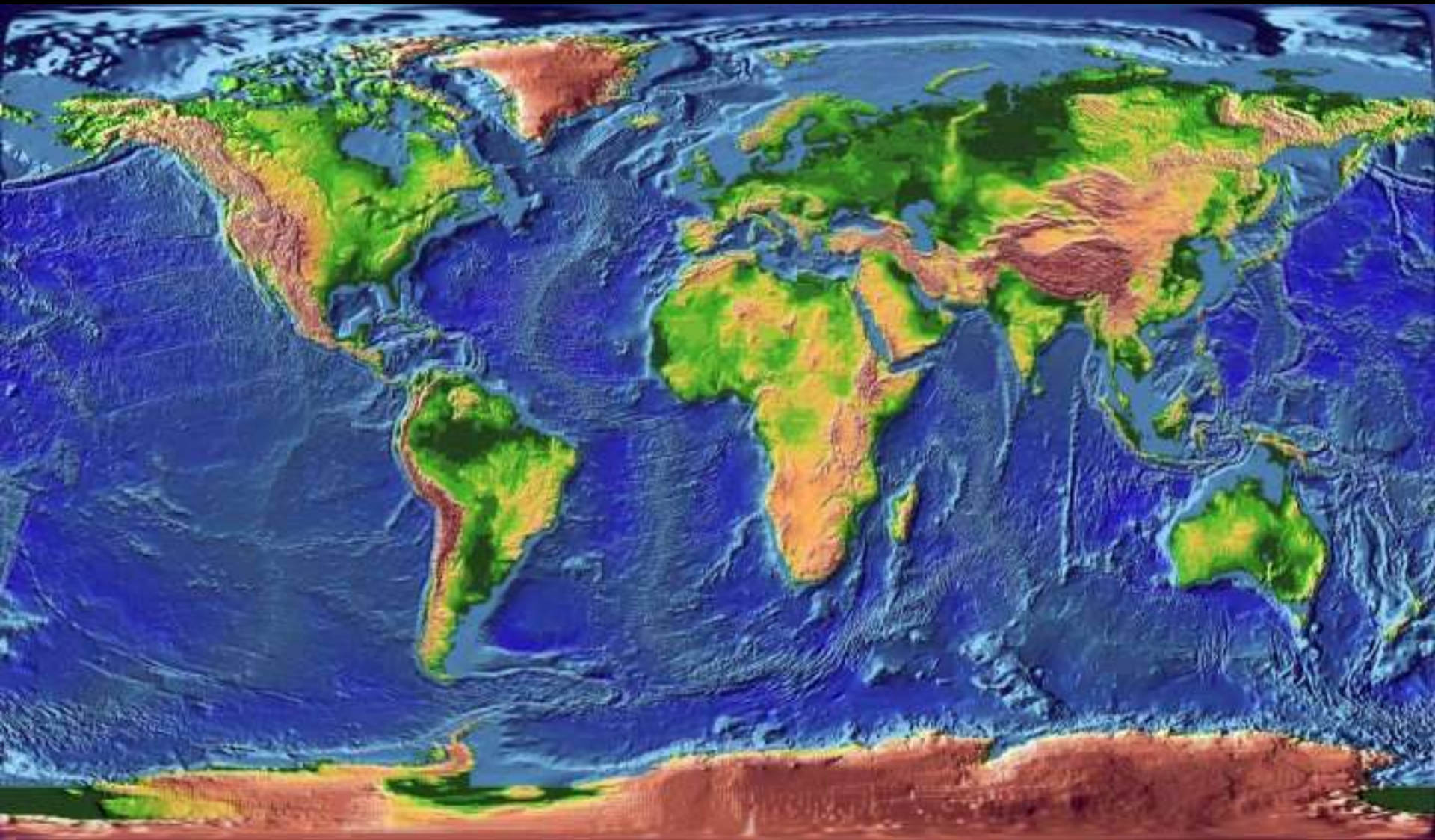
**But the
problem of agriculture
goes back to its beginnings
10-12,000 years ago with
soil erosion.**

Why is soil important?

Periodic Table of the Elements

1 H 1.007																	2 He 4.00													
3 Li 6.94		4 Be 9.01																		5 B 10.0		6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2				
11 Na 23.0		12 Mg 24.5																		13 Al 27.0	14 Si 28.0	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9					
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8													
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 99.0	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131													
55 Cs 133	56 Ba 137	57-71 See Below	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 208	84 Po 209	85 At 210	86 Rn 222													
87 Fr 223	88 Ra 226	89- See Below	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 262	108 Hs 265	109 Mt 266	110 271	111 272																				
																57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm 147	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
																89 Ac 227	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu 242	95 Am 243	96 Cm 247	97 Bk 245	98 Cf 251	99 Es 254	100 Fm 253	101 Md 256	102 No 259	103 Lr 260

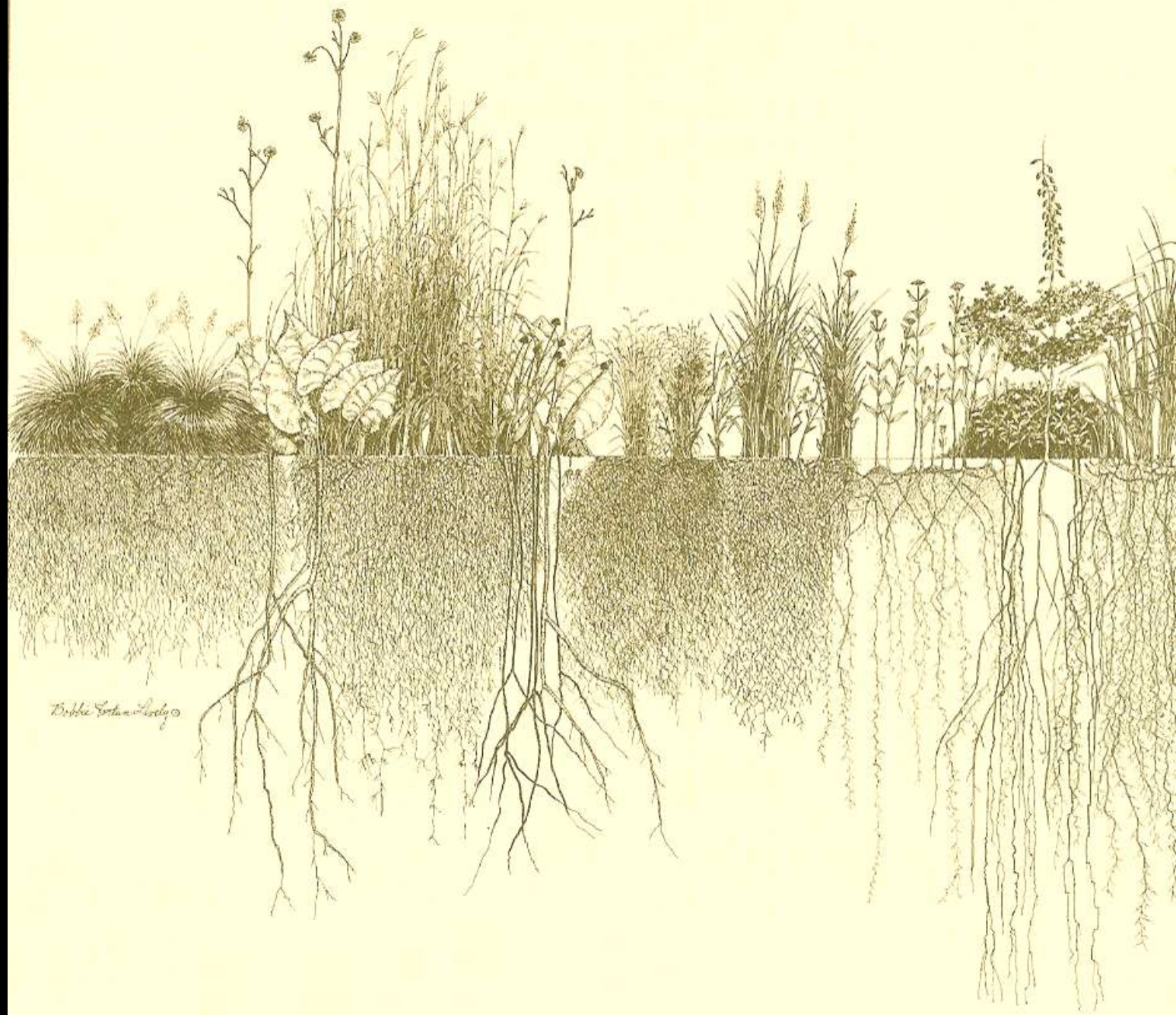
**What are Nature's
arrangements on the
landscape?**









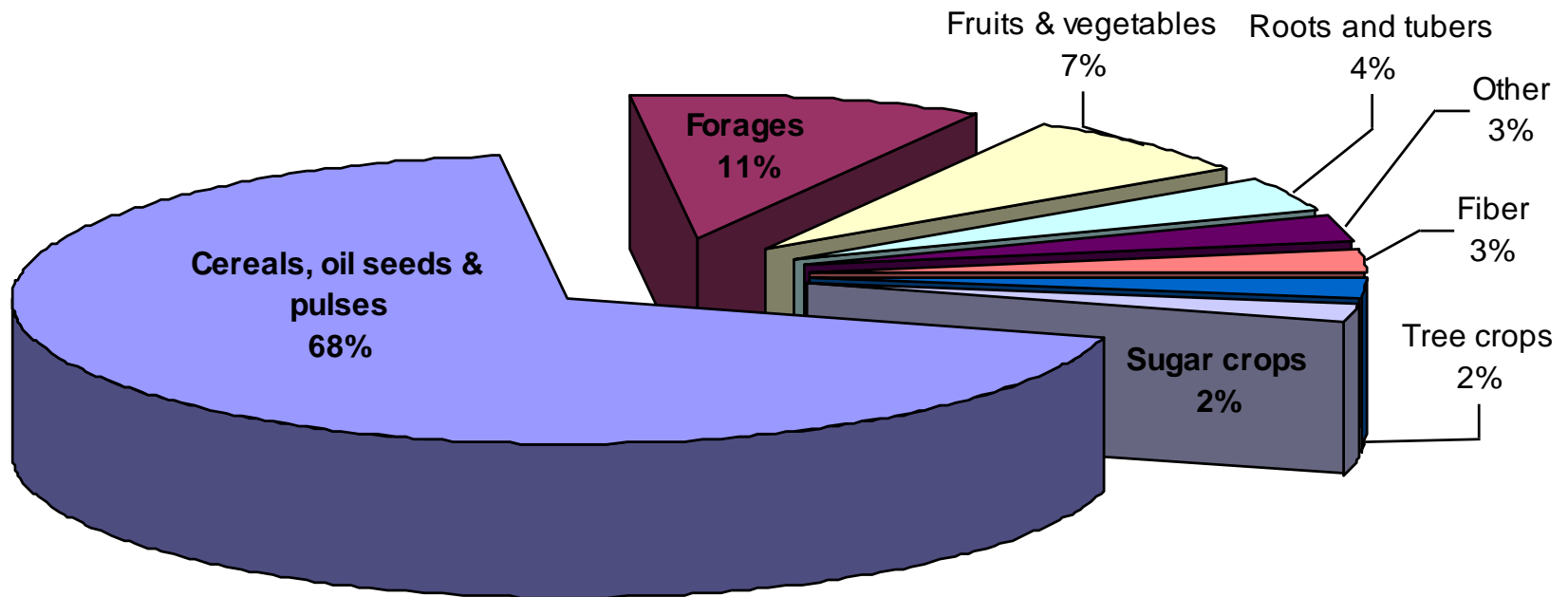


Bobbi Sutton-Lord ©

**Agriculture mostly reversed
nature's way**

The Global Ag Reality

2000 Distribution of Global Agricultural Acres

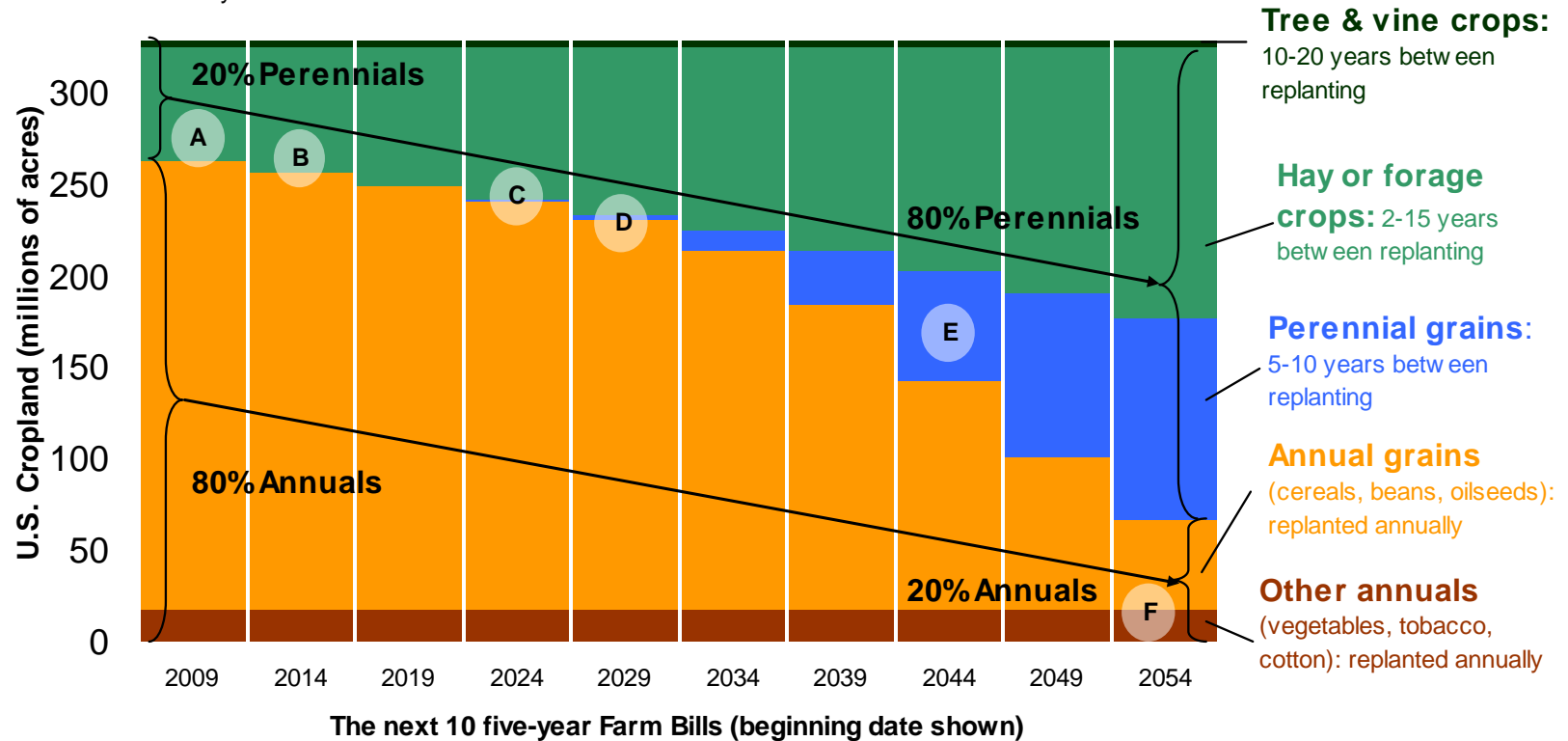


The Core Proposal of the 50-Year Farm Bill

Protecting our soil with perennials: National acreage goals for the next 50 years.

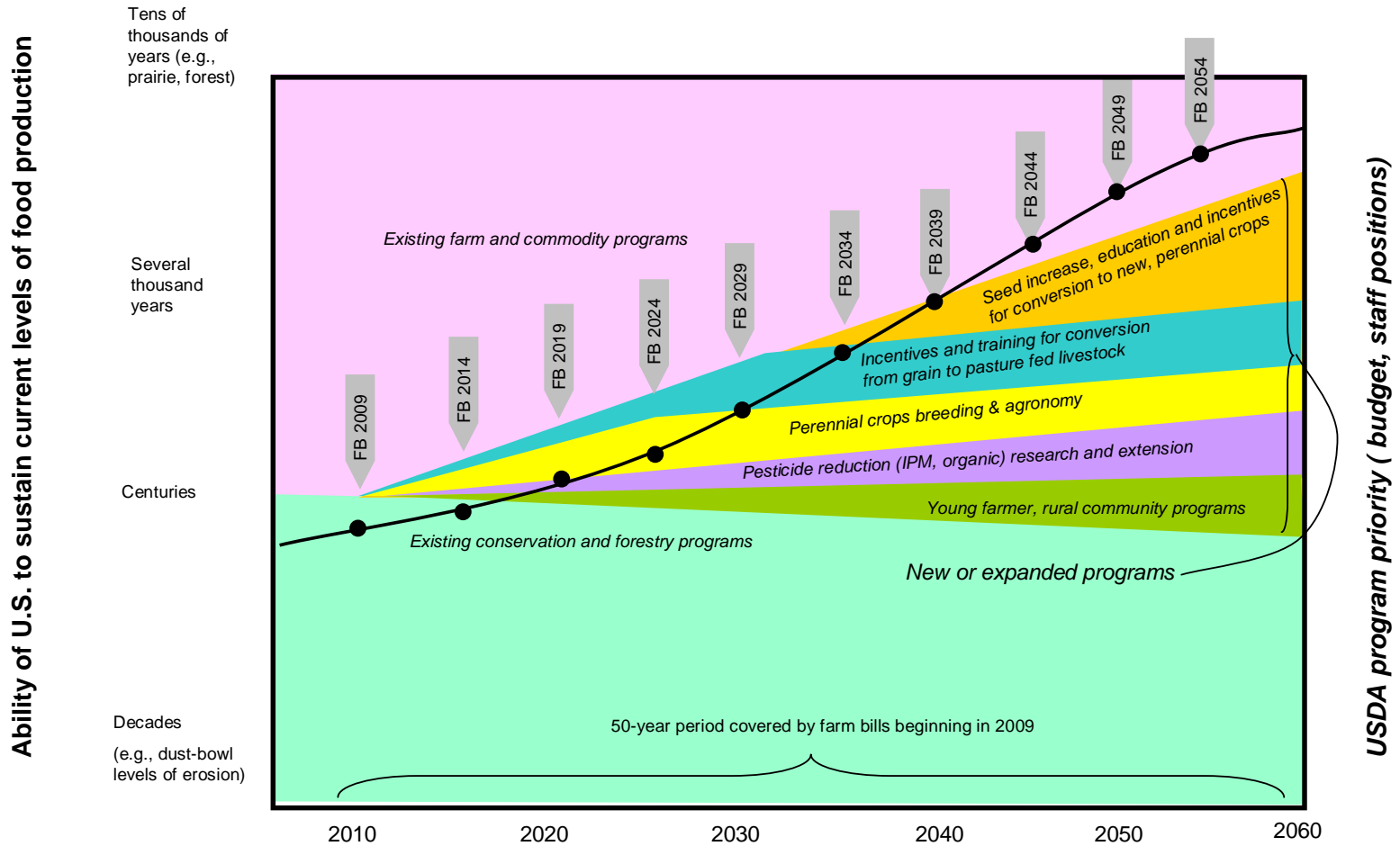
Half a century of concerted investment in research, education and incentives could increase the acreage protected by deep-rooted, long-lived perennial crops from 20% to 80%.

Unlike rangeland or forests, the individual fields that comprise our nation's 320 million acres of cropland are frequently being rotated between different crops. A field producing corn one year may be planted to potatoes or hay the next year. Government programs influence which kinds of crop gain or lose acreage over time. We are proposing agricultural programs that would influence farmers to rotate fields into and between perennial crops more and more often over the next 50 years.



(A) "Combine for Cows" exchange program helps grain farmers convert to hay or grazing operations;(B) Subsidies continue to serve as an incentive for the substitution of grass for grain in meat, egg and milk production ;(C) First perennial grain crops released after years of intense development; (D) Farmer and consumer education about new grain crops; (E) New perennial grain varieties for expanded geographical range (F) High value annual crops now mainly grown on the least erodible fields or as short rotations between perennial crops.

A 50-year plan to increase the productive lifespan of US cropland through changes in USDA program priorities



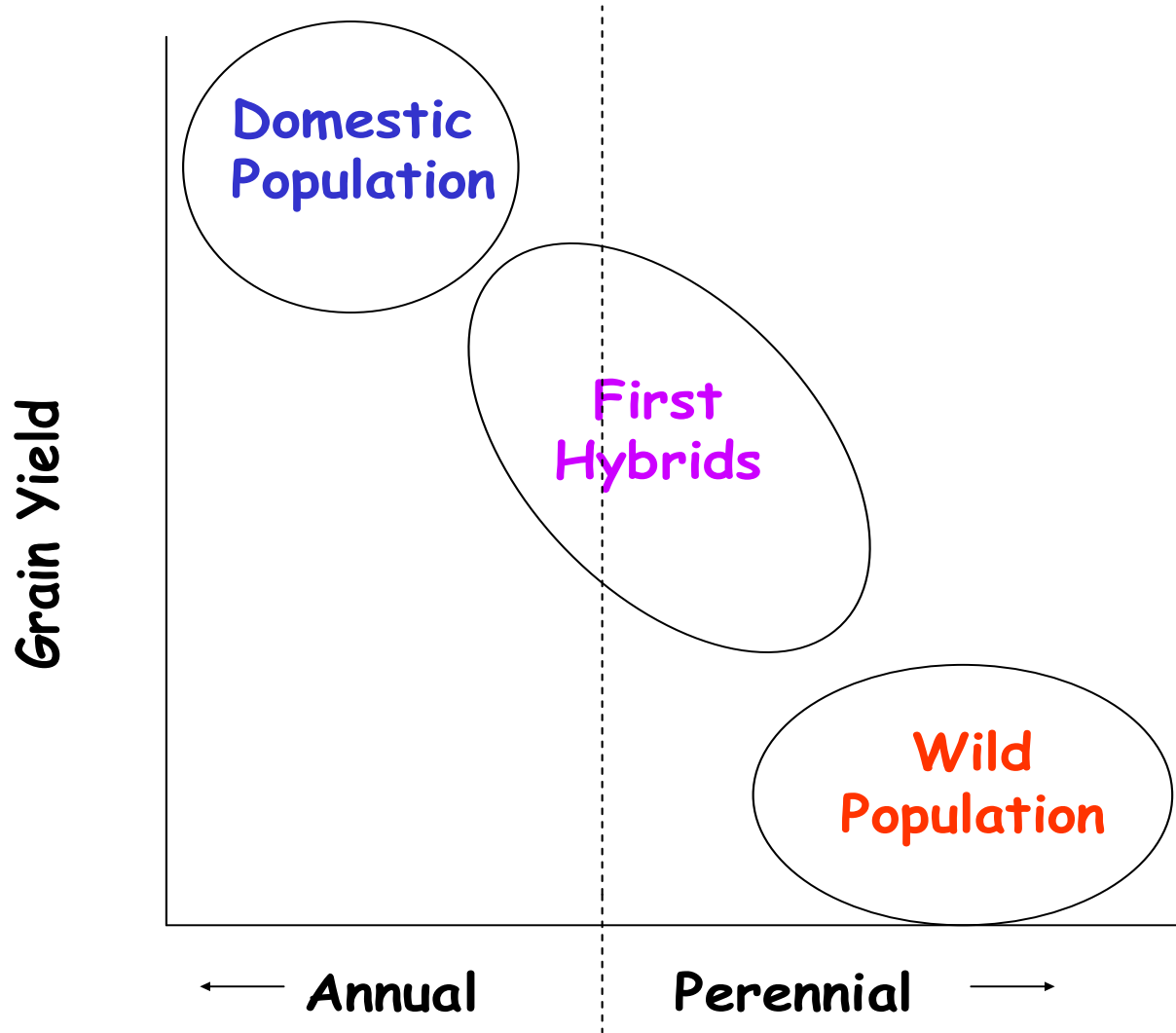
Closed circles indicate estimates—changing over time as annual grains are replaced by perennial crops—of the remaining productive life of U.S. agriculture shown on the left-hand axis. Colored areas and captions in italics refer to changes in USDA priorities (right-hand axis) as the result of new policies reflected in the next 10 farm bills.

But is it possible?

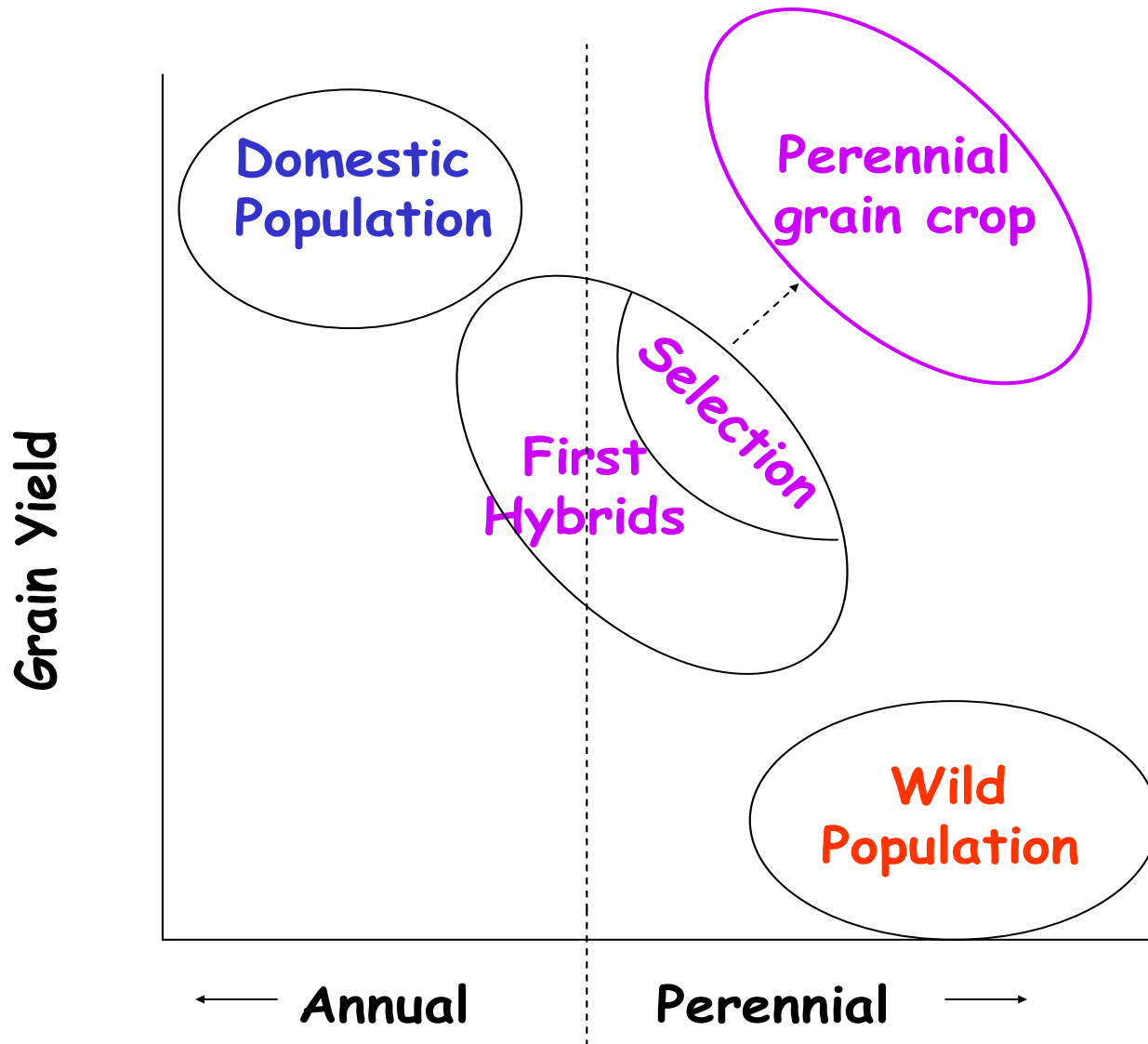
Breeding Perennial Grains



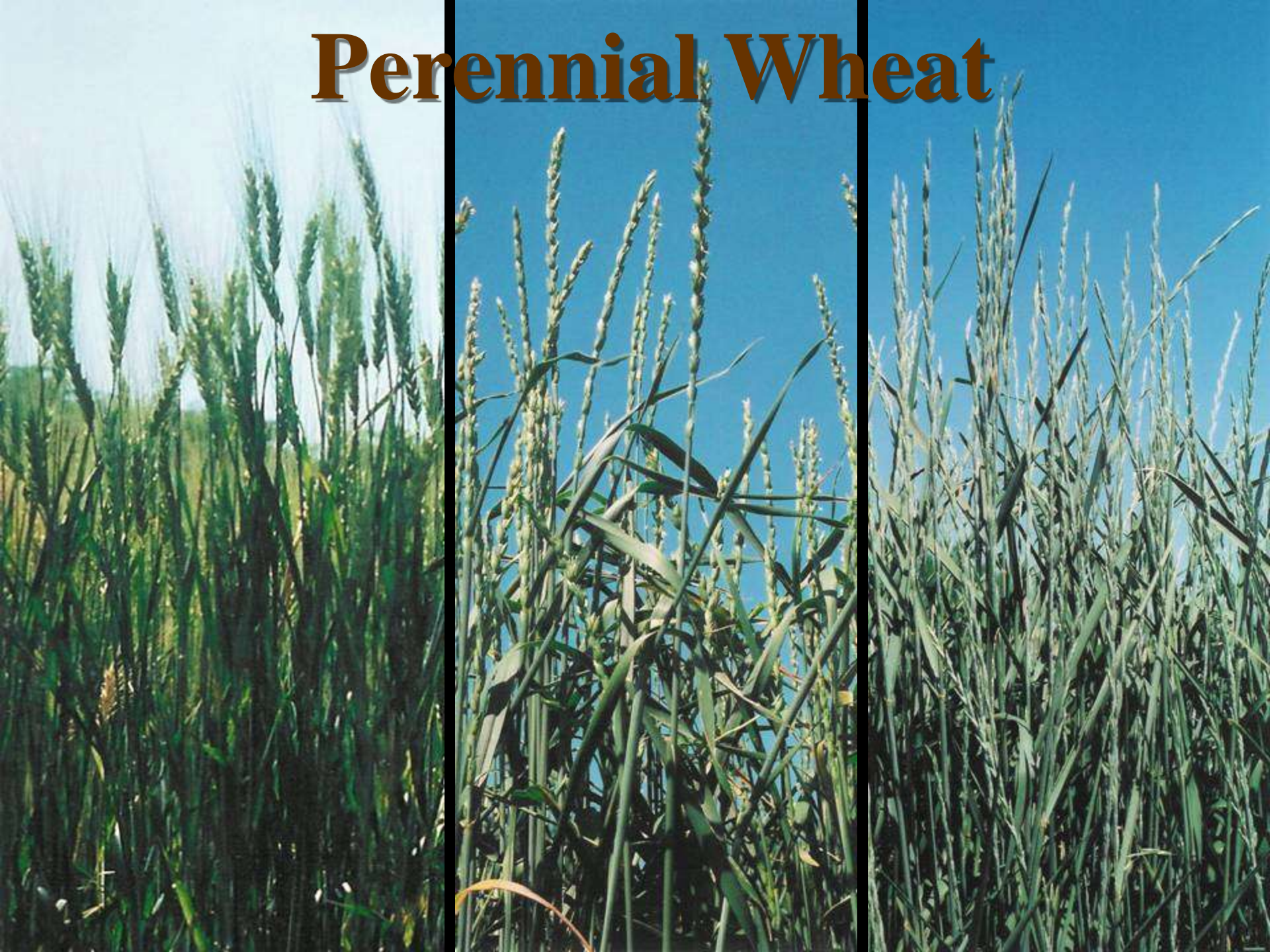
Perennial Grain Development Via Wide Hybridization



Perennial Grain Development Via Wide Hybridization



Perennial Wheat





12.18.2001







annual

perennial

October 27, 2003

Sept

Dec

March

June

1 m

2 m

12 mos

21 mos

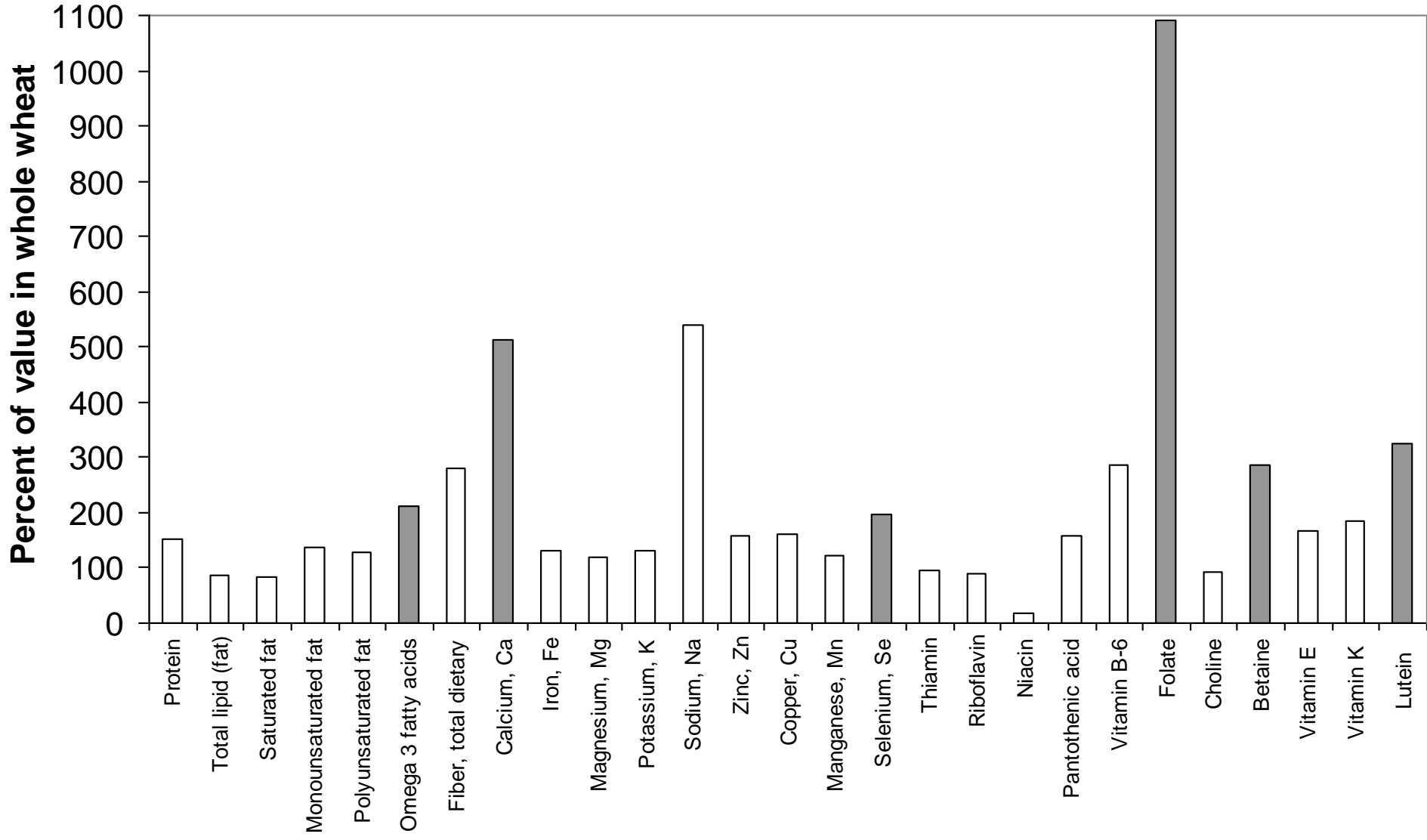
Annual wheat (on left in each panel) and Perennial wheatgrass



September, 2005: Field trial of 1000 intermediate wheatgrass plants divided into 3 clonal replicates each









Sorghum bicolor,
 $2n = 20$



Sorghum halepense,
 $2n = 40$



Illinois bundleflower, *Desmanthus illinoensis*





X



Helianthus annuus

H. maximiliani



Lowlands: paddies store water, minimize erosion



But...



But...

Crops are also grown on the steep hills where it is too costly to terrace



Professor Feng-yi Hu at Yunnan Academy of Agricultural Sciences shows us progeny of a cross between rice and a wild perennial species



A rhizomatous plant?



“mother” plant

Shoot growing from an
underground rhizome ??



Crosses are made with the very rare plants that have

- rhizomes
- viable pollen
- good seed set

Australia: salinization



Washington state, USA



S. Jones, 2001

**Australia, China, United
States and Canada**

**Does it have
intellectual legs?**

CURRENT PLANT SCIENCE AND
BIOTECHNOLOGY IN AGRICULTURE

Agriculture as a Mimic of Natural Ecosystems

E.C. Lefroy
R.J. Hobbs
M.H. O'Connor
J.S. Pate
editors



KLUWER ACADEMIC PUBLISHERS

**Are professors and
graduate students
interested?**



**This vision of Nature as a
standard or measure
fits K-State's
longstanding motto**

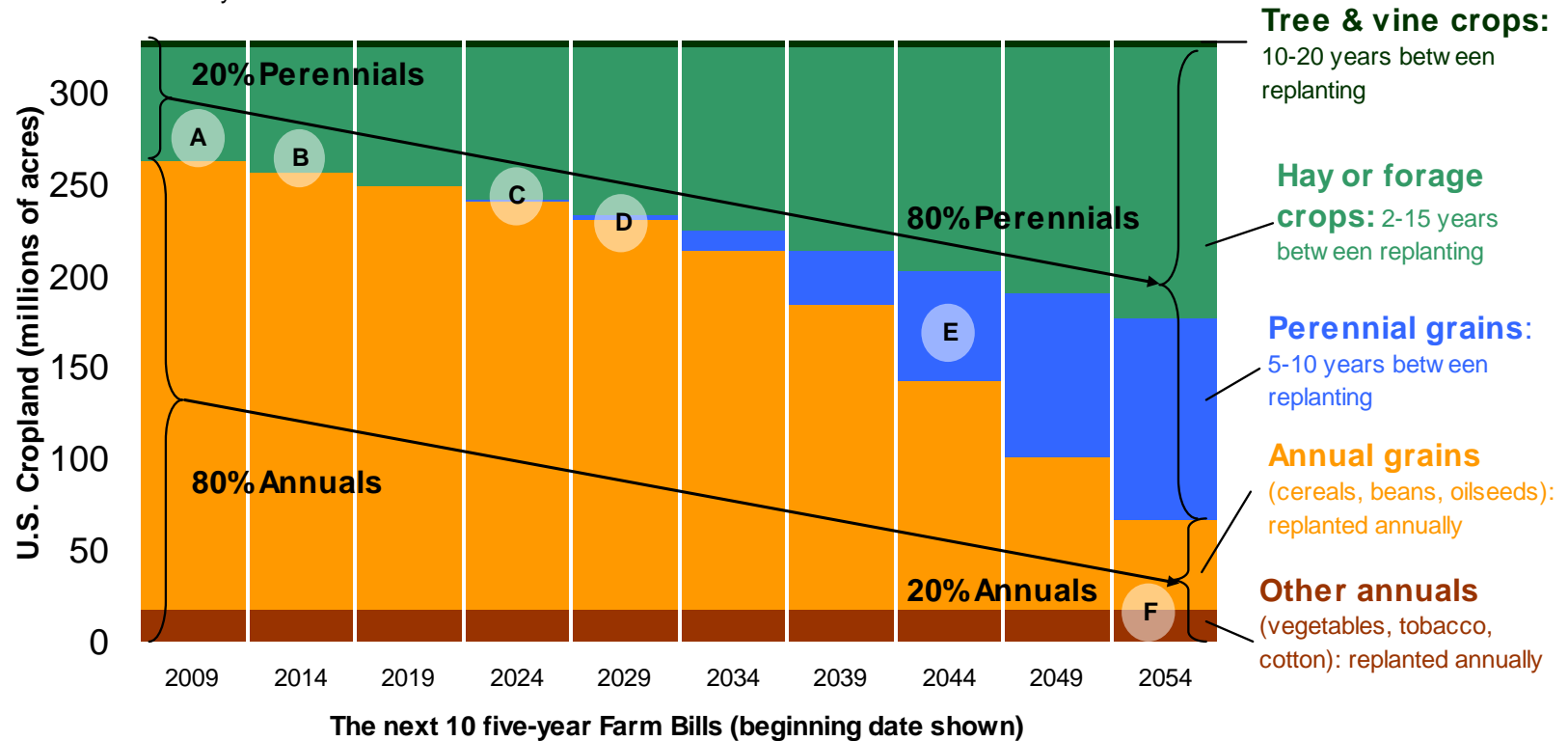


This seal reading "Kansas State University, February 16, 1863" may be used without permission.

Protecting our soil with perennials: National acreage goals for the next 50 years.

Half a century of concerted investment in research, education and incentives could increase the acreage protected by deep-rooted, long-lived perennial crops from 20% to 80%.

Unlike rangeland or forests, the individual fields that comprise our nation's 320 million acres of cropland are frequently being rotated between different crops. A field producing corn one year may be planted to potatoes or hay the next year. Government programs influence which kinds of crop gain or lose acreage over time. We are proposing agricultural programs that would influence farmers to rotate fields into and between perennial crops more and more often over the next 50 years.



(A) "Combine for Cows" exchange program helps grain farmers convert to hay or grazing operations;(B) Subsidies continue to serve as an incentive for the substitution of grass for grain in meat, egg and milk production ;(C) First perennial grain crops released after years of intense development; (D) Farmer and consumer education about new grain crops; (E) New perennial grain varieties for expanded geographical range (F) High value annual crops now mainly grown on the least erodible fields or as short rotations between perennial crops.



**THE LAND
INSTITUTE**

SALINA, KANSAS
www.landinstitute.org



**So, Let's
Get On With It!**