

When the Cupboard Is Bare



BRONX BOUNTY City Harvest, which collects surplus food from restaurants and grocers, runs a twice-monthly farmers' market in the South Bronx.

When the Cupboard Is Bare

REBECCA MUSCARELLO had long worked as a secretary, so she never imagined that at age 35 she would be left with no choice but to take her two children to a food pantry to get groceries. But like a growing number of Americans whose jobs have evaporated in a shrinking economy, Ms. Muscarello ran out of money and then food.

Outline for the Day

Ecology, Agriculture, & Soils

Importance of Soil Organic matter

Soil Health and its Management

Understanding soil tests

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Ecology, Natural Systems, and Soil Management

The Limiting Factor framework is reductionist

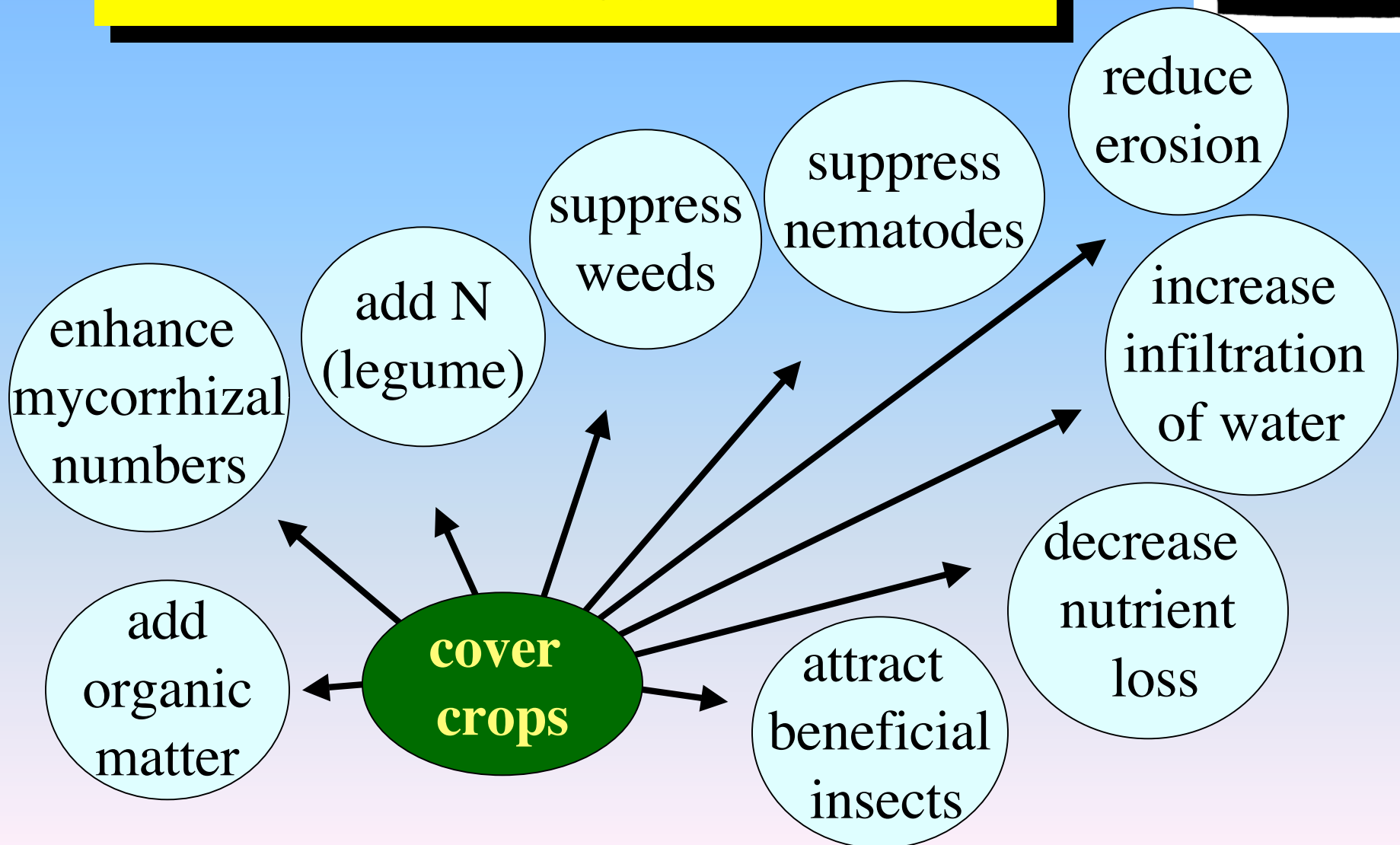
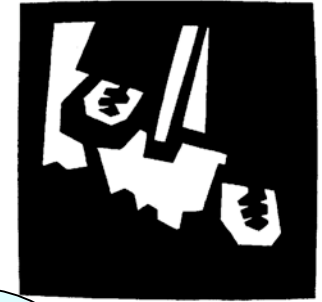
- It encourages us to look at the individual factors separately
 - removed from the relationships and interactions that always occur.
- It encourages us to respond to each “factor” as a separate issue (or problem).

What happens when we reduce our field of vision?

- An example —

Research by soil fertility specialists frequently shows that the economic returns of a legume cover crop is such that the costs of planting and seed just about covers the cost of nitrogen saved. They consider it a marginal practice.

However, practices have multiple effects



Limiting Factor “solutions” are also reductionist

“Problem”

“Solution”

Low N availability

Apply N fertilizer

Insect infestation

Apply insecticide

Compact soil

Use subsoiler


Droughty soil

Irrigate frequently

Weedy conditions

Apply herbicide

Limiting Factor “solutions” are
short-term responses
(reactions) to perceived
“problems”



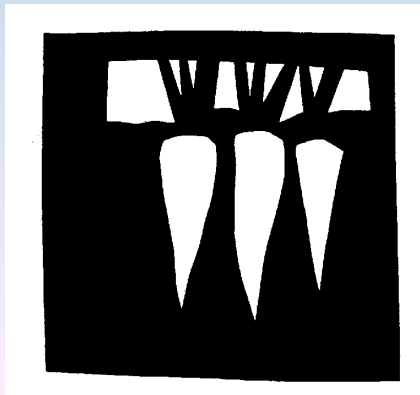
What if the things we think of
as problems are really
symptoms of a deeper and
more fundamental problem?

What if the underlying *problem*
is a poorly managed
ecosystem?

We will need new tools and frameworks to help us understand the real problem and how to address it.

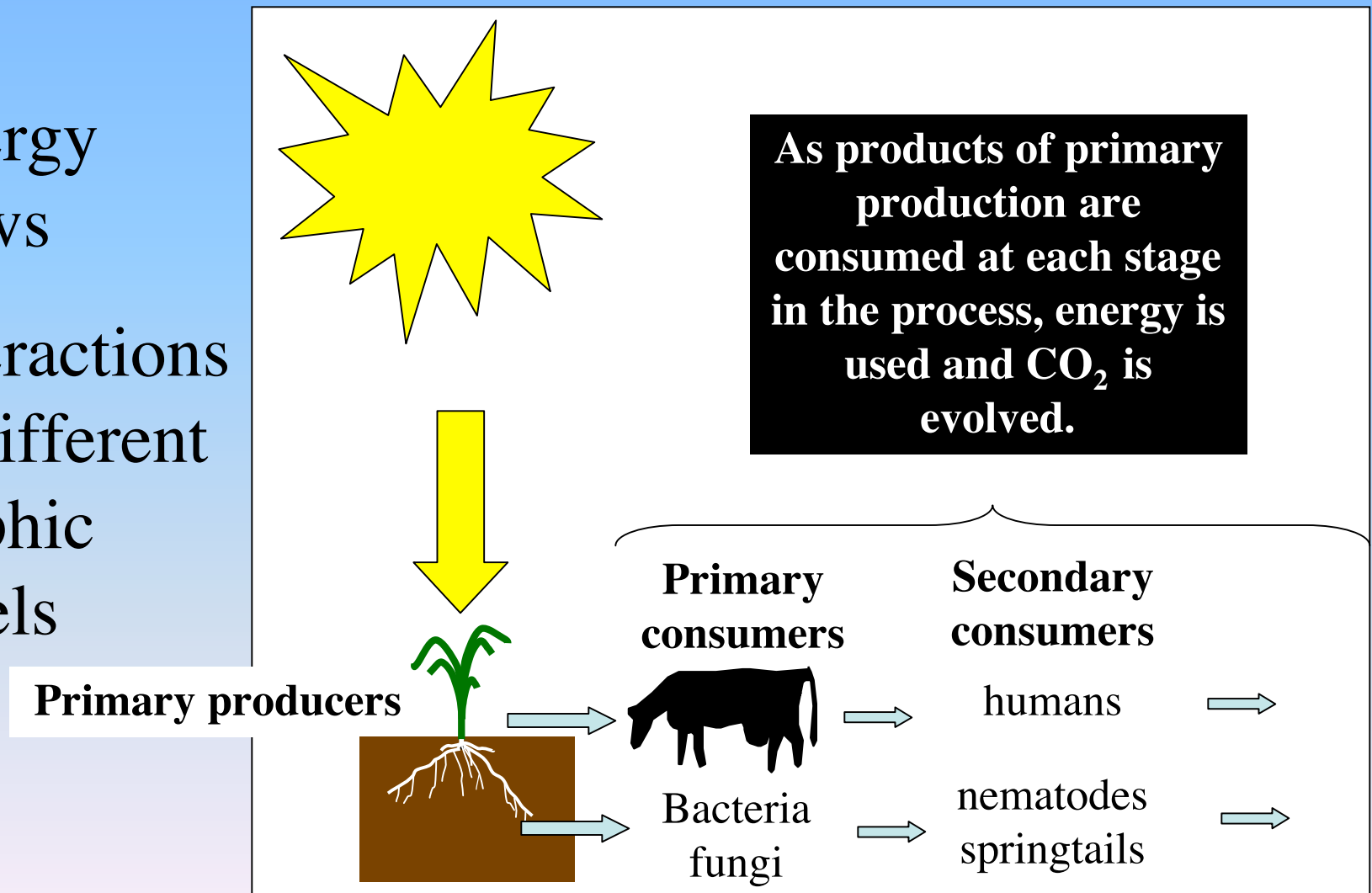


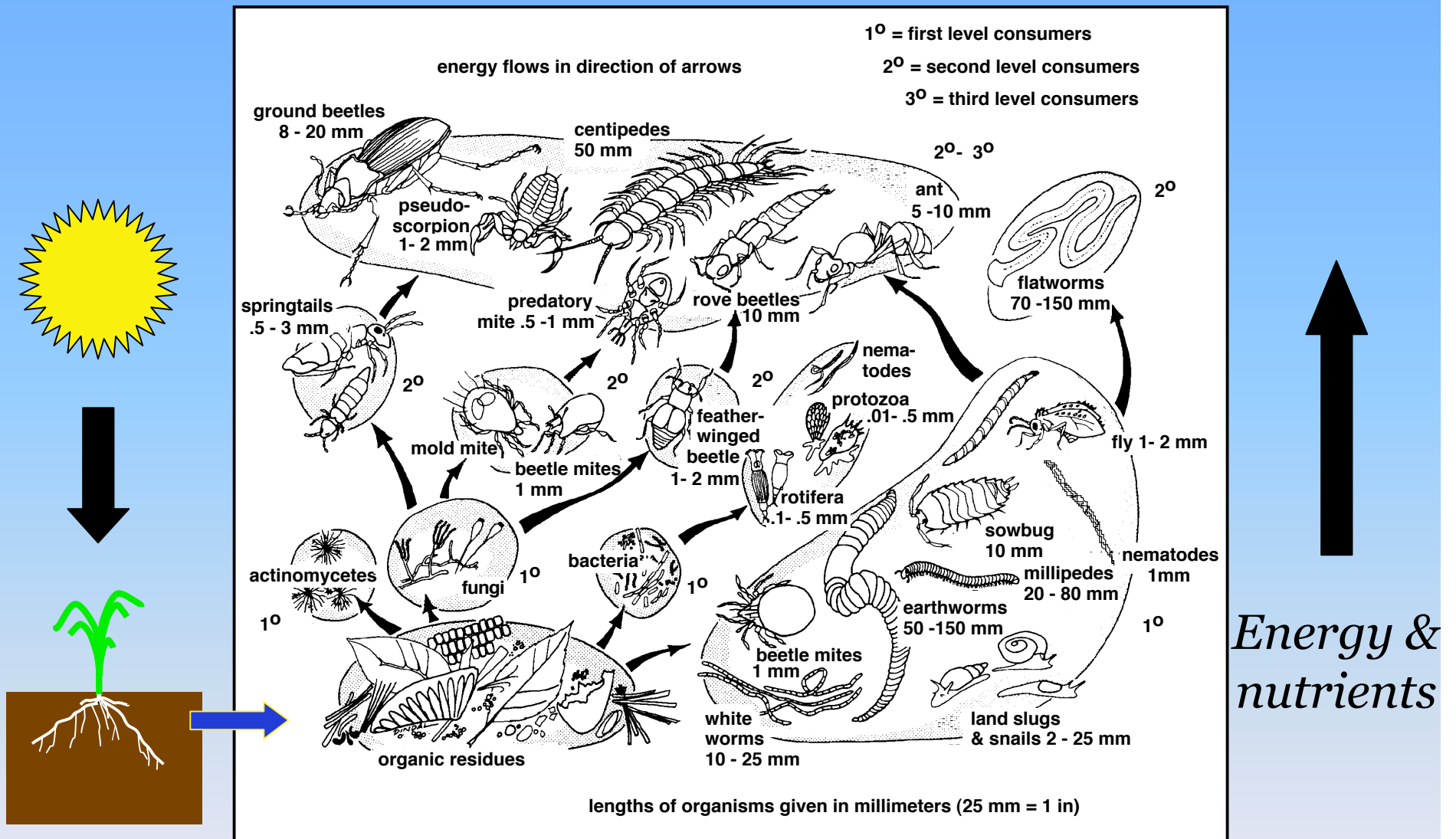
Ecology and the study of natural systems provide a more useful framework than “limiting factors” for approaching agricultural science.



Functioning of Ecosystems

- Energy flows
- Interactions at different trophic levels

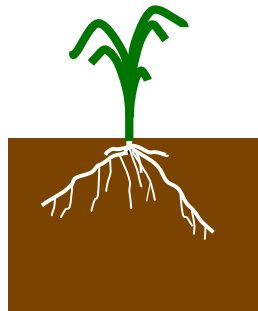
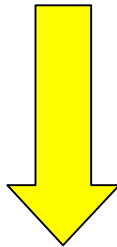
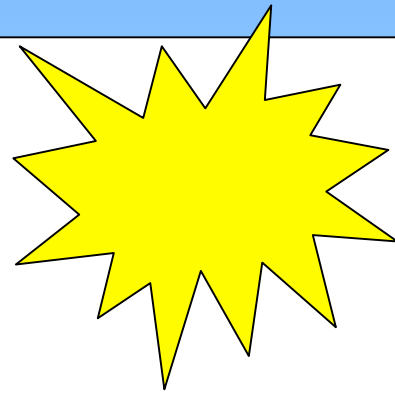




Soil organisms and their roles in decomposing residues.

Functioning of Ecosystems

- ENERGY FLOWS

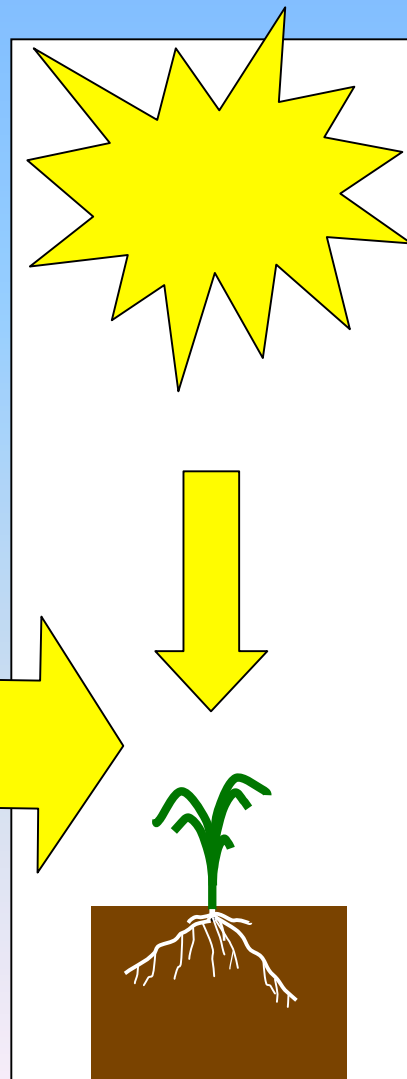


Natural terrestrial ecosystems run mainly on current and very recent past solar energy — this season's sunshine plus residues from recent years.

Functioning of Ecosystems

- ENERGY FLOWS

fertilizers,
pesticides,
machinery, fuel,
etc.



Much of the energy going into Agricultural ecosystems comes from fossil fuels

Table 4: Energy Summary Comparison for Corn with and without Manure

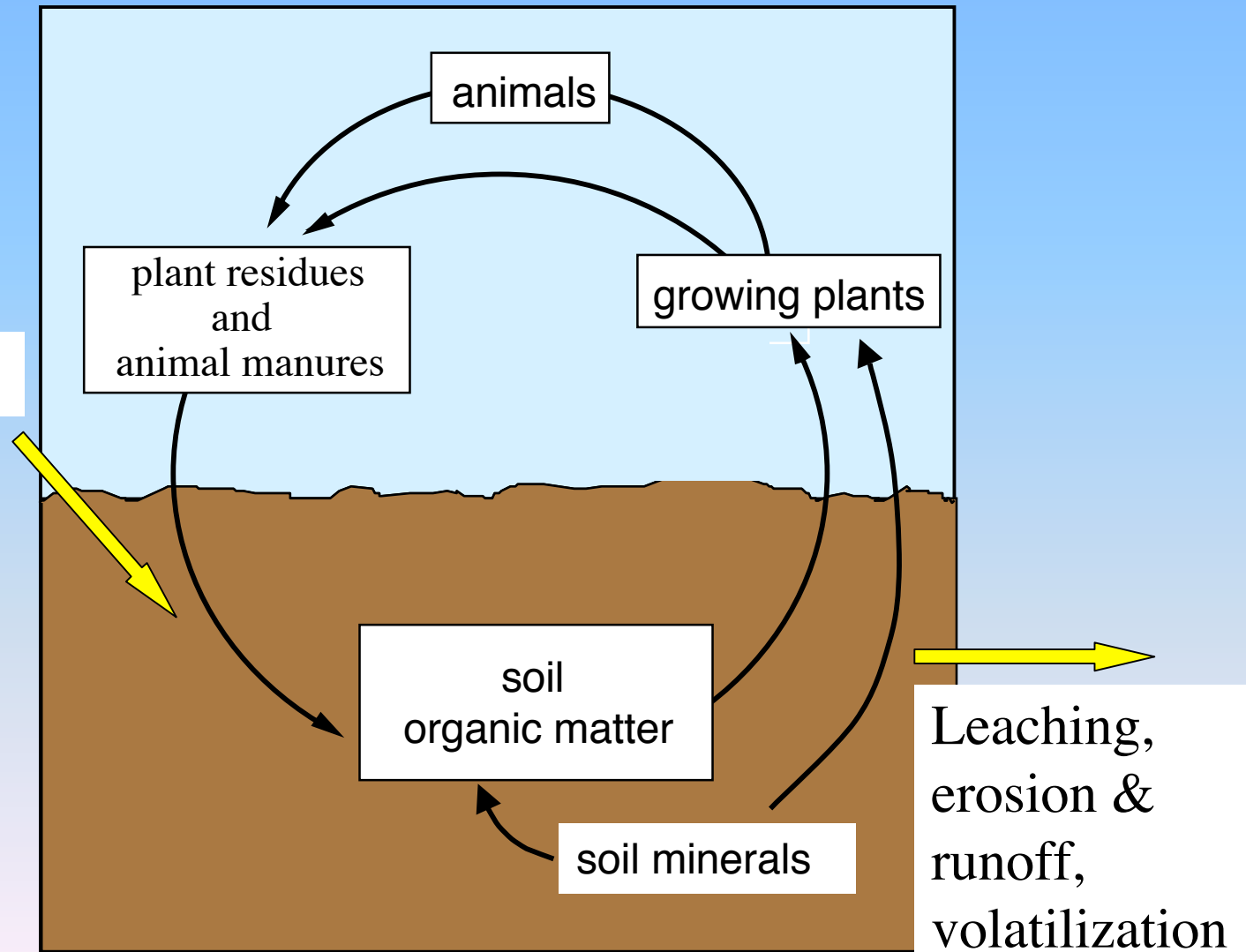
Gallons Diesel Fuel Equiv./A	Corn After Corn	
	+ Manure	- Manure
Produced	29.23	27.07
Used	34.63	38.67
Balance	-5.40	-11.60

Impact of Manure on Costs, Returns, and Energy Use on Corn Fields in Iowa
 by Michael Duffy (Leopold Center for Sustainable Agriculture)

Functioning of Natural Ecosystems

- NUTRIENT FLOWS

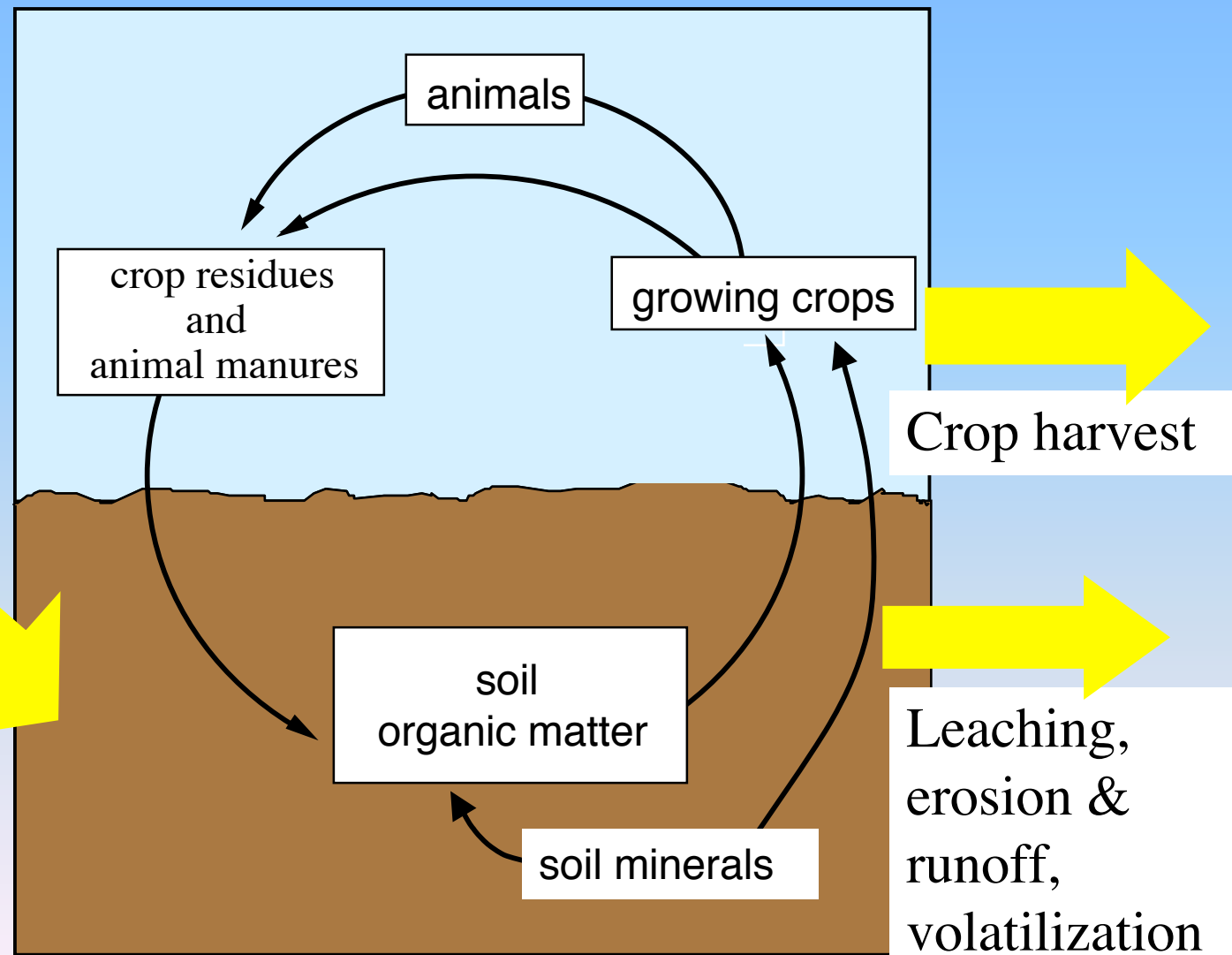
atmosphere

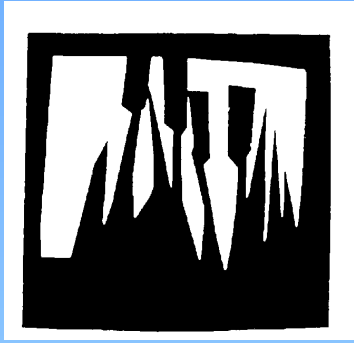


Functioning of Conventional Agricultural Ecosystems

- **NUTRIENT FLOWS**

fertilizers,
amendments,
feeds, etc.





Ecosystems

- Most natural ecosystems have significant inherent strengths.
- These are usually ignored by people working with — and teaching about — agricultural ecosystems.

Strong Natural Ecosystems

The diagram features a light yellow 3D rectangular block at the top, representing the concept of 'Strong Natural Ecosystems'. This block is supported by five vertical blue pillars. Each pillar is topped with a yellow rectangular label containing a specific characteristic. From left to right, the pillars and their labels are: 1. A pillar with a label 'self regulation' positioned to its left. 2. A pillar with a label 'efficiency' positioned to its left. 3. A pillar with a label 'diversity' positioned to its left. 4. A pillar with a label 'self sufficiency' positioned to its right. 5. A pillar with a label 'resiliency' positioned to its right. The background is a light blue gradient.

*self
regulation*

efficiency

diversity

*self
sufficiency*

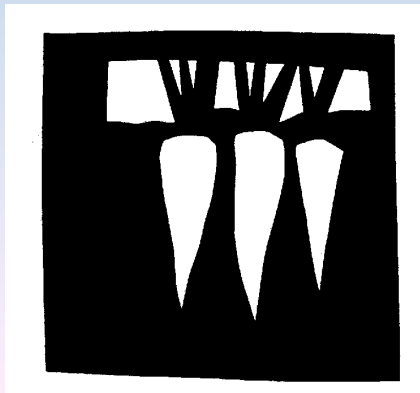
resiliency



Farming

The intentional disturbance of ecosystems to promote a goal

- production of food and fiber.



Strong Agricultural Ecosystems

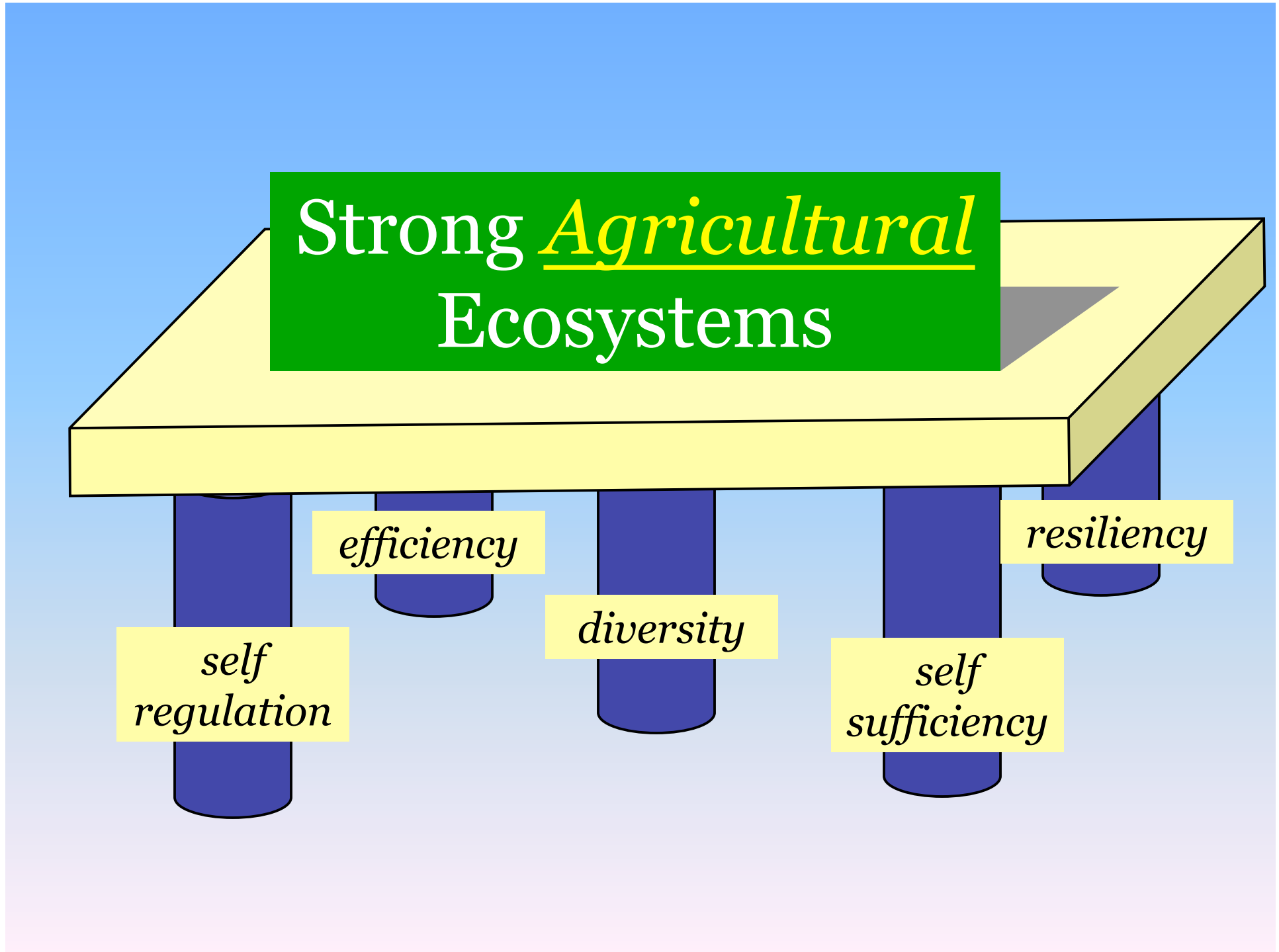
efficiency

resiliency

*self
regulation*

diversity

*self
sufficiency*



Agricultural Ecosystems

The entire farm in its setting, including

- Farmers, farm workers (their needs and skills)
- The soil environment (including living organisms)
- Crop plants in particular fields, rotations, farm animals
- The arrangement of fields (and neighbors' fields?)
- The field boundary vegetation
- The farm buildings and their surroundings
- Riparian zones and streams
- Climate, etc.

The Key Task

Nature provides many natural strengths that allow ecosystems to function efficiently and to be stable and resilient.

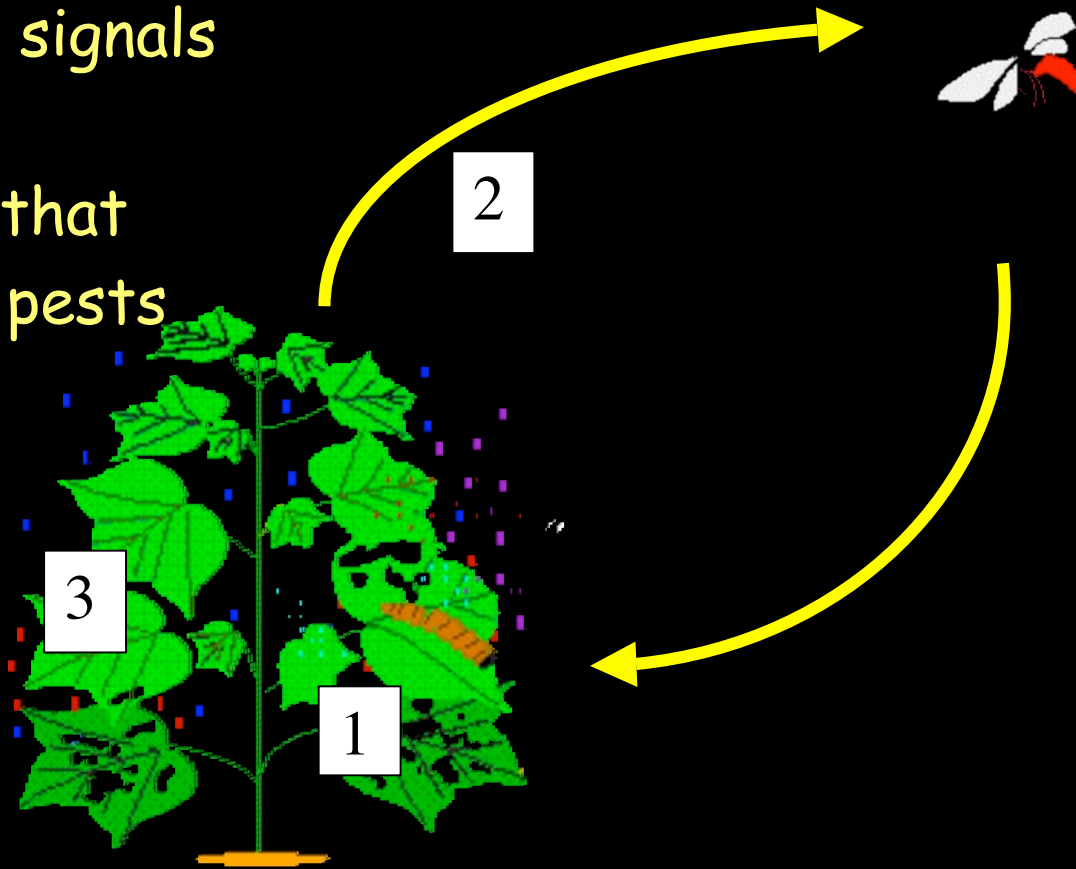
How can we learn to design farms, farming systems, and landscapes to take advantage of the inherent strengths of natural systems, using minimal amounts of external interventions (inputs)?

An Example

Plants have a number of defense systems vs. insects and diseases. How can we strengthen their abilities to defend themselves?

Plants use a number of defense strategies following damage by feeding insects

2) Give off signals to attract beneficials that attack the pests

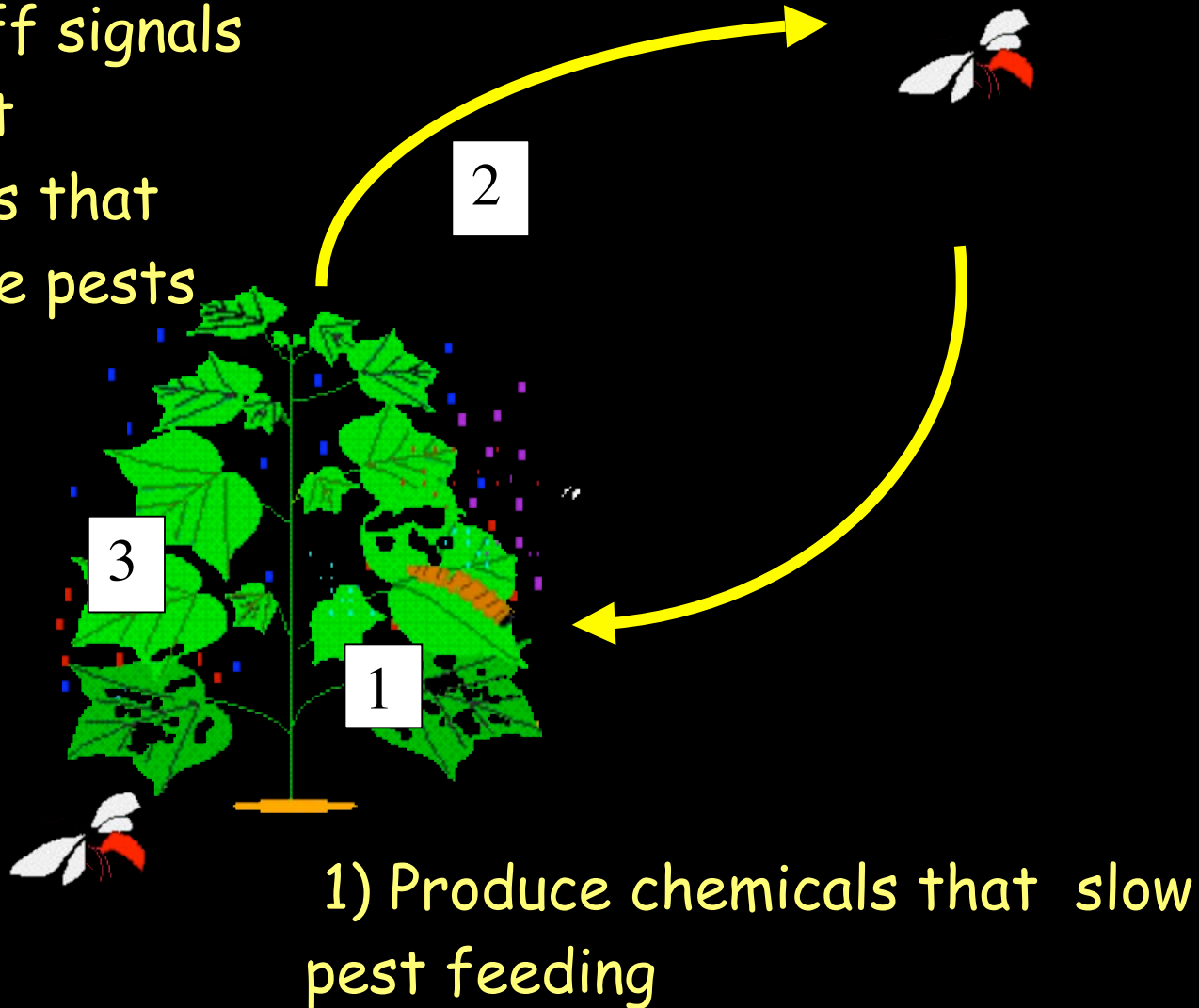


1) Produce chemicals that slow pest feeding

Plants use a number of defense strategies following damage by feeding insects

2) Give off signals to attract beneficials that attack the pests

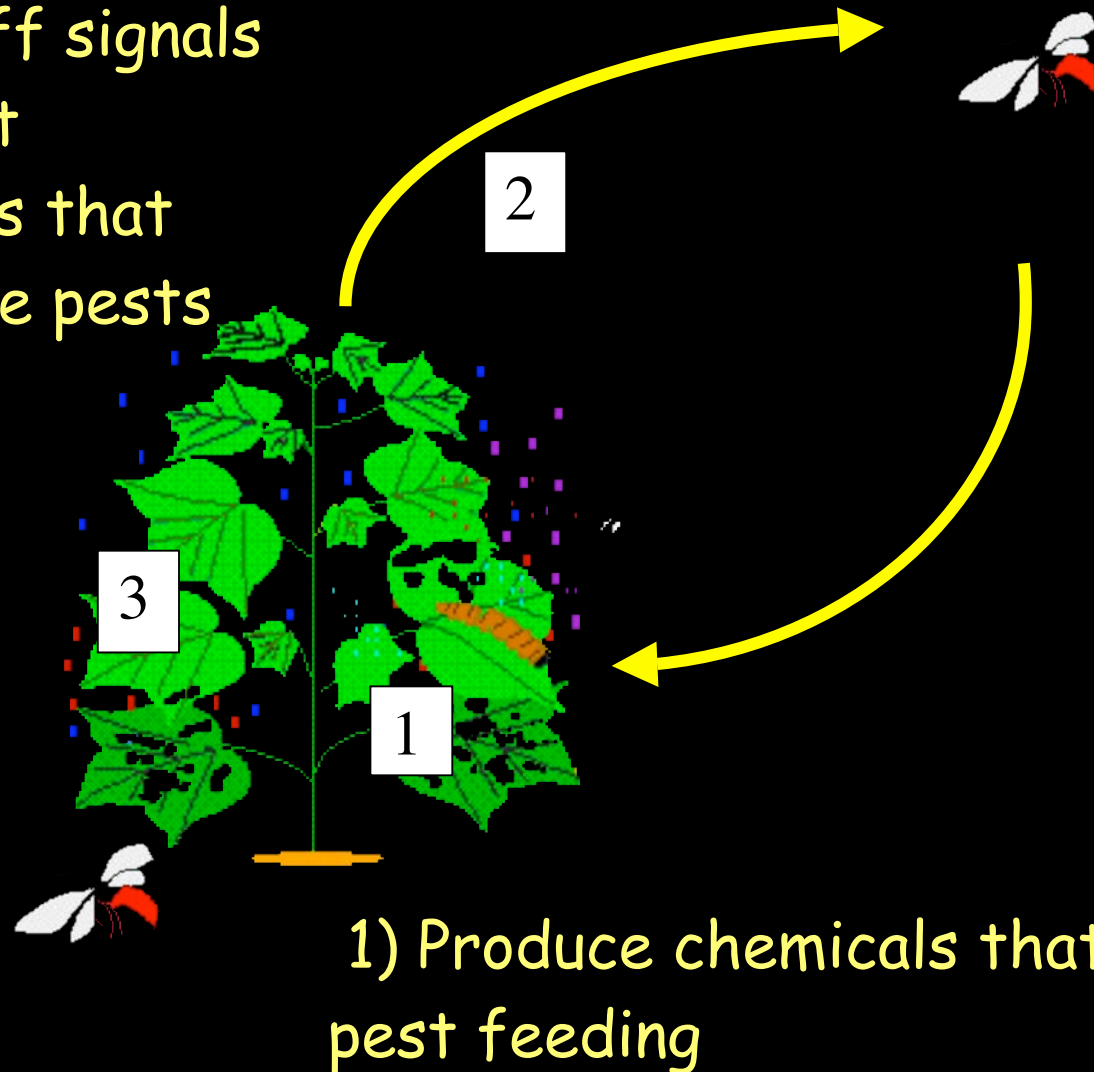
3) Increase extrafloral nectar flow as food for adult beneficials



Healthy plants are usually less attractive to pests or better able to defend themselves.

2) Give off signals to attract beneficials that attack the pests

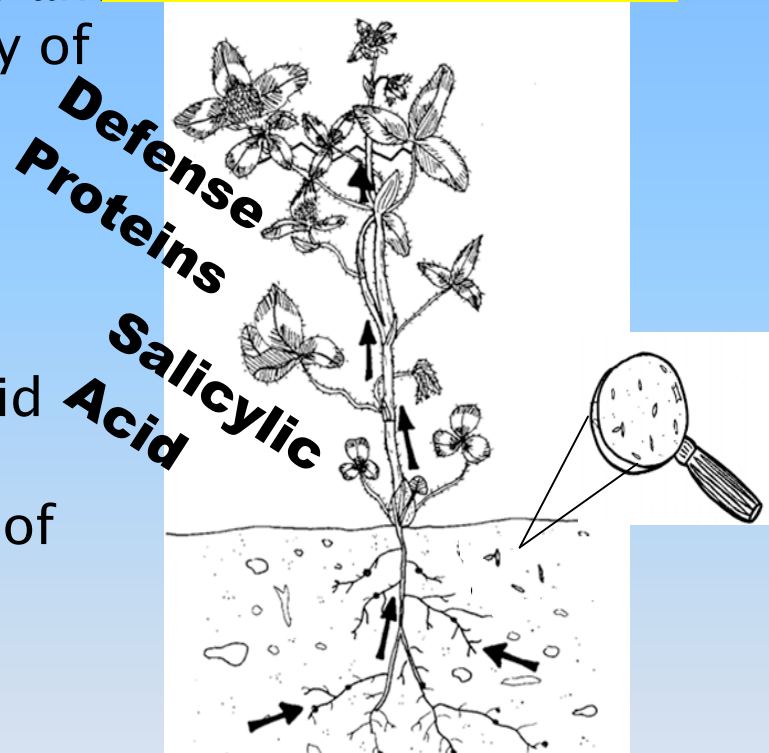
3) Increase extrafloral nectar flow as food for adult beneficials



a) SAR Induced Resistance

The plant defense proteins provide the plant resistance to a variety of plant pathogens.

An increase in the hormone salicylic acid causes the plant to produce many types of defense proteins.



Disease organisms and nonpathogenic microbes stimulates the plant above or belowground to produce the hormone salicylic acid.

b) ISR Induced Resistance

Plant hormones
Jasmonate and Ethylene
increase throughout the
plant and induce
resistance to a wide
variety of plant
pathogens.



Plant growth promoting
rhizobacteria (PGPR) stimulate plants
roots, causing production of plant
defense hormones

Whole System (Ecological) Management



Prevention

Develop, and rely on,
the internal strengths
of the agricultural
ecosystem

instead
of

Reaction

Rely on external
interventions such as
pesticides and
commercial fertilizers.

Overall strategies of ecologically-based agriculture

**a) create soil & above
ground conditions for
healthy plants with
enhanced defenses**

b) stress pests

c) enhance beneficials

**For annual crops,
ecological management
can be visualized as a
three step process
during a growing season.**

Build internal strengths
into agricultural
ecosystem

*Prevention (of symptoms
and consequences of weak
ecosystem)*

Routine ecologically
sound practices
during season to keep
plants healthy

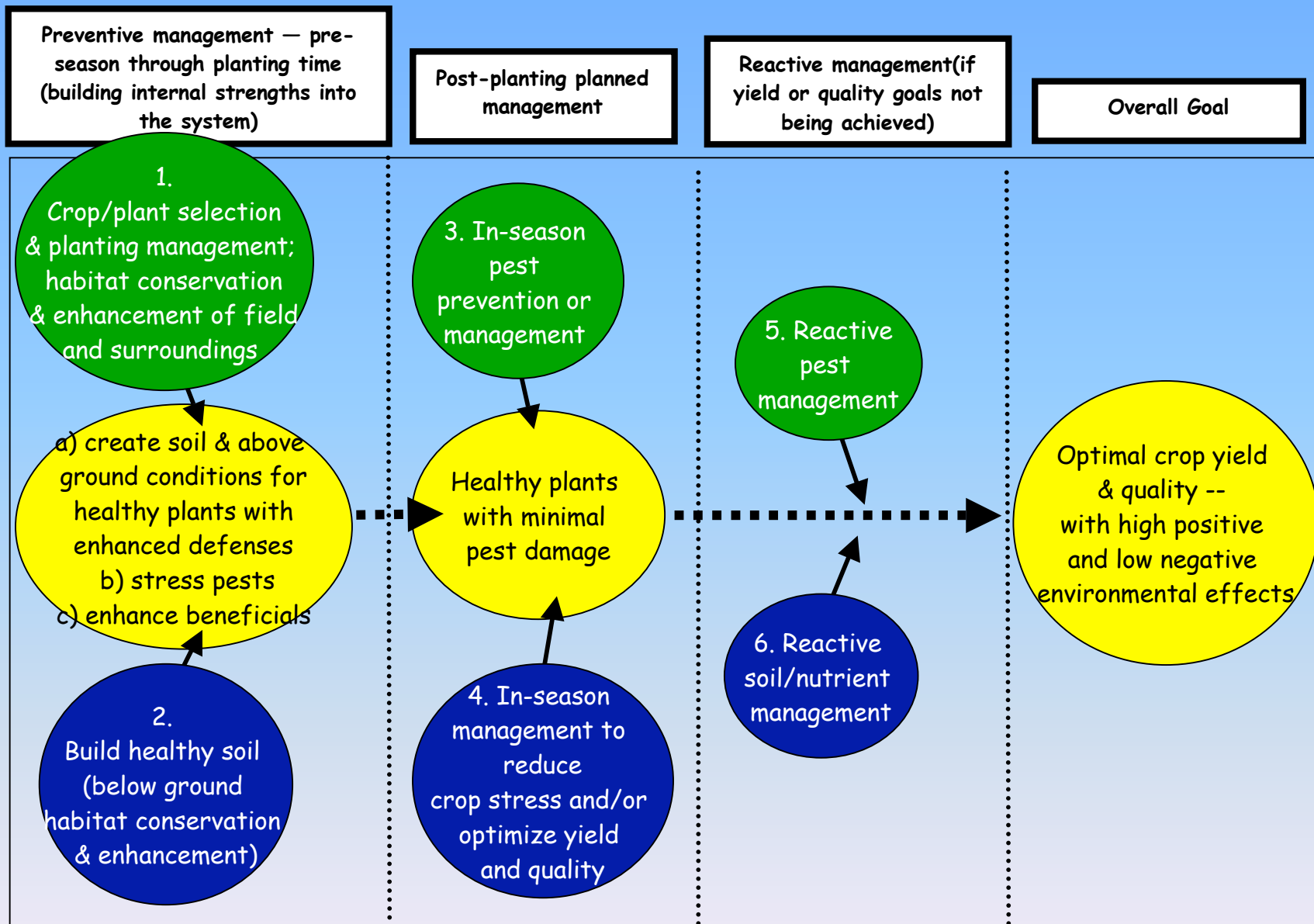
Reactive
management

Preventive management
pre-season through planting time
(building internal strengths into the system)

1. Crop/plant selection
& planting management;
habitat conservation
& enhancement of field
and surroundings

2. Build healthy soil
(below ground
habitat conservation
& enhancement)

- create soil & above ground conditions for healthy plants with enhanced defenses
- stress pests
- enhance beneficials



A whole system approach to soil and crop management at the field level.

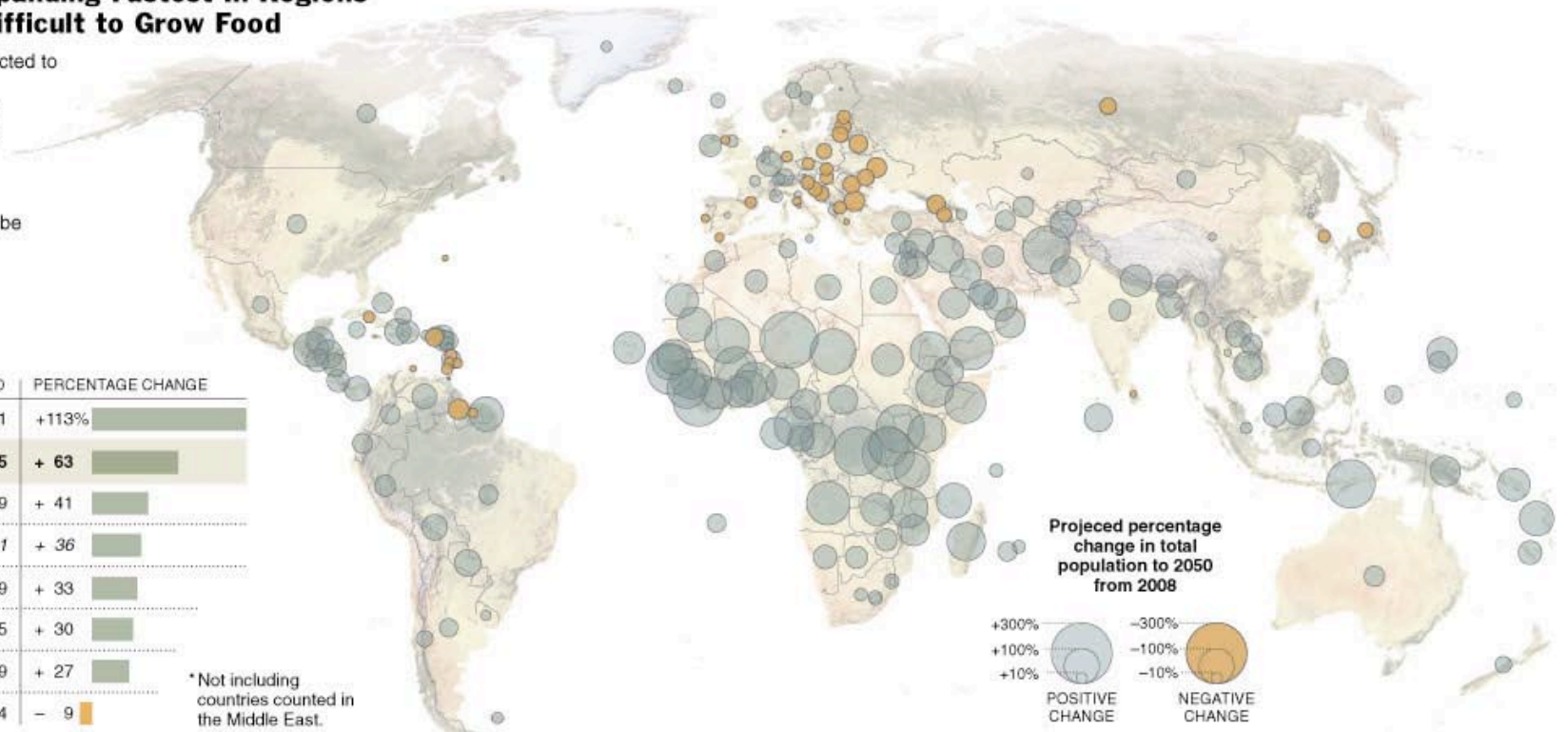
Populations Are Expanding Fastest In Regions Where it Is Most Difficult to Grow Food

The world's population is projected to grow to 9 billion before 2050. Proportionally, the countries in Northern Africa and the Middle East are among the fastest growing. But those are the world's driest regions, and by 2050, fresh water there will be twice as scarce.

Projected total population

IN MILLIONS	2008	2050	PERCENTAGE CHANGE
Sub-Saharan Africa	827	1,761	+113%
Middle East and Northern Africa	364	595	+ 63
Oceania	35	49	+ 41
<i>World</i>	<i>6,750</i>	<i>9,191</i>	<i>+ 36</i>
Latin America and the Caribbean	579	769	+ 33
Northern America	342	445	+ 30
Asia*	3,872	4,909	+ 27
Europe	731	664	- 9

* Not including countries counted in the Middle East.



Projected percentage change in total population to 2050 from 2008



Sources: United Nations, Department of Economic and Social Affairs, Population Division "World Population Prospects: The 2006 Revision"; "Natural Earth" base map by Tom Patterson

KARL RUSSELL/THE NEW YORK TIMES

Mideast Facing Choice Between Crops and Water

NY Times 7/21/08

Cotton farmers face a formidable foe

July 18, 2008



Stanley Culpepper, an agronomist at the University of Georgia, stands in a cotton field that is heavily overrun by pigweed resistant to Roundup .