

Eco-efficiency in sugar beet production

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Introduction

Sustainable development in cropping systems requires the efficient use of natural resources while minimising environmental impacts. The reduced emission of toxic substances or gases into soil, water and air, as well as conservation of biodiversity and prevention of soil degradation as a result of farm management practices are particularly concerned. The term **eco-efficiency** describes the ratio of **ecological** and **economic** efficiency for a production process. In sugar beet production the aim of eco-efficiency is the reduced input of economic and ecological resources per unit of sugar produced. In this way, the concept may contribute to a sustainable development in sugar beet production.

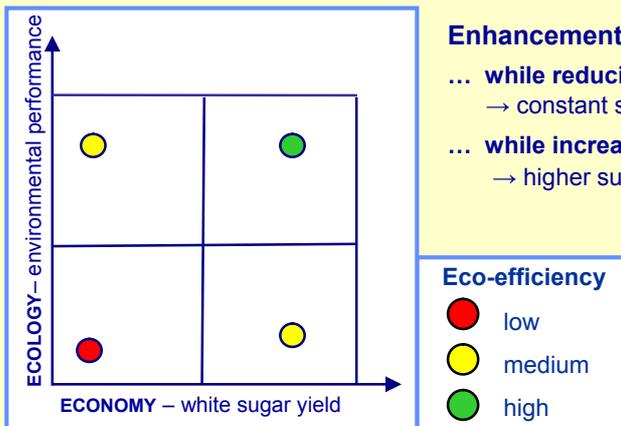
Definition "Eco-efficiency"

„Eco-efficiency is reached by the delivery of competitively priced goods and services [...], while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity. World Business Council for Sustainable Development (1992) Eco-efficiency can be characterized shortly by the following formula.

$$\text{Eco-efficiency} = \frac{\text{affected environmental impact}}{\text{WSY} \cdot [\text{t}]}$$

*White sugar yield (WSY) reflects the performance of sugar beet in terms of yield and quality. WSY is not subjected to a market price variation.

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Enhancement of eco-efficiency ...

- ... while reducing environmental impacts and production costs
→ constant sugar yield at a lower resource input level
- ... while increasing acreage productivity
→ higher sugar yield at a constant resource input level



Improvement of the resource input in sugar beet production considering individual site-specific requirements from sowing to harvest.

Eco-efficiency unites economic and ecological aspects

Implementation by the use of eco-efficiency criteria

Process	Objective	Eco-efficiency-criteria
Tillage	Increase of conservation tillage area	$\frac{\text{Energy input tillage [GJ]}}{\text{WSY [t]}}$
Fertilisation	Optimisation of N-fertilisation	$\frac{\text{N-fertilisation [kg]}}{\text{WSY [t]}}$
Plant protection	Optimisation of plant protection product use	$\frac{\text{Plant Protection Index}}{\text{WSY [t]}}$
Harvest	Soil protection	$\frac{\text{Axle load [t]}}{\text{WSY [t]}}$
	Reduction of soil tare	$\frac{\text{Soil tare [t]}}{\text{WSY [t]}}$

- Survey of eco-efficiency criteria in a network of pilot farms will be carried out.
- Possible target values of all eco-efficiency criteria are under consideration.
- E.g., eco-efficiency criterion tillage: the intensity of tillage (depth and frequency of operations; machinery) is approximately described as energy input.
- A continuous survey of the eco-efficiency criteria allows statements about the achievement of objectives related to eco-efficiency.
- Appropriate organisations, sugar beet grower associations and sugar companies are invited to implement measures in practice that will enhance efficiency.

Proposals for eco-efficiency-criteria in Germany's sugar beet production