ASSESSING THE ENVIRONMENTAL IMPACT OF THE APPLICATION OF A SMART FARMING SYSTEM VIA LIFE CYCLE ANALYSIS
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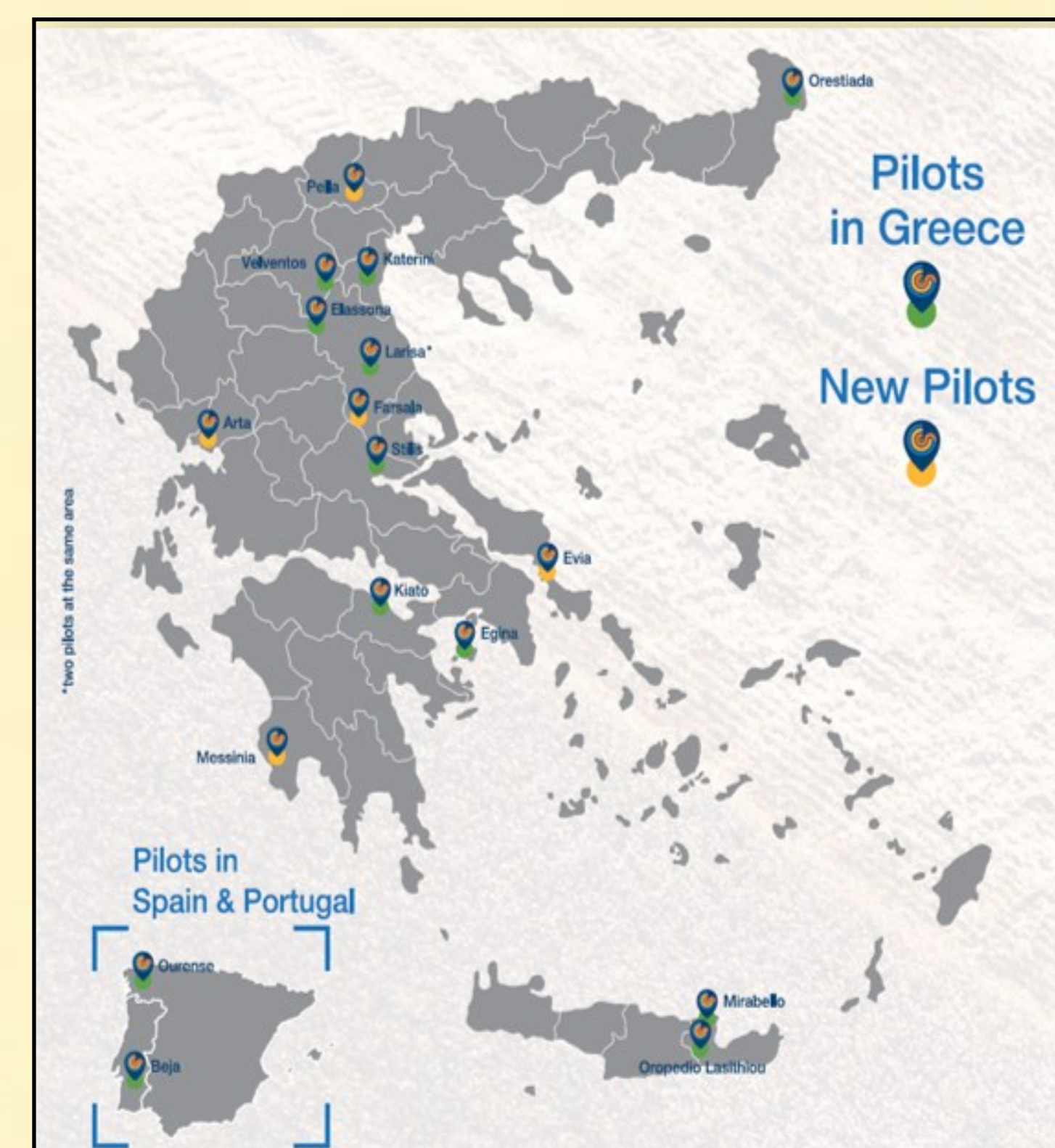## RECOMMENDING BEST MANAGEMENT PRACTICES

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GAIA Sense Smart Farming System for Sustainability in Agriculture

- **Smart Farming (SF):** State-of-the art data-driven technology. Contributes to mitigation of agriculture related impacts, promoting the economic prosperity of rural communities through achieving higher yields and less expenses to farmers.
- **GAIA Sense SF System:** Consulting farmers to use inputs (fertilisers, pesticides & irrigation) in an efficient and sustainable way. Aims at promoting resource efficiency and moderating environmental impacts, while enhancing annual yield.
- **LIFE GAIA Sense Project:** 18 pilot cases across Greece, Spain & Portugal. Each one contained reference (conventional farming) and treatment areas (SF) under comparison. Individual farmers, cooperatives and companies participated in the project.

Methodology

Goal & Scope

- Evaluation of the potential environmental advantage of Smart Farming solution.
- Recommendations for best agricultural management practices.
- **Cradle-to-field Gate** approach: Any activity beyond the field's exit boundary (field gate) was not considered.

Inventory

- Primary input data for building the Life Cycle Inventory (LCI) were based on field calendars (fertilisers/pesticides application, irrigation, etc.).
- **AGRIBALYSE** (v3.0.1) database and OpenLCA software (v.1.11.0) were used.
- **Field activities Emission Factors** (Tier 1 & 2) based on EMEP/EEA 2019 guidebook, IPCC & AGRIBALYSE dataset.
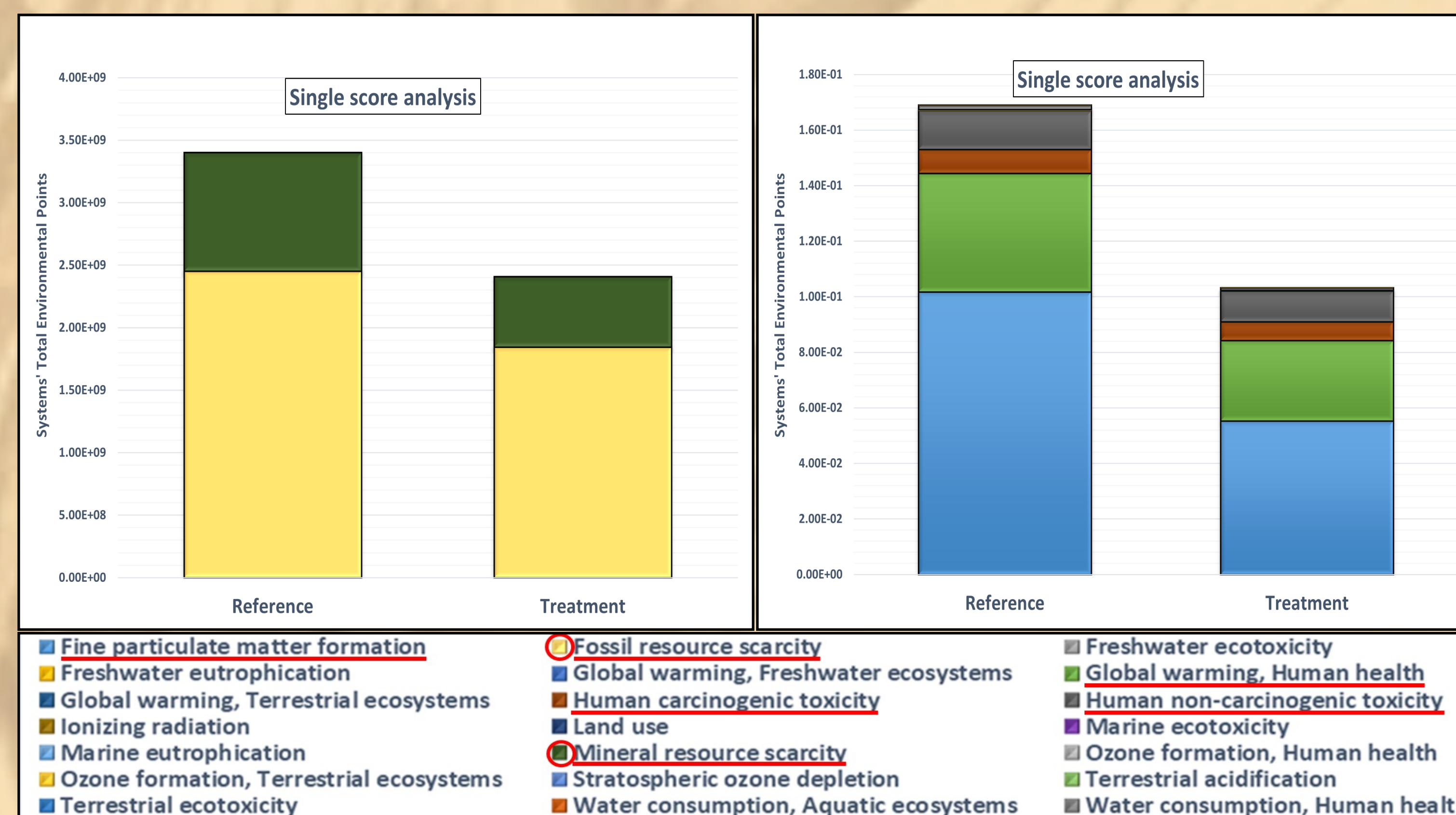
Impact Assessment

- **ReCiPe 2016 (Hierarchist)** impact method (Midpoint & Endpoint) was selected for conducting all related calculations and analysis.

SF System Boundaries
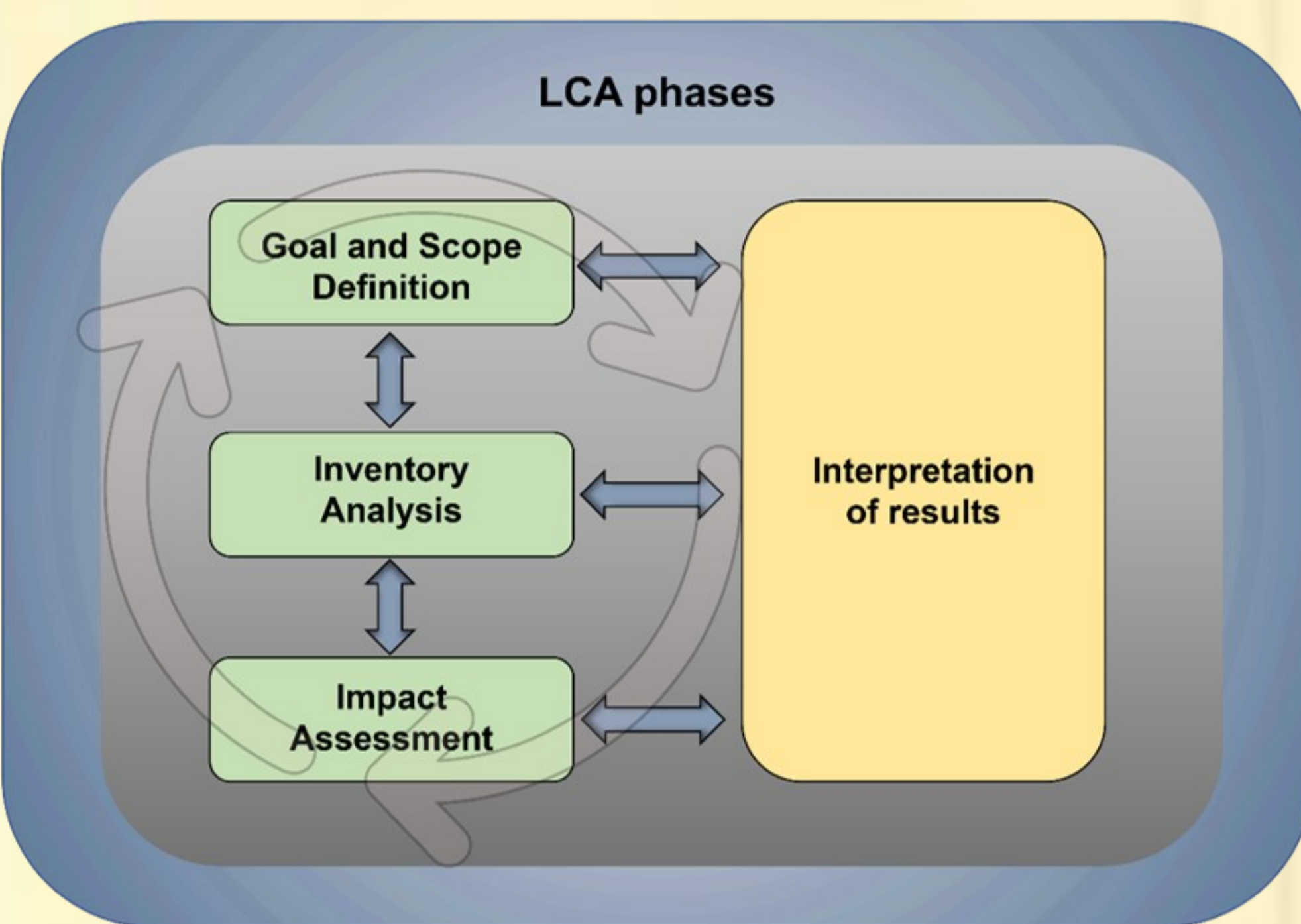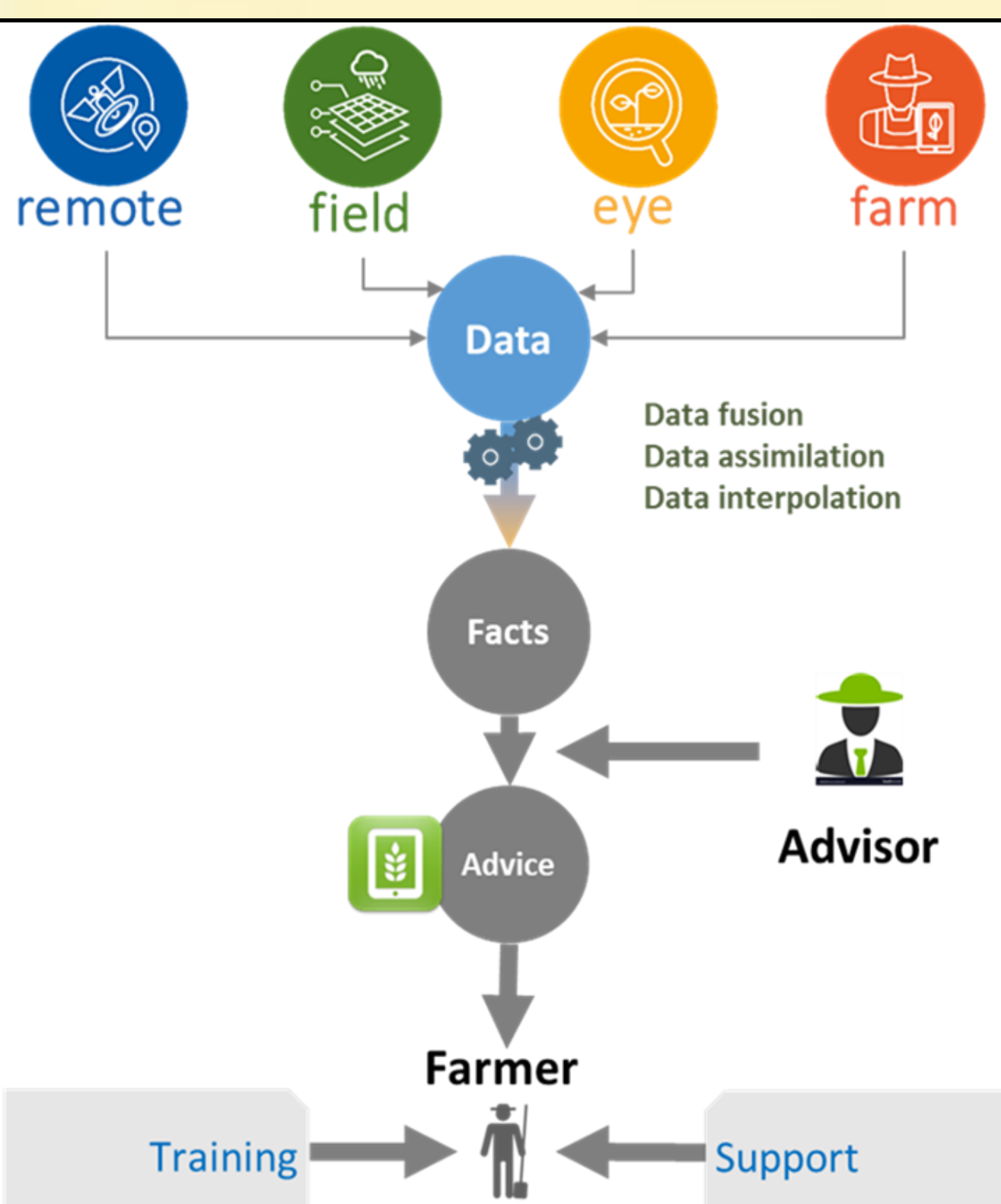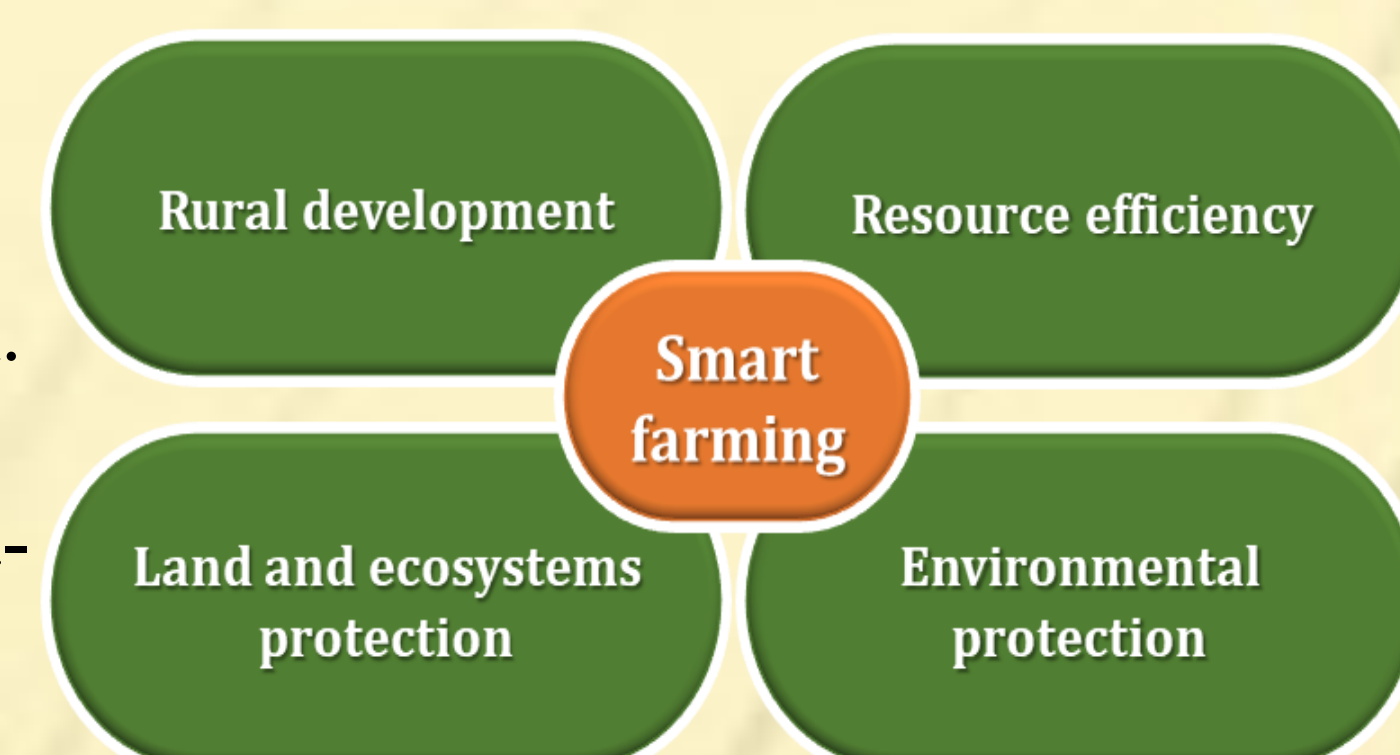
Challenges
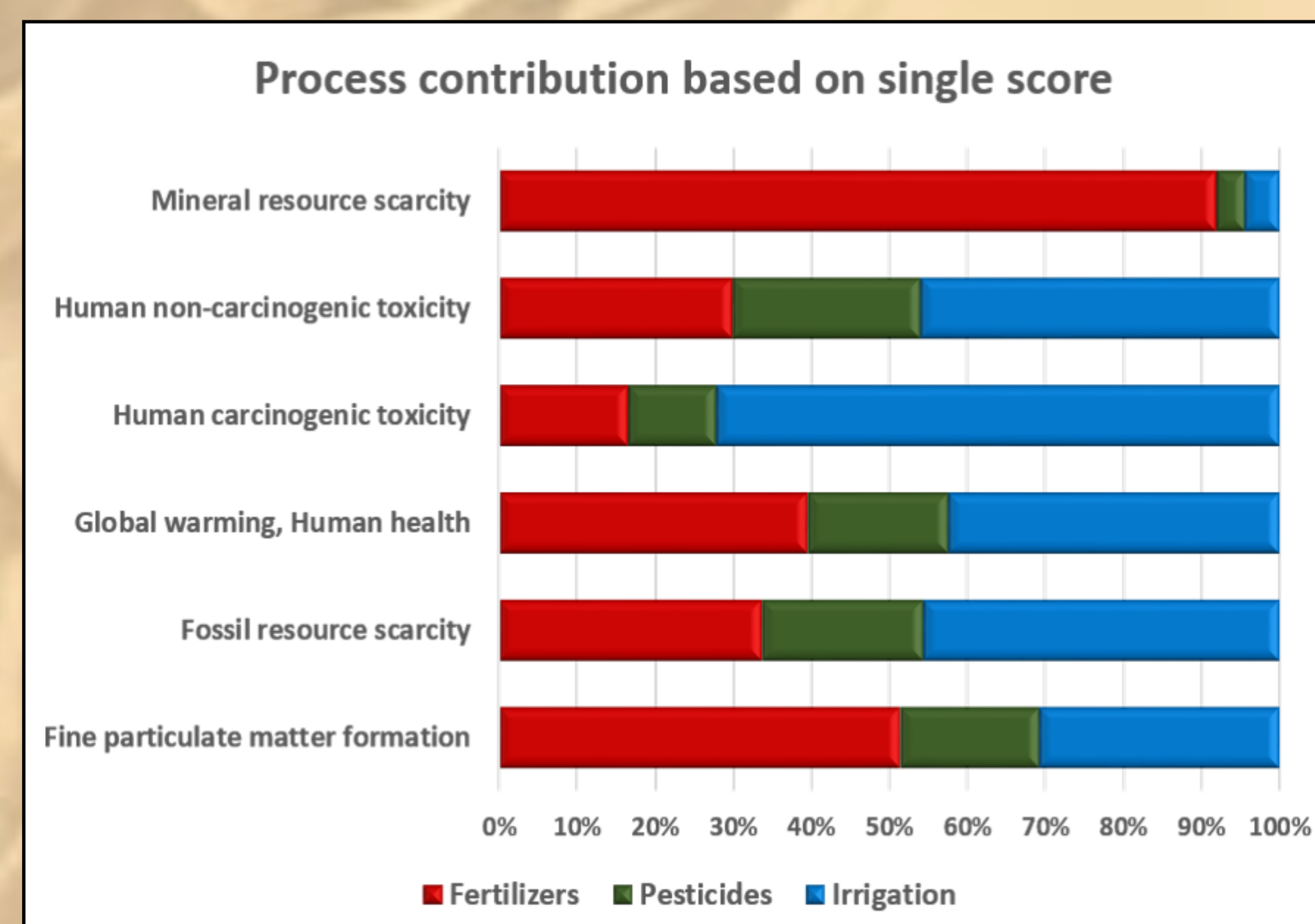Regionalization in LCA applied on Agricultural Crop Production Systems
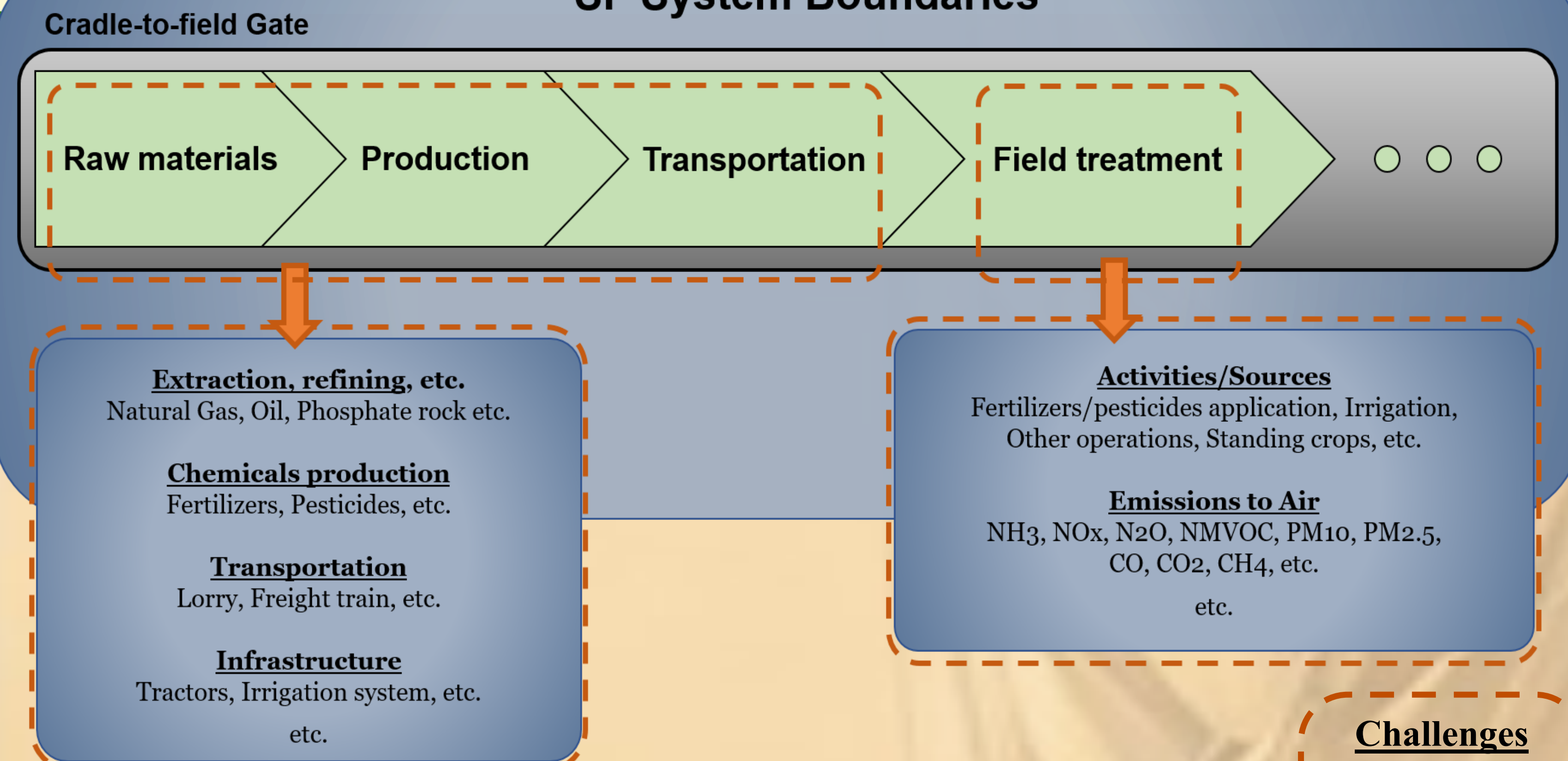
Results and Recommendations

Single Score analysis

- For the pilot case of Pieria in 2020, the results highlight resources (fossil and mineral) depletion as the most important impacts, which are mainly decreased for the treatment fields.
- Fine particulate matter formation, global warming (human health) and human carcinogenic (& non-carcinogenic) toxicity are also impacts with high environmental scores.

Midpoint Impacts analysis

- Except for some cases that showed no differences by applying the SF technology, there were mainly reductions in most of the impacts.
- Decreases are correlated to reductions in fertilizers, pesticides and irrigation and their life cycle.
- For the pilot case in Pieria in 2020, reductions in SF treatment were noticed for most impacts, except for those which are mainly affected by the pesticides application, as in the treatment field the respective amount was observed to be higher than the reference.
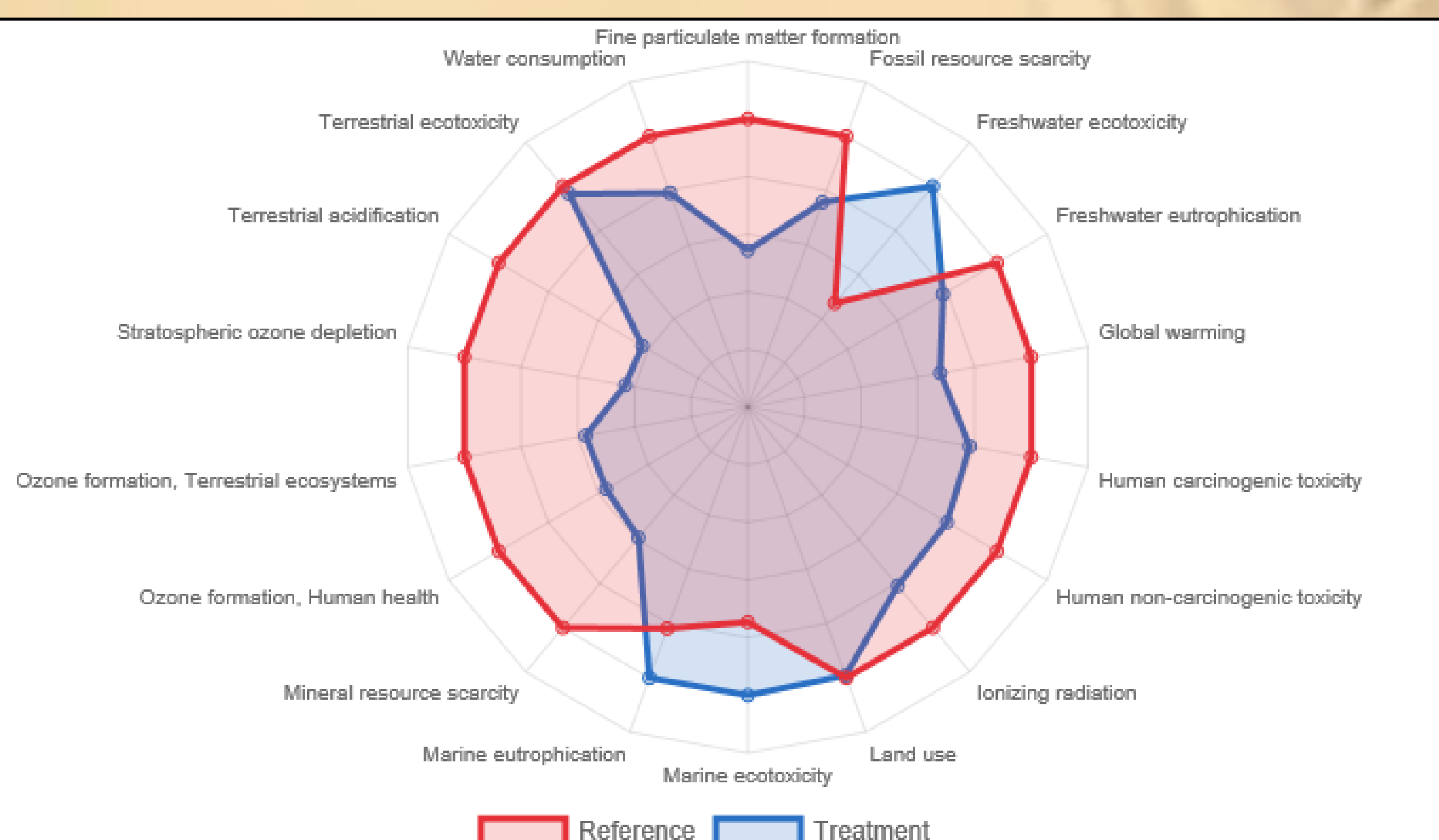

Recommendations

- Single score based recommendations, focusing on the most significant impacts.
- The contribution of the basic agricultural activities (fertilizers/pesticides & irrigation) to each impact was calculated.
- Recommendations targeted:
  1) NH_3 emissions reduction via shifting to different fertilization types (e.g., NPK, Urea).
  2) Alternative irrigation methods (e.g., sprinkler, drip).

Acknowledgements