5

Fallstudie I

Landwirtschaft, oder wie viele Menschen kann die Erde ernähren?

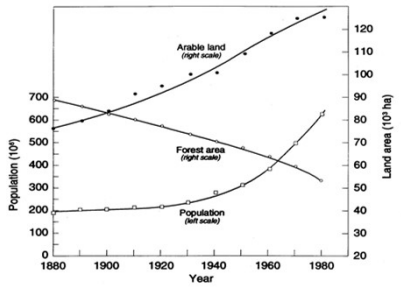
1

Feeding More People: Static vs Dynamic Models

- Population growth→growing food demand→more cropland→less forests
- Carrying capacity defined by cropland area available
- Demographic transition→dietary changes→agricultural yield growth→changing land-use patterns
- Carrying capacity defined by interplay of dynamic variables (rates of change)

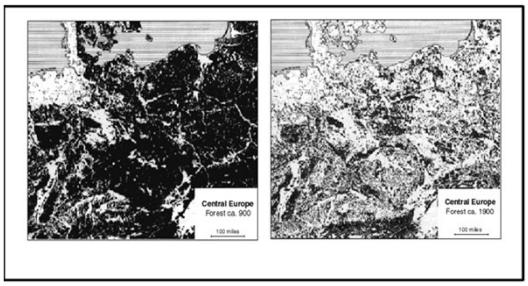
2

Population and Land-use Change in Asia (Source: Marland, 1989)



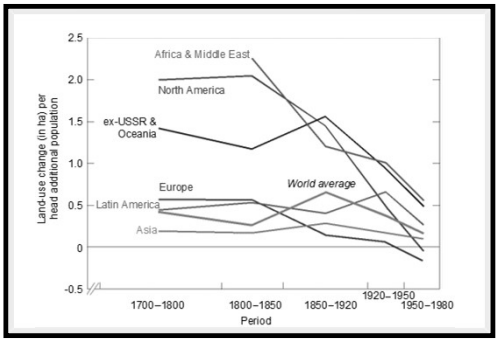
3

European Forest Cover AD 900 and 1900 (Source: Darby, 1956)



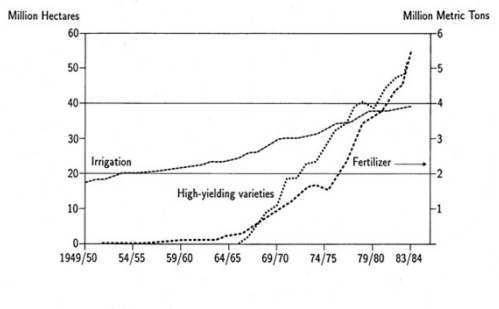
4

Land-use Change per Head Additional Population (ha per person)



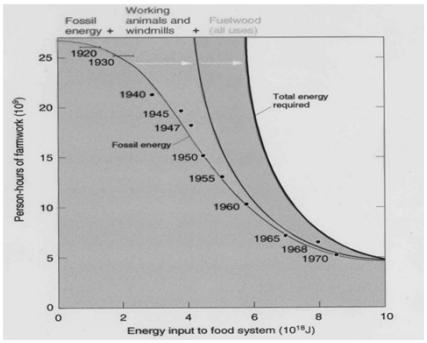
5

India – Factors Behind Increasing Land Productivity (Source: Sarma&Gandhi, 1990)



6

Labor & Energy for US Food



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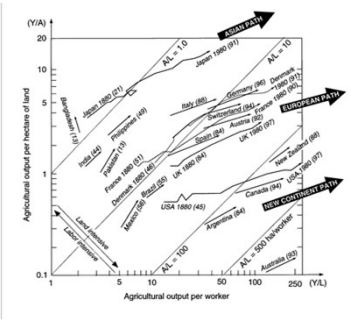
Agriculture – Path Dependent Development:
Output (Y) per Land (A) and Labor (L). Hayami&Ruttan, 1985.



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Nature – People – Technology: 2 Opposing Views

Thomas Malthus: *Principle of Population (1798)*:
More mouths to feed

Malthusian Model (dynamic mismatch):

-- Population: geometric (exponential) growth

-- Agriculture output: arithmetic (linear) growth

Ester Bosserup: *Population and Technological Change (1981):* More hands (and brains) to work

Bosserup's positive feedback model:

Population growth→innovation →technological change →expanding carrying capacity

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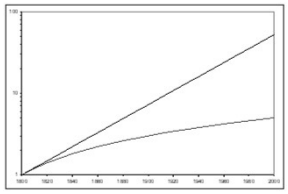
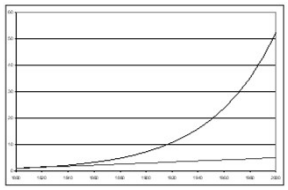
A Malthusian Model (2%/yr growth, index 1800=1)

Log scale



Population: Exponential growth

Linear scale



Agriculture: Linear growth

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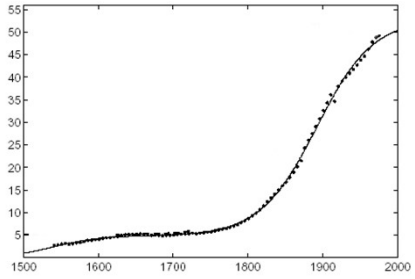
Population of England 1541-1975.

Source: Meyer&Ausubel, 1999 based on Wrigley& Schofield, 1981.



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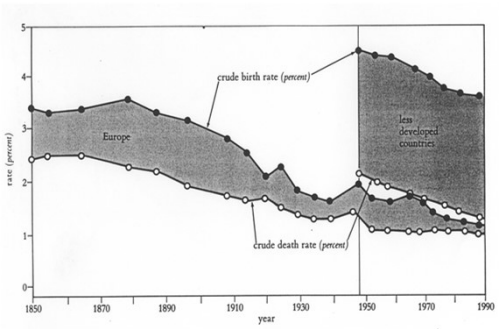
The Demographic Transition (Kelley, 1988)



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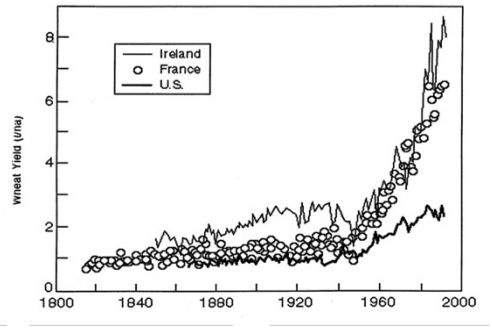
Long-term Wheat Yields

(Waggoner, 1997).



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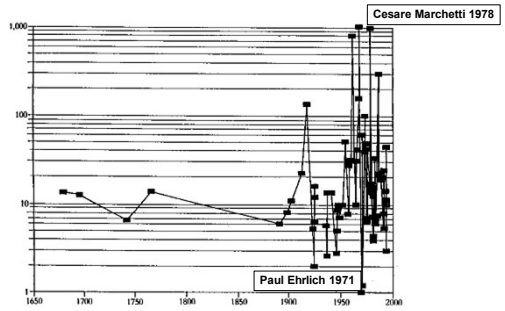
Estimates of Earth Carrying Capacity (in billion people). Source: Cohen, 1995.



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Zusammenfassung Block 5

(Landwirtschaft)

- **Agriculture: people x productivity = impacts**
- **Sources of productivity growth: biological, synthetic inputs (fertilizer), mechanical innovations**
- **Path dependency: productivity increases as function of relative resource endowments (prices) and resulting cumulative technological change (no convergence!); illustration: Hayami/Ruttan model**
- **Structural change in employment and residence (urbanization)**
- **Impacts: land-use changes (agriculture uses 1500 million ha globally)**
- **Impact on CO2 balance (soil carbon): up to 230 GtC since 1800**
- **Agriculture: largest user of water resources (3000 km3/yr, reservoir size: 5000 km3)**
- **Carrying capacity (1-1000 billion people): dependent on technology**
- **Malthus versus Bosserup: static vs. dynamic population and technology**
- **Demographic transition**

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