I.09 (C.44) – Agricultural sector resilience progress indicator- first results

- **Policy Context**
- **Measuring agricultural sector resilience**
- **Analysis of components**
- **Composite indicator**
- **Discussion/outlook**

Contacts: Frank Dentener (JRC); Nicola di Virgilio (AGRI)

Contributors: Matteo Zampieri, Ad de Roo, Emanuele Lugato et al.

GREXE- 27.04.2021

Resilience Indicator- policy context

- Adaptation is mentioned in the CAP objectives: "Contribute to climate change mitigation and adaptation, as well as sustainable energy".
- MS with adaptation needs prioritized in their SWOT analysis, need to reflect these in their CAP Strategic Plans.
- The importance of adaptation to climate change is also highlighted in the Commission's Country recommendations.
- The proposed list of indicators in Annex I on Impact, Result and Output indicators considers an Impact indicator on Resilience of EU agricultural sector.
- The recently EU Adaptation strategy recognizes the importance of developing metrics for resilience.

Agricultural sector climate resilience indicator

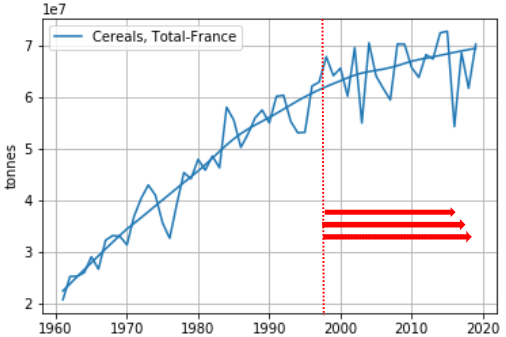
- **Composite *impact* indicator** to measure **good status or progress** of MS wrt to (long-term) **climate resilience** of the agricultural sector.
- **3 aspects of resilience** – robustness (resisting change, shock absorption, return to original state), adaptability (adjusting existing practices) and transformation (structural change of practices).
- **4 dimensions of resilience** – financial, social/innovation, governance and climate/environmental.
- Using **available datasets/indicators** (available in CMEF, Eurostat, EEA, JRC, and possibly augmented MS data)
- **First version**: Agricultural Production, Agricultural Factor Income, WEI+, Soil Organic Carbon.
- Tested using available data on the **current CAP** (begin, mid, end)
- Harmonized analysis, dashboard approach, simple summary score.

Annual Cereal Production Resilience

- Cereal Production: Wheat, Barley, Maize, Paddy Rice, etc
- National production (Eurostat); long time series to capture climate change impacts: "resisting shocks"
- Resilience: squared mean divided by the variance of the production (Zampieri et al. 2020).
- 3 periods: 1998-2013; 1998-20016; 1998-2018

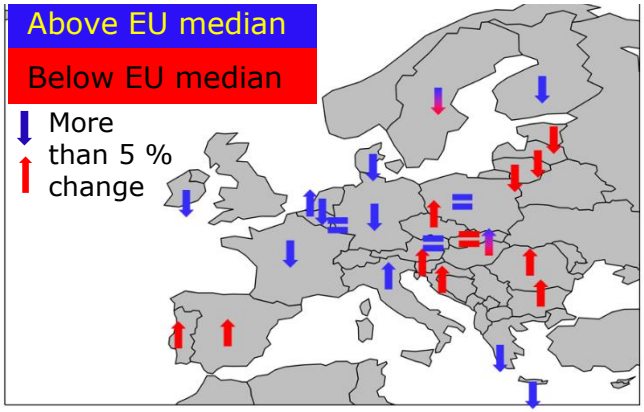
$$R_p = \mu^2 \sigma^{-2}$$

France Cereal Production

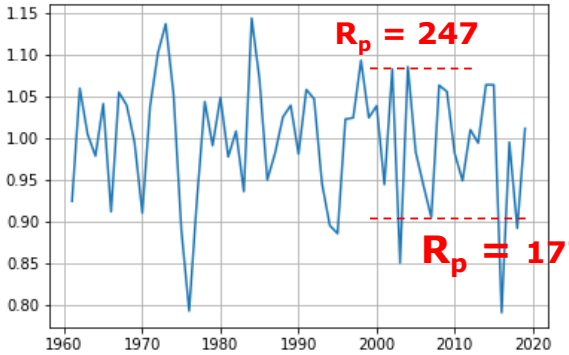


Reference period 1998-2013

Resilience change wrt reference period



French Cereals



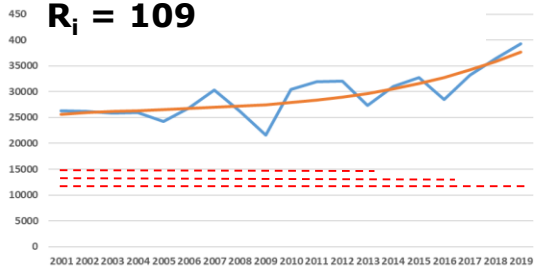
Normalized time-series

- Can be applied for other properties, e.g. calories, proteins, other crops,…., Euro's
- Resilience is dependent on climatic and environmental properties, agro-management, suitability of crops, diversity of cropping system, etc., should not be used to compare MS.
- Resilience is increasing with crop diversity, i.e. Italy's resilience is high because of the combination of wheat, maize, and rice production.

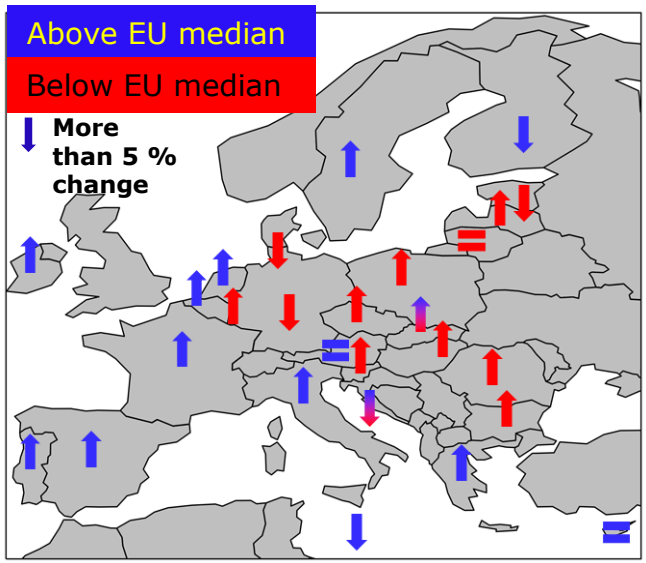
Agricultural Factor Income (C.5)

- Agricultural Factor Income per annual Work Unit (Eurostat/AGRI)
- Income remunerating borrowed or rented factors of production (capital, wages and land rents) as well as own production factors (own labour, capital and land)
- Data since 2001 to 2019 for most MS.
- Change in Factor Income and variability reflects much more than climate change
- Similar approach as production: normalized variance since 2001

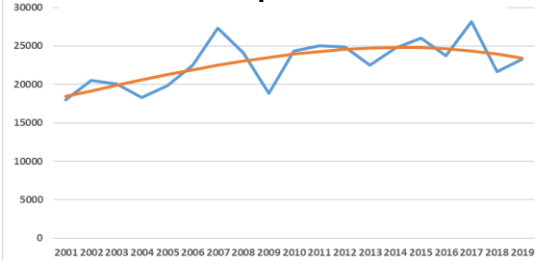
France Factor income: R_i = 109



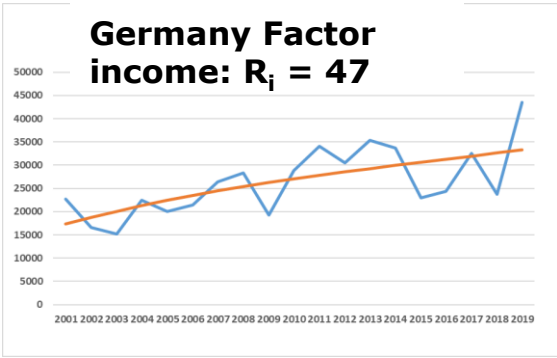
Factor Income Resilience change wrt reference period



Sweden Factor income: R_i = 107



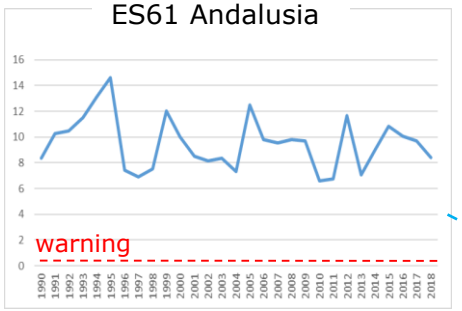
Germany Factor income: R_i = 47

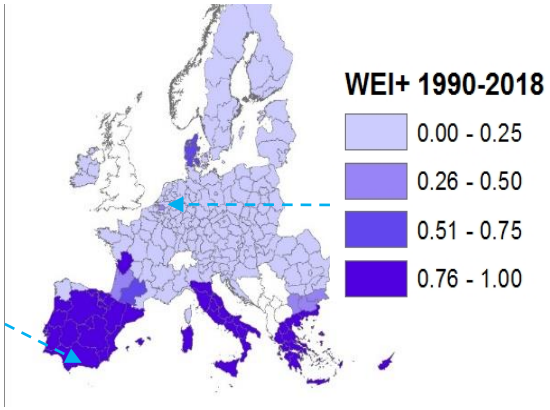


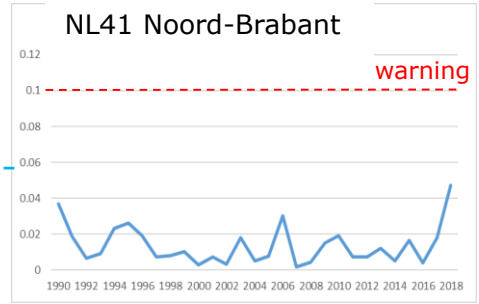
Water Exploitation Index (WEI+) for agriculture (C.37)

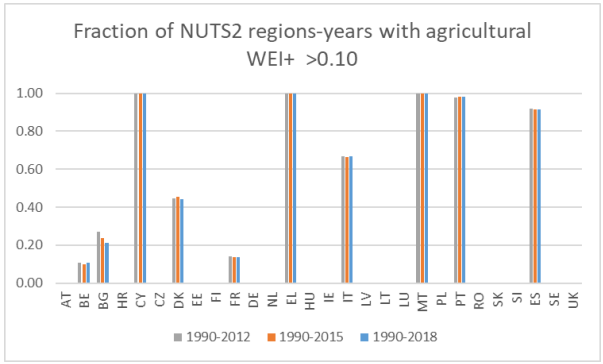
- Modified from WEI+ (C.37), reported by EEA on national/watershed level, and for all sectors.
- **Net** water consumption divided by renewable resources (including upstream inflow)
- Considers monthly **net** water consumption from irrigated agriculture
- JRC's LISFLOOD hydrological model (5x5 km; subgrid 100m) aggregated to **NUTS2**.
- Analysis focuses on the months with the highest net water use on NUTS2 for 1990-2018
- Member state: counts the number of NUTS2 regions and months with WEI+ >**0.1**

Fraction of years with WEI+>0.1





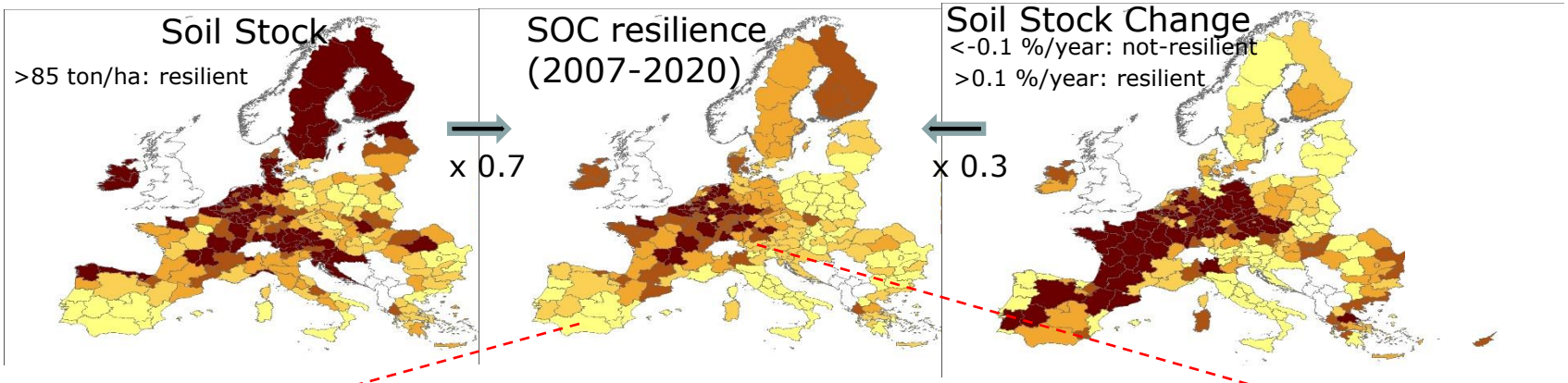


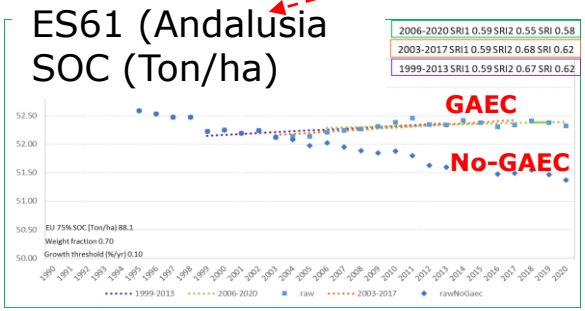


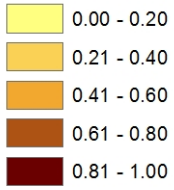
- Beginning, mid-term and end of CAP considering change relative to climatic periods.
- Lack of sensitivity points to incomplete/inaccurate quantification of agricultural water abstraction and efficiency measures
- Iterative process with EEA and Eurostat to improve MS reporting on water abstraction and irrigated agricultural land.

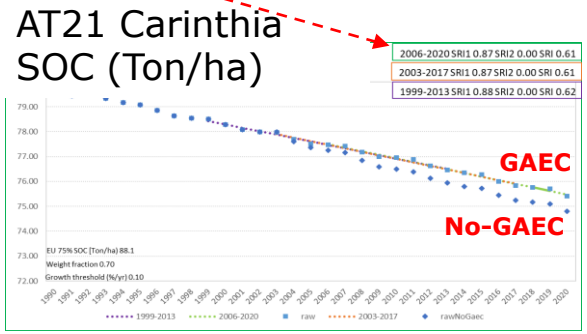
Soil Organic Matter (C.39)

- Composite of normalized Soil Organic Carbon **stock** (I.11) and **stock change**
- DayCent biogeochemical model at 1x1 km for 1990-2020; calibrated with LUCAS survey data; shown at NUTS2
- Includes uptake of GAEC agro-management (cover crops, reduced/no-tillage) using FSS







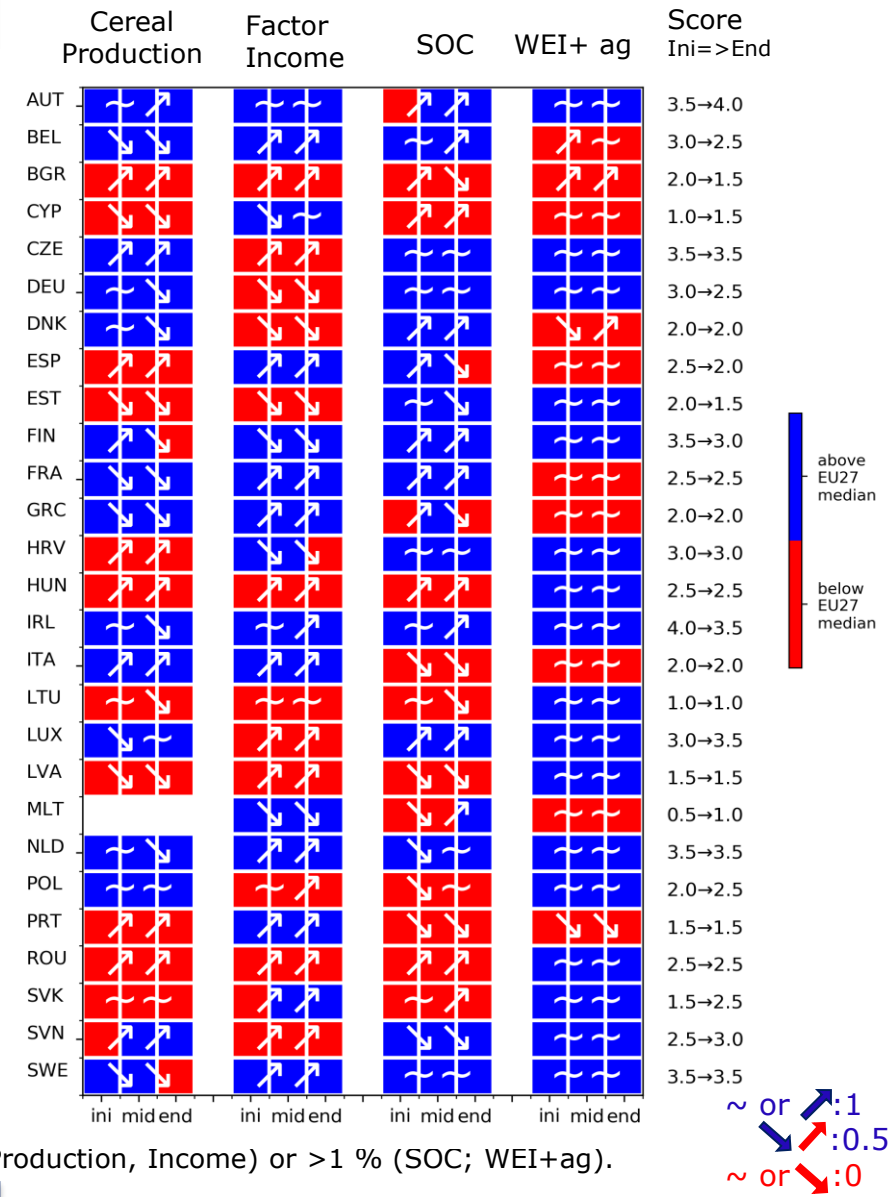


- Need a long-term perspective to detect slow change (15 year periods, begin, mid, end of CAP)
- MS score is weighted average of NUTS2 regions.
- Improvements possible with additional information on management practices (e.g. FSDN, IACS etc)
- Special attention to agriculture on high-carbon peatlands

I.09 (C.44) – Agricultural sector resilience progress indicator

- Demonstration for current programming period using available data until ca. 2018/2020.
- 3 periods; change from reference period
- Relative to the EU27 median for each individual contributing indicator.
- Almost always context dependent, and shall not be used for comparing MS
- Score, dashboard=>more detailed analysis
- Resilience score counts status and progress of contributing indicators.

- As any composite indicator: a quick inspection of overall resilience, inviting to look into the details, i.e. a communication tool.



Changes wrt reference period are >5 % (Production, Income) or >1 % (SOC; WEI+ag).

Discussion & outlook

- Demonstration based on current CAP, concept is ready to be implemented in the indicator framework of the new CAP.
- Improve current indicators with information on management practices, water abstraction, irrigation efficiency and infrastructure
- Not all dimensions are covered: climate/environmental, financial, social/innovation, governance.
- Include additional indicators when available, e.g. detailed information on crop diversity/diversification; risk management (including climate services), training, etc.

Questions?