Definition:

$$\frac{Grain/Fruit/\ Tuber\ yield}{GHG\ emissions}$$

Description

Benefit: Yield refers to the weight of harvested parts of plants that possess economic value. It is suitable, where production is to be used food or feed purposes or as a non-energetic production factor in bio-refineries. Crops with high per hectare yield will show high efficiencies in this impact area.

Resource: Under current policy targets such as the 2015 Paris Agreement or the United Nations' Sustainable Development Goals (SDG), the total amount of greenhouse gases that can safely be emitted into the atmosphere is limited. Greenhouse gas emissions can therefore be treated as a limited resource.
For this indicator, emissions of different greenhouse gases are combined by calculating carbon dioxide equivalent emissions (CO2 eq.), based on the 100-year global warming potential (GWP) of each gas. It is necessary to define both the spatial reference (e.g. emissions per hectare) and the temporal reference (e.g. emissions per year).

Correlation with soil management

[125] Conservation management (including the use of organic compost, cover crops, and reduced level of tillage) management was more efficient in terms of yield per GHG emissions than conventional management
[241] Highest land use efficiencies (potato yield per hectare of area) were achieved in regions that produce potatoes under irrigation in summer where solar radiation is high and lowest land use efficiencies were reported for the predominantly dryland and partially dryland regions.

Strength & weaknesses pertaining to measurement of this impact area

Yield: Yield values are generally easy to measure and readily available at farm level or in the form of national inventories. However, their informative value is limited where they do not account for qualitative differences between types of biomass and are not accompanied by information on site conditions such as local climate or soil fertility. Therefore, comparisons between efficiencies of different production processes with regard to yields should only be made where products and site conditions are similar. In some cases, it may be advisable to select alternative indicators where the type of benefit is more clearly defined (e.g., energetic value, financial benefit).

GHG Emissions: For this indicator, a number of standard values and national inventories exist. The use of the 100-year GWP enables comparability between studies and between emissions of different greenhouse gasses. However, for short lived gasses such as methane, this standard underestimates the contribution to global warming in the short term and overestimates their

contribution in the long term.

Can be measuredas:

Yield:

- yield, fresh weight [t]
- yield, dry matter weight [t]

GHG Emissions:

- total emissions [Mg CO2 eq. ha^{-1} yr^{-1}]

Sample Indicators

Indicator values from		Survey	
Experiment or direct measurement		Statistical- or census data	
Expert assessment		Literature values	
Model		Maps or GIS	
Stakeholder participation		Not provided	

Table 1: Field Scale

Indicator	**Unit**	**Indicator values from**
[125] Potato yield/GHG emission	kg * kg^{-1}	

Table 2: Regional Scale

Indicator	**Unit**	**Indicator values from**
[241] Energy use efficiency (Potato yield/Energy use (CO2 emissions) associated with irrigation, fertilizer and seed production)	ton * kg^{-1}	

References

ID	Citation	[1]Soil type/ texture
125	Khakbazan, M., et al. (2017). "Energy Use Efficiency of Conventional versus Conservation Management Practices for Irrigated Potato Production in Southern Alberta." American Journal of Potato Research **94**(2): 105-119.	Mainly orthic brown Chernozemic soils
241	Steyn, J. M., et al. (2016). "Resource use efficiencies as indicators of ecological sustainability in potato production: A South African case study." Field Crops Research **199**: 136-149.	Loam, sandy-loam, sand

[1]**Soil type/ texture:** If provided, what are type and texture of the soils studied in the paper?