# Today I Learned About Farming a Warmer Planet

"Crops and livestock just in and of themselves are highly vulnerable to increasing temperatures. Farmers are dealing with a changing climate that is altering planting and harvest dates; the length of the growing season, bringing high temperatures during critical growth stages; [and] shortening growing periods for annual crops."
*Dr. Cynthia Rosenzweig, NASA Goddard Institute for Space Studies*
*TILclimate podcast: Today I Learned About Farming a Warmer Planet*

## A Warming Climate, Shifting Maps

We need a regular amount of carbon dioxide ($CO_2$) in the atmosphere to support life on Earth – it acts like a blanket, trapping heat from the sun. As we burn fossil fuels like coal, oil, and natural gas, we release rampant $CO_2$ into the atmosphere, which traps too much heat. This excess trapped heat is warming our air, Earth, and ocean and dramatically changing climate and weather patterns.

When choosing which crops to plant, farmers (and gardeners) refer to US Department of Agriculture (USDA) Plant Hardiness Zones. These maps show broad bands of color, indicating the coldest average temperatures each area experiences. Plants have different temperature needs to be planted, germinate, and grow, as well as different growing times.

Some varieties of tomato plant can be planted at 55˚F and are ready to harvest in 60 days, while others require 70˚F and 80 days.

Which would be a better choice where you live?

The first hardiness zone system was developed in 1927 and updated in 1938 and 1951. The USDA released its first map in 1960 and revised in 1965. The next update did not happen until 1990, and then not again until 2012. Each time the map has been updated, the zone lines have shifted. Some shifts were the result of better data, but most are due to changing low temperatures.

Temperature is not the only factor that farmers consider when choosing plant varieties – precipitation, daylight, humidity, winds, soil type, growing season, subsidies, market forces, and more all influence what grows where. These factors are also shifting, along with the temperature.

On the next pages, will find a simplified 1990 map, 2012 map, and a map that highlights the changes between the two maps.

Image from The Noun Project by Michael Zick Doherty

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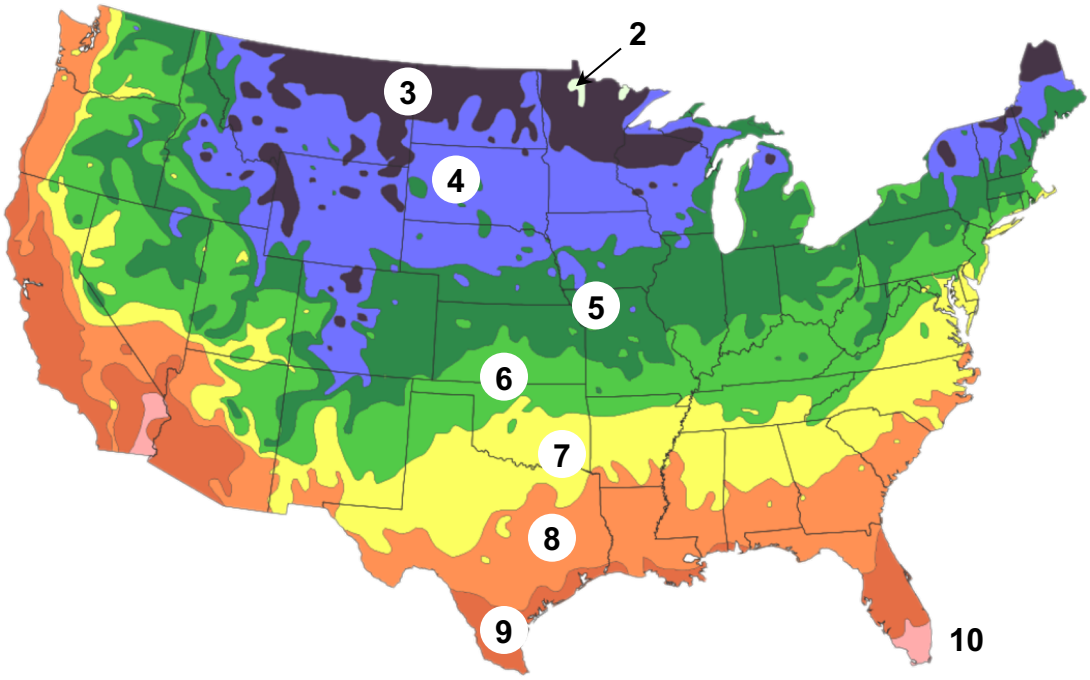
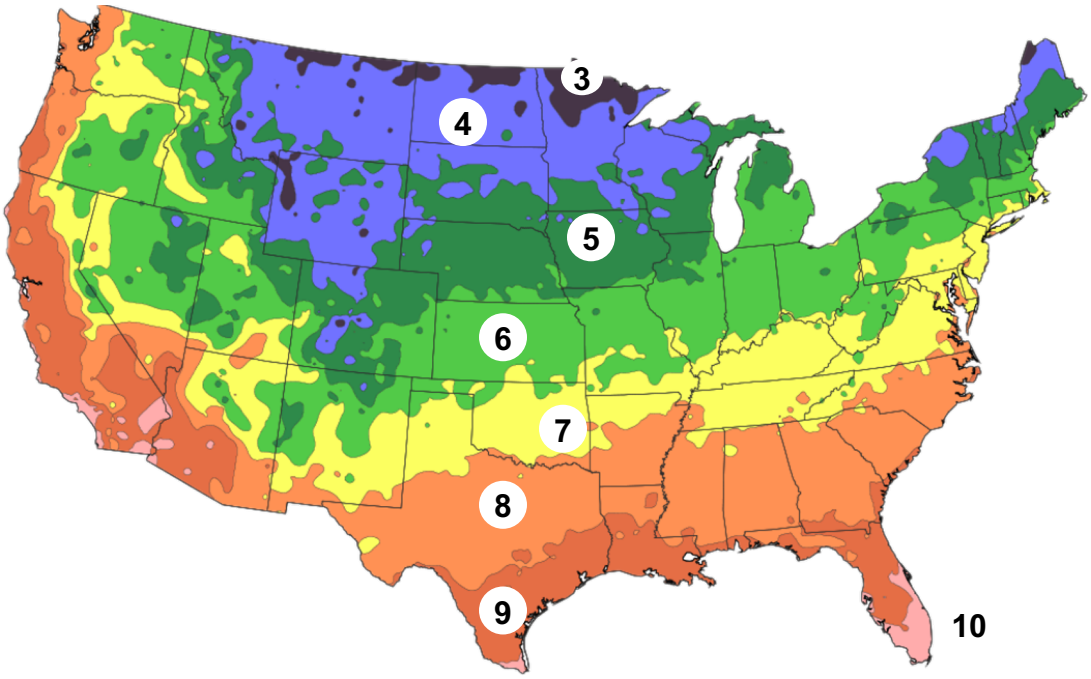
## USDA Plant Hardiness Zones, 1990



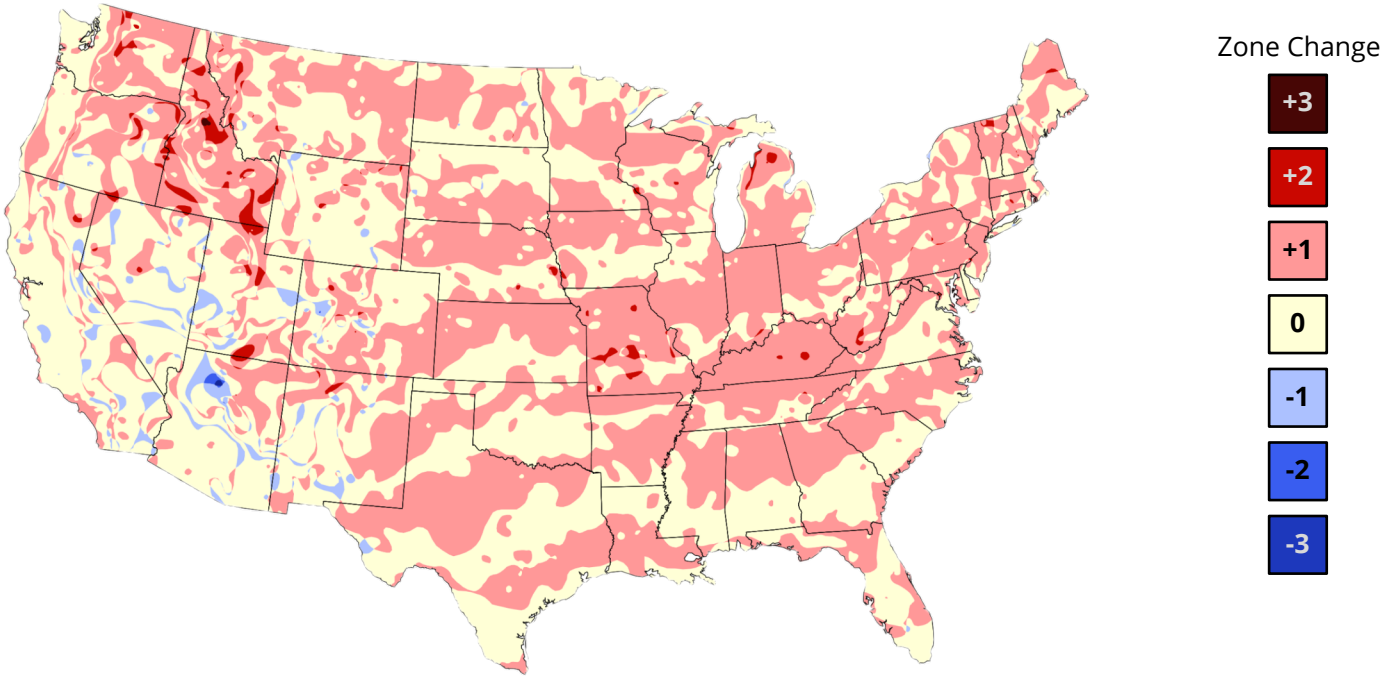

## USDA Plant Hardiness Zones, 2012




| Zone | Average Coldest Temp |
|---|---|
| 2 | -50˚F |
| 3 | -40˚F |
| 4 | -30˚F |
| 5 | -20˚F |
| 6 | -10˚F |
| 7 | 0˚F |
| 8 | 10˚F |
| 9 | 20˚F |
| 10 | 30˚F |

# Today I Learned About Farming a Warmer Planet

## Changes to the USDA Plant Hardiness Zones from 1990 to 2012




## Questions

1. Choose a few locations on the map that you are familiar with. Did their Zones shift between 1990 and 2012? How much and in which direction?
2. What patterns do you notice in how the Zones have shifted?
3. Have all Zones shifted warmer? Why do you think this is?
4. Imagine you are a farmer in an area where the zones have shifted by more than one zone (for example, areas of Idaho that have shifted from Zone 4 to Zone 6.) How do you think this might change your farming practices?
5. One critique of the Hardiness Zone maps is that they only focus on lowest average temperature, and do not include highest average temperature or number of warm days per year. How do you think these other factors might be changing, along with coldest average temperature?
6. What other questions do you have about how climate shifts are affecting farms and farmers? How might you answer these questions?
7. Extension: Visit https://ipad.fas.usda.gov/rssiws/al/us_cropprod.aspx and compare one or more crop production maps to the Zone change map. Which crops would you expect to be the most affected by temperature shifts?

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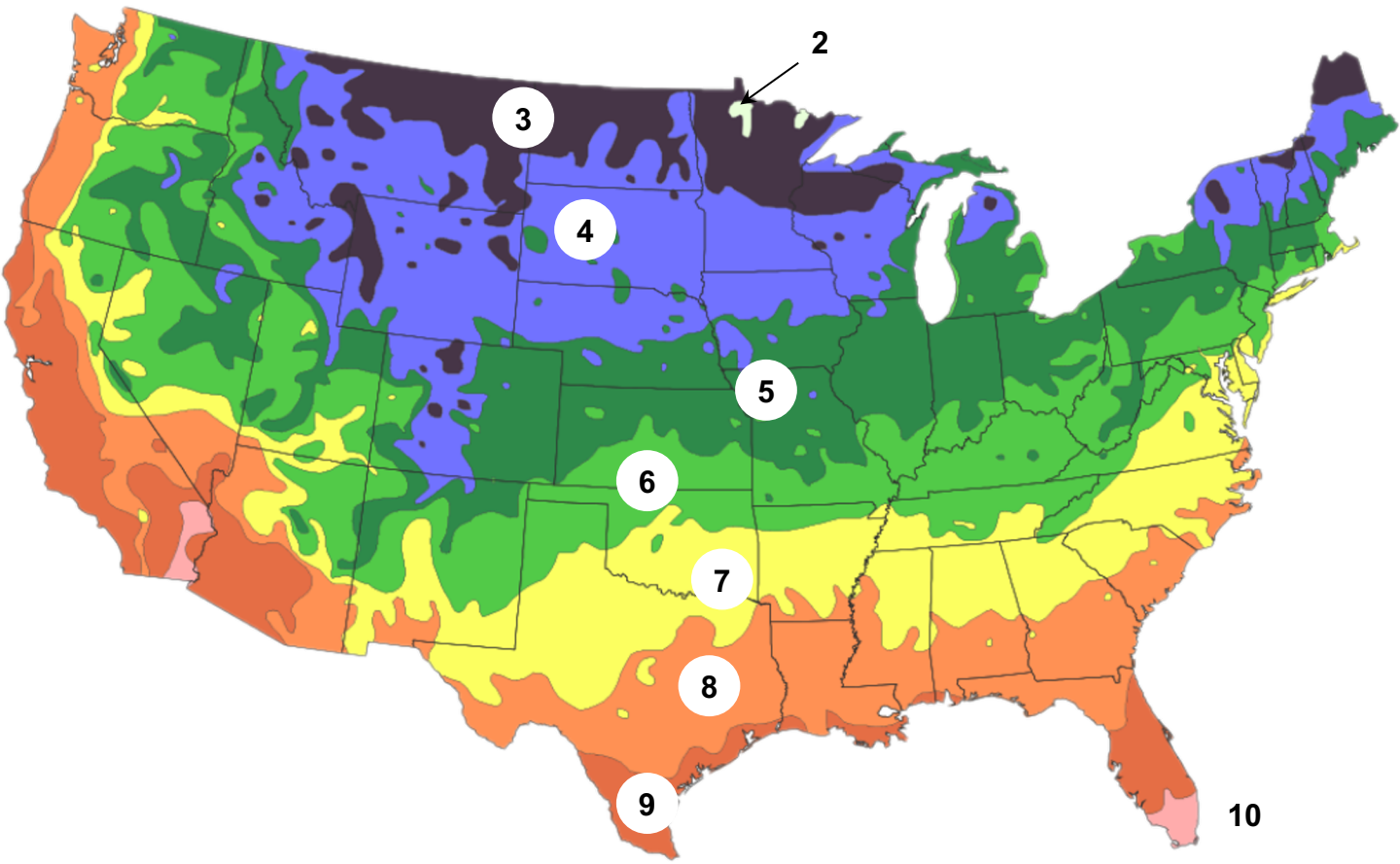
## USDA Plant Hardiness Zones, 1990

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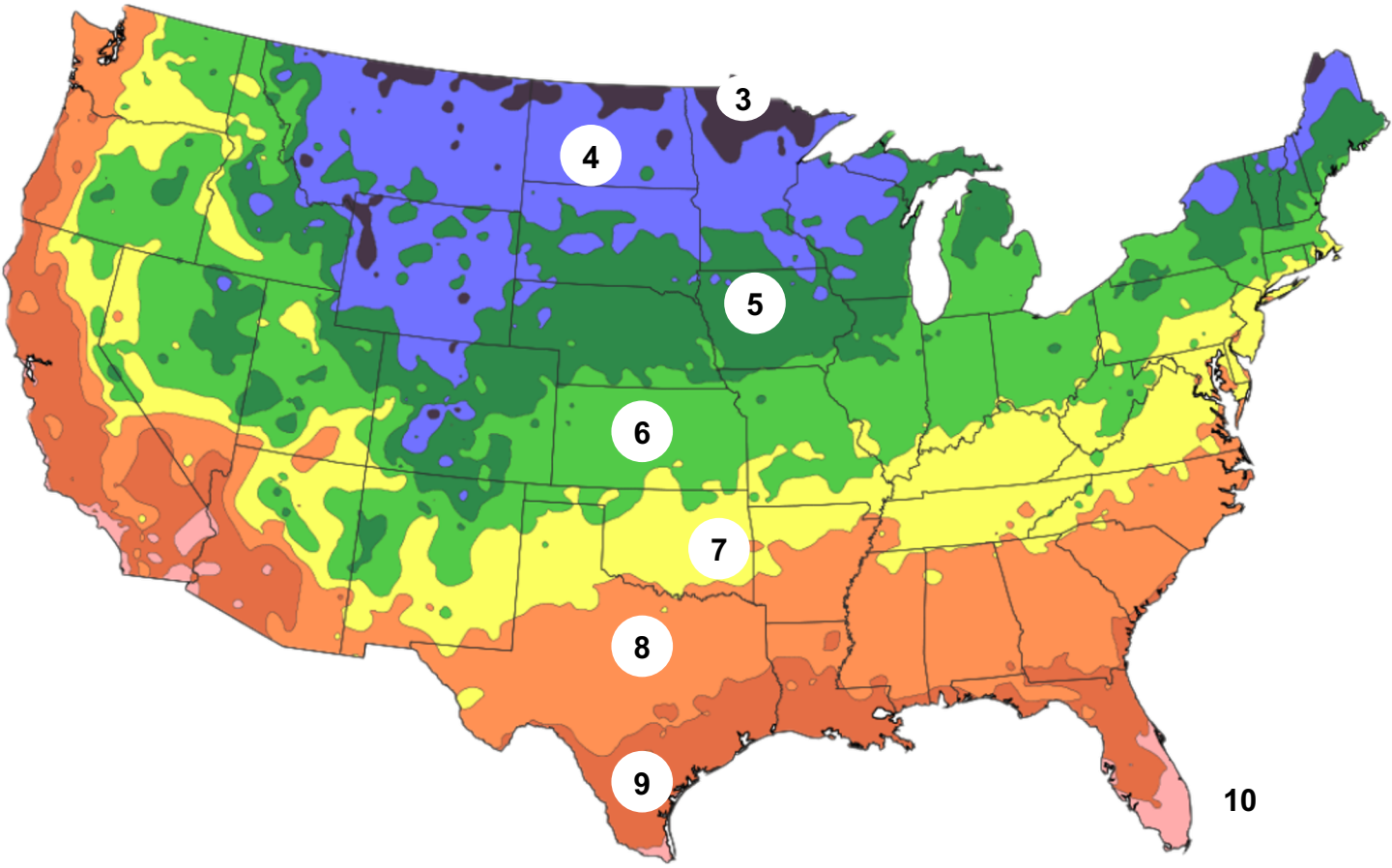
## USDA Plant Hardiness Zones, 2012

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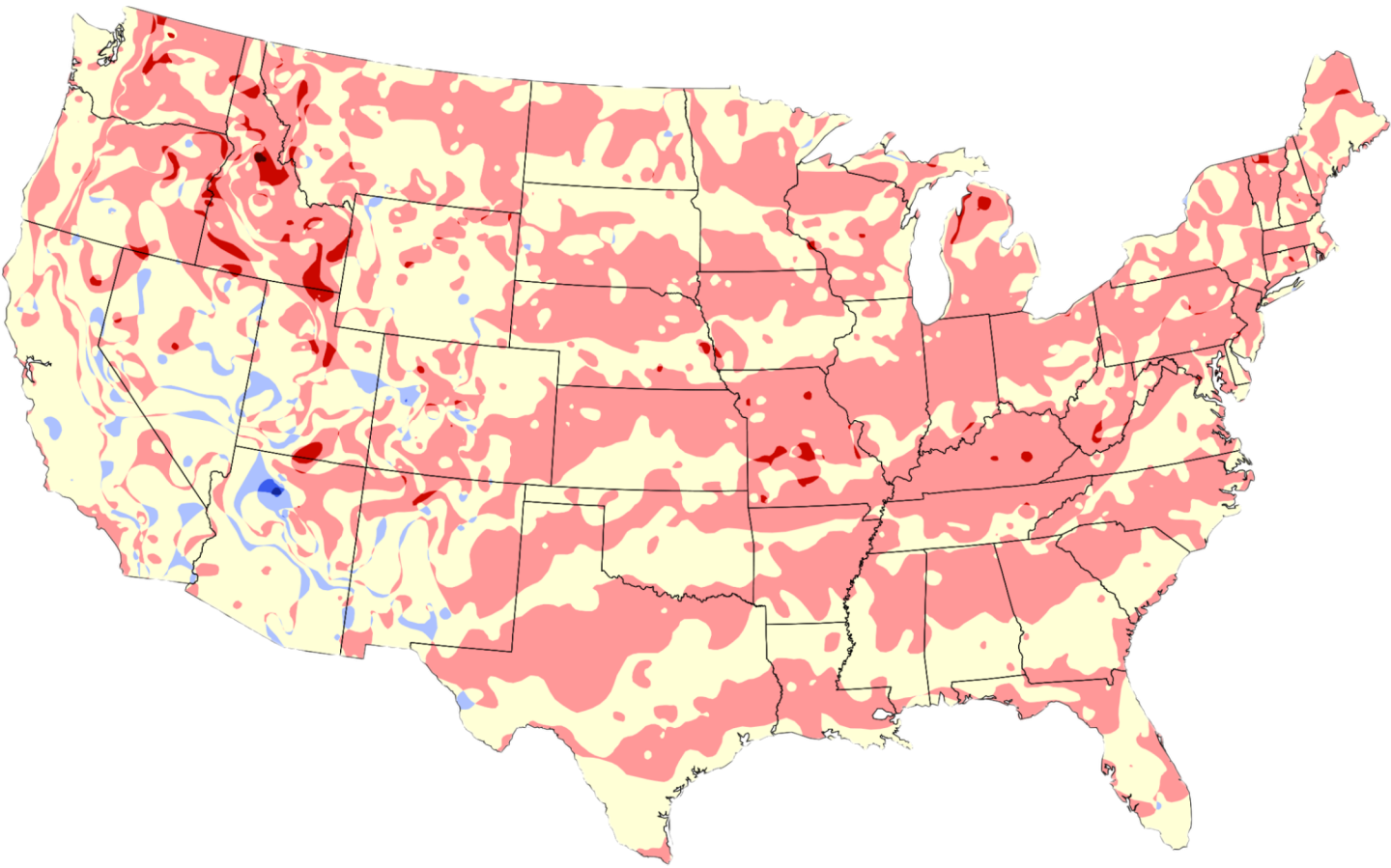

Zone Change

+3
+2
+1
0
-1
-2
-3

# Today I Learned About Farming a Warmer Planet

"On a farm, greenhouse gas emissions are coming from clearing of the forest to create the fields; use of fertilizers (often $N_2O$, nitrous oxide); fossil fuels burned to run the tractors; methane from rice paddies, beef and dairy cattle, and manure."

*Dr. Cynthia Rosenzweig, NASA Goddard Institute for Space Studies*
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## Agriculture, Forestry, Land Use, and the Climate

Carbon dioxide ($CO_2$) methane ($CH_4$), and other gases act like a blanket in Earth's atmosphere, trapping heat. A regular amount of trapped heat is needed to support life on Earth. Rampant heat-trapping gases from the burning of fossil fuels and other human activities are trapping too much heat and warming our Earth, air, and ocean. This extra warming causes dramatic changes to Earth's climate and weather patterns, such as hotter summers, warmer winters, and stronger storms.

Agriculture (growing plants and animals for human food and plants for animal food) releases about 21-37% of all heat-trapping gas emissions globally[1].

| % Global Emissions | Activity |
|---|---|
| 5-9% | Crops & crop-related land use change |
| 6-10% | Livestock |
| 5-14% | Other land use & change |
| 5-10% | Supply chain & processing |

- Animals such as cattle and sheep burp methane as they digest their food.
- While soil has the potential to be a *carbon sink* – something that absorbs more $CO_2$ than it emits – most modern agricultural practices cause the soil to be a *carbon source* – something that emits more $CO_2$ than it absorbs. Adding synthetic fertilizers can also cause soils to release heat-trapping gases.
- Food for livestock, artificial fertilizers and pesticides, and other inputs are made in factories that release $CO_2$ and other heat-trapping gases.
- Forests and peatlands are cut down to make room for more agriculture. This releases carbon from the trees and the soils.
- Farms burn fossil fuels to produce energy for machinery, heating, cooling, and transportation, releasing $CO_2$.
- Flooded rice paddies are home to bacteria that release methane.

Less global poverty, more international aid, and innovations in agriculture have brought food to billions of people who did not have access to stable food, but this system is also causing farms to add to the heat-trapping blanket. New innovations – and some returns to old practices – can help reduce the impact of agriculture on the climate, while continuing to provide healthy food and ecosystems.

1 Climate Change and Land: an IPCC special report https://www.ipcc.ch/site/assets/uploads/sites/4/2019/11/08_Chapter-5.pdf

# Today I Learned About Farming a Warmer Planet


## Agroecology

Around the world, farms are experiencing increased drought, flooding, storms, insects, and diseases, which can lead to crop failures. Farming is never an easy or predictable way to make a living, but it is becoming less predictable as climate patterns change worldwide. One solution to unpredictable and changing weather and climate is to change the way food is grown.

According to the United Nations Food and Agriculture Organization (FAO,) agroecology is "the science of applying ecological concepts and principles to manage interactions between plants, animals, humans and the environment for food security and nutrition."[1] In other words, agroecology is a practice that looks at farms and ranches the way an ecologist might look at a forest or prairie – as a network of living and nonliving things interacting. The goal of agroecology is to grow food for people in a way that supports health at all levels: human, animal, plant, and ecological.

## Explore

Visit https://www.fao.org/agroecology/knowledge/practices/en/ and scroll through the pages of case studies. Choose one you are most interested in. On the page for your case study, read the brief description, and then click the **Full text** link below it.

Read the full case study. It is not necessary to understand every technical detail about the project, but you should be able to get a general sense of how the project solves problems for the people involved.

As an extension, visit https://www.fao.org/agroecology/overview/overview10elements/en/ and read about The 10 Elements of Agroecology (images above). Which Elements are you most interested in? Which connect most strongly to the case study you read?

1 Food and Agriculture Organization of the United Nations Agroecology Knowledge Hub https://www.fao.org/agroecology/knowledge/practices/en/

# Today I Learned About Farming a Warmer Planet

## Agroecology Questions

1. What is one change that the farmers made to adopt agroecology practices? What was the result of this one change?
2. What are some other benefits to these farmers and their communities?
3. How do the new practices in this case study help this farm stay resilient to climate-related challenges?
4. Many agroecology practices have been developed on small farms. How could some of the practices you learned about be scaled up for larger farms or collections of farms?

## Each One, Teach One

In a small group, each member will briefly explain the case study they read to the others.

5. Discuss:

- Were your case studies in similar or different locations in the world? How does location affect which kinds of practices they were adopting?
- Where was there overlap? Were there practices that were common among all or most of your case studies?

6. Together, create your own definition of agroecology. How would you explain it to a friend or family member who is interested in farming and food?
7. If you were a farmer in your own area (not the location of your case study,) are there any agroecological practices you think would work well?

Image from PNGEgg www.pngegg.com