SDGs under the climate change threat: an impact assessment

L. Campagnolo[1], Marinella Davide[1,3], E. Delpiazzo[1,2]
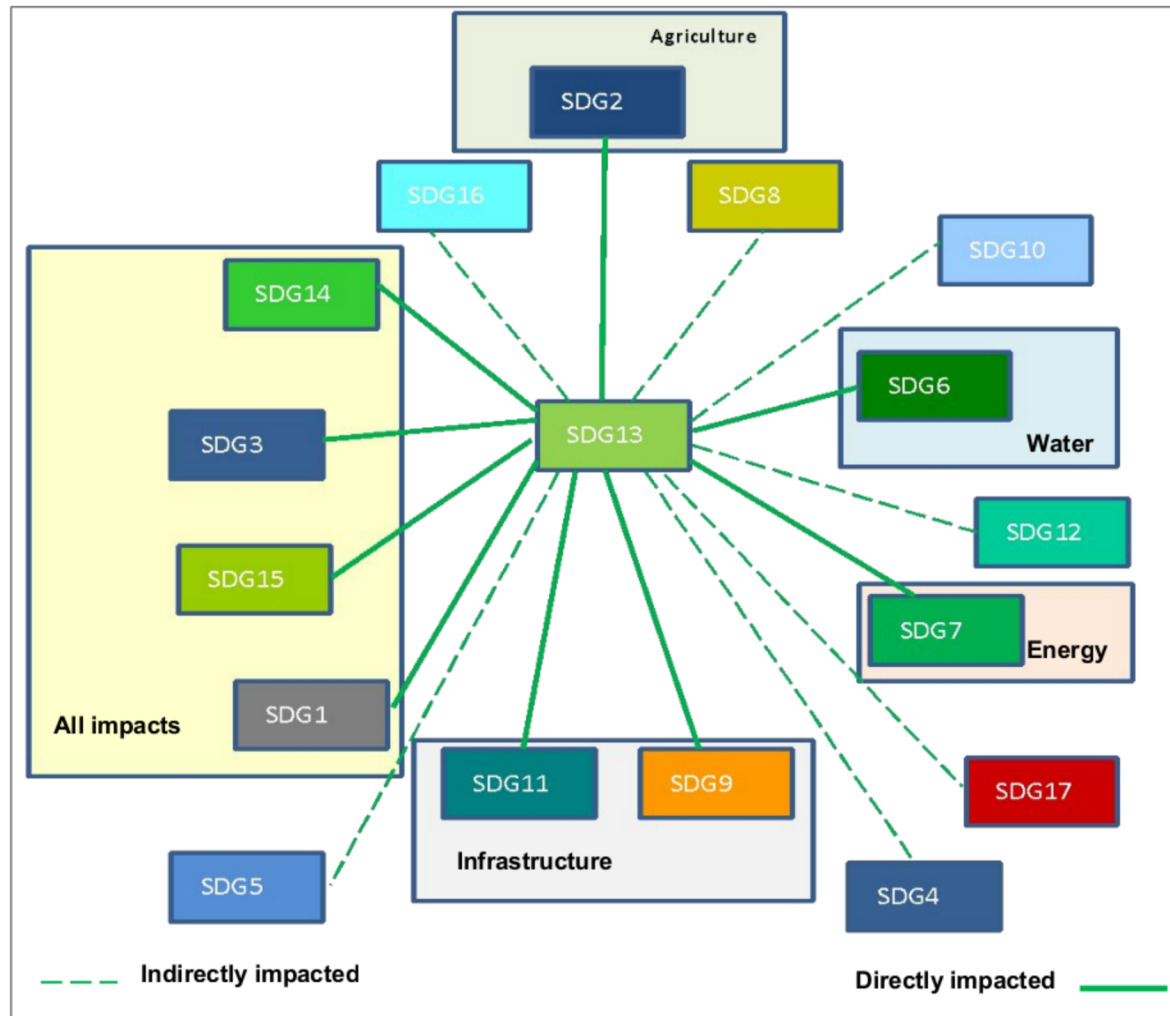
[1] Fondazione Eni Enrico Mattei (FEEM)
[2] Centro Euro-Mediterraneo per il Cambiamento Climatico Fondazione (CMCC)
[3] Cà Foscari University

Impact World 2017

Potsdam, 13 October 2017

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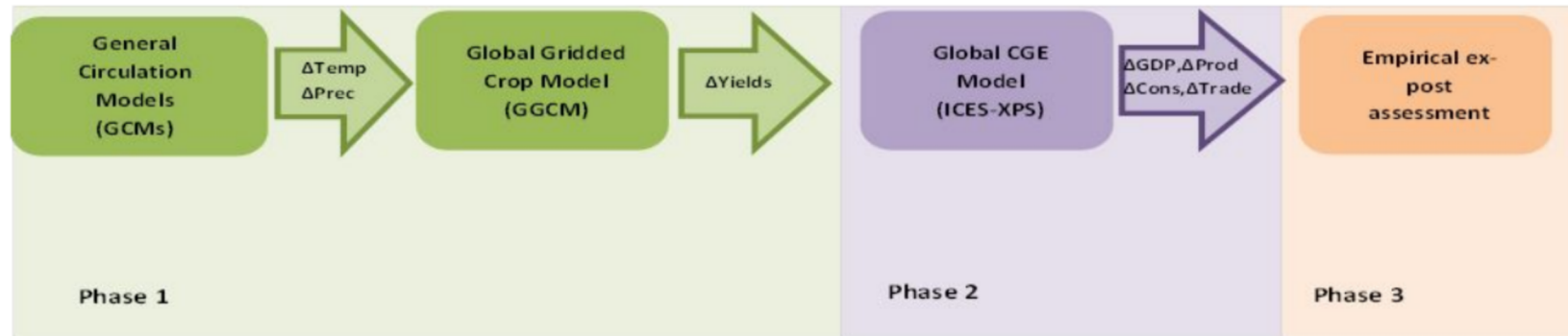# Climate Change in the SDG Architecture

Climate Change Impacts on Agriculture

→ What happens if we fail SDG13 (climate action)?

→ Which are the implications of global warming for the agricultural sector?

→ Which are the ramifications for other SDGs?

Outcomes useful to:

1) Assess uneven distributed impacts;
2) Assess vulnerabiity to better target adaptation measures;
3) This analysis gives also insights in social indicators such as poverty, undernurishment, inequality.

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Methodology

Uncertainty forecasts:
5 GCMs (median scenario), 2 RCPs, CO2 and non-CO2 fertilisation
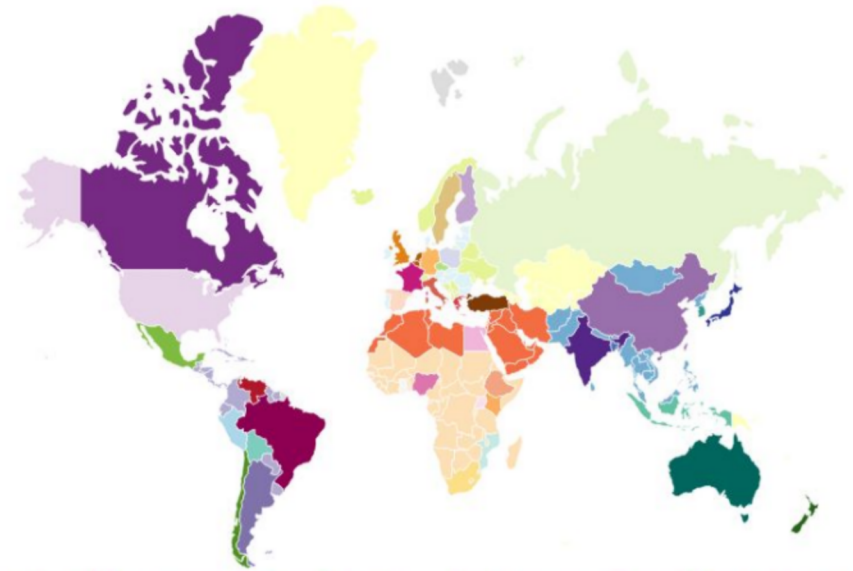
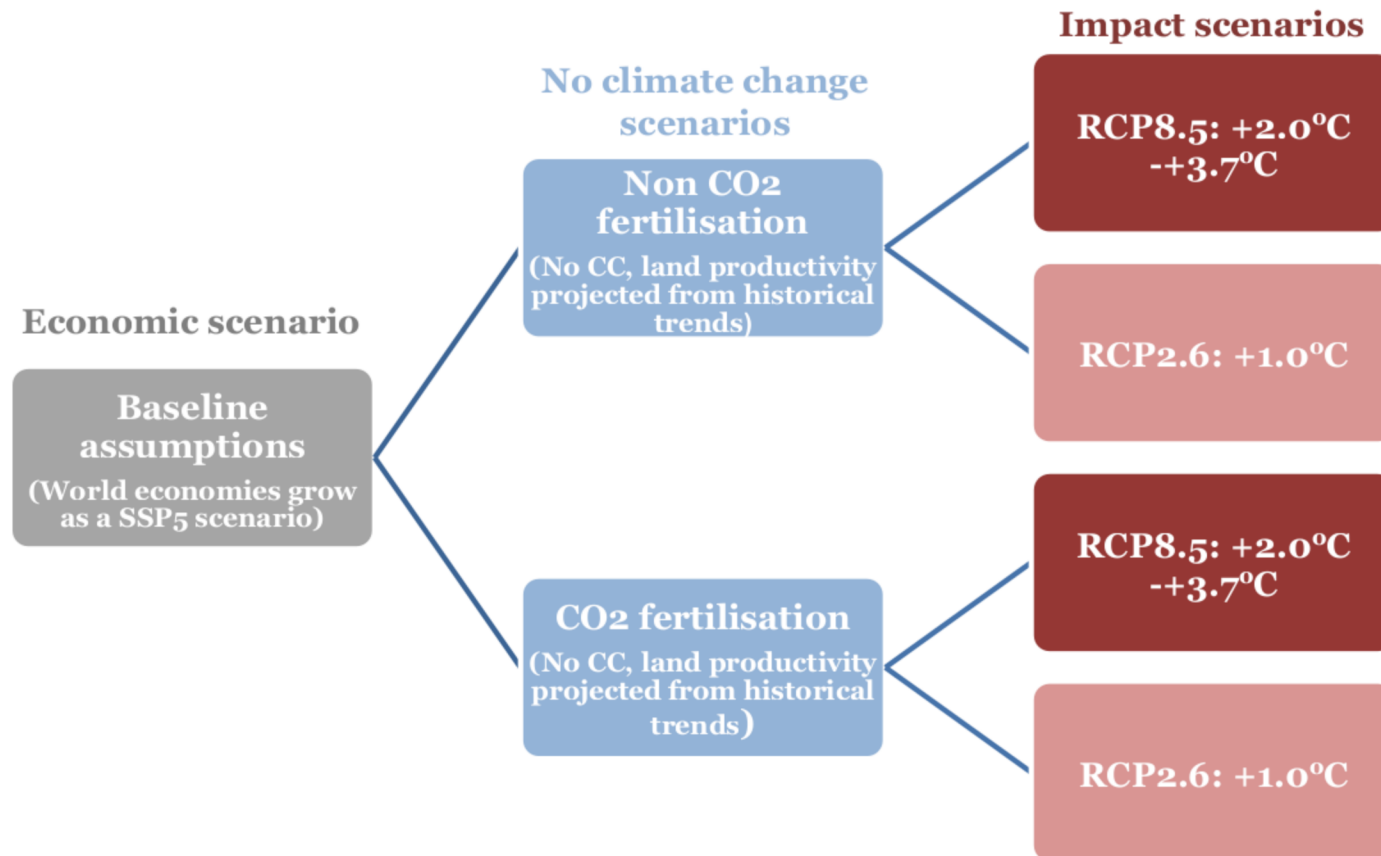**Calibration on GTAP database v.8**

Calibration on historical data

- GCMs: HadGEM, GFDL, IPSL, MIROC, NorESM
- GGCM: LPJmL (Bondeau et al., 2007)
- APPS framework

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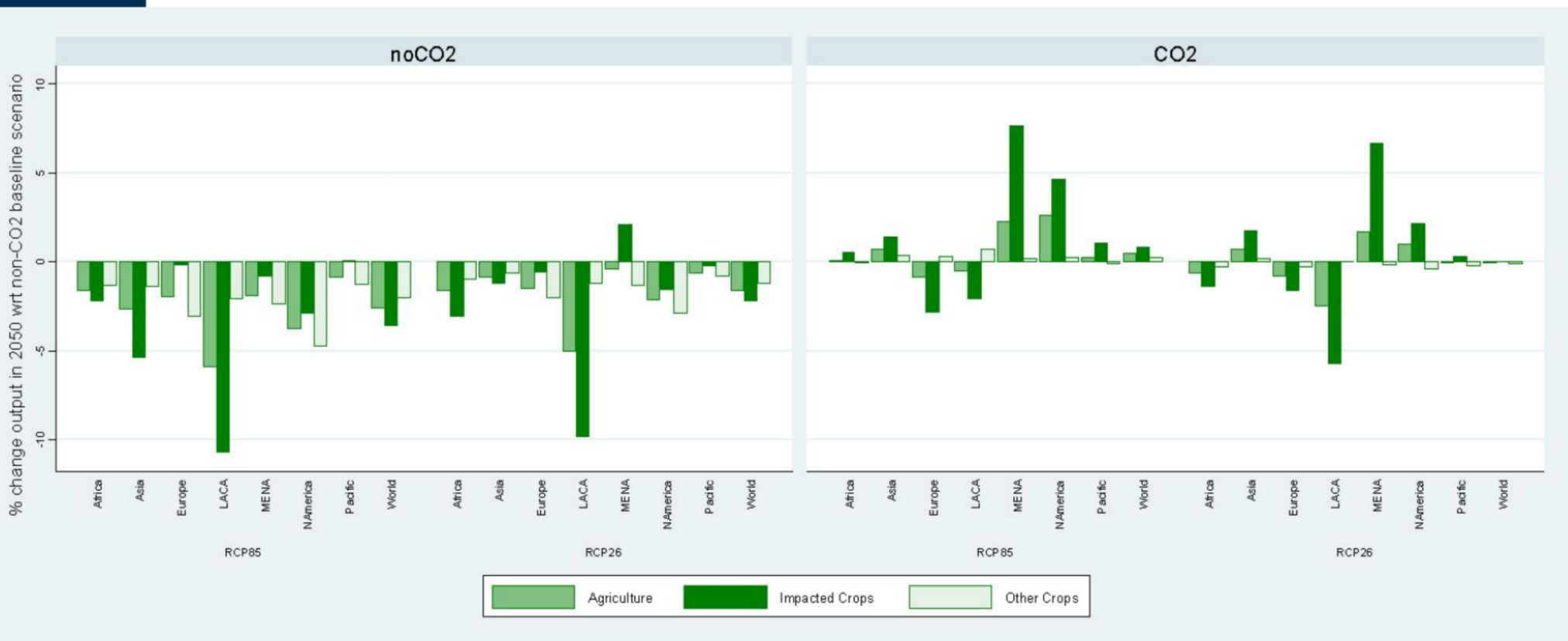ENRICO MATTEI

ICES model description

- The ICES model (Eboli et al., 2010) is a recursive-dynamic General Equilibrium model
  - ✓ stylized behavior for economic agents
  - ✓ markets are interconnected within each country by input-output relationships and across countries by international trade
  - ✓ accumulation of physical capital stock, international and government debt connects intertemporally the sequence of static equilibria
  - ✓ More detailed representation of public Sector (ICES-XPS, Delpiazzo et al. 2017)

- Long term analysis: 2050
- 45 countries/macro regions
- 28 sectors (6 crops)

- Reference scenario:
  - SSP5 "Fossil-fuelled development"
  - Land productivity: extension of LPJmL historical trend

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4

Scenario description

Economic scenario

Baseline assumptions
(World economies grow as a SSP5 scenario)

No climate change scenarios

Non CO2 fertilisation
(No CC, land productivity projected from historical trends)

CO2 fertilisation
(No CC, land productivity projected from historical trends)

Impact scenarios

RCP8.5: +2.0°C -+3.7°C

RCP2.6: +1.0°C

RCP8.5: +2.0°C -+3.7°C

RCP2.6: +1.0°C

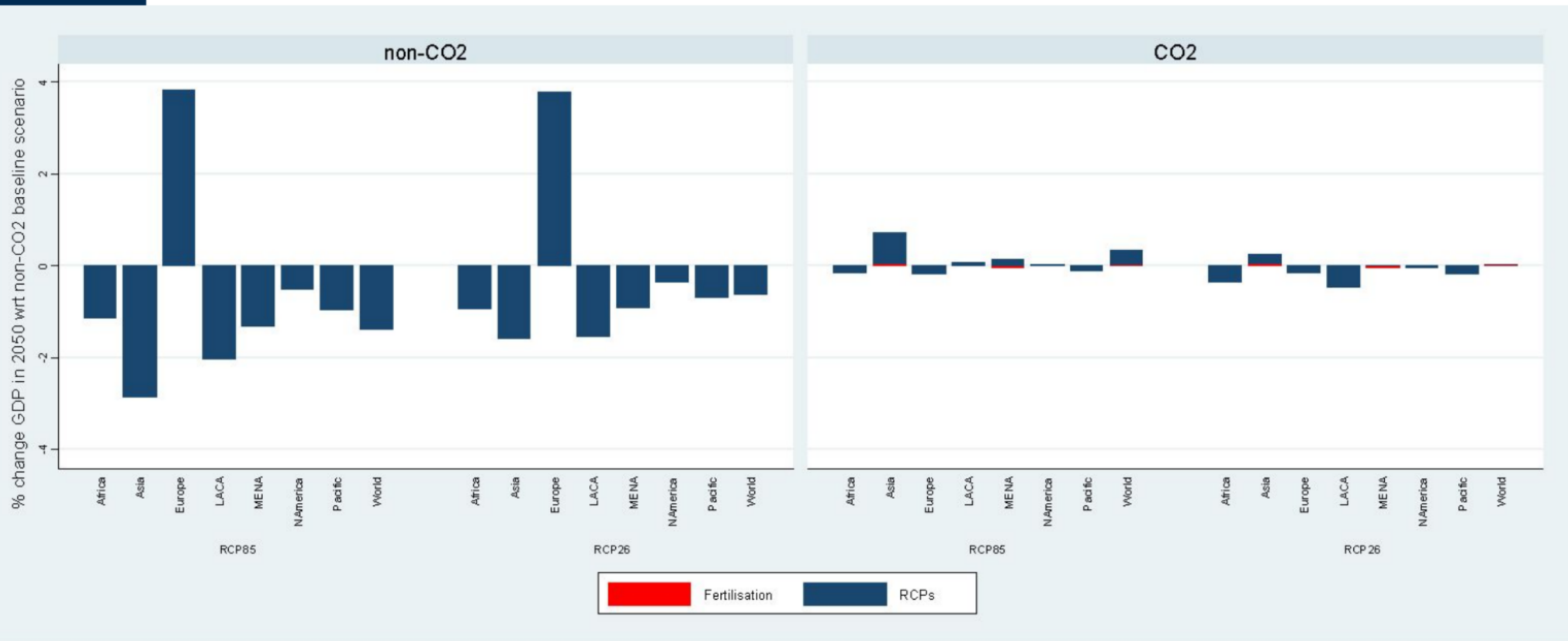FONDAZIONE ENI ENRICO MATTEI

Output change under impact scenarios (2050)

- Not considering CO2 fertilisation effect, agricultural output drop in both RCP 8.5 and RCP 2.6 scenarios.
- CO2 effect determines a more heterogeneous outcome
- Rice is the most affected crop

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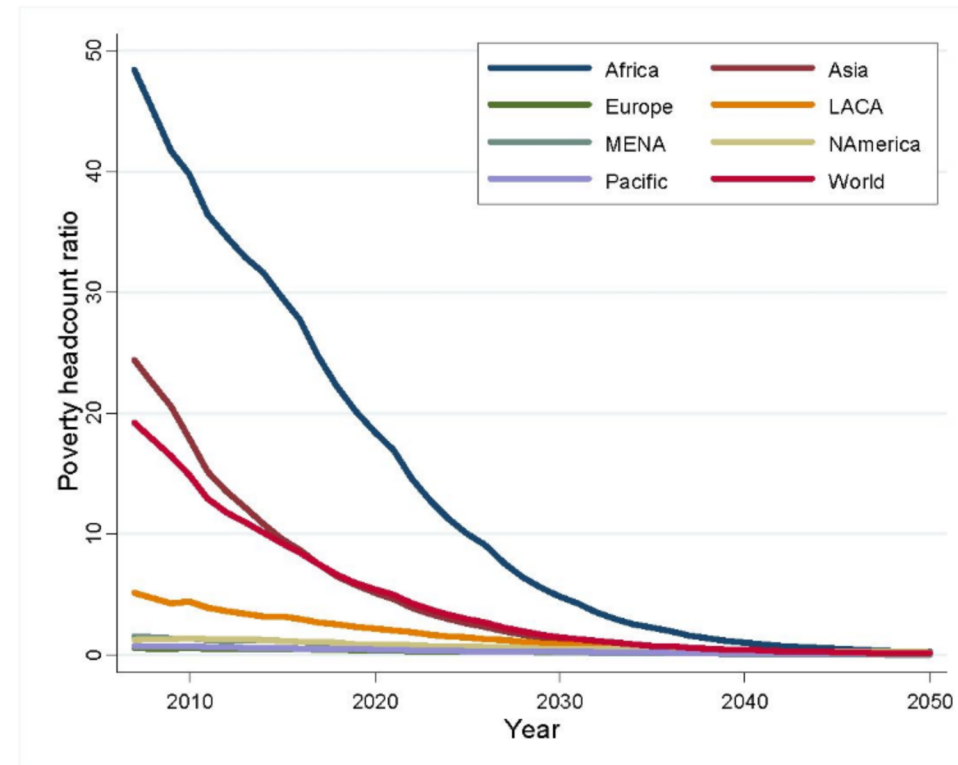ENRICO MATTEI

GDP change under impact scenarios (2050)

- When CO2 fertilisation is not considered, all regions excluding Europe experience a GDP loss
- Asia is the most impacted region (-3%)
- The moderate loss of GDP in Africa (-1%) is determined by a more heterogeneous outcome at country level (Ethiopia and Kenya)

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Poverty headcount ratio at $1.25 a day (PPP) (SDG 1)

	$\ln(POV_{i,t})$
$\ln(POV_{i,t-1})$	-2.2573***
	(0.000)
$GDP_{i,t-1}$	0.2143***
	(0.000)
Constant	22.8850***
	(0.000)
Observations	512
Number of country	99
R²	0.931

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

No climate change scenario

- Fast poverty reduction in the last decades (around 1 billion of people escaped from extreme poverty between 1990 and 2015)
- Higher GDP growth and lowering inequality keep high the poverty reduction rate
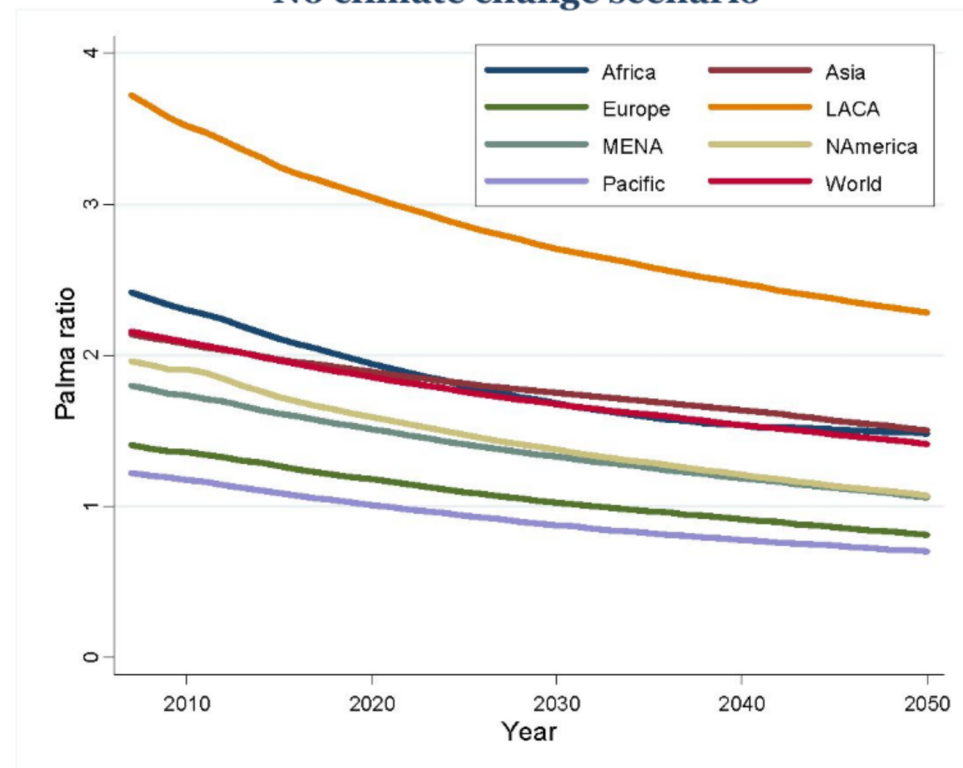
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Palma Ratio (SDG 10)

	y_{40}	y_{10}
$\hat{p}_{t-1}$	0.0227**	-0.0169**
	(0.021)	(0.014)
$\ln(\hat{p}_{t-1})$	0.1220***	-0.0853***
	(0.000)	(0.000)
$\ln(\hat{p}_{t-1})$	0.1989**	-0.1127**
	(0.013)	(0.047)
$\hat{p}_{t}$	0.0295	-0.0227
	(0.168)	(0.225)
$\hat{p}_{t-1}$	-0.0033*	0.0026
	(0.084)	(0.103)
k	0.0151	-0.0018
	(0.436)	(0.918)
t	0.0090***	-0.0066***
	(0.000)	(0.000)
Constant	-16.1529***	17.2309***
	(0.000)	(0.000)
Observations	663	667
Number of country	120	0.183
R^2	0.225	119

pval in parentheses
*** p<0.01, ** p<0.05, *p<0.1

No climate change scenario
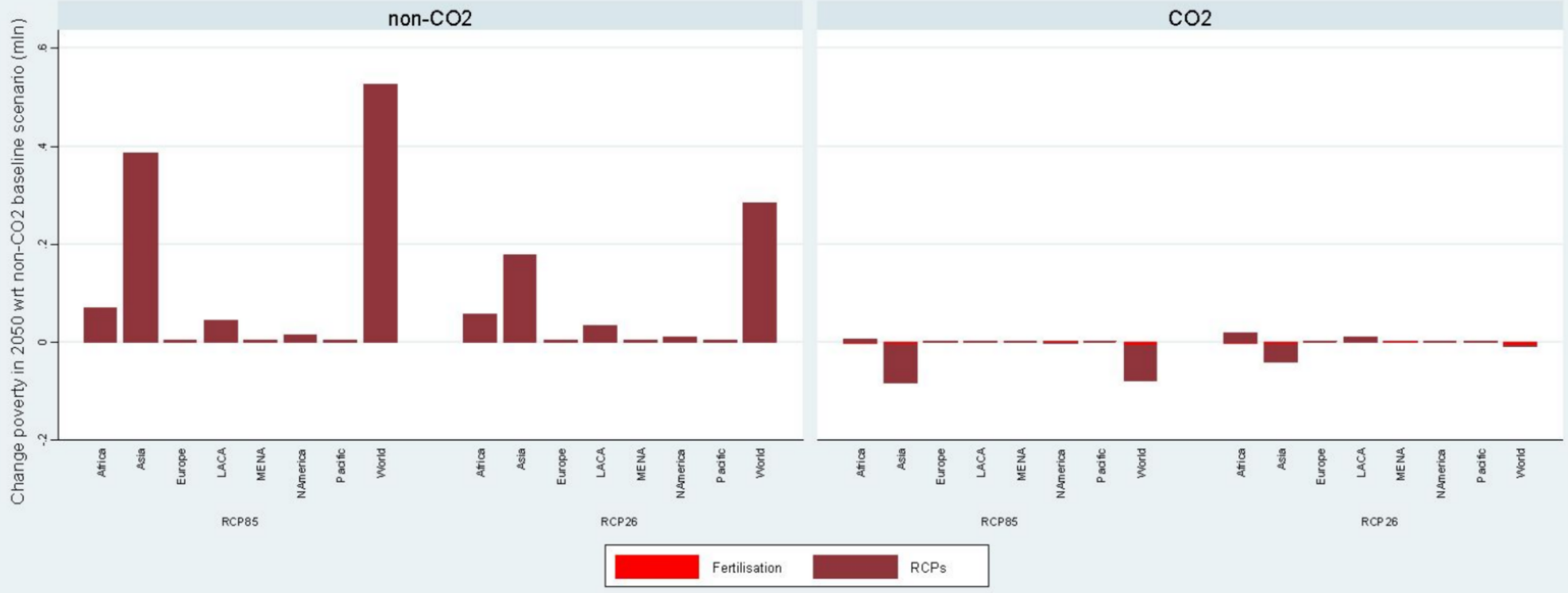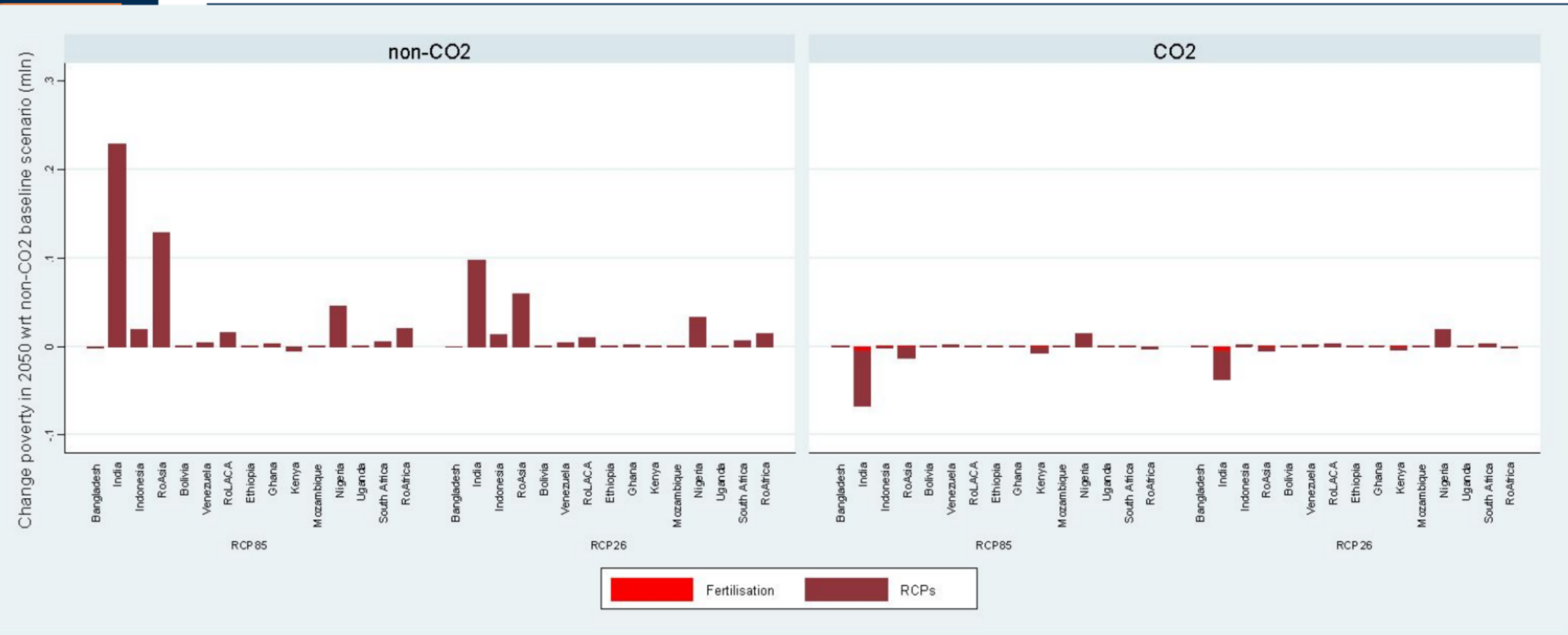
- Palma ratio of the income share of the richest 10% to that of the poorest 40% (Cobham and Sumner, 2013)

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Poverty under impact scenarios (2050)

- Not considering CO2 fertilisation, climate change impacts in agriculture will bring between 300 and 500 thousand people below poverty line (+2 and 4% rise in poverty prevalence)
- Asia is the most affected region

10

Poverty under impact scenarios (2050): country detail
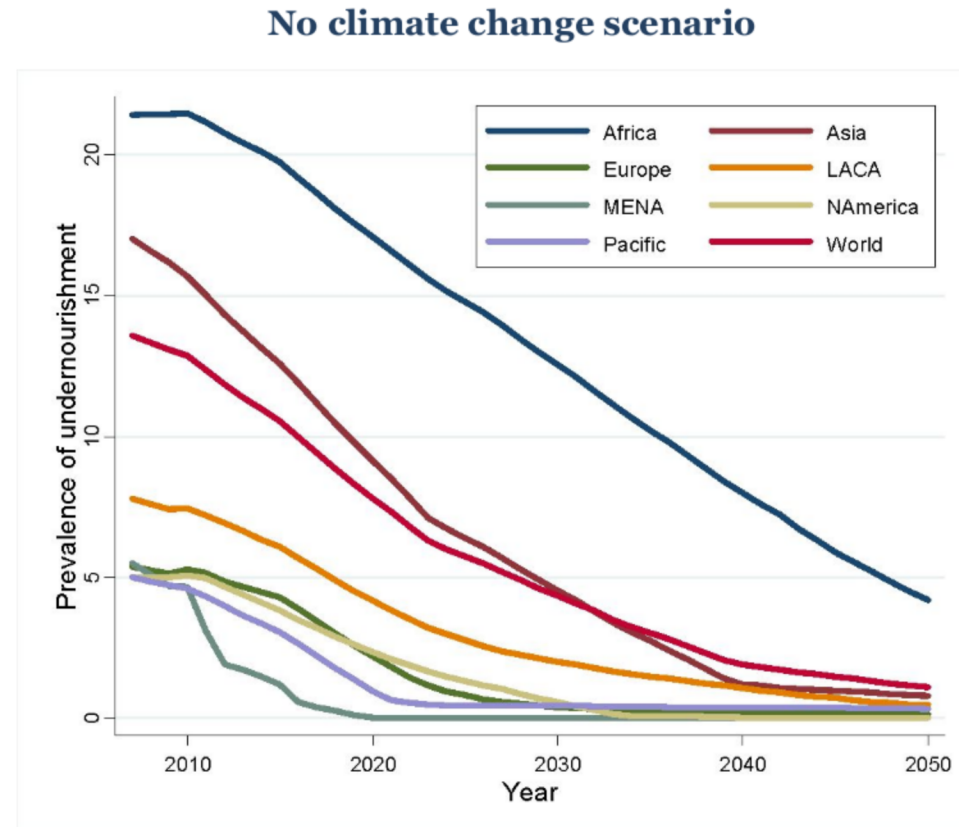

- Focusing on countries with a current poverty prevalence higher than 5%, the majority of population falling below poverty line is concentrated in India and Rest of Asia.
- Poverty prevalence increases in Nigeria under all impact scenarios
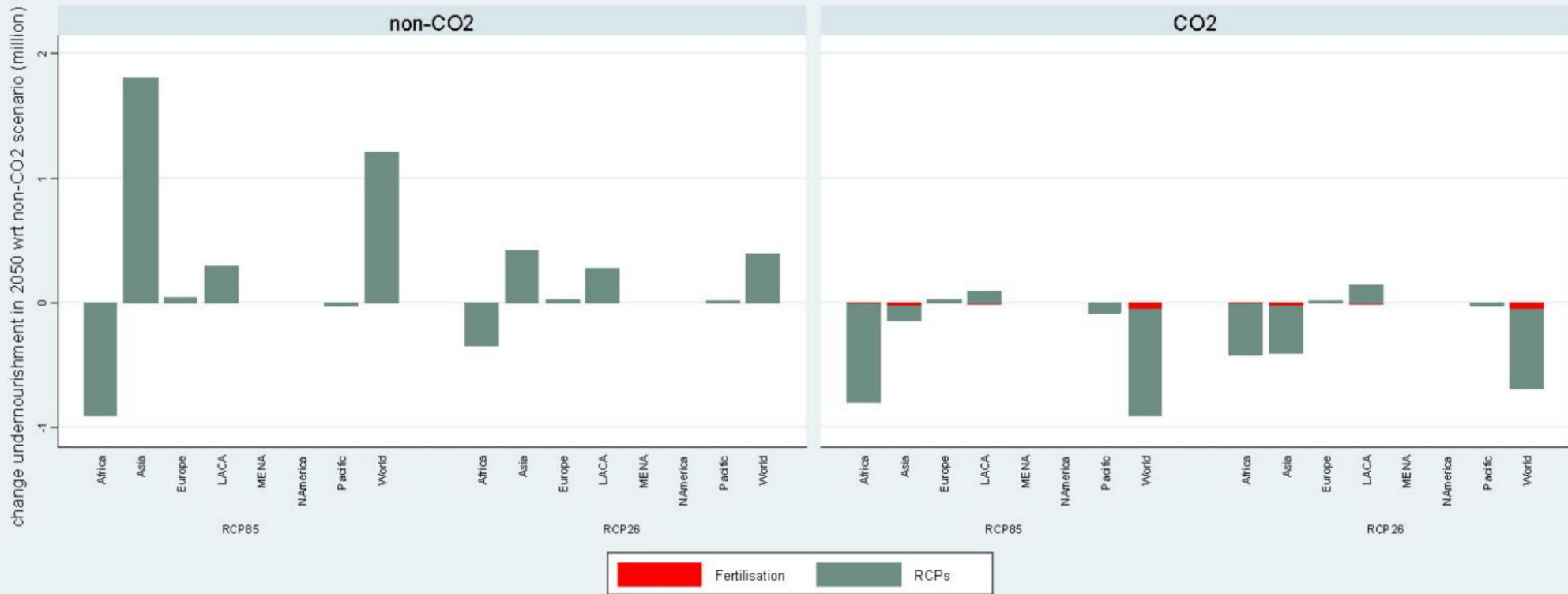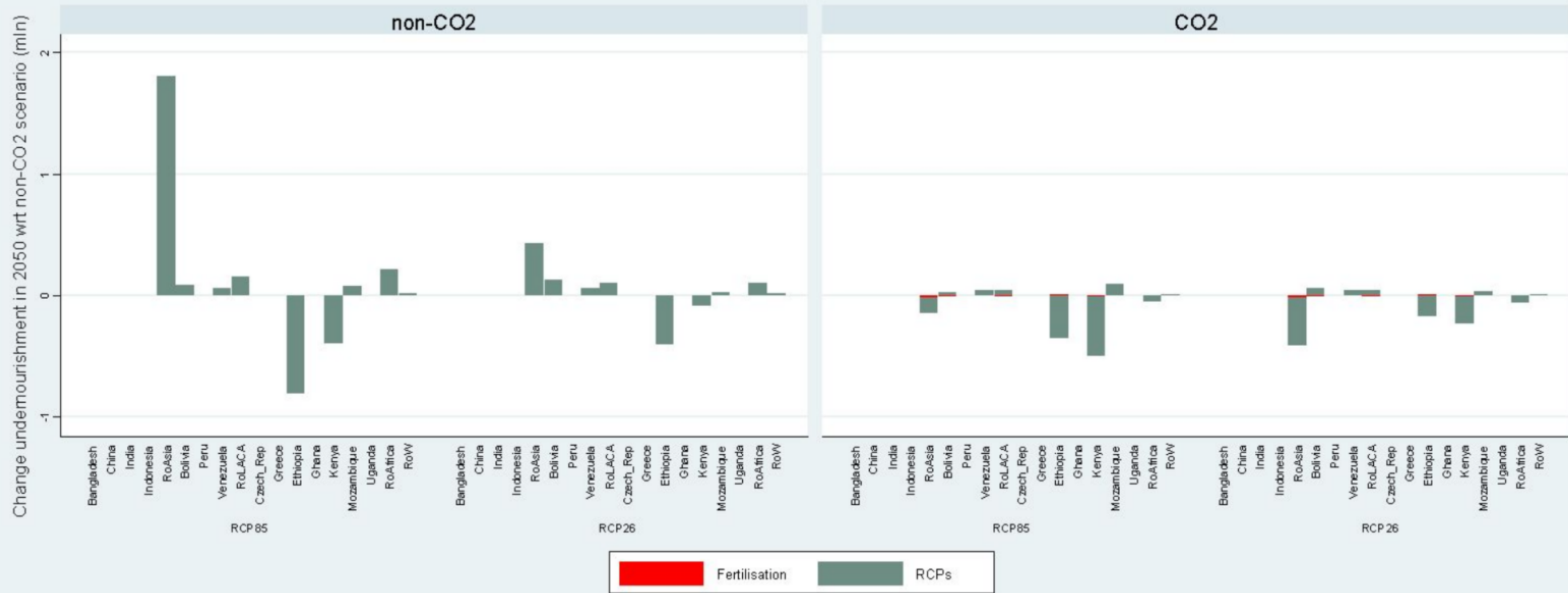
Prevalence of undernourishment (SDG 2)

- The proportion of undernourished people in the developing regions is nearly half today compared to 1990
- The downward trend continues

Undernourishment under impact scenarios (2050)

- In the most pessimistic scenario, there will be between 1 million and 400 thousand more undernourished people
- Most of them will be in Asia

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Undernourishment under impact scenarios (2050): country detail

- The most affected region is Rest of Asia under RCP8.5, but the impact reduces when temperature rise is lower and fertilisation effect is considered
- Even a small alteration of climate parameters determines a rise of undernourishment in Mozambique
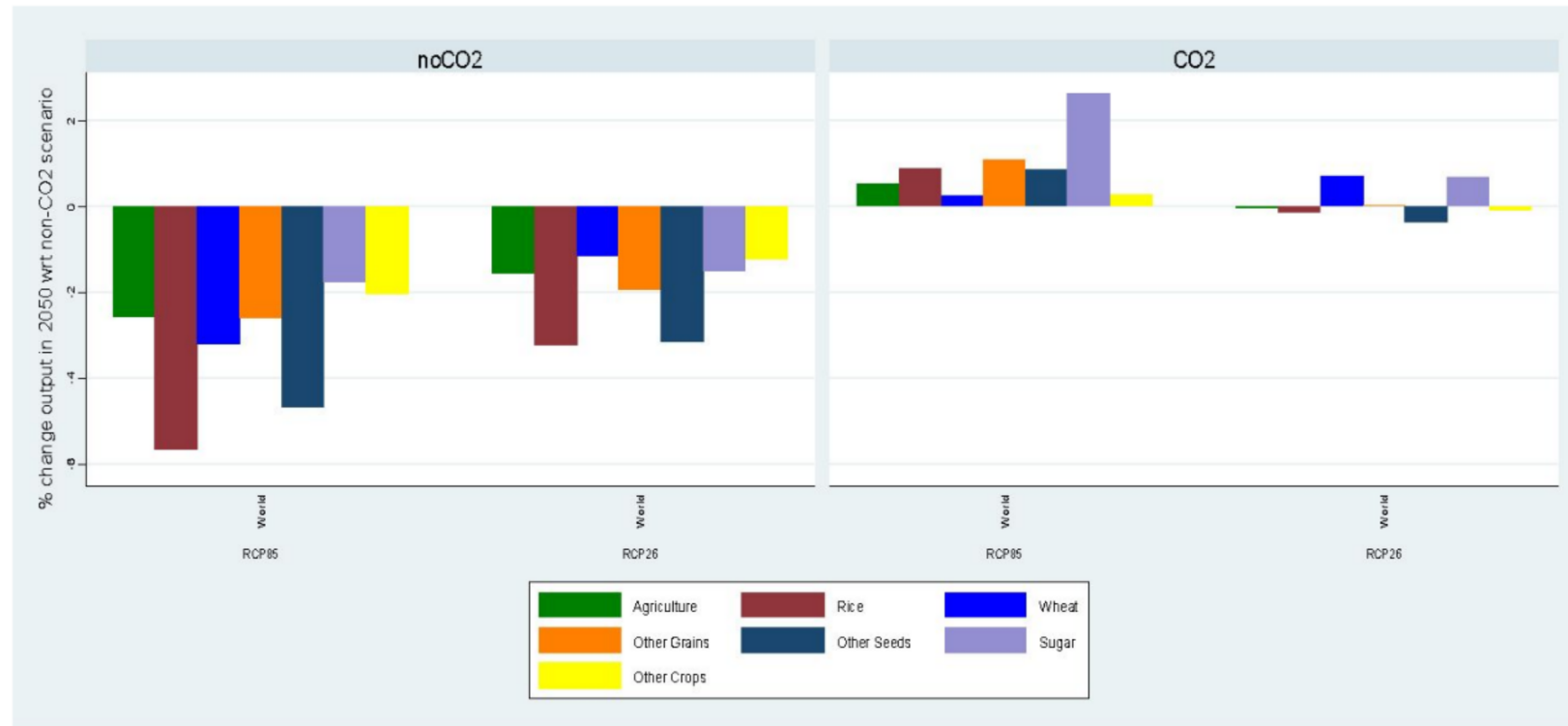
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Conclusions

- Climate change impact assessments stop to the evaluation of economic costs, but other components need to be measured

- Linking empirically SDGs indicators to a CGE model allows assessing future trend of these indicators under different scenarios and policy interventions

- In 2050 under RCP 8.5, climate change impacts in agriculture may bring 500 thousand people below poverty line and 1 million more people undernourished. Asia is the most vulnerable region.

- Further developments:
    - Different impacts to be included
    - Range of climate change and socio-economic projections
    - Adaptation measures to be implemented
    - Including mitigation costs

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Thank you for your attention!

For more information on the APPS framework and methodology visit: http://www.feemsdgs.org

For Q&A email: lorenza.campagnolo@feem.it

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Crop specific output change under impact scenarios (2050)

- Rice is the most affected crop if CO2 fertilisation is not considered in both RCPs and also in RCP2.6 with fertilisation effect
- Sugar cane and beet is more resilient to different combinations of rising temperature and changes in precipitations (+3% in RCP 8.5 co2 fertilisation)

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