



A climate storyline approach to cross-border climate risks

Cacao production in Ivory Coast and Ghana

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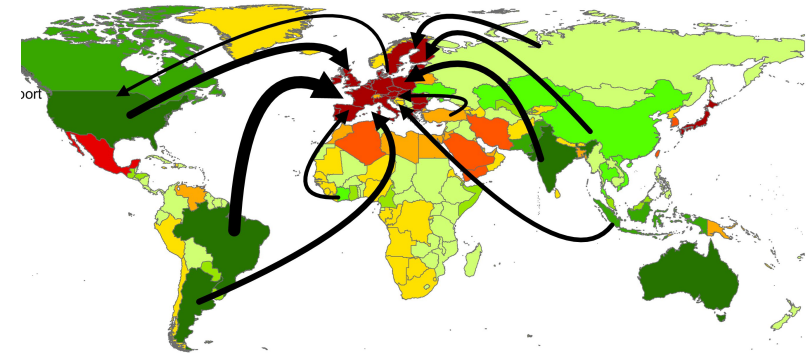
Postdam Conference, 17.10.2023

Agriculture in RECEIPT project

Potential implications to the EU

- **Food security perspective**
- **Economy perspective**
- **Supply-chain perspective**

Import dependency > 25%



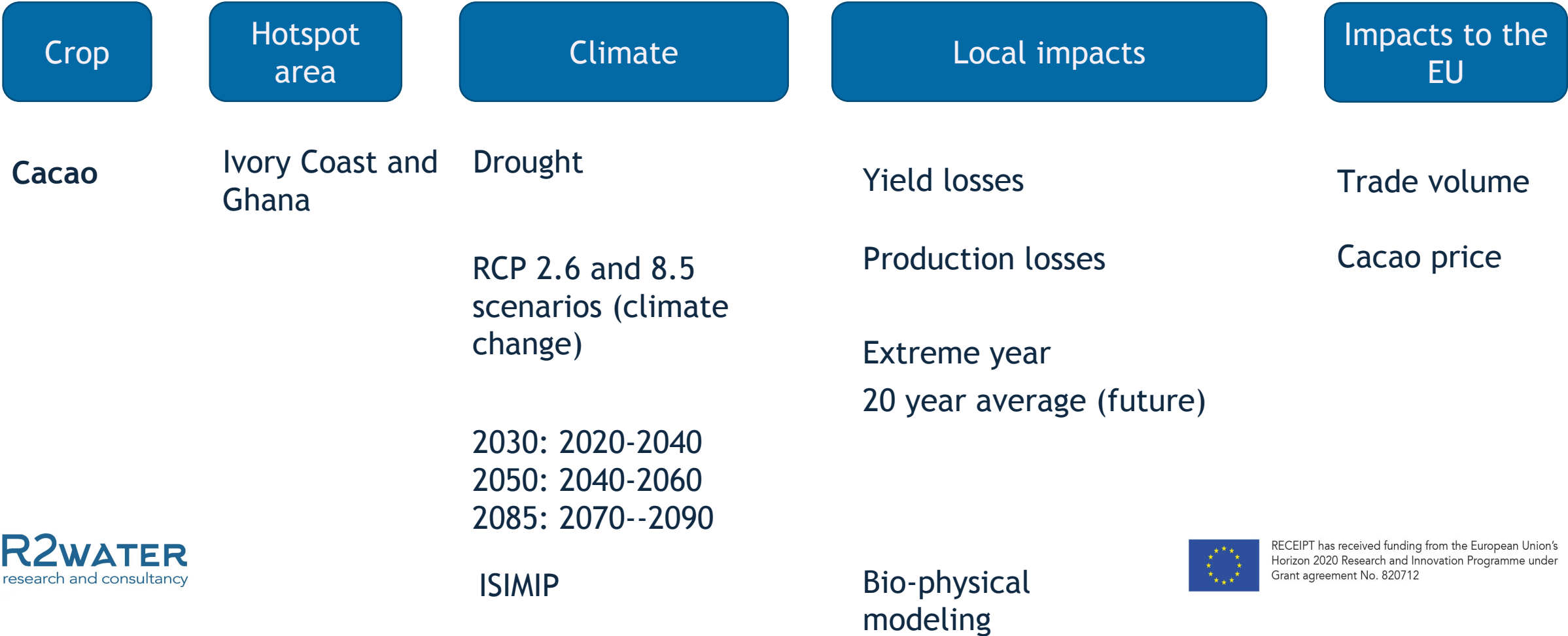
Cacao imports and EU economy

- Europe is the world's largest chocolate manufacturer.
- Industry with confectionary valued at €46 billion (2020) (10% of total agri-food).
- World's largest chocolate exporter, 76% of global sales.
- Around 250,000 jobs.





CACAO storyline



Cacao Storyline - Modeling approach

1- Cacao yield: soil moisture deficit (proxy):

- T, P (historical, future periods)
- **FAO water production function** $\left(1 - \frac{ya}{ym}\right) = Ky \cdot \left(1 - \frac{ETa}{ETp}\right)$
- **Evapotranspiration (SPHY model, water balance model)**

Variable	Source	Native resolution
Historic precipitation	CHIRPS	5km
Historic temperature	ERA5-Land	9km
Future precipitation Future temperature	ISIMIP3b (Ensemble, Downscaled)	55km
Soil data	HiHydroSoil	250m
Cacao production area	Abu et al., 2021	10m

3- Economic impacts GRACE model (GCE)

Cacao Storyline

Crop

Hotspot
area

Climate

Local impacts

Impacts to the
EU

Cacao

Two policy options:

(i) No policy on deforestation

(i) Trade ban on cacao produced in protected land area.

Ivory Coast
and Ghana

Drought
(represented in
terms of soil moisture
deficit)

Reference year
(1983)

RCP 2.6 and 8.5
scenarios
(2030,2050,2085)

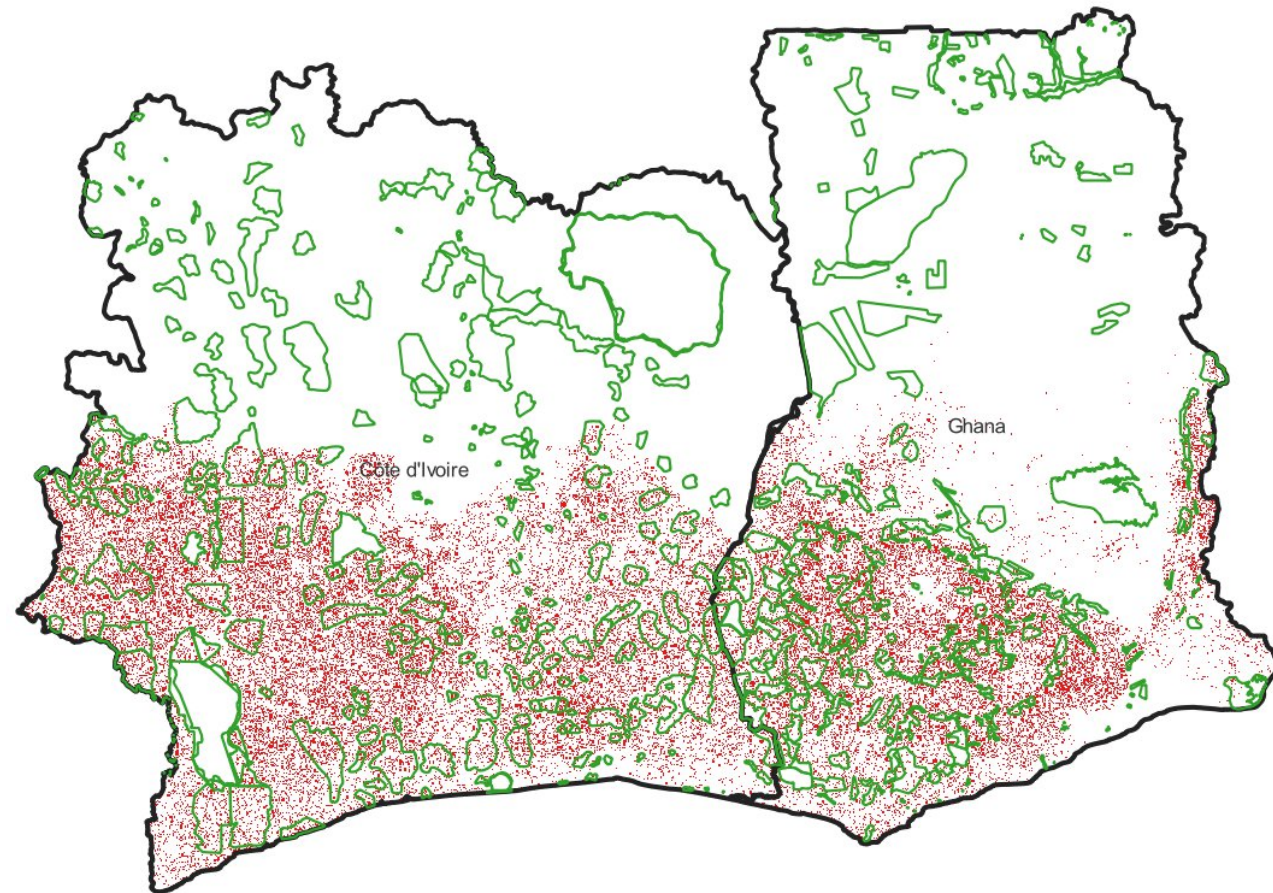
Yield losses

Production losses

Extreme year and long
term average (future)

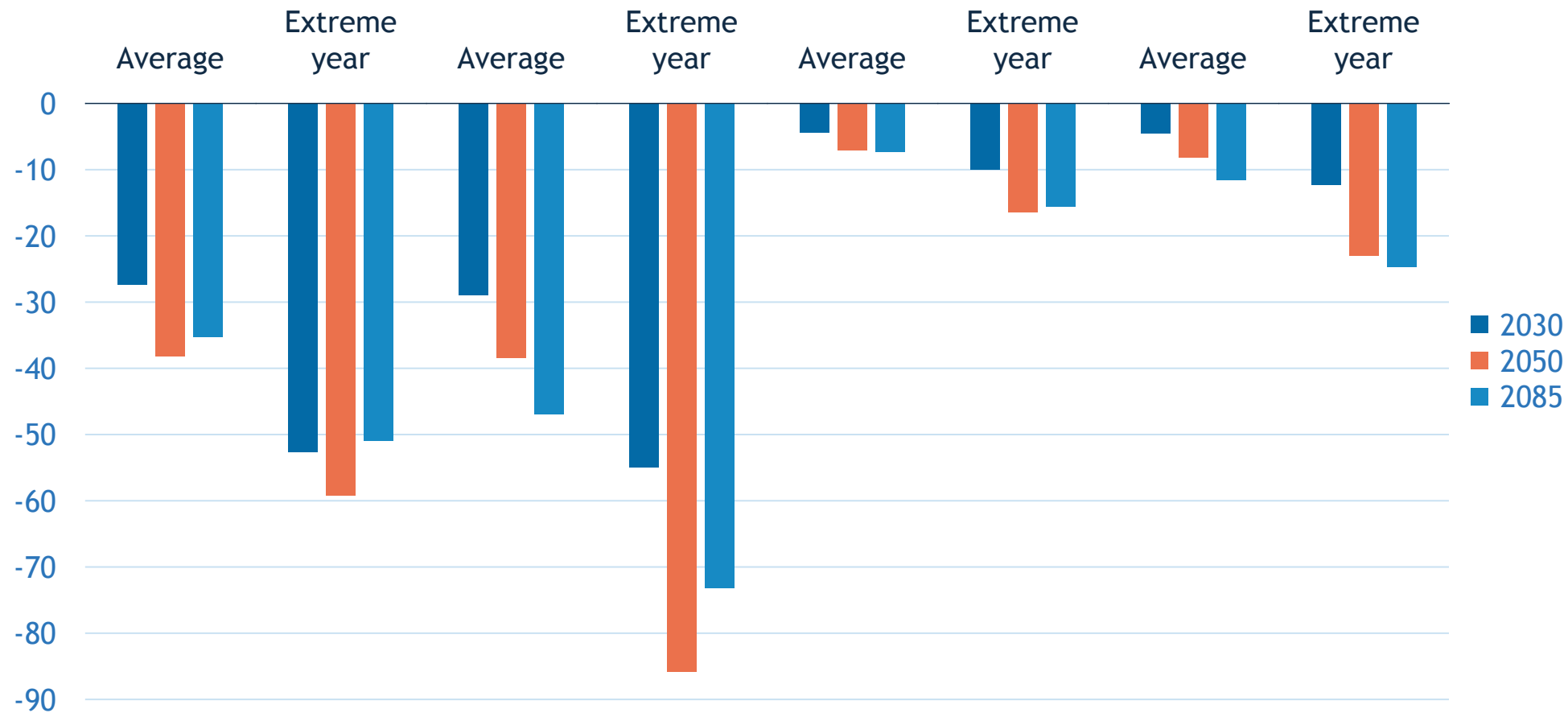
Import volume,
Cacao price,
Cacao
consumption,
Chocolate price.

Production areas



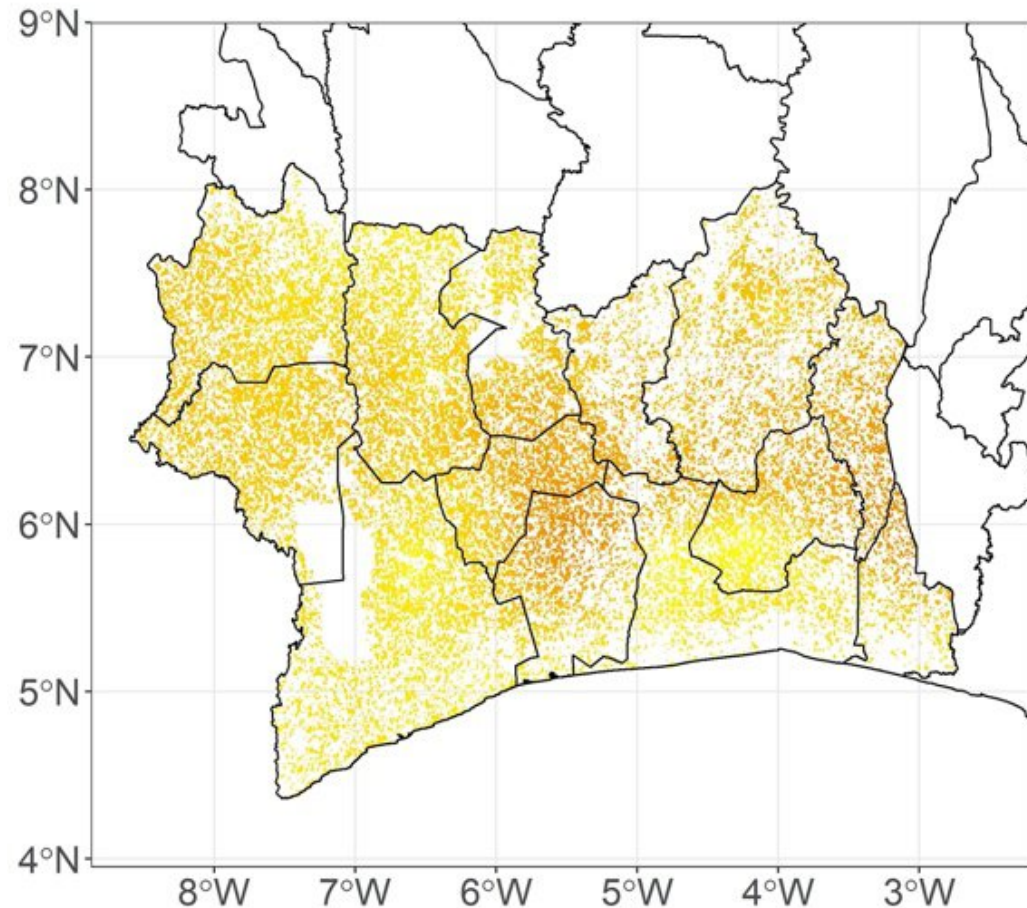
Green areas are
protected land

Cacao Yield - historic vs future (loss)

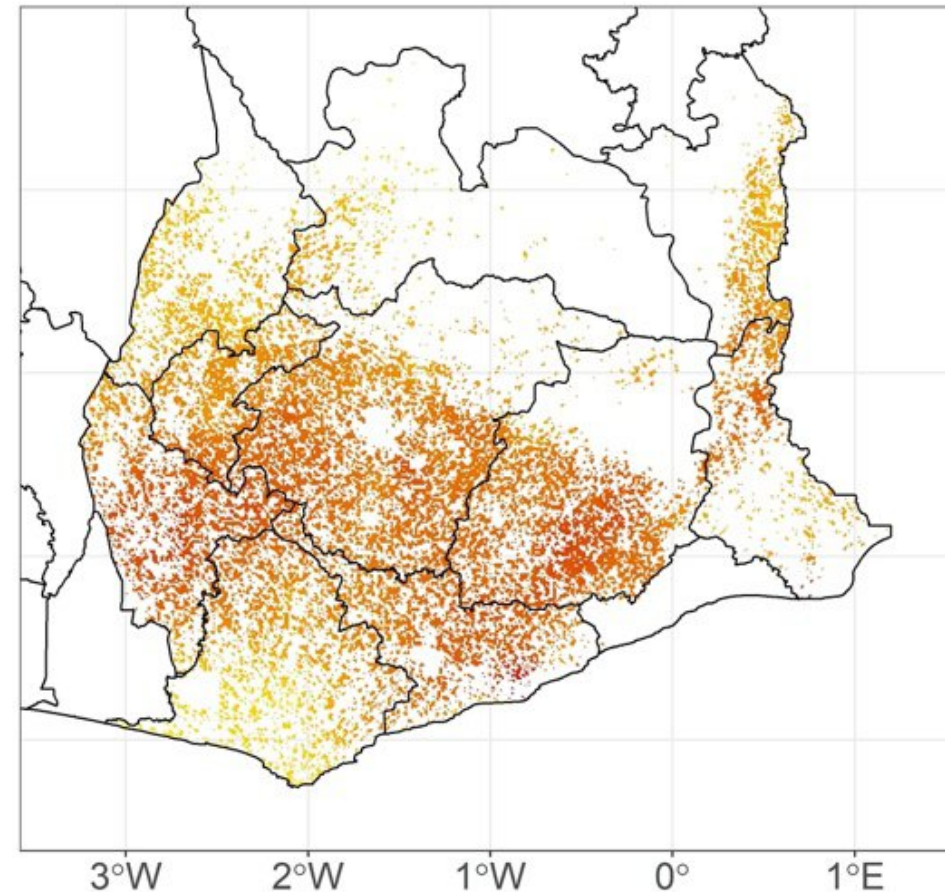


Yield change (ΔY). 2041-2060 (RCP 8.5)

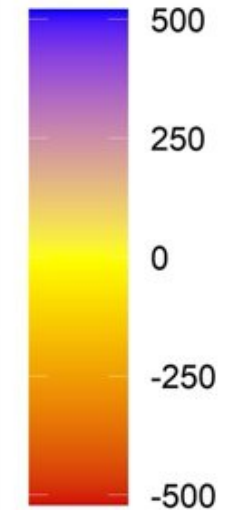
Ivory Coast



Ghana



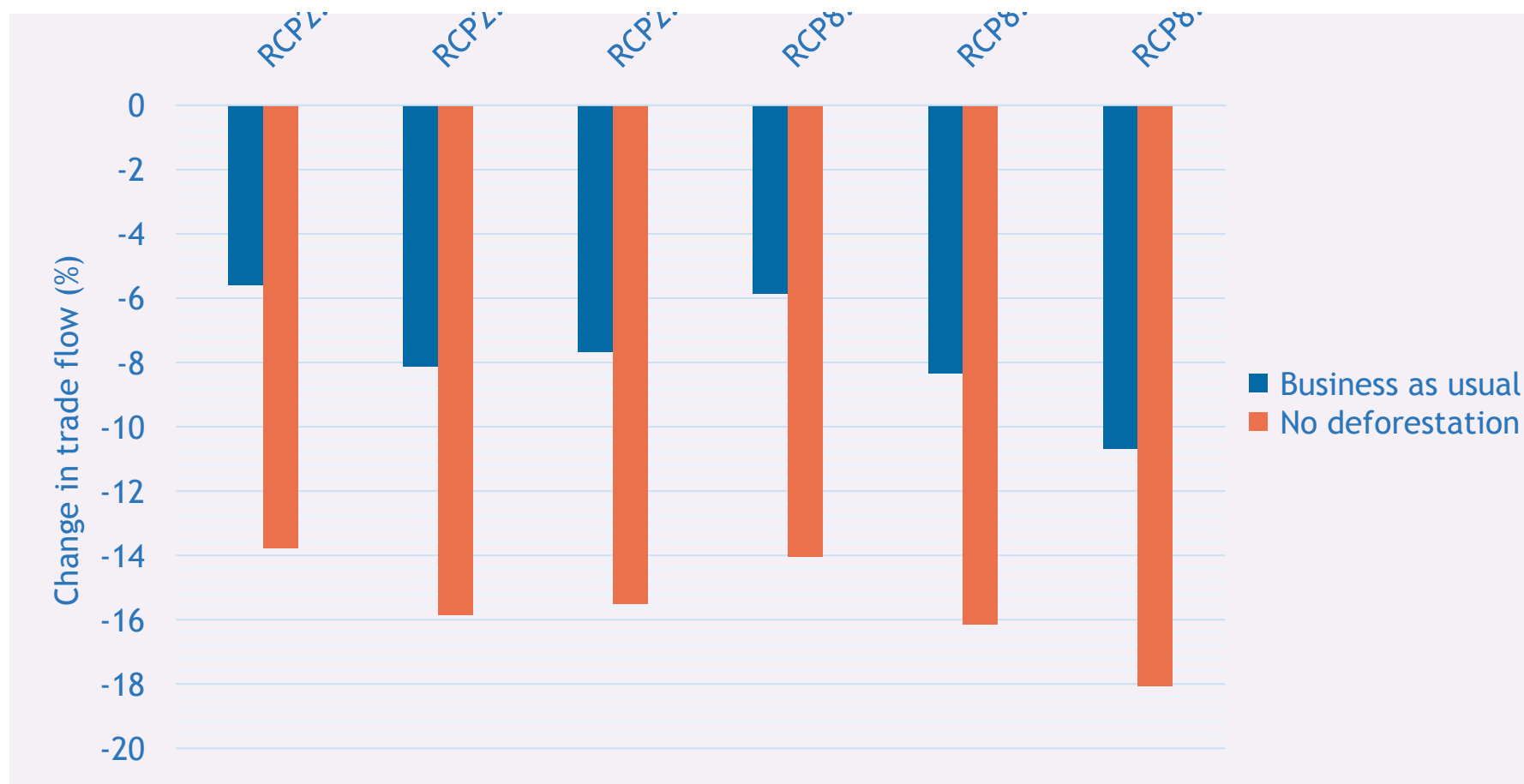
Yield_{future-historical} (kg/ha)



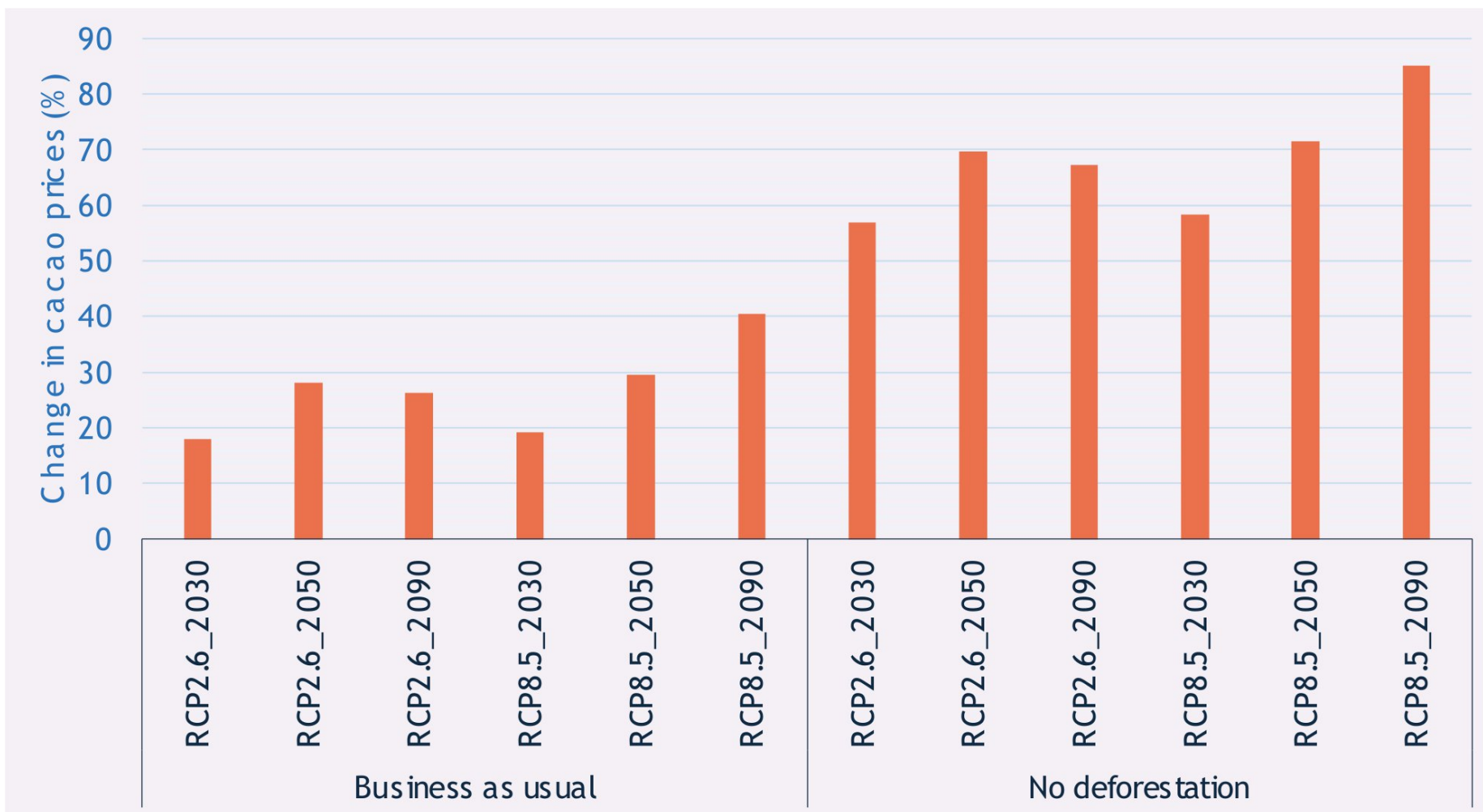
Cacao production - historic vs future

- Loss in cacao production (only climate change)
 - Ivory Coast: **11%** (RCP 8.5), extreme year **16.5%** (RCP 8.5)
 - Ghana: **47%** (RCP 8.5), extreme year **66%** (RCP 8.5)
- Additional loss in cacao production (no import from protected land)
 - Ivory Coast: **24%**
 - Ghana: **16%**

Trade flow- historic vs future



Cacao prices - historic vs future



Cacao prices - historic vs future

