Water consumption, Ecotoxicity and Global Warming Potential Assessment of Sugar Beet Production Using Different Irrigation Sources

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OUTLINE

Sugar Beet Production and Environmental Impacts

Agricultural production, which contributes to nearly **11% of greenhouse emissions**, is one of the production systems that needs to be evaluated thoroughly and **cleaner methods** should be recommended

Sugar beet is one of the major products of Turkey, which ranks within the **first five sugar beet producing** countries.

Agricultural production processes of sugar beet rely heavily on inputs including **water, energy, fertilizer, and pesticides**, making the environmental impacts potentially high.

The extensive water requirement of sugar beet production is particularly believed to have substantial environmental consequences, but in Turkey no comprehensive study has been conducted to quantify them.

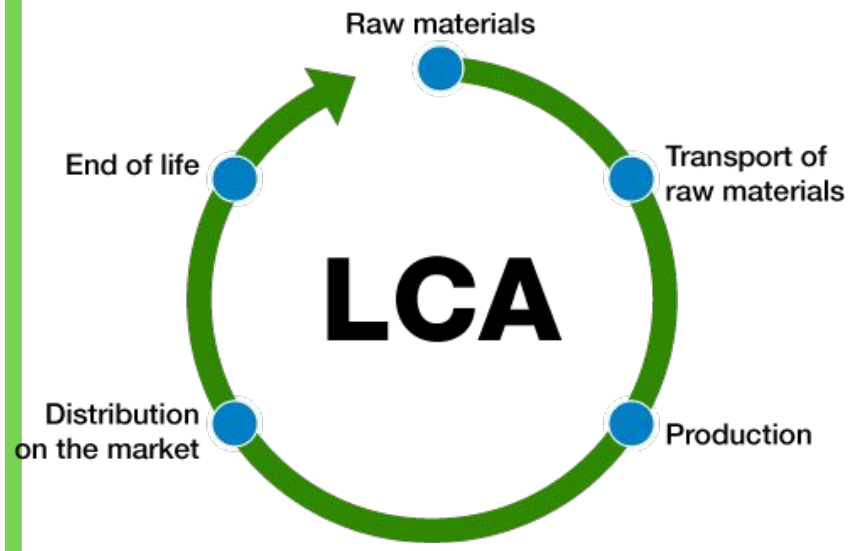
Objective of the Study

- **Sugar beet** is one of the most important products as it is a **major source** for sugar and biofuel.
- Its production heavily relies on agricultural inputs and an intense irrigation regime either from **groundwater** or **surface water sources**.
- This study aims to measure **the environmental impacts** of sugar beet agricultural production **under different irrigation sources** (i.e., groundwater vs. surface water).

The Study Area

- The study area is located in **Kayseri,** a city in Central Anatolia, Turkey.
- Turkey ranks the **5th in the world** in the sugar beet and sugar production.
- As the local area shows a **dry steppe ecosystem** structure and sugar beet production season is dry with generally no rain, an extensive irrigation is required.
- Depending on the water source available to the farmers, either **surface water or groundwater** is used.

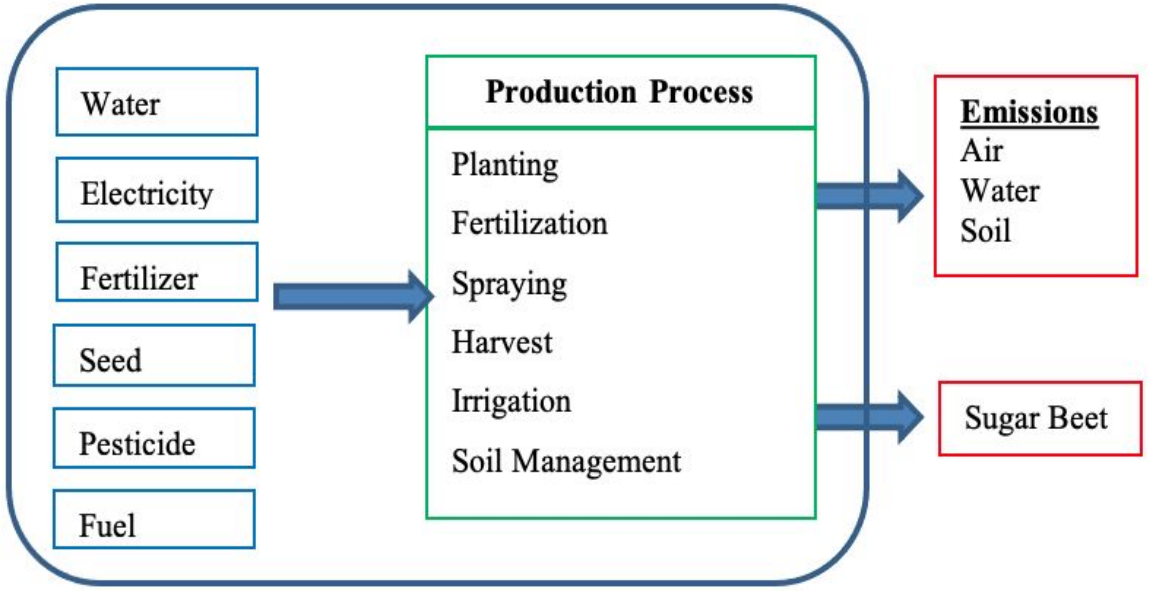
Methodology



- **Life cycle assessment (LCA)** methodology was applied for the comparison of the environmental performance of a single-family house and multi-storey apartment building based on **ISO 14040** and **ISO 14044** standards which covers four main phases
- (i) goal and scope definition,
- (ii) life cycle inventory,
- (iii) life cycle impact assessment and
- (iv) interpretation

Goal and Scope Definition

- The main goal of this study is to measure **the environmental impacts** of sugar beet agricultural production **under different irrigation sources** (i.e., groundwater vs. surface water).
- **Functional Unit:** Both **hectare of area** and a **ton of sugar beet**
- **Approach:** Cradle-to-gate



Life Cycle Inventory

- This study used the **current data from farmers' practices** in the Kayseri region in Central Turkey to evaluate environmental impacts of the use of surface water and groundwater for the irrigation of sugar beet.
- Inventory data were collected from **nine local farmers**.
- **Nine** farmers, **five** of which are using **surface water**, **four** of which are using **ground water** for irrigation, contributed to the data on the agricultural processes.
- **Ecoinvent v3**. database in **SimaPro software**

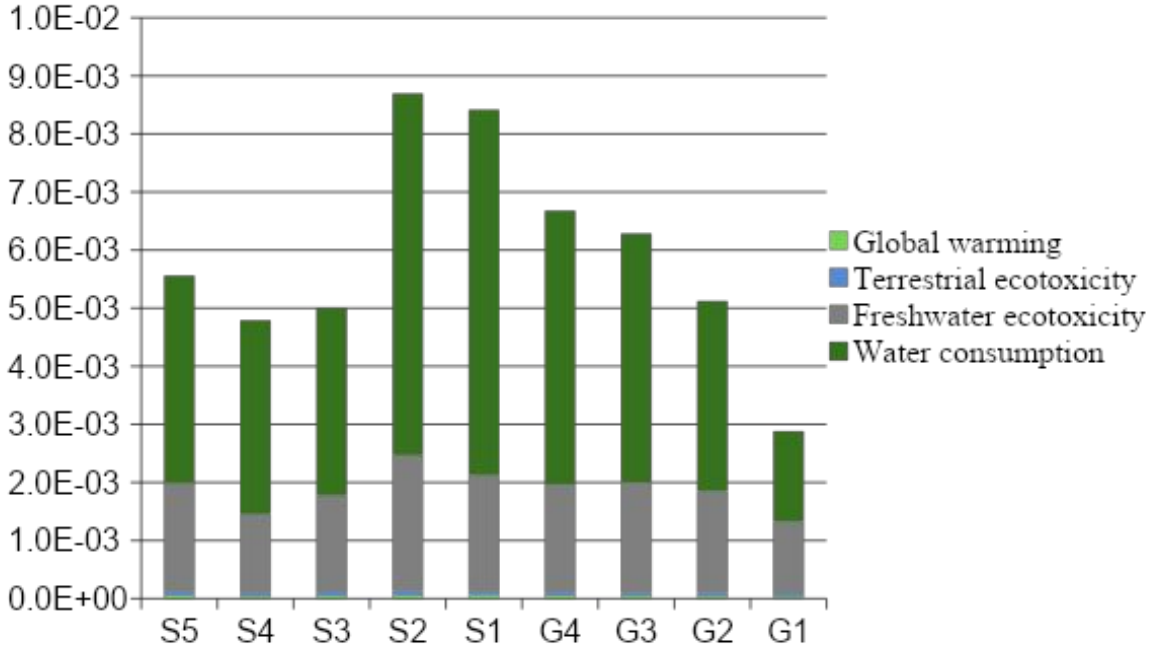
Life Cycle Impact Assessment (LCIA)

- The **ReCiPe 2016 Midpoint (H) method** was selected for the impact assessment of the sugar beet agricultural production.
- The ReCiPe method consists of **totally 18 midpoint impact categ**ories. In this study, the following **four impact categories** were selected for LCIA:
  - Global Warming Potential
  - Terrestrial Ecotoxicity
  - Freshwater Ecotoxicity
  - Water Consumption

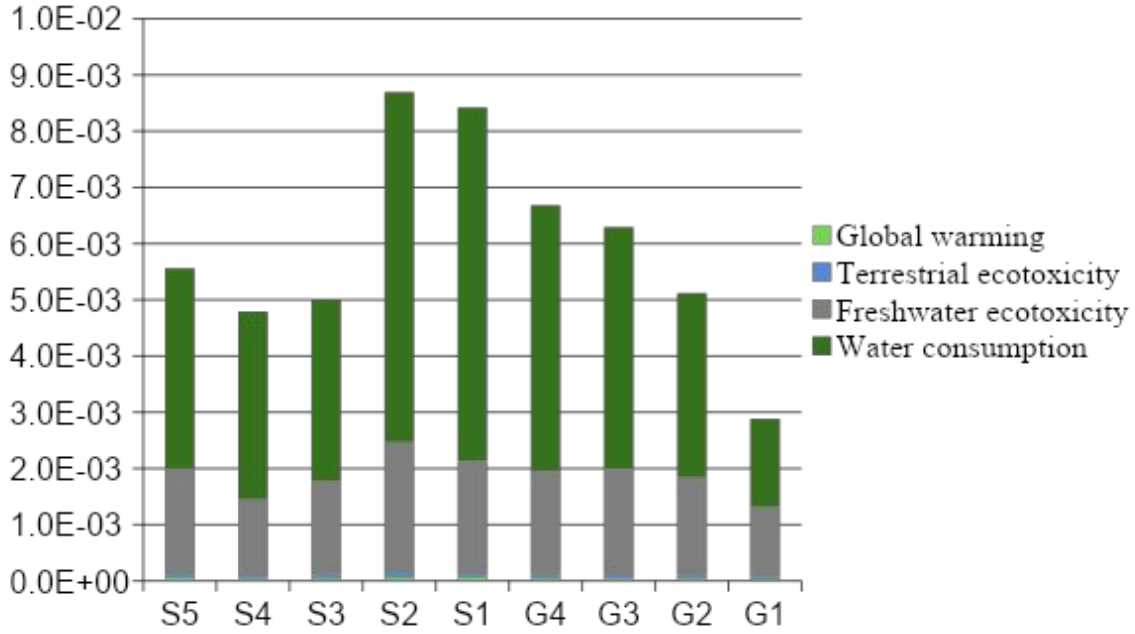
Results and Discussion

Normalization results of the environmental impacts of sugar beet farms

S: Surface water, **G:** Groundwater



Functional unit: per ton of sugar beet

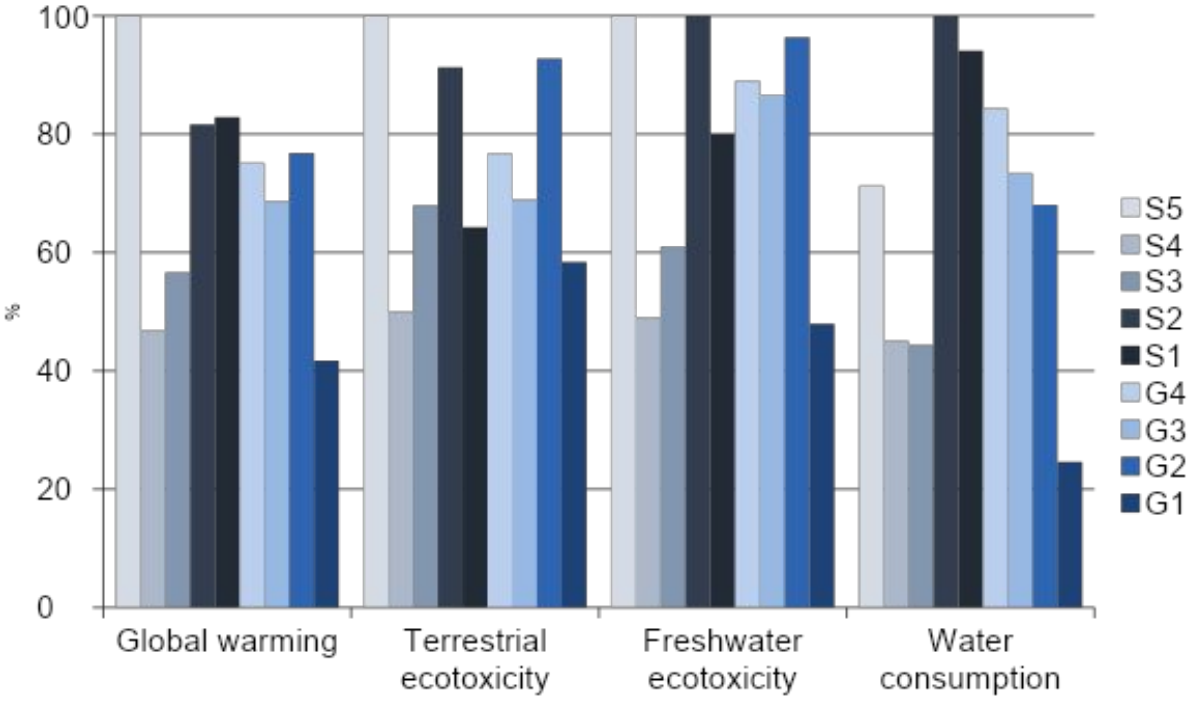


Functional unit: per hectare of agricultural area

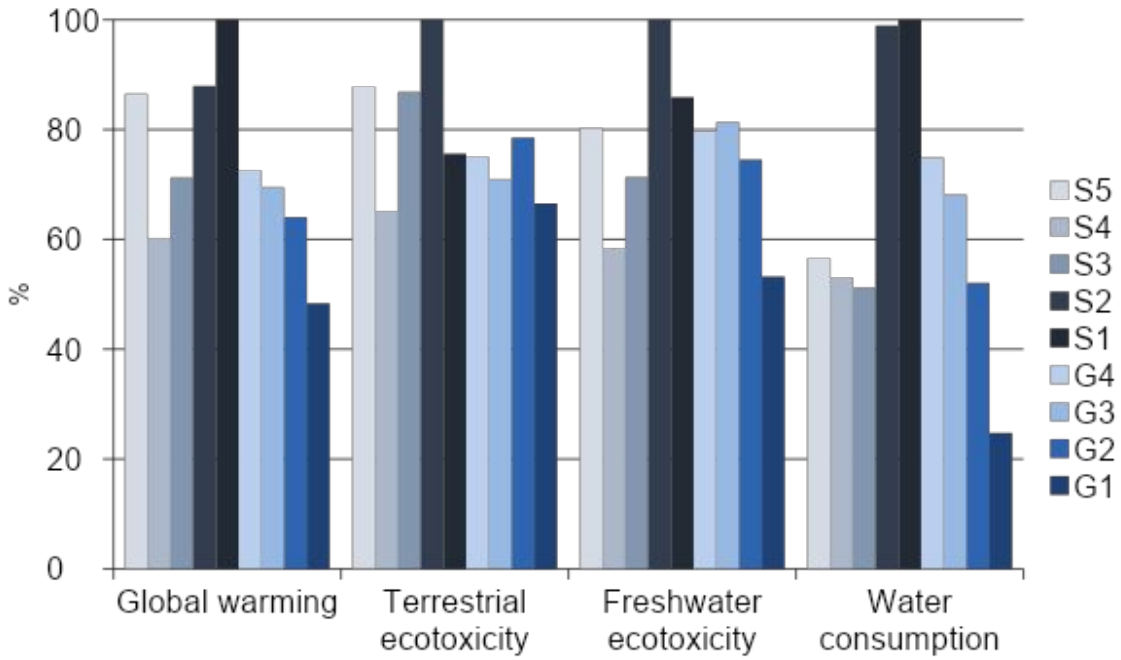
Results and Discussion

Characterization results of the environmental impacts

S: Surface water, **G:** Groundwater



Functional unit: per ton of sugar beet



Functional unit: per hectare of agricultural area

Conclusions

- This study shows that as well as the **water source**, **effective quantitative and qualitative water management** is critical.
- **Planned irrigation regimes** are very important both for eliminating the overuse of limited water resources and for **decreasing the environmental impacts**.
- This study provides a basis for the **future improvements** for agricultural production of sugar beet in Turkey.
- Further, LCA proved itself as a **valuable method** for comparing the effects of various water sources and irrigation/fertilization management practices.

Thank You…

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