

- ~6,000 Years Ago: canals + dams along rivers to irrigate crops + organic matter (decaying plant and animal matter) as fertilizer
- ~2,000 Years Ago: rotating crops btw fields + allowing fields to remain unplanted (fallow) helped restore soils
  - Does not decrease soil erosion and land degradation?
- NA enriched soil w/ fish + companion planting
- Companion planting: growing multiple crops in close proximity to facilitate nutrient uptake, pollination, and pest control
- Agricultural Revolution: Increase in agricultural production mid-17th/late 19th C
  - New agricultural practices such as crop rotation, selective breeding, and a more productive use of arable land
- Columbian exchange brought new foodstuffs from Americas to Eurasia (potato)
- Integration of machines since Industrial Revolution = farming less labor-intensive

### Modern Agricultural Practices – The Green Revolution:

- New technologies in twentieth century led to the Green Revolution
  - Pesticides, crop breeding, irrigation, synthetic fertilizers
- After 1960, tripling average grain yields only took 40 years
- **Green Revolution – Genetic manipulation:**
  - Plant geneticists cross-bred crops to create varieties that thrive with intensive irrigation + fertilization while resisting common diseases
  - Genetic engineering developed in 1970s → GMOs
- **Green Revolution – Gasoline or Diesel Powered Farm Equipment:**
  - Replaced human + animal powered tools, reduced time/effort
  - Less employees needed but increased use of fossil fuels
- **Green Revolution – Modern Irrigation:**
  - Large-scale dams and reservoirs, electric aquifer pumps, long-distance canals and pipelines, and automated sprinkler systems
- **Green Revolution – Synthetic Pesticides:**
  - Use of synthetic pesticides has also increased globally
  - Synthetic pesticides: chemicals applied to combat insects and weeds
  - Found to harm pollinators. Top food crops rely on pollinators

### Agroecosystems:

- Nitrogen
  - Cycles rapidly between atmosphere and biosphere
  - Plants modify to create essential compounds
    - Amino acids
    - Nucleic acids
  - Nitrogen enters biosphere by nitrogen fixation
    - Bacteria convert  $N_2$  to  $NH_3$  and then other molecules
    - Small amount by lightning
  - Soil bacteria carry out nitrification
    - Makes nitrogen available to other organisms
  - Denitrification
    - Bacteria transform nitrates to  $N_2$  gas