

Future Employment in Global Agriculture: Trends and Drivers in the Shared Socioeconomic Pathways

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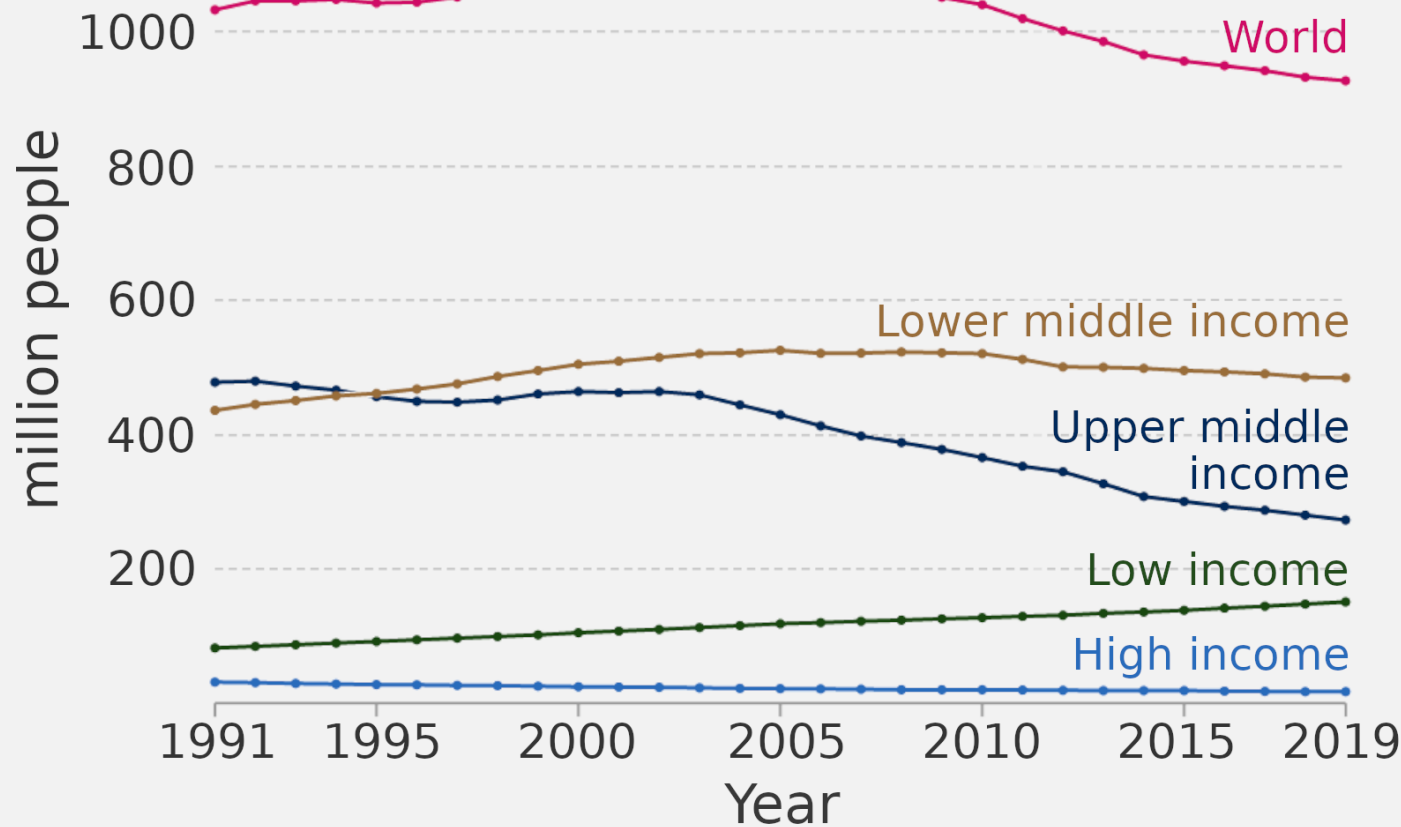
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How does employment in agriculture develop?



- Globally, over $\frac{1}{4}$ of the **working population** is employed in agriculture
- The **absolute number** of employment in agriculture is **still increasing in countries with low income**
- **Future development is uncertain** and depends on many **socio-economic factors**

Figure adapted from Our World in Data: https://ourworldindata.org/employment-in-agriculture?source=post_page

Method: Projection of agricultural employment using MAgPIE

Model of Agricultural Production and its Impact on the Environment

- is a **partial equilibrium** model of the **land use** sector
- operates **recursive dynamically** in 5-year time-steps until **2100**
- is **spatially explicit** with **global** coverage
- **Minimization of total costs** while **meeting demand** for agricultural products and complying with **other constraints** results in optimal **land-use patterns, agricultural investments and trade flows**
- Other outputs are e.g. GHG emissions, production costs, agricultural water withdrawal, ...

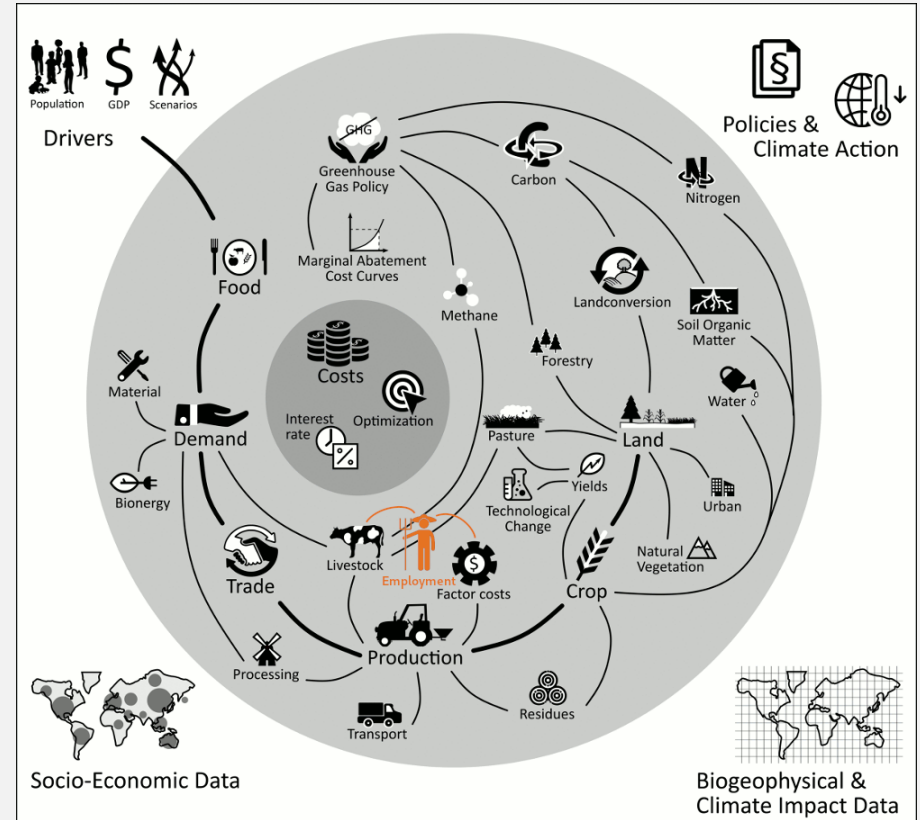


Figure adapted from Dietrich et al. 2019

Implementation of agricultural employment in MAgPIE

- Factor costs (F) are calculated based on production quantity (q) and factor (i.e. labor and capital) requirements (f) per output unit. Applying a cost share (s_{lab}) results in labor costs (L).

$$L_{MAgPIE}(t, i, k) = q(t, i, k) \cdot f(i, k) \cdot s_{lab}(t, i)$$

t Year
 i Region
 k Crop/livestock category

F Factor costs
 (USD_{MER05})
 L Labor costs
 (USD_{MER05})
 q Production quantity
 (tDM)
 f Factor requirements
 (USD_{MER05}/tDM)
 s_{lab} labor cost share

Regression for labor cost share



Implementation of agricultural employment in MAgPIE

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$$L_{MAgPIE}(t, i, k) = q(t, i, k) \cdot f(i, k) \cdot s_{lab}(t, i)$$

- quantification of the relation between labor costs and employment based on historic data from the International Labour Organization (ILO):

1. number of people employed in agriculture (E_{ILO})
2. mean yearly hours worked per employed person (h)
3. mean hourly labor costs per employee (w)

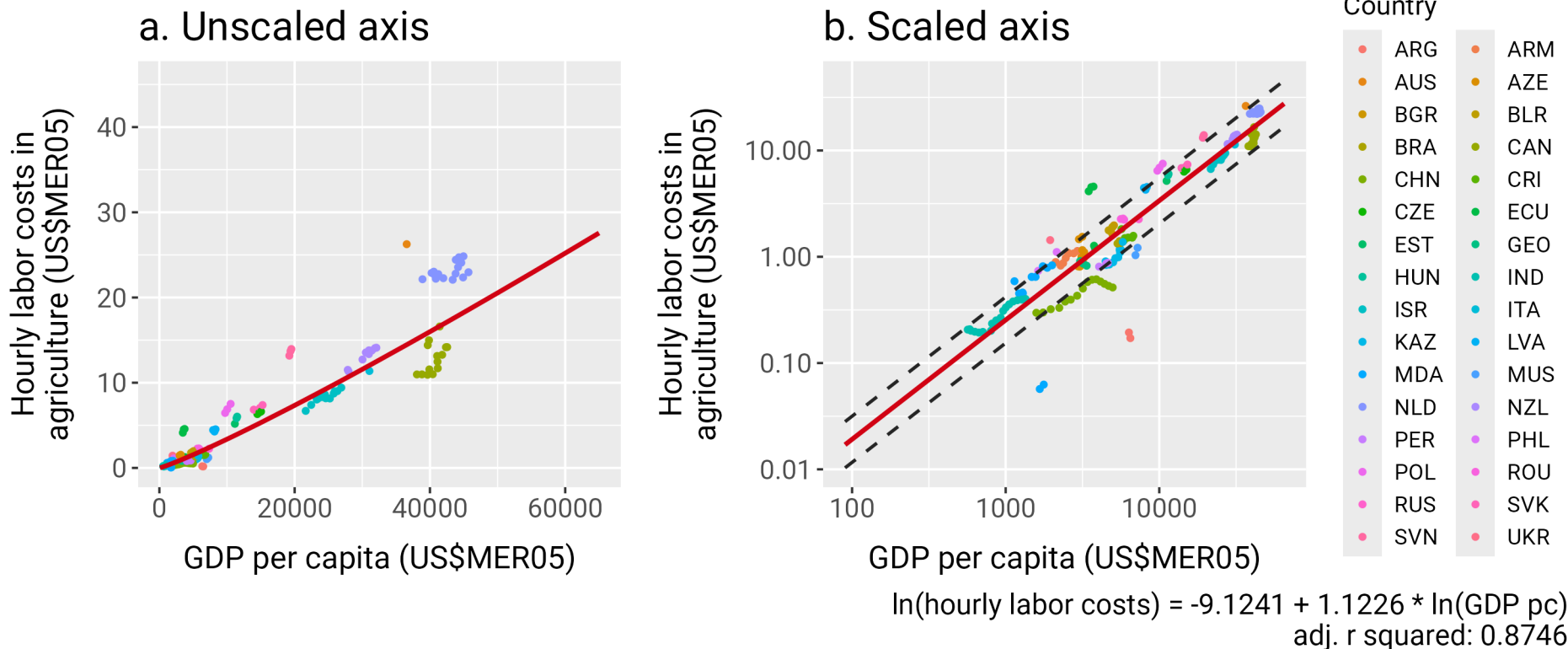
$$L_{ILO}(t, i) = E_{ILO}(t, i) \cdot h(t, i) \cdot w(t, i)$$

$$\Rightarrow E_{MAgPIE}(t, i) = \frac{\sum_k L_{MAgPIE}(t, i, k)}{h(t, i) \cdot w(t, i)}$$

t	Year
i	Region
k	Crop/livestock category
F	Factor costs (USD_{MER05})
L	Labor costs (USD_{MER05})
q	Production quantity (tDM)
f	Factor requirements (USD_{MER05}/tDM)
s_{lab}	labor cost share
E	Employment (people)
h	hours worked (h/year)
w	hourly labor costs (USD_{MER05}/h)

Implementation of agricultural employment in MAgPIE

Regression for hourly labor costs in agriculture



Calibration of global regression to country level by adjusting intercept

Implementation of agricultural employment in MAgPIE

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$$L_{MAgPIE}(t, i, k) = q(t, i, k) \cdot f(i, k) \cdot s_{lab}(t, i)$$

- quantification of the relation between labor costs and employment based on historic data from the International Labour Organization (ILO):

1. number of people employed in agriculture (E_{ILO})
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$$L_{ILO}(t, i) = E_{ILO}(t, i) \cdot h(t, i) \cdot w(t, i)$$

$$\Rightarrow E_{MAgPIE}(t, i) = \frac{\sum_k L_{MAgPIE}(t, i, k)}{h(t, i) \cdot w(t, i)} = E_{ILO}(t, i)$$

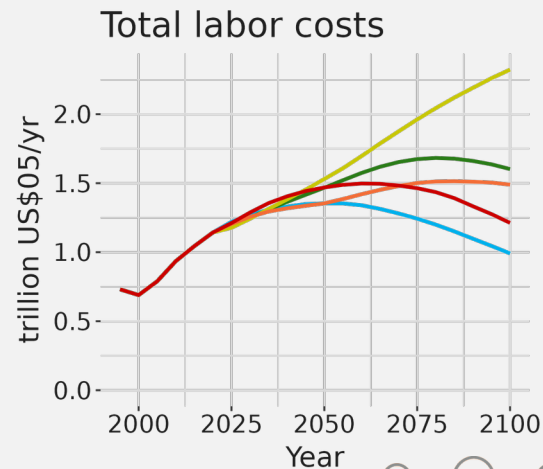
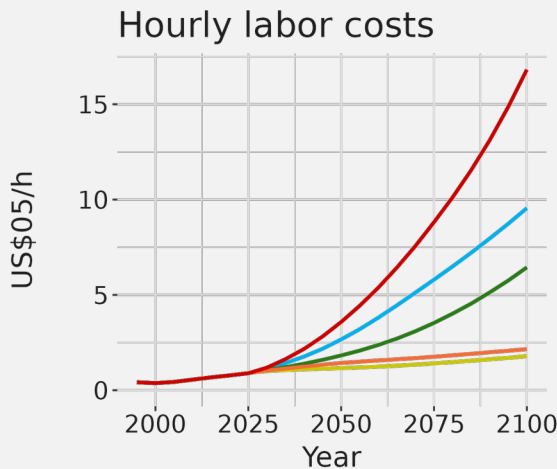
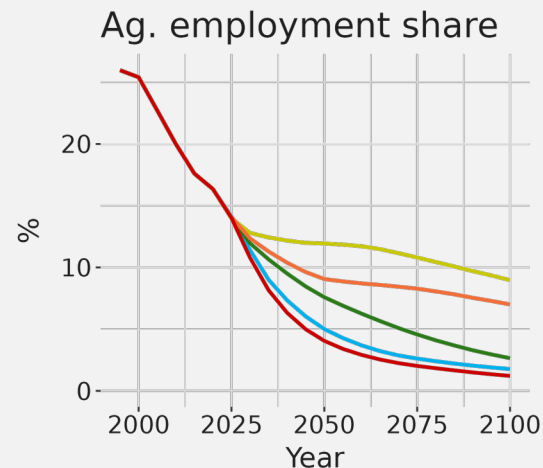
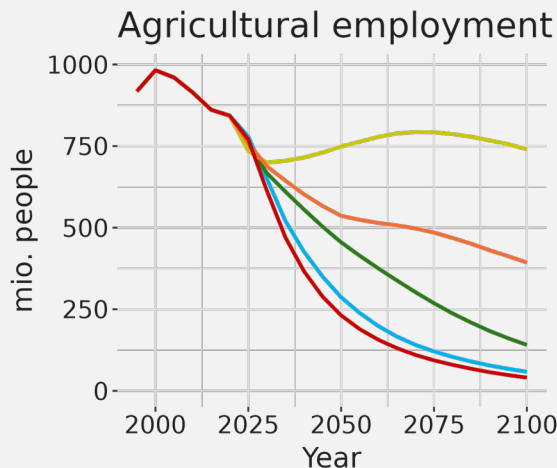
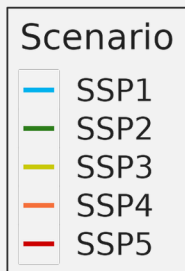
for $t = 2010$

t	Year
i	Region
k	Crop/livestock category
F	Factor costs (USD_{MER05})
L	Labor costs (USD_{MER05})
q	Production quantity (tDM)
f	Factor requirements (USD_{MER05}/tDM)
s_{lab}	labor cost share
E	Employment (people)
h	hours worked (h/year)
w	hourly labor costs (USD_{MER05}/h)

Agricultural employment share is decreasing for all SSPs

Global development of key indicators:

- **only SSP3** shows a slight **increase** in the absolute number of **agricultural employment**
- the **share** of the working age population employed in agriculture is **decreasing in all SSPs**
- development of **hourly labor costs** is **strongly dependent on GDP** in the respective SSP
- **total labor costs** are driven by agricultural demand and **labor-to-capital ratio**



Increasing labor productivity drives agricultural employment

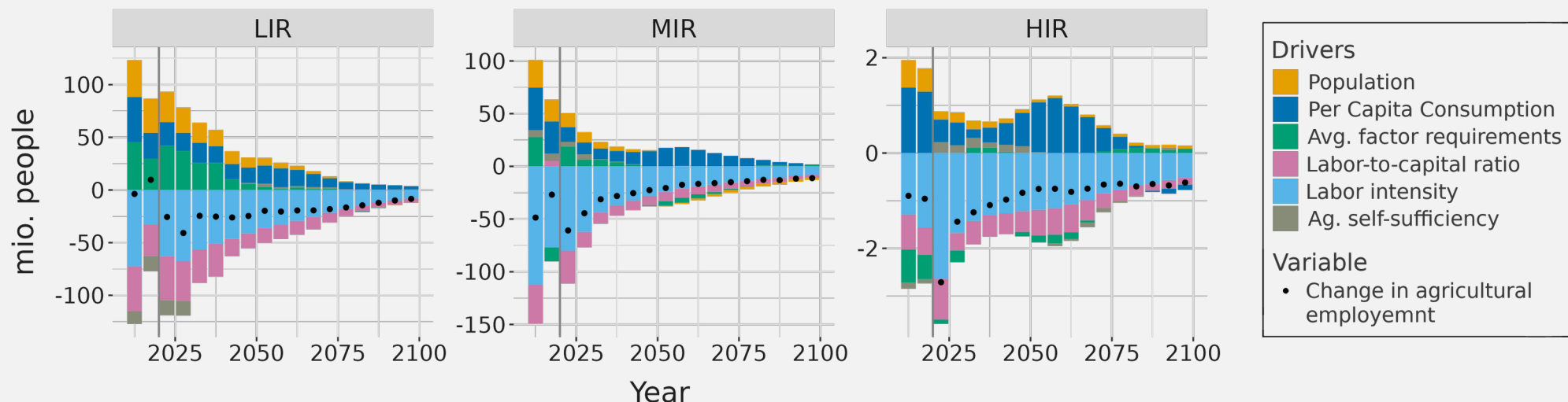
Global change in agricultural employment and decomposition to main drivers:



- **labor intensity** is the **strongest driver** across SSPs
- increasing agricultural employment in **SSP3** is mainly **driven by population growth**

Drivers differ depending on the economic development level

Decomposition for SSP2 by economic region:



- agricultural employment is **decreasing across all economic regions**
- the **self-sufficiency ratio is increasing in HIR**, balanced by lower self-sufficiency in LIR
- **avg. factor requirements** are a strong positive driver in **LIR** where the **transition towards “western diets”** is still ongoing

- Novelty: **first global & long-term analysis** of future **development of agricultural employment** in primary production **across the five SSPs** using a **land-use model**
- Caveats: **no specific implementation** of the **labor market and structural change** due to the use of a partial equilibrium model
- Relevance: **for an inclusive development** of the food and land-use system we need to take into account **how and why employment in agriculture will be affected**