

Quantifying synergies and trade-offs in the water-land-energy-food-climate nexus using a multi-model scenario approach

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Introduction

- Economic and population growth lead to growing demand for natural resources which increases the pressure on the environment.
- We use the Nexus concept and the SDG framework to investigate synergies and trade-offs across environmental and socio-economic sectors at the global scale.
- Scenario study to quantify interactions using two integrated assessment models (IAMs): MAgPIE and IMAGE.

Results

- Synergies between food policy (SDG2) and water (SDG6), climate (SDG13) and biodiversity (SDG15) due to reduced meat consumption leading to less agricultural pressure.
- Synergies between climate policy (SDG13) and biodiversity (SDG15) due to avoided deforestation and reforestation, and vice versa from extra nature protection limiting deforestation.
- Trade-offs between climate policy (SDG13) and food security (SDG2), due to large-scale bio-energy and afforestation.
- Trade-offs between water policy (SDG6) and food security (SDG2), due to limits to water extraction.

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Approach

- 6 Nexus scenarios with harmonized policy packages improving different Nexus sectors:
 - 1 reference scenario
 - 4 sector-specific scenarios
 - 1 scenario that aims to improve all sectors



Scenario	Policies	SDG Indicators	
<i>Reference -</i>			
7 AFFORDABLE AND CLEAN ENERGY, 13 CLIMATE ACTION	<i>Energy and climate</i>	<ul style="list-style-type: none"> Global CO₂ price: increased renewables and bio-energy use Forest protection, reforestation 	<ul style="list-style-type: none"> GHG emissions Renewable energy share
15 LIFE ON LAND	<i>Land and biodiversity</i>	<ul style="list-style-type: none"> Nature protection Improved fertilizer efficiency 	<ul style="list-style-type: none"> Forest share of total land
2 ZERO HUNGER	<i>Food</i>	<ul style="list-style-type: none"> Healthy reference diet (EAT Lancet recommendations) Improved agricultural efficiency 	<ul style="list-style-type: none"> Food price/food availability
6 CLEAN WATER AND SANITATION, 14 LIFE BELOW WATER	<i>Water</i>	<ul style="list-style-type: none"> Limited irrigation expansion, increased irrigation efficiency Improved sanitation, high wastewater treatment efficiency Improved fertilizer efficiency 	<ul style="list-style-type: none"> Water withdrawal Nitrogen concentration/fertilizer use
2 ZERO HUNGER, 7 AFFORDABLE AND CLEAN ENERGY, 6 CLEAN WATER AND SANITATION, 13 CLIMATE ACTION, 14 LIFE BELOW WATER, 15 LIFE ON LAND	<i>Total</i>	All of the above	All of the above

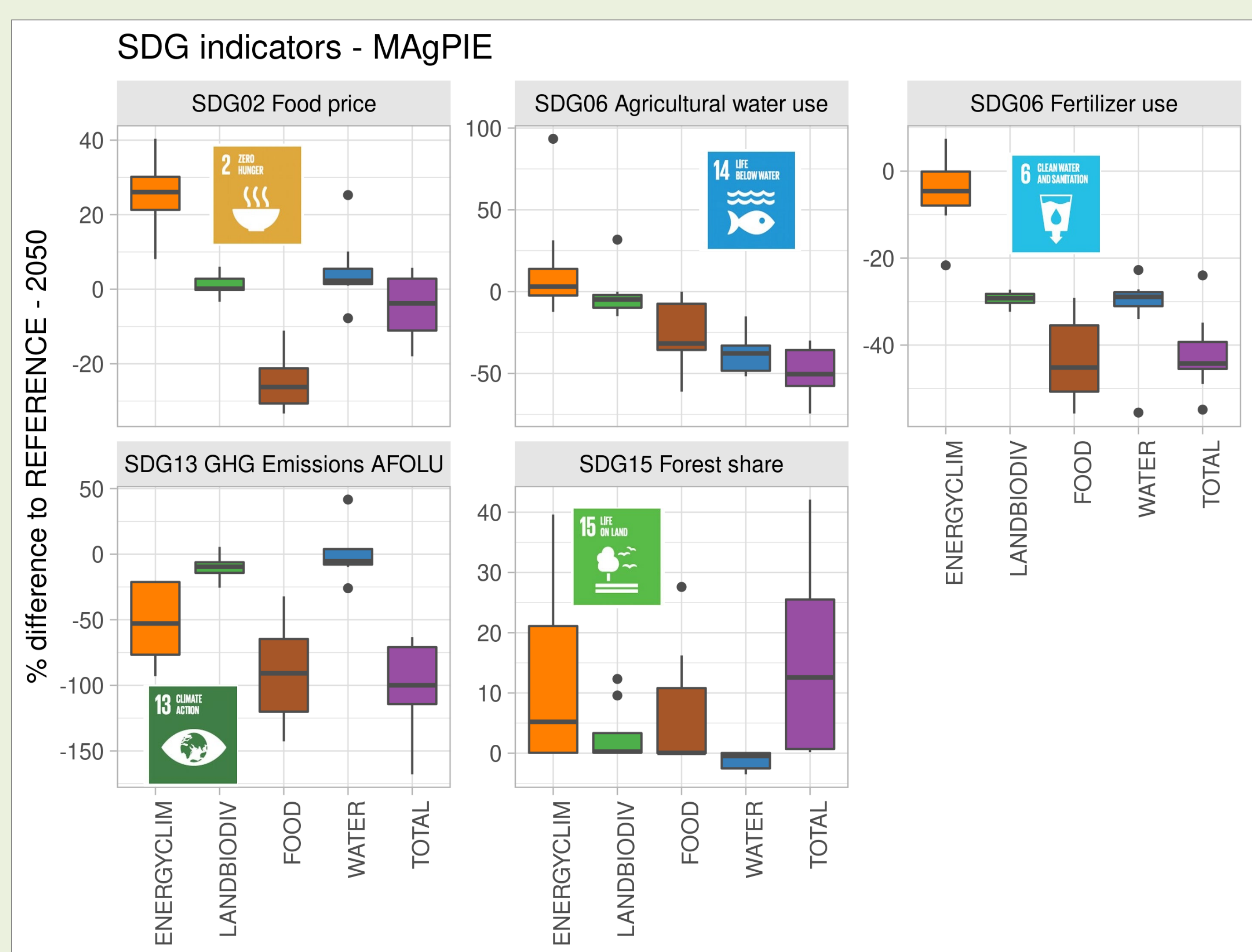


Fig. 1: boxplot of regional differences in percentage between reference and five target scenarios in 2050 for five SDG indicators based on MAgPIE model results.

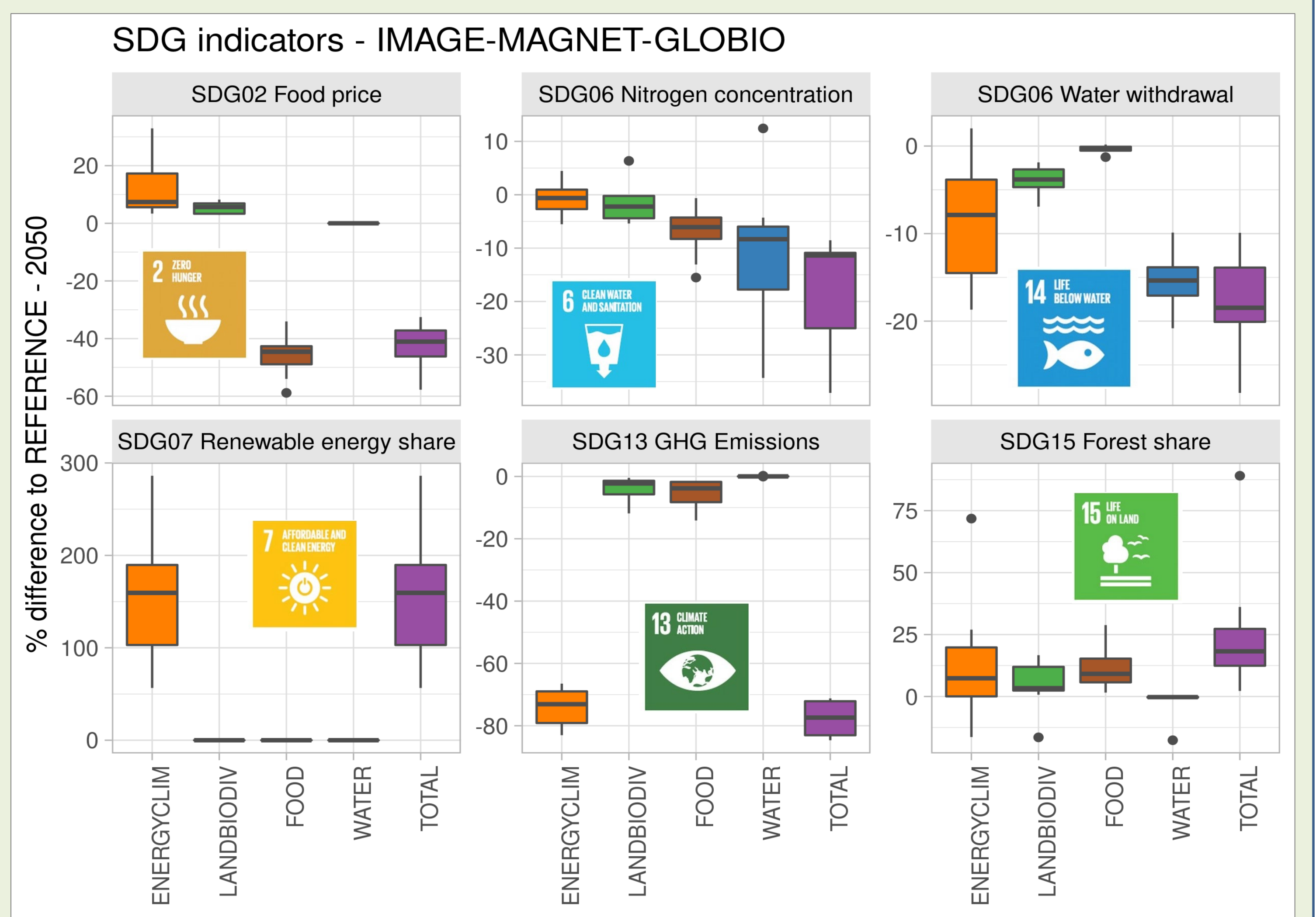


Fig. 2: boxplot of regional differences in percentage between the reference and five target scenarios in 2050 for six SDG indicators based on IMAGE model results.