Decoupling Environmental Impacts of Food from Economic Growth

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Introduction

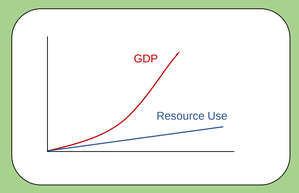
- The total world population is predicted to reach 9.3 billion by 2050, 10.1 billion by 2100 (Lee, 2011)
- Increasing world population and affluence is putting pressure on our shared finite resources (United Nations Environment Program, 2011)
- Sustainable development and food security require countries to increase productivity of food systems while decreasing their environmental impacts, and for poor countries to increase their affluence (United Nations Environment Program, 2011)

Background

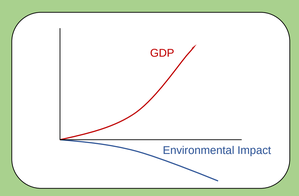
- Agriculture takes up roughly half of habitable land on Earth (FAO, 2019)
- Current food systems emit 30% of global GHG emissions (Clark, 2020)
- Globally, half of all the nitrogen used for agriculture is lost to the environment; polluting our natural resources (Lassaletta, 2014)

Decoupling

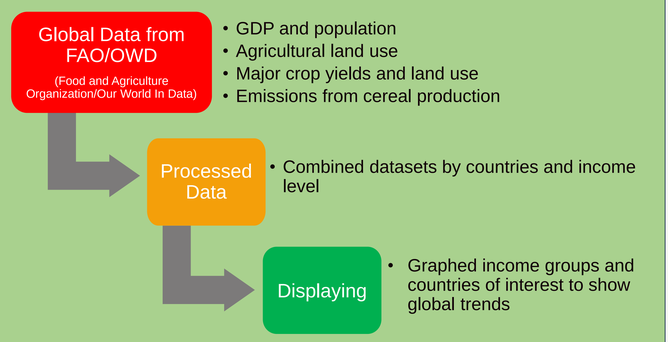
- **Resource Decoupling**: Economy grows, and resource use grows at a slower rate (UNEP, 2011)



- **Impact Decoupling**: Economy grows, and negative impact on the environment decreases (UNEP,2011)



Methods



Agricultural Land Use (Cropland plus pastureland)

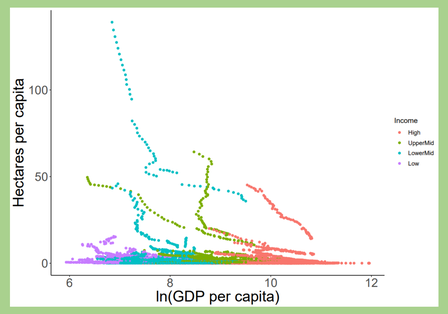


FIGURE 1.1 Higher-income countries use fewer hectares per person than other income groups. As countries grow their GDP per capita, they reduce their amount of agricultural land per person.

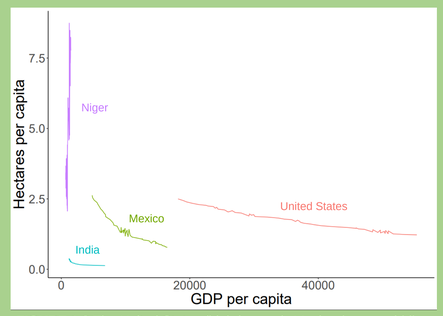


FIGURE 1.2 The United States (high-income), Mexico (upper-middle-income), and India (lower-middle-income) have all decreased their hectares per person as their GDP per capita grew, by 50%, 70%, and 65% respectively. Niger (low-income) is an exemption to that rule; they decreased their hectares per person while their GDP per capita also decreased.

Fertilizer Use

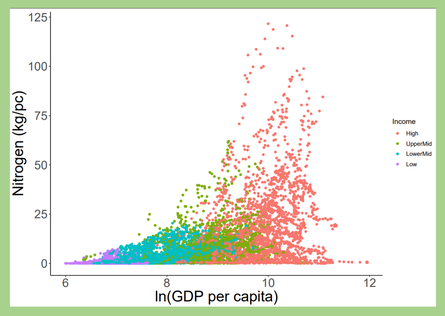


FIGURE 2.1 Higher-income countries use more kilograms of nitrogen per person (kg/pc) than other income groups. Other income groups use more nitrogen (kg/pc) as their GDP per capita grows.

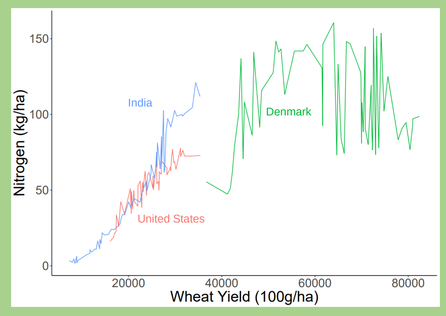


FIGURE 2.2 The United States (high-income) and India (lower-middle-income) are two of the largest producers of wheat in the world (Ang & Rastogi, 2022). As their yields grow, so does their use of nitrogen. Denmark (high-income) is one of the few countries that has been able to decrease its nitrogen use while increasing their wheat yield. Since 1985, US nitrogen use grew by 40%, India by 250%, and Denmark decreased by 33%.

Yearly CO_2 Emissions from Cereal Production

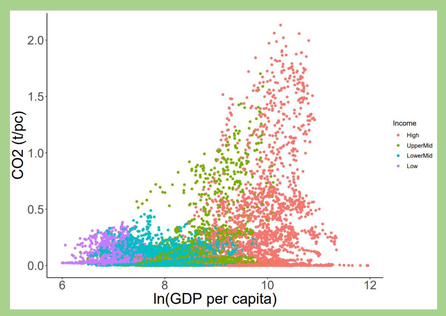


FIGURE 3.1 High-income countries emit more CO_2 per capita than the other income groups. Other income groups emit more CO_2 as their GDP per capita grows.

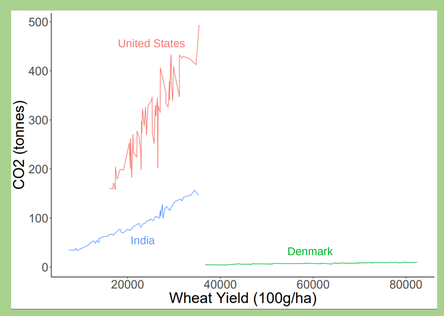


FIGURE 3.2 The United States (high-income) and India (lower-middle-income) both grow their CO_2 emissions as they increase their cereal yields per hectare. Denmark does not see the same growth in CO_2 emissions as they increase their cereal yields. Since 1961, the US grew their CO_2 emissions by 150% and India by 350%. In that time, Denmark doubled their emissions from ~5 tones to ~10 tones.

Discussion

- Economic development leads to shifts in land use depending on a country's affluence (Taylor & Rising, 2021)
- As countries become wealthier, natural ecosystems are converted to agriculture at a rate that slows and then reverses (Taylor & Rising, 2021)
- Increases in nitrogen use are related to a desire to produce higher yields (Stuart et al., 2018)
- Government policies are responsible for declines in nitrogen use in some Nordic countries (Dalgaard et al., 2014)
  - Denmark implemented 8 policies targeted at pollution from nutrient loss from 1985-2011
- Higher-income groups produce more GHGs from cereal production than lower-income groups (Gani, 2022)

Conclusion

- Some resource decoupling is found in agricultural land use as GDP per capita increases and hectares per capita decrease (Figure 1.1 and 1.2)
- The use of fertilizers, in regard to nitrogen, has not been decoupled from economic growth (Figure 2.1)
  - Except for some Nordic countries, e.g., Denmark, who have increased wheat yields while decreasing their nitrogen use (Figure 2.2)
- CO_2 emissions from cereal production have not been decoupled from economic growth (Figure 3.2)

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References