# Determinants of global HANPP patterns: Where do we stand?

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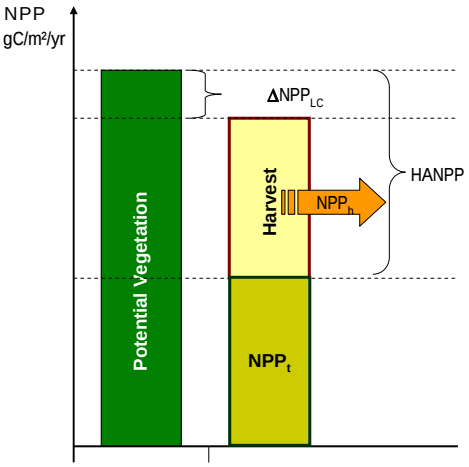
## Overview

- Introduction of HANPP and its determinants
- Geographical patterns of global HANPP
- Population density has a strong influence on HANPP
- HANPP and economic activity: Weak correlation, complex interrelations
- HANPP determinants: Towards a conceptual framework

# Definition of HANPP




- **Ecological perspective:**
  HANPP measures human impact on trophic energy in ecosystems

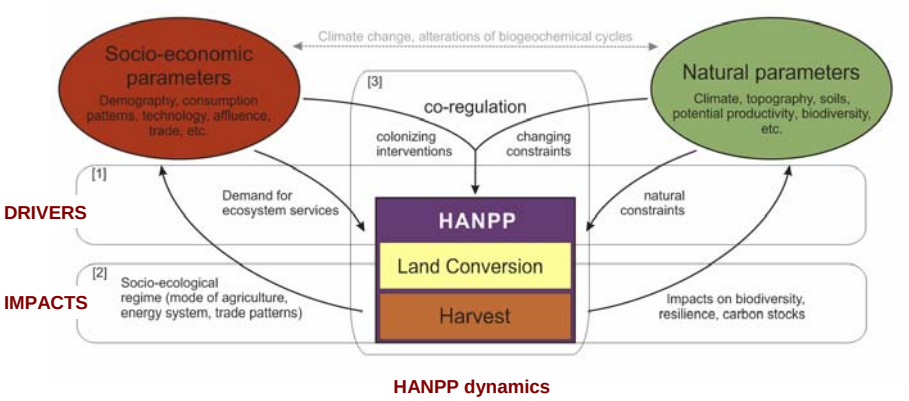
  HANPP = $NPP_0 - NPP_t$

- **Socioeconomic perspective:**
  HANPP is the sum of land-use induced changes in NPP and biomass harvest:

  HANPP = $\Delta NPP_{LC} + NPP_h$



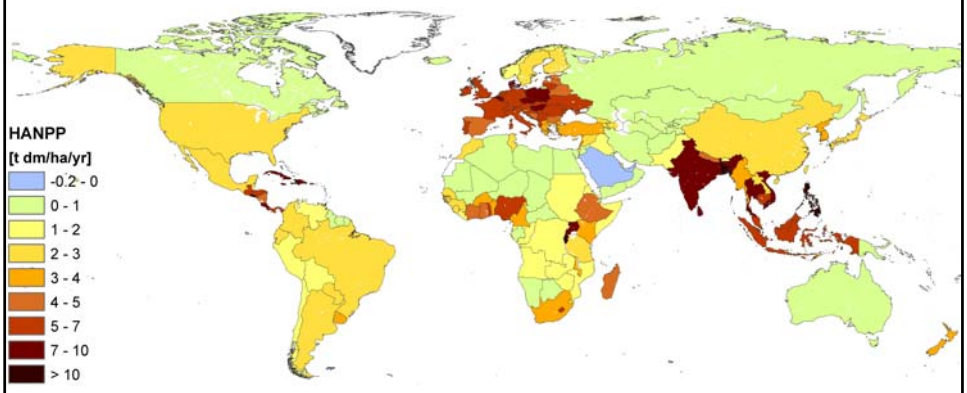
# HANPP (dynamics) depends on socioeconomic and natural parameters




**HANPP dynamics**

**Krausmann et al., 2009**
***J. Land Use Sci.*, 4: 15-34.**

# Geographical patterns of global HANPP [1]: HANPP per unit area and year




**Krausmann et al., 2009**
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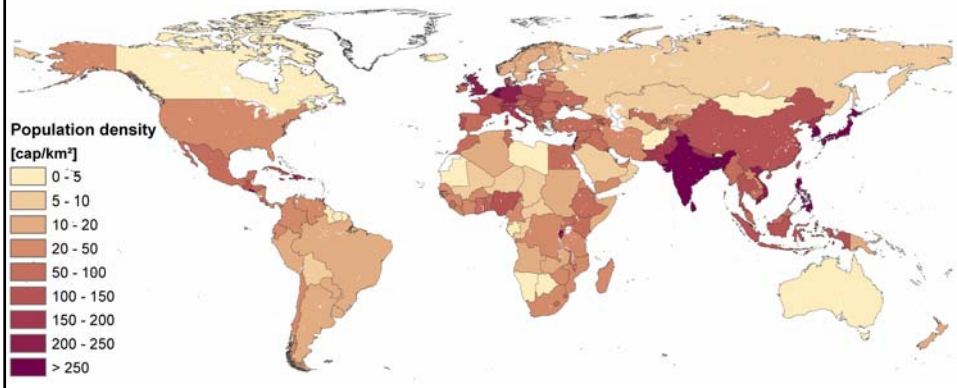
# Population density





Global LAND Project

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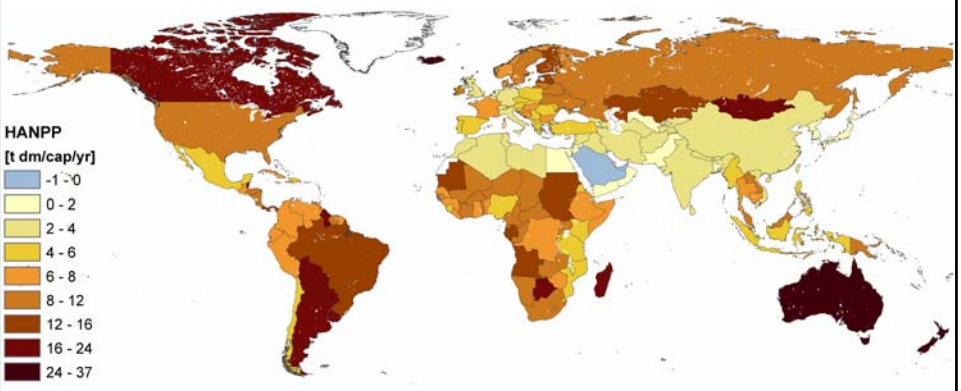
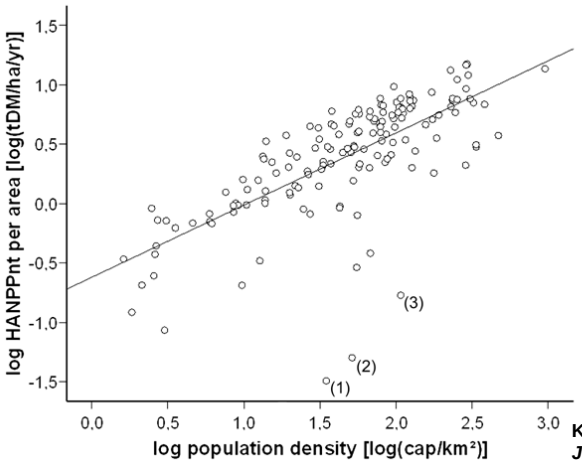
# Geographical patterns of global HANPP [2]: HANPP per capita and year




**Krausmann et al., 2009**
***J. Land Use Sci.*, 4: 15-34.**



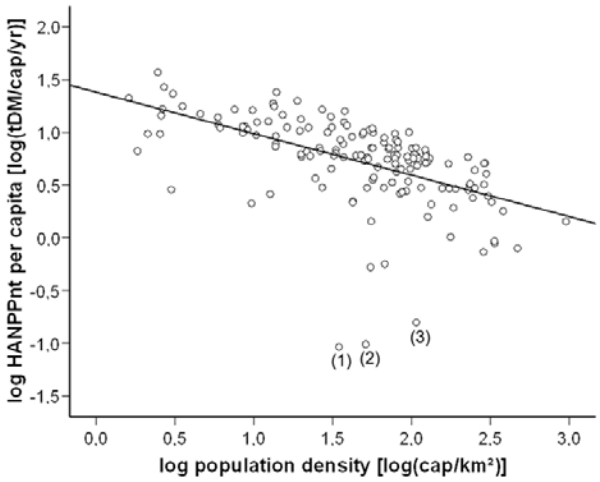
# Population density strongly influences HANPP per hectare, but…




**(1) Yemen**
**(2) Qatar**
**(3) Kuwait**

**Krausmann et al., 2009**
***J. Land Use Sci.*, 4: 15-34.**

# … HANPP per capita is smaller in densely populated countries




(1) Yemen
(2) Qatar
(3) Kuwait

Krausmann et al., 2009
*J. Land Use Sci.*, 4: 15-34.



# The interrelation between economic activity, welfare and HANPP is complex

Table 3. Regression coefficients (Pearson's *r*) and number of countries (*N*) in the respective sample for correlations between the logarithm of per-capita GDP ($/cap/year) and the HDI and selected other parameters.

| | GDP | | HDI | |
|---|---|---|---|---|
| | *r* | *N* | *r* | *N* |
| Animal protein as percentage of total food intake (%) | 0.77** | 149 | 0.81** | 124 |
| Log fertilizer use per capita (t/cap/year) | 0.62** | 147 | 0.72** | 121 |
| Log number of tractors per capita (#/cap) | 0.64** | 153 | 0.76** | 130 |
| Log net biomass trade per capita (t DM/cap/year) | 0.70** | 95 | 0.70** | 79 |
| Log biomass import per capita (t DM/cap/year) | 0.85** | 149 | 0.80** | 129 |
| Log biomass export per capita (t DM/cap/year) | 0.67** | 146 | 0.65** | 129 |
| Log final biomass consumption per capita (t DM/cap/year) | 0.34** | 153 | 0.26* | 125 |
| Log final biomass consumption per HANPP (%) | 0.24* | 151 | 0.17 | 123 |
| Log livestock units per capita (LU/cap) | 0.05 | 153 | 0.02 | 125 |
| Log biomass harvest ($NPP_h$) per capita (t DM/cap/year) | 0.01 | 153 | −0.03 | 125 |
| Log HANPP per capita (t DM/cap/year) | −0.04 | 151 | −0.03 | 123 |

Note: *Significant at $p < 0.05$; **Significant at $p < 0.001$; no asterisk – not significant.

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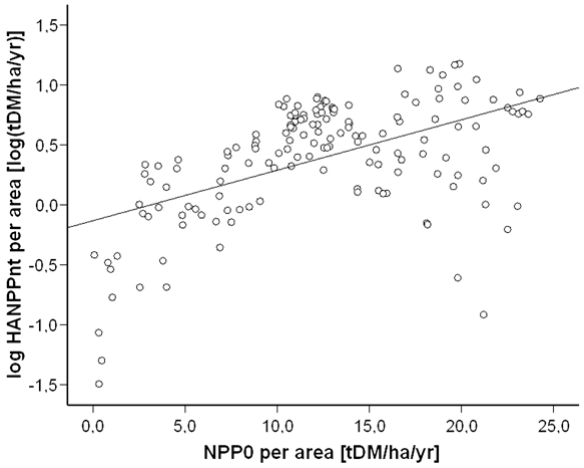
# Natural productivity potential constrains HANPP per unit area and year




- HANPP is constrained by productive potential in poor environments
- In favourable environments socioeconomic factors determine the level of HANPP



| | |
|---|---|
| **Final biomass demand:** How much biomass products are required by final consumers/for exports? | • population +; population density –<br>• affluence ± (some demand categories decline, some increase with affluence)<br>• trade: exports +; imports –<br>• other factors: climate |
| ↓ | |
| **Harvested NPP ($NPP_h$):** How much biomass is extracted to produce final demand? | • composition of final use/dietary patterns (affluence+, population density–)<br>• conversion efficiency (affluence+, population density+) |
| ↓ | |
| **Land use induced productivity changes ($NPP_{LC}$):** How is the land used and what is the impact on productivity? | • population density – (efficient land use system)<br>• affluence – (high yields)<br>• biogeographic factors ± (various effects) |
| ↓ | |
| HANPP | |

## From final demand to harvest to HANPP:

## A complex picture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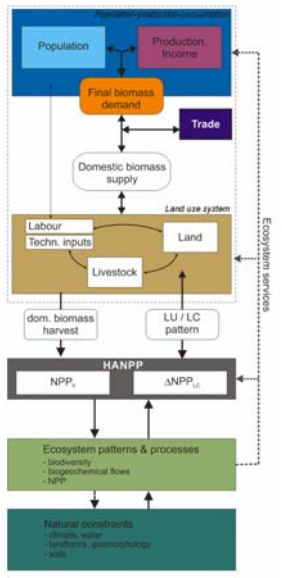


# Towards a white-box model of global HANPP

- Multiple feedbacks between
  - Population, modes of subsistence
  - Economic activity, growth and trade
  - Land-use system (cropping, livestock..)
  - Natural constraints (climate, soil, land forms)
  - HANPP and its components
  - Patterns and processes in ecosystems
  - Ecosystem services

- ***Under construction!***



# Download HANPP and land use data
## http://www.uni-klu.ac.at/socec/inhalt/1088.htm

# The end



# The HANPP approach

$NPP_0$


Productivity of potential vegetation

(hypothetical vegetation assumed to prevail in the absence of land use; e.g., forests, grasslands, savannahs, deserts, shrubs, etc.)

$NPP_{act}$


Productivity of actual vegetation

(including croplands, grasslands, built-up area, etc.

$NPP_t$


Energy remaining in the ecosystem after harvest

Productivity change

Harvest (NPPh)

- **Indicator of land-use intensity**
- **‚Pressure' indicator, useful to analyze drivers of land use**