National Institute for Environmental Studies, Japan

AIM ASIA-PACIFIC INTEGRATED MODEL

Identifying trade-offs and co-benefits of climate policies in China to align policies with SDGs and achieve the 2°C goal

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Outlines

- Introduction
- Methodology
- Results
- Conclusions

Introduction

- Paris Agreement and UN 17 SDGs in 2015
- Climate policies have side-effects on SDGs related indicators.
  - Energy, air quality, food, land and so on
- Country-level analysis: China
- Scope:
  - SDG 7 energy security
  - SDG 3.9 health through air quality
  - SDG 2 hunger
  - SDG 15.2 forest management

Research questions

- What are the trade-offs and co-benefits associated with climate change mitigation policies with respect to the SDGs spaces ?
- Are there possible ways to implement a sustainable climate policy instruments that will not cause trade-off relationship but in line with the 2 ° C goal?

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Investigated indicators

SDGs	Indicator Calculation	Standardization
Energy security	Primary energy diversity indicator, Shannon index	Negative value: co-benefits Positive value: trade-offs
Energy security	Primary energy imports	
Air quality	SO2 emissions per year	
Air quality	NOx emissions per year	
Air quality	BC emissions per year	
Food security	Non-Energy Crops and Livestock aggregated price	
Food security	People at risk of hunger	
Food security	Import per consumption	
Forest management	Forest area	

Model: AIM/CGE

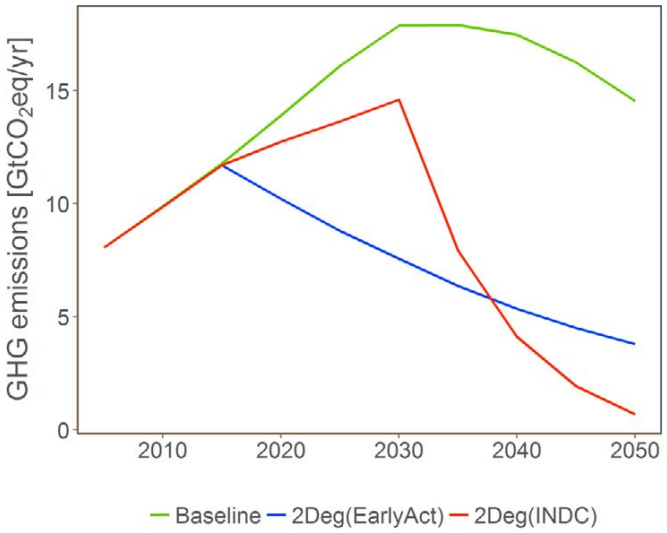

Figure Emissions trajectories

Scenario categories	**Scenarios and descriptions**
baseline	**No carbon prices**
Simple policy scenarios	2Deg(INDC): reflects the tendency of current policy in China before 2030 but meets 2 °s at the end of this century 2Deg(EarlyAct): follow least cost mitigation scenario.
Comprehensive policy scenarios	2Deg(EarlyAct)+Combine: 300% forest subsidy and 67% food subsidy was assumed on the basis of 2Deg(EarlyAct) scenario.
Sensitivity scenarios	See below

Sensitivity scenarios

Scenario name	Description
GDP_High	SSP1 assumption. Higher GDP.
GDP_Low	SSP3 assumption. Lower GDP.
POP_High	SSP3 assumption. Higher population.
POP_Low	SSP1 assumption. Lower population.
Trs_High	SSP3 assumption. Higher transportation demand.
Trs_Low	SSP1 assumption. Lower transportation demand.
Yield_High	SSP1 assumption. Higher yield.
Yield_Low	SSP3 assumption. Lower yield.
NoCCS	CCS not available.
NoBECCS	BECCS not available.

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Scenarios

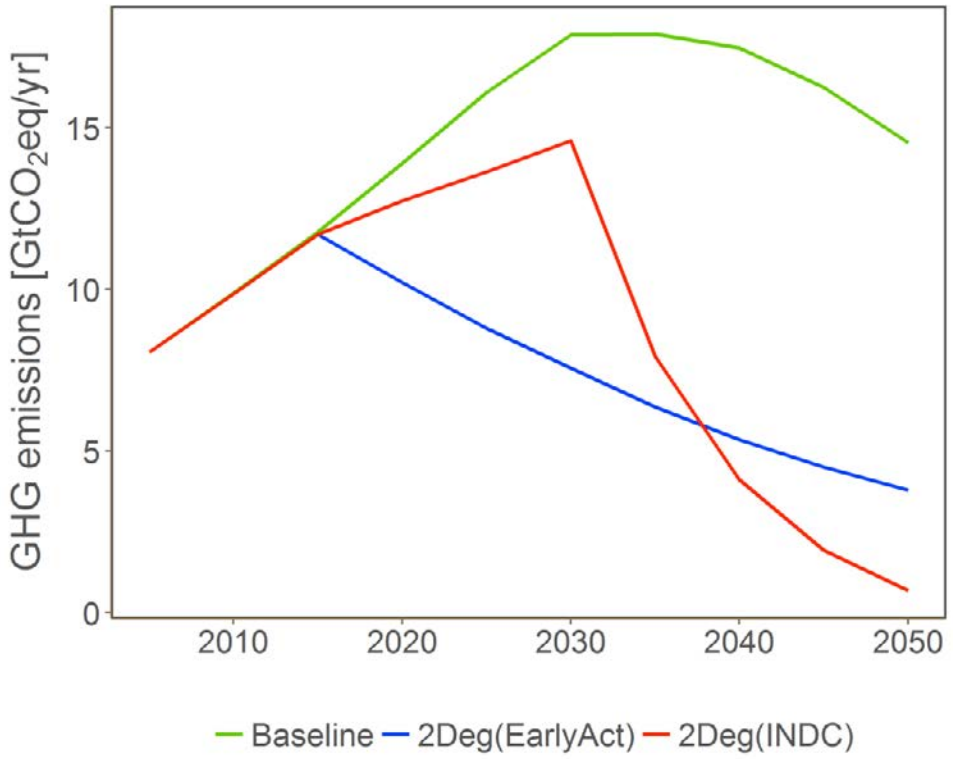
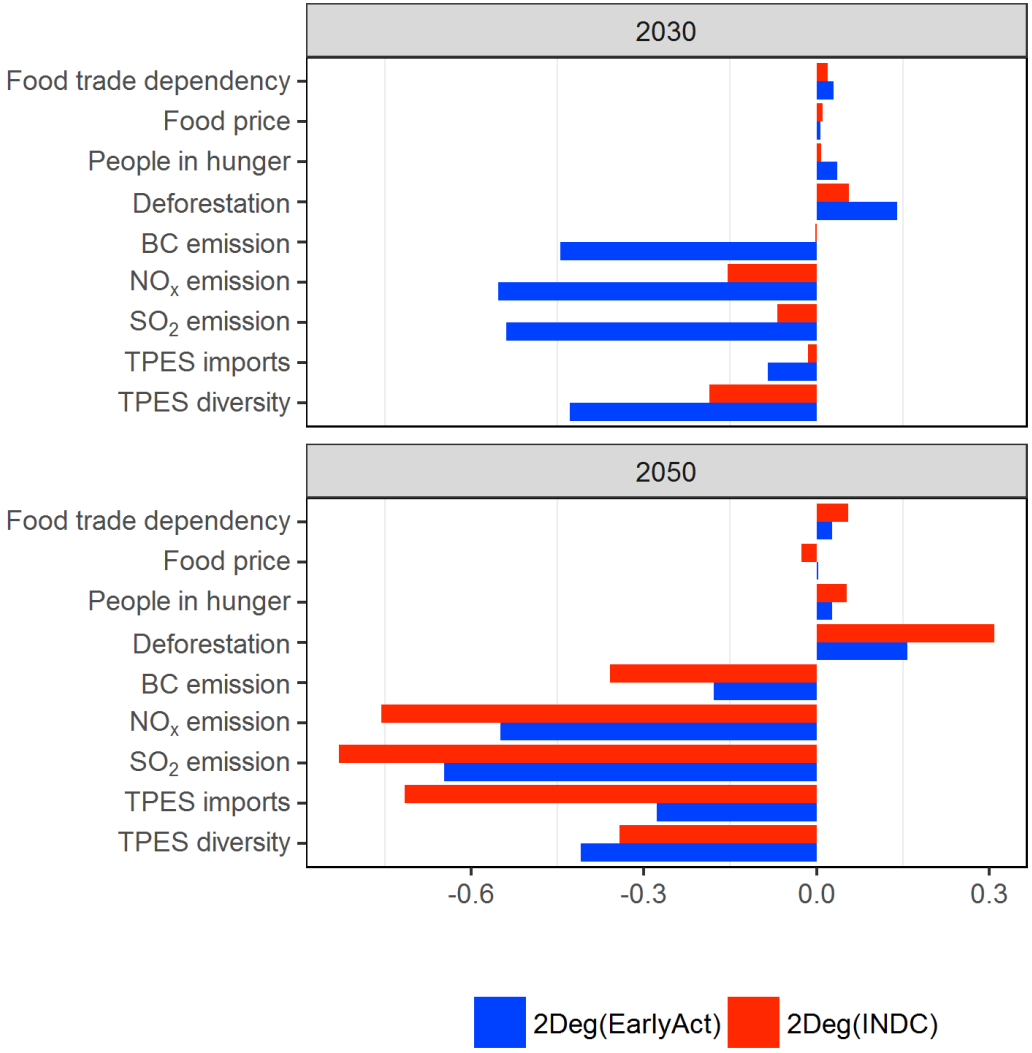


Figure Emissions trajectories for simple climate policy scenarios

Positive and negative side effects of climate policy

Figure risk of sustainability in reference to Baseline

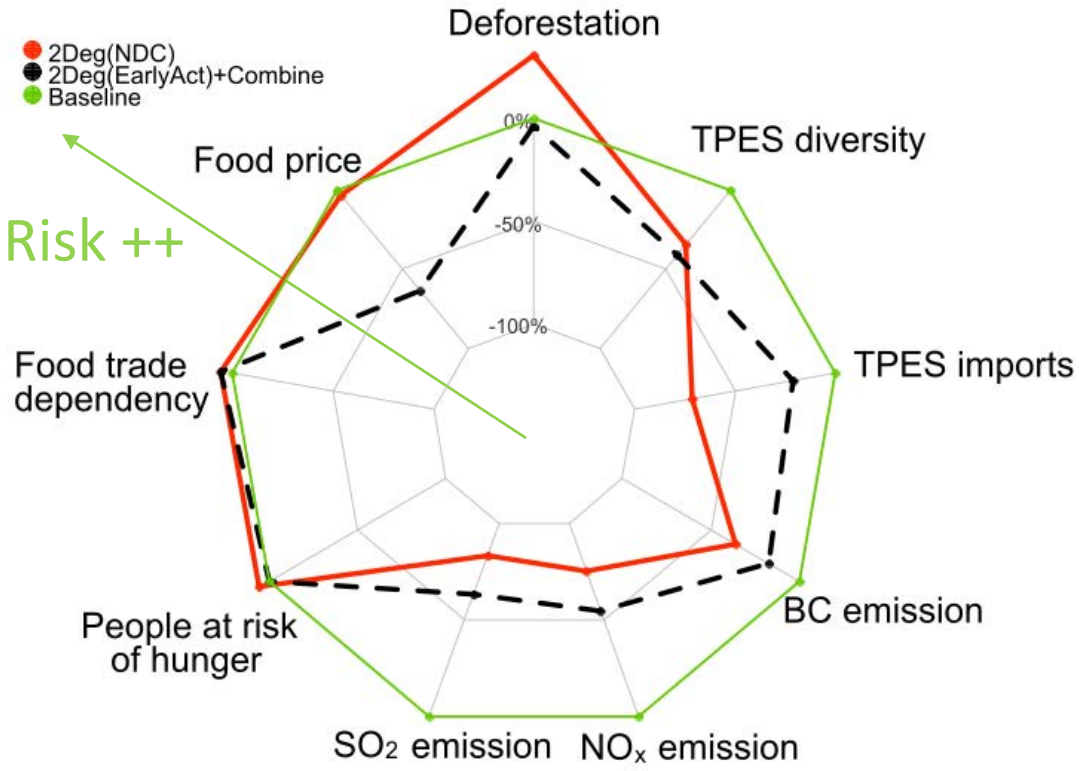


- Energy security and air quality have co-benefits, which would back climate policies.
- Deforestation risk changes the most from BaU therefore would be the major source of criticisms and concerns for climate policies. 2Deg(EarlyAct) is with less deforestation than 2Deg(INDC) in 2050.
- Food security raise some concerns too.

Scenarios

Scenario categories	Scenarios and descriptions
Baseline	No carbon prices
Simple policy scenarios	2Deg(INDC): reflects the tendency of current policy in China before 2030 but meets 2 °s at the end of this century
Comprehensive policy scenarios	2Deg(EarlyAct)+Combine: 300% forest subsidy and 67% food subsidy was assumed on the basis of 2Deg(EarlyAct) scenario.

Necessity of complementary policy package

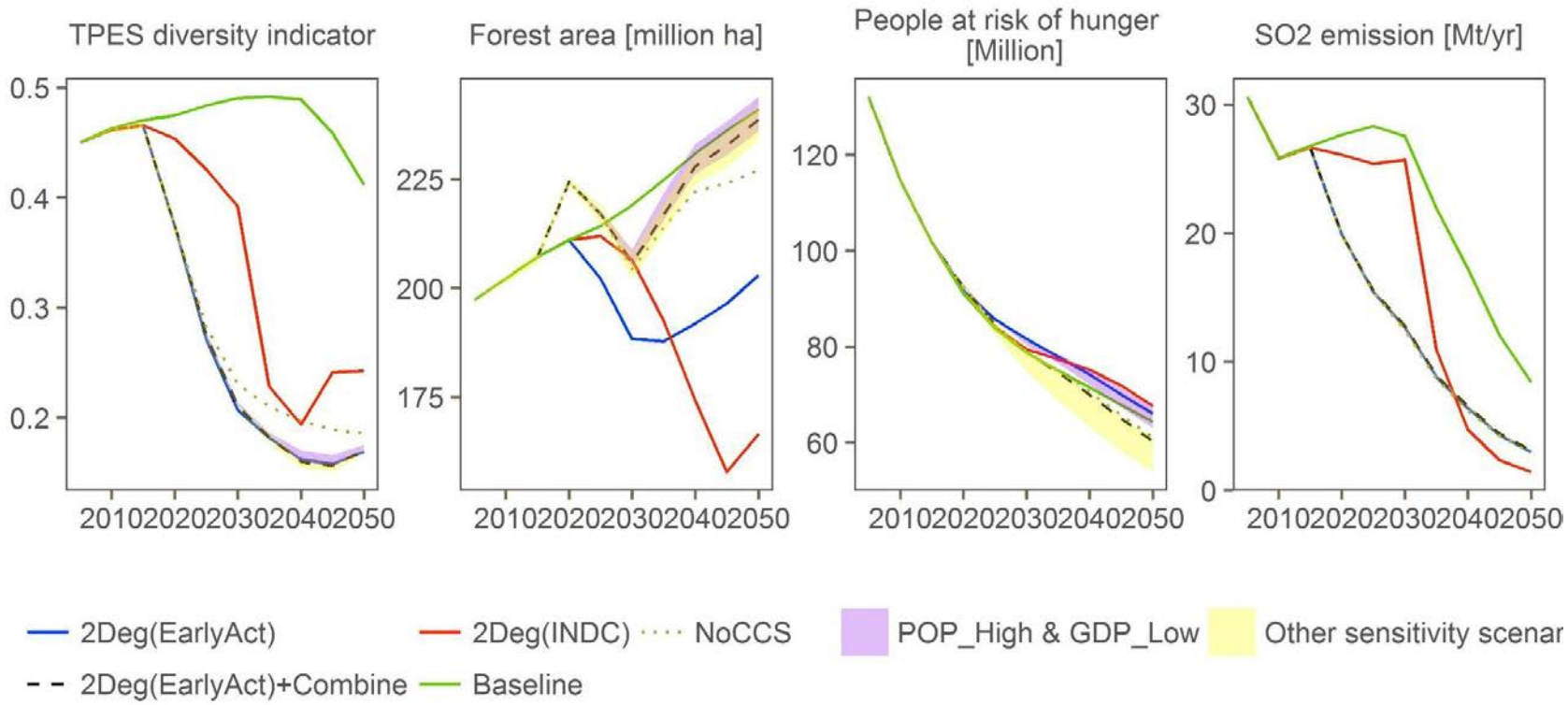


- All of the indicators are achieved zero-trade-off in 2050 comparing with Baseline in 2Deg(EarlyAct)+Combine.
  - Early climate action
  - Forest protection policy
  - Food subsidy policy

Sensitivity Scenarios

Scenario name	Description
GDP_High	SSP1 assumption. Higher GDP.
GDP_Low	SSP3 assumption. Lower GDP.
POP_High	SSP3 assumption. Higher population.
POP_Low	SSP1 assumption. Lower population.
Trs_High	SSP3 assumption. Higher transportation demand.
Trs_Low	SSP1 assumption. Lower transportation demand.
Yield_High	SSP1 assumption. Higher yield.
Yield_Low	SSP3 assumption. Lower yield.
NoCCS	CCS not available.
NoBECCS	BECCS not available.

Sensitivity analysis



- The sustainable pathway 2Deg(EarlyAct)+Combine is robust regarding energy security, deforestation and air quality.
- Food security indicators are largely affected by social economic condition rather than the climate policies.
- CCS technology needs special attention.

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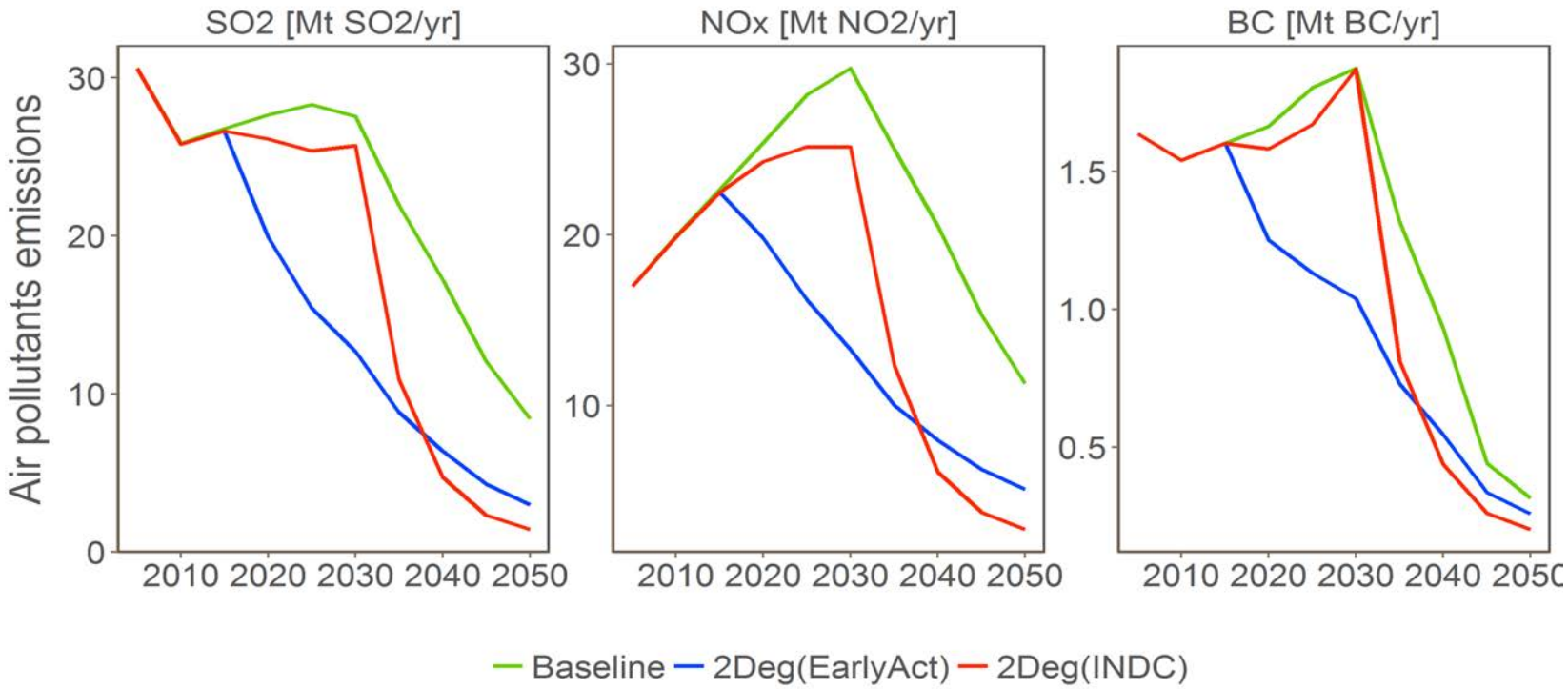
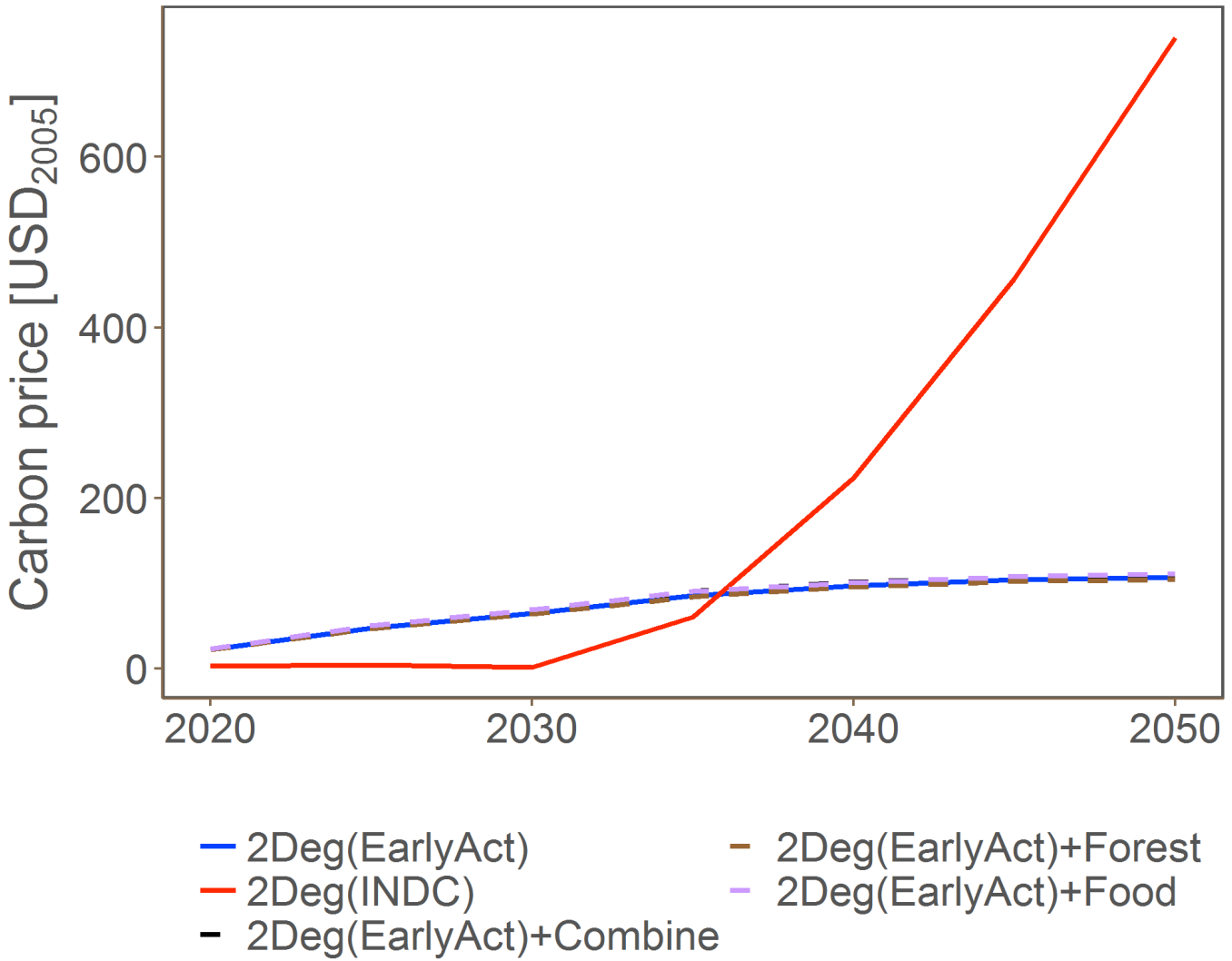
Conclusions

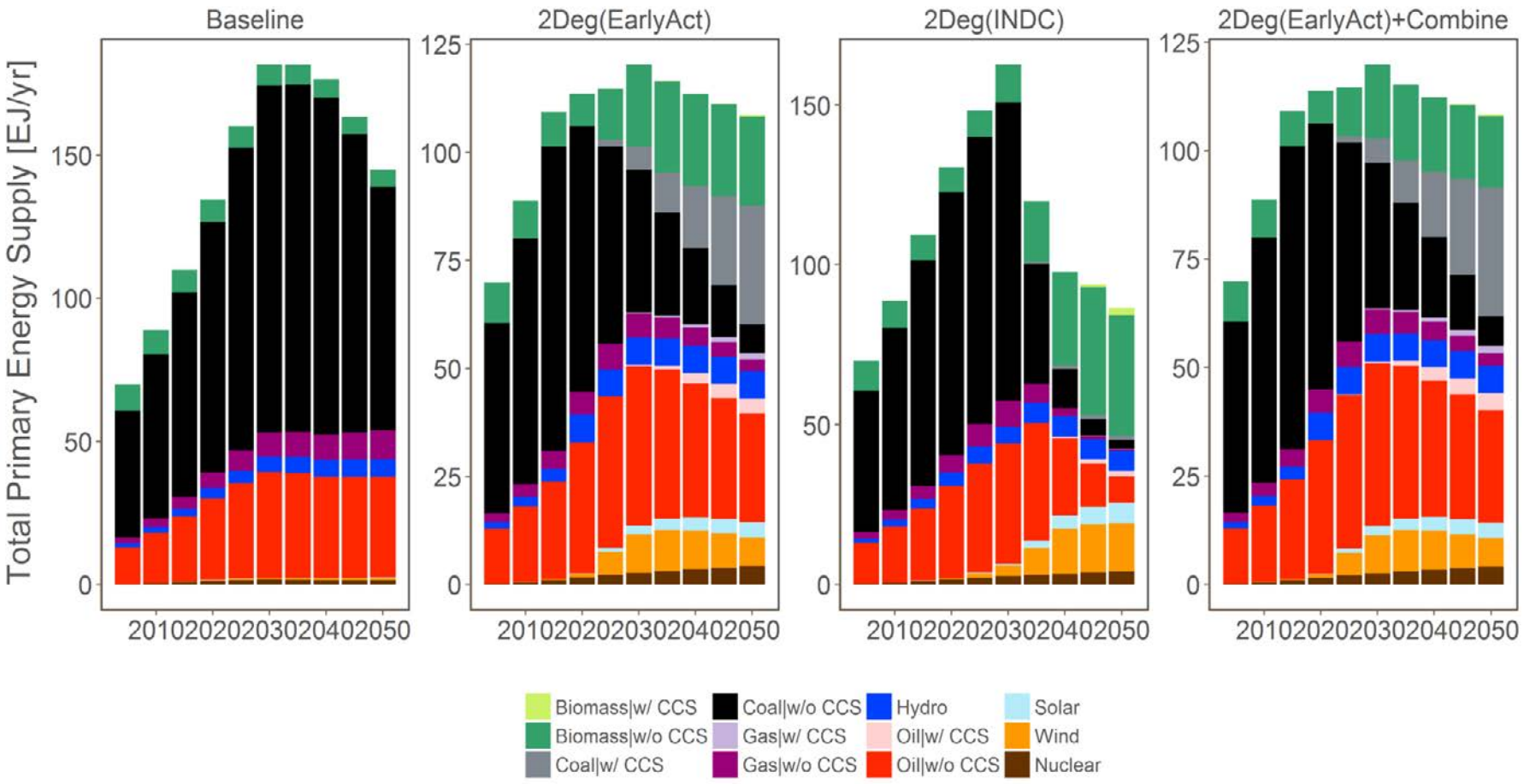
- **Energy security and air pollution** can have a great **benefit** from the climate mitigation measure while **food security and land** can have a **negative** side effects.
- To resolve this trade-off relationship, **early climate action** is preferable.
- **Subsidy mechanism in food goods and land rent** successfully **diminished the negative side effects keeping other area's co-benefit** aligning with climate targets.
- Subsidy mechanism is just an **illustrative** example of a complementary policy package.

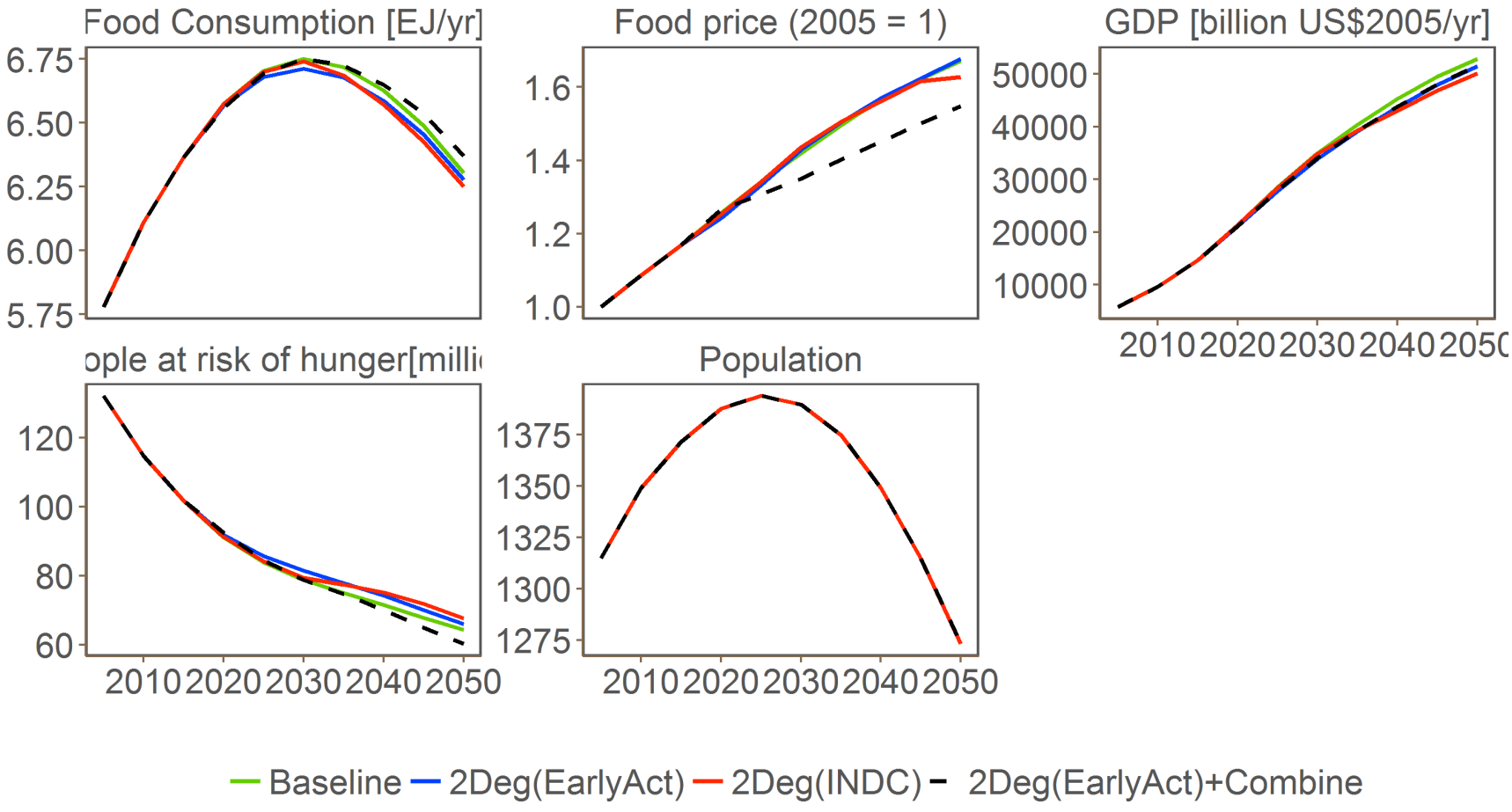
Thank you!

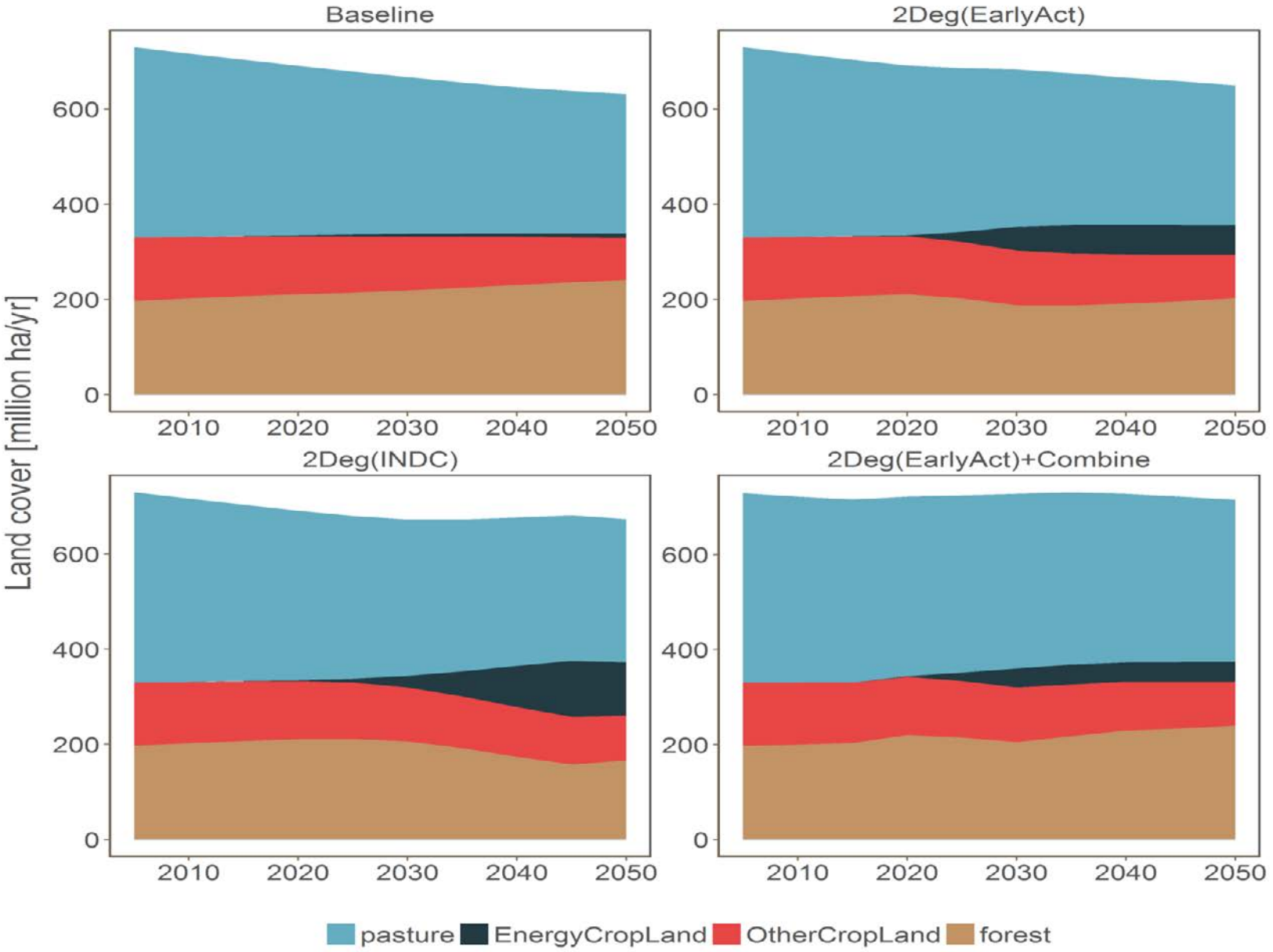
Backup slides




Carbon price [USD2005]
600
400
200
0
2020
2030
2040
2050
2Deg(EarlyAct)
2Deg(INDC)
2Deg(EarlyAct)+Combine
2Deg(EarlyAct)+Forest
2Deg(EarlyAct)+Food


Baseline
2Deg(EarlyAct)
2Deg(INDC)
2Deg(EarlyAct)+Combine
Total Primary Energy Supply [EJ/yr]
0
25
50
75
100
125
150
2010
2020
2030
2040
2050
Biomass|w/ CCS
Biomass|w/o CCS
Coal|w/ CCS
Coal|w/o CCS
Gas|w/ CCS
Gas|w/o CCS
Hydro
Oil|w/ CCS
Oil|w/o CCS
Solar
Wind
Nuclear


Food Consumption [EJ/yr]
6.75
6.50
6.25
6.00
5.75
Food price (2005 = 1)
1.6
1.4
1.2
1.0
GDP [billion US$2005/yr]
50000
40000
30000
20000
10000
2010 2020 2030 2040 2050
ople at risk of hunger[milli
120
100
80
60
2010 2020 2030 2040 2050
Population
1375
1350
1325
1300
1275
2010 2020 2030 2040 2050
Baseline
2Deg(EarlyAct)
2Deg(INDC)
2Deg(EarlyAct)+Combine


Baseline
2Deg(EarlyAct)
2Deg(INDC)
2Deg(EarlyAct)+Combine
Land cover [million ha/yr]
0
200
400
600
2010
2020
2030
2040
2050
pasture
EnergyCropLand
OtherCropLand
forest

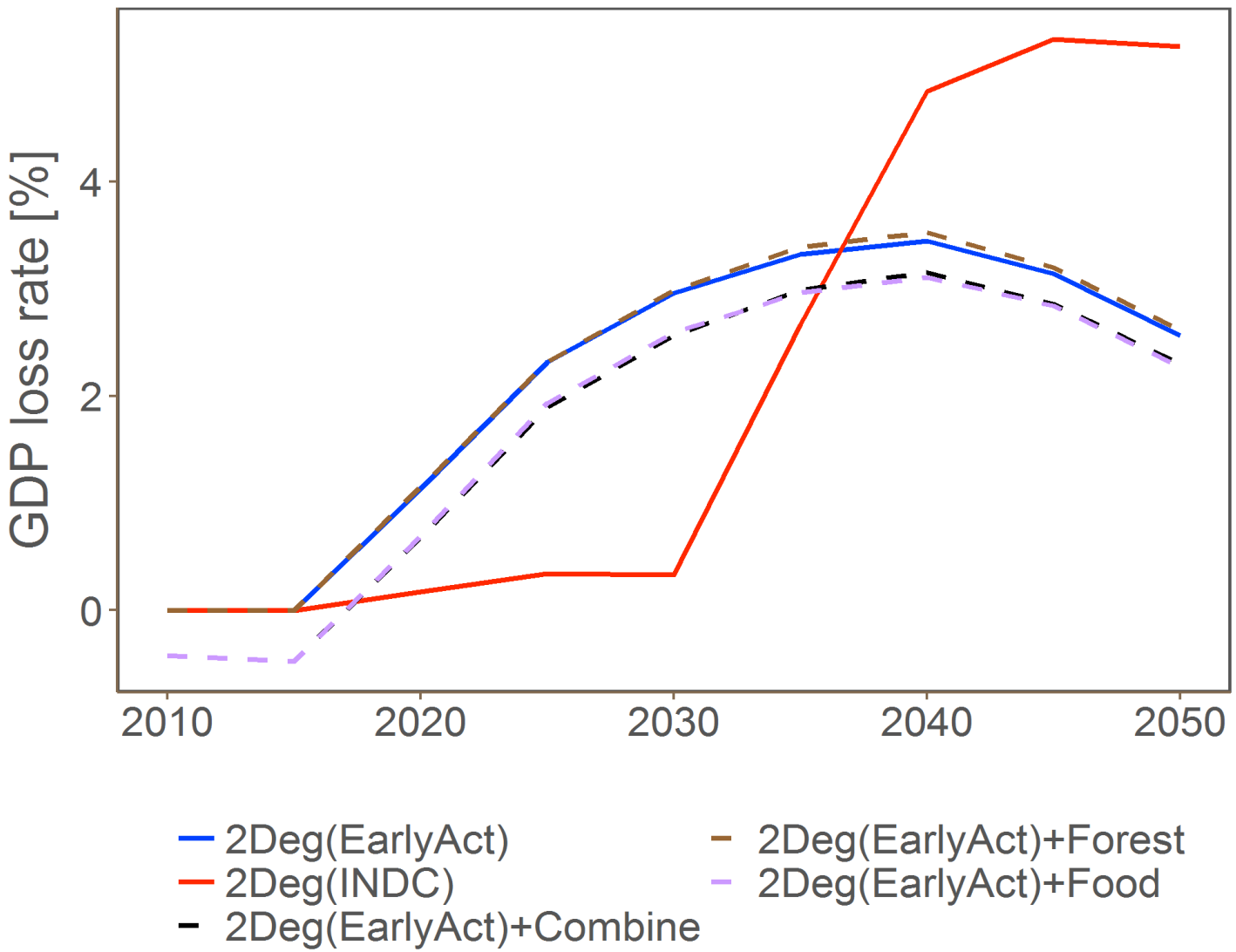
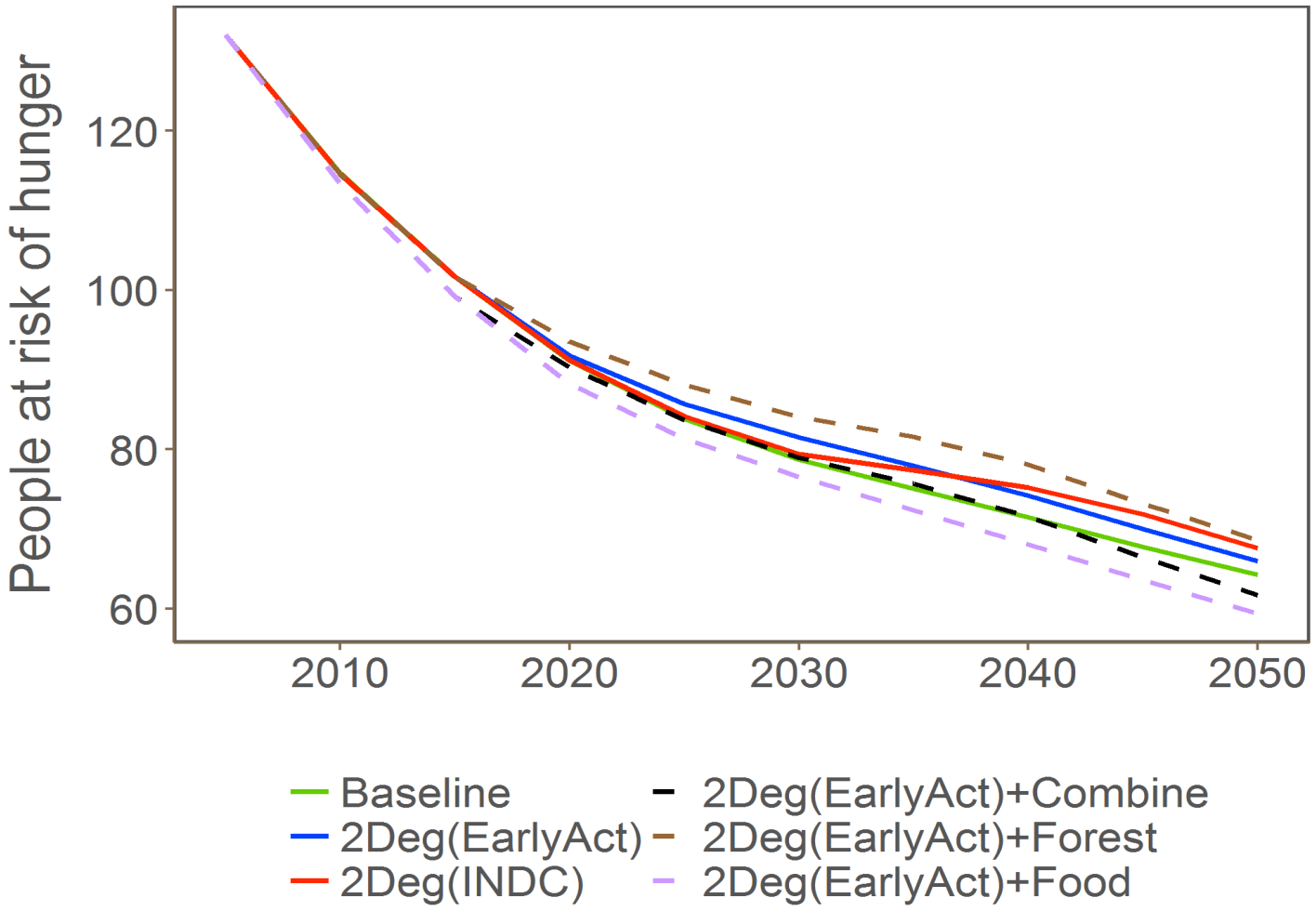
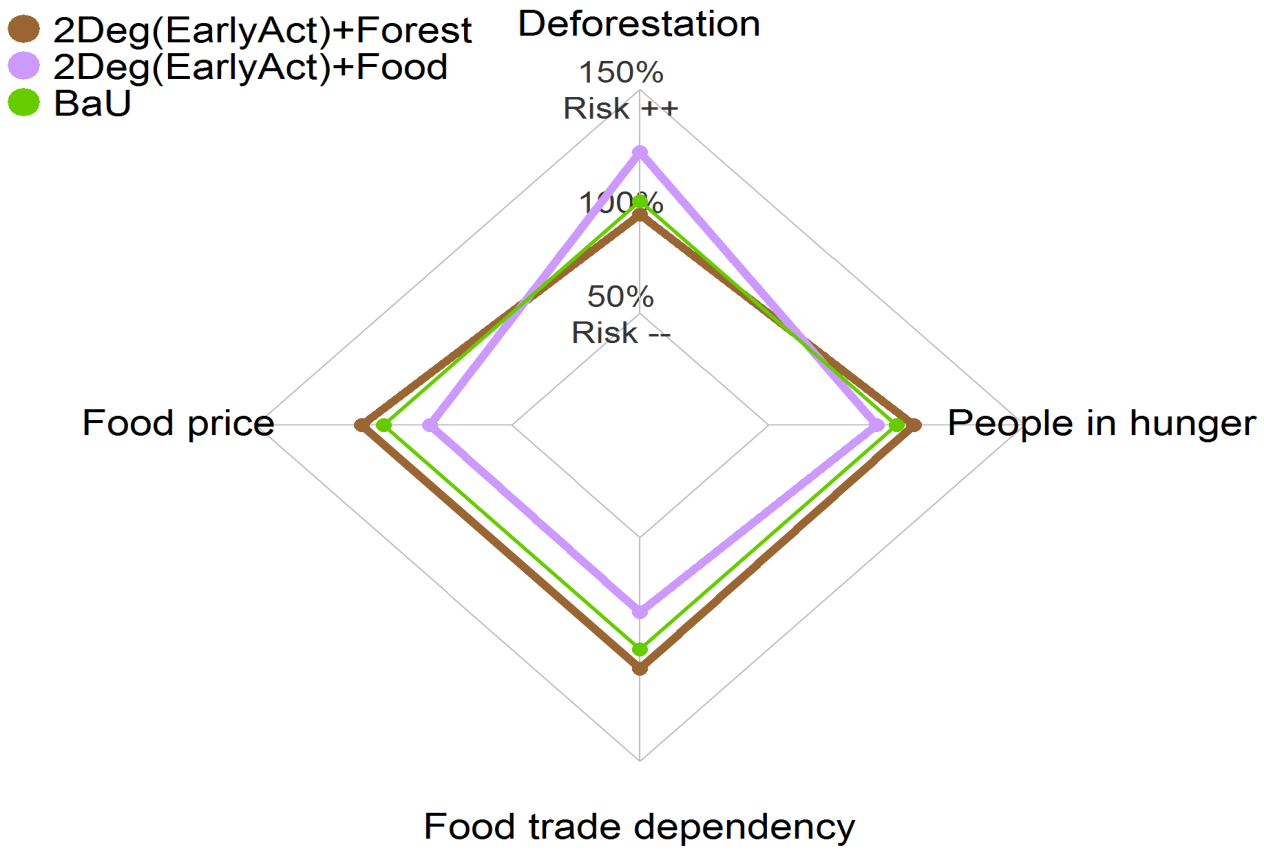

GDP loss rate [%]
4
2
0
2010
2020
2030
2040
2050
2Deg(EarlyAct)
2Deg(INDC)
2Deg(EarlyAct)+Combine
2Deg(EarlyAct)+Forest
2Deg(EarlyAct)+Food

Table SI.1 Additional scenario designs

Scenario categories	Research purposes	Scenarios and descriptions
Single complementary policy scenarios	Assess the negative side-effects on SDGs of policy scenarios where single complementary policy is added.	2Deg(EarlyAct)+Forest: only 300% forest subsidy was assumed on the basis of 2Deg(EarlyAct) scenario. 2Deg(EarlyAct)+Food: only 10% food subsidy was assumed on the basis of 2Deg(EarlyAct) scenario.


People at risk of hunger
120
100
80
60
2010
2020
2030
2040
2050
Baseline
2Deg(EarlyAct)
2Deg(INDC)
2Deg(EarlyAct)+Combine
2Deg(EarlyAct)+Forest
2Deg(EarlyAct)+Food


2Deg(EarlyAct)+Forest
2Deg(EarlyAct)+Food
BaU
Deforestation
150%
Risk ++
100%
50%
Risk --
Food price
People in hunger
Food trade dependency