

# Reactive Nitrogen and Animal Agriculture Effects on Human Health

Health in a Changing Climate –  
Understanding the Impacts on Virginians  
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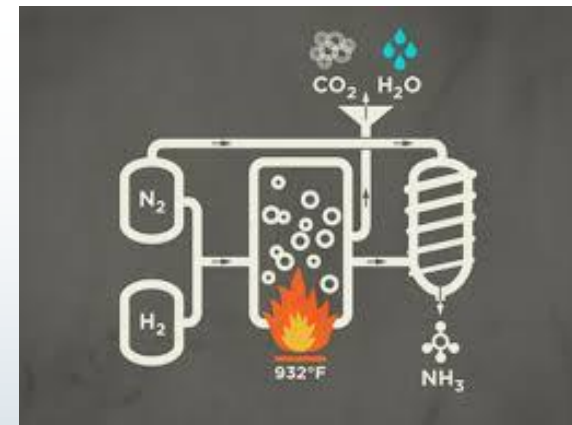
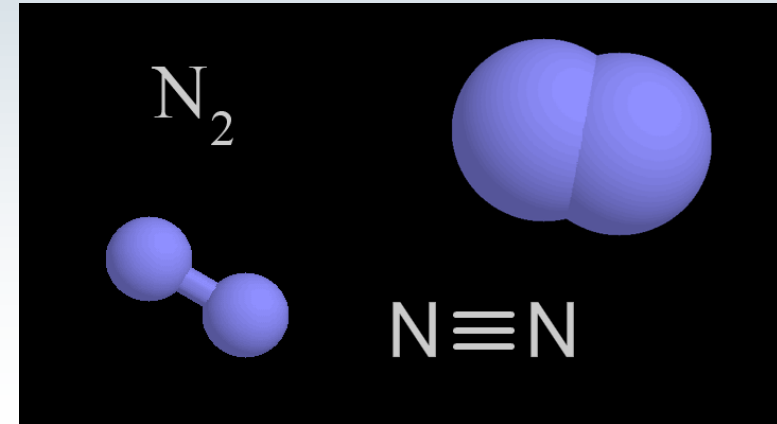
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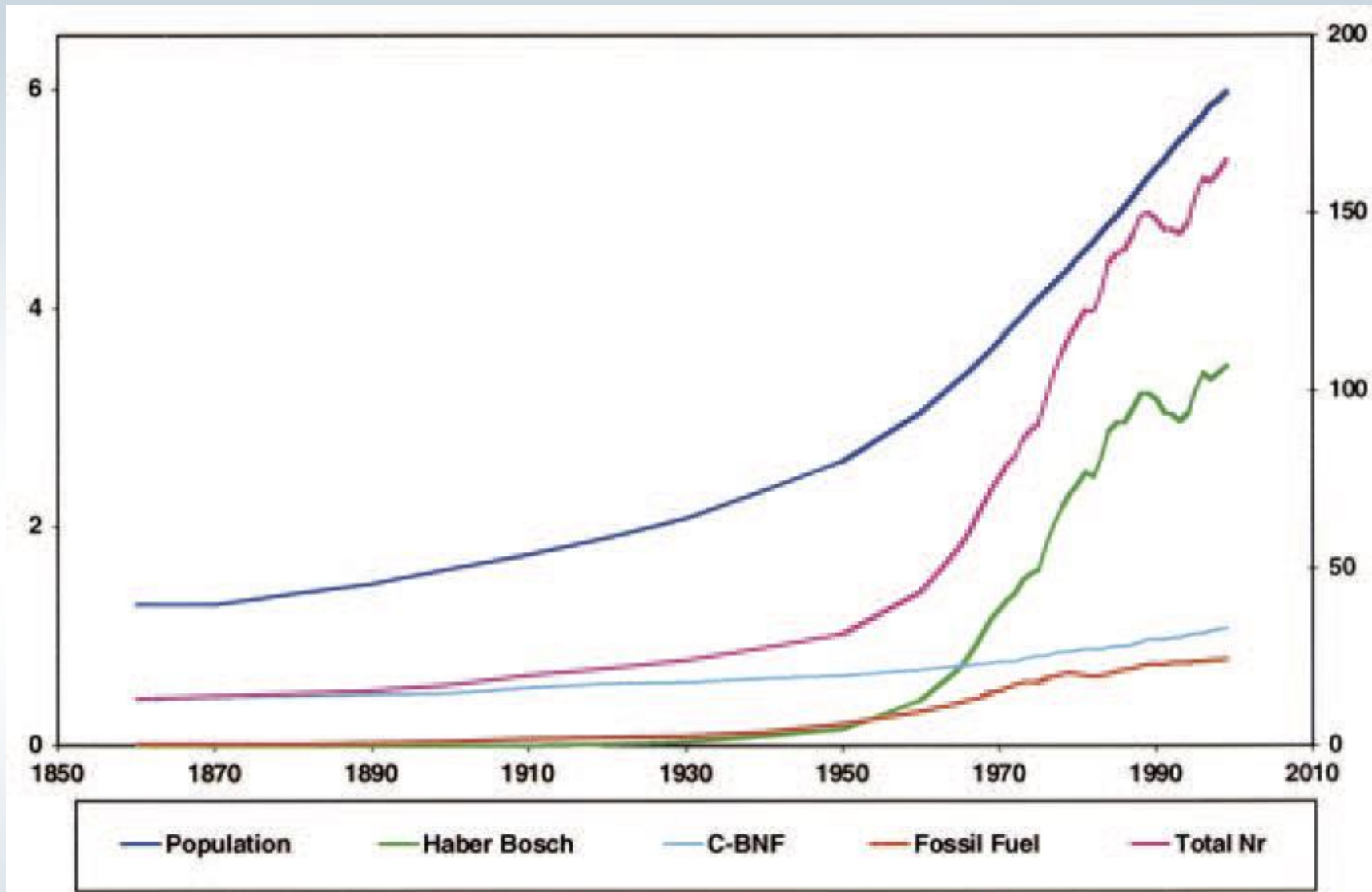


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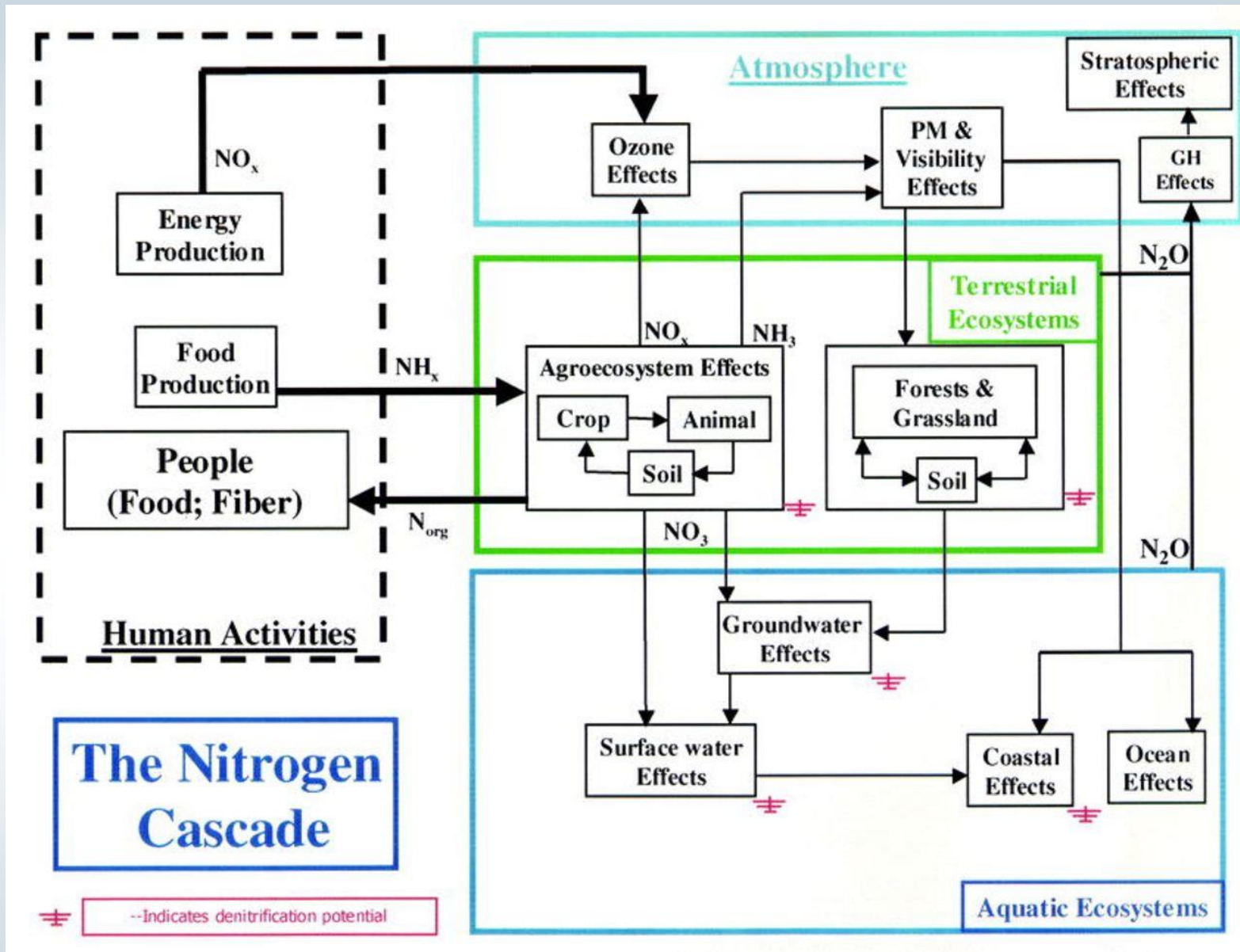
# Nitrogen (N)

- N is an essential plant and animal nutrient.
- Human activity fixes more atmospheric N ( $N_2$ ) into reactive forms (Nr) than all terrestrial natural processes combined (Vitousek et al., 1997).





Global population (billions, left axis) and Nr creation (Tg N/yr, right axis); Galloway et al., 2003



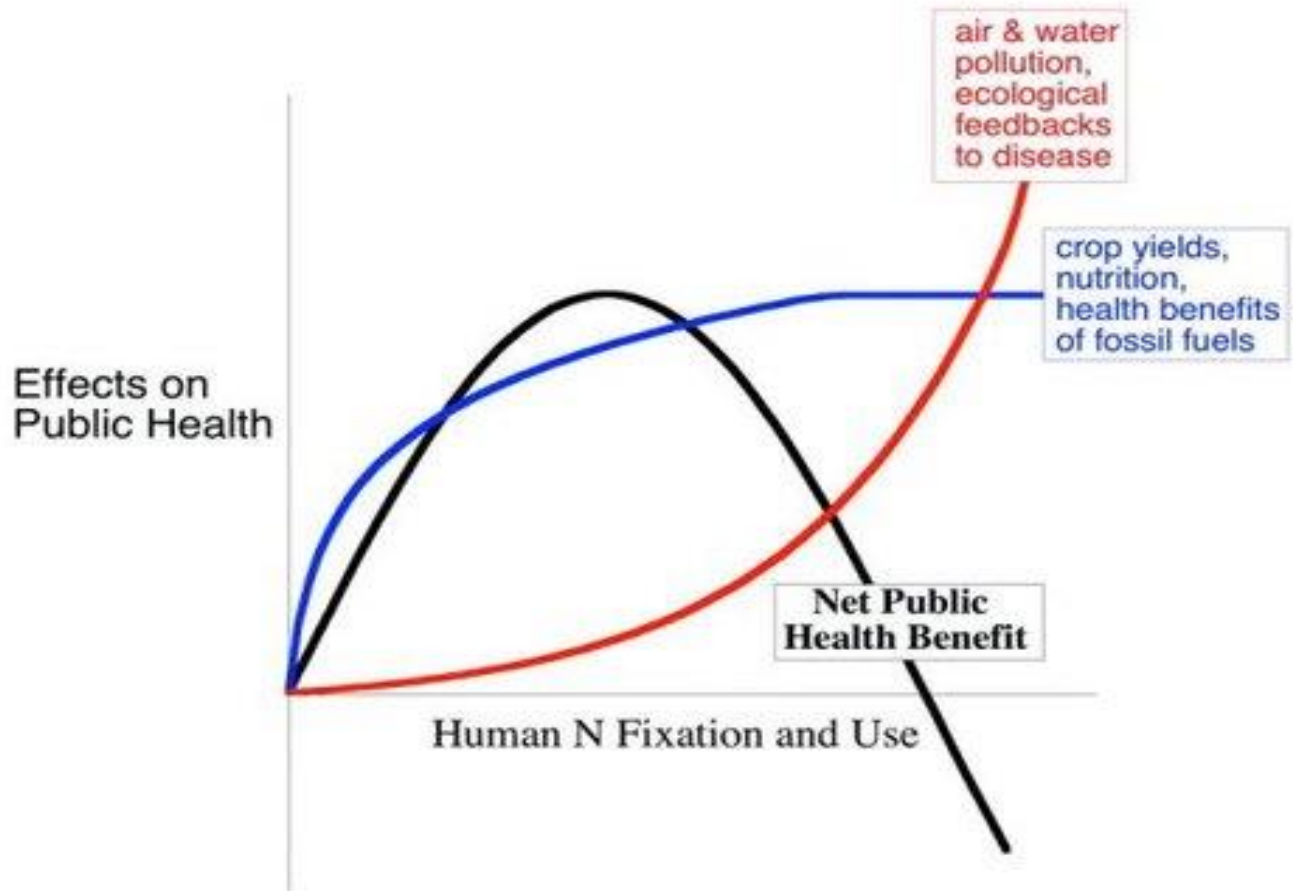
N Cascade:  
 Consequences of circulation of anthropogenic  $\text{N}_r$  are magnified over time.

Source: Galloway et al., 2003

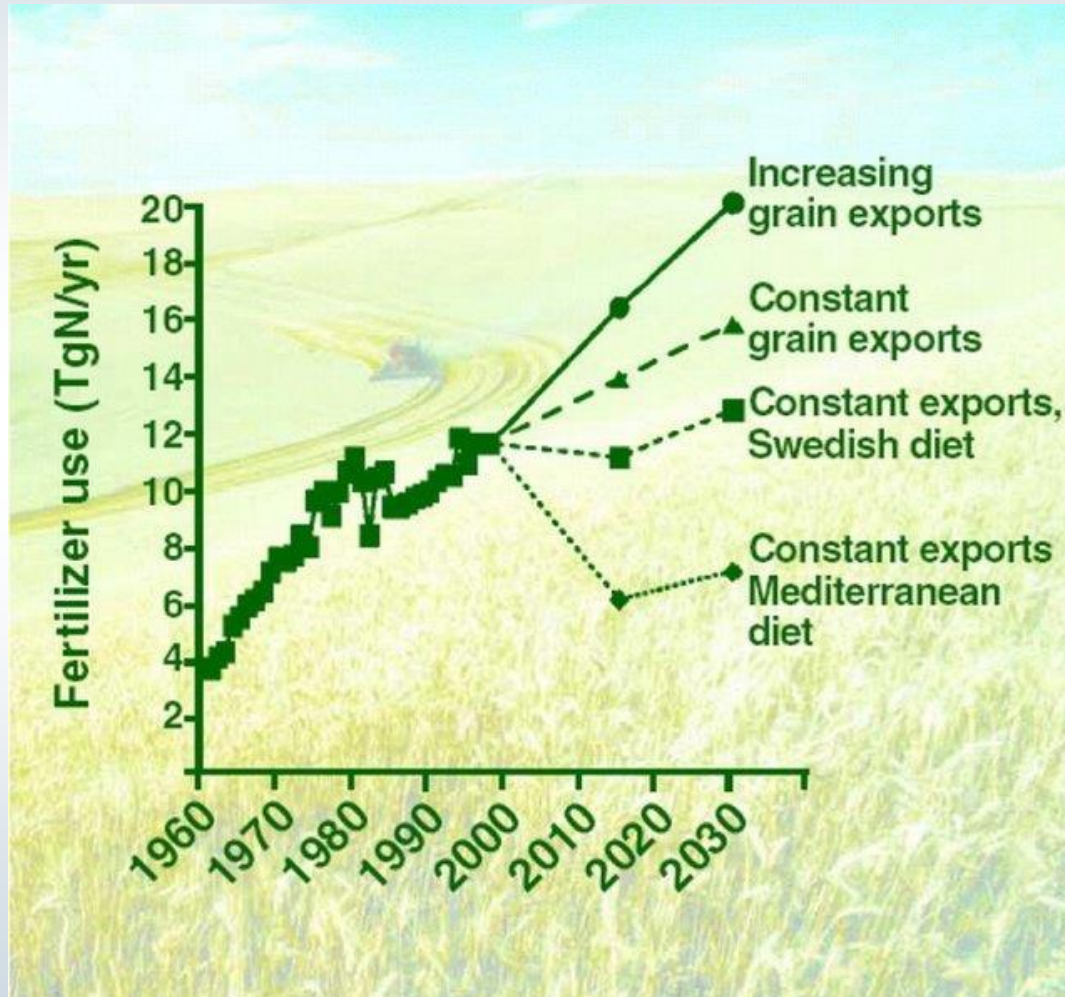
# Human Health Consequences of Nr

- Air pollution:  $\text{NO}_x \rightarrow$  tropospheric  $\text{O}_3$ 
  - respiratory and cardiovascular diseases
- Water pollution:  $\text{NO}_3^- \rightarrow \text{NO}_2^-$ 
  - methemoglobinemia, cancers, reproductive disorders
- Indirect ecological feedbacks to health:  $\text{NO}_3$ ,  $\text{NH}_4$ ,  $\text{N}_2\text{O}$ 
  - increases harmful algal blooms (HABs) and climate change-induced disease vector proliferation and pollen production

Conceptual model  
of overall net  
public health  
effects of  
increasing human  
fixation and use of  
atmospheric  $N_2$   
(Townsend et al.,  
2003)



# Reductions in health problems associated with a changing N cycle are possible (Howarth et al., 2002)



- Fertilizer N addition is single largest alteration of N cycle.
- Meat production dependent on cheap N fertilizer.
- Reducing animal products in American diet may reduce health impacts of N cascade and diet.

# Actionable Solutions

- Advise patients/clients to make dietary changes
  - Eat lower on food chain, i.e., more plant-based
  - Reduce consumption of meat and animal products
- Be alert to increases in Nr-promoted:
  - Respiratory and cardiovascular diseases/ailments
  - Infectious disease proliferation



# References

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