Definition:

$$\frac{Embodied\ Nitrogen}{Area\ of\ land}$$

Description

Benefit: Refers to the total amount of nitrogen in the harvested product. The indicator is relevant for the assessment of food or feed quality as nitrogen content is indicative of the amount of proteins. Furthermore, high protein concentrations are essential for some uses in bio-refineries.
Protein rich crops will show high efficiencies in this impact area.

Resource: Agricultural land is always a limited resource. The type of land can be specified to distinguish between different land qualities. Distinctions are often made, for example, between cropland and pasture, high nature value (HNV) farmland and other farmland, or based on soil fertility and yield potential. For this indicator, the temporal reference must always be specified. However, in case of the standard period of one year, this information is sometimes omitted in scientific publications.

Correlation with soil management

[245] Higher nitrogen fertilizer rates applied to spring wheat results in an increase of grain and aboveground biomass N and in a decrease of the N effectiveness indicators
[261] Paper showed as regards fertilizer treatments, higher yields were obtained in wet years than in dry ones

Strength & weaknesses pertaining to measurement of this impact area

Embodied Nitrogen: can be used to calculate nitrogen use efficiencies (NUE) (e.g., the share of nitrogen recovered by plants relative to the amount of nitrogen fertilizer applied). However, efficiency measures are less suited to assess risks of environmental contamination by nitrogen fertilizer than nitrogen budgets (i.e. amount recovered – amount applied).

Area of land: While area of land is a standard measure that is used as reference in most statistics and inventories, a weakness of this indicator is that other relevant information like soil type, soil fertility or management history is often not provided.
In short, one hectare of dry, sandy cropland soil is very different from one hectare of pasture on drained peat soils.

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**
[206] Nitrogen content of the shoots/Area of land	kg * ha^{-1}	
[245] N content of grain yield/Area of land	kg * ha^{-1}	
[245] N content of aboveground biomass/Area of land	kg * ha^{-1}	
[246] Content of mineral nitrogen (Nmin)/Area of land	kg * ha^{-1}	
[246, 247] Nitrogen uptake by fertilized plants/Area of land	kg * ha^{-1}	
[246] Nitrogen uptake by control plants (unfertilized)/Area of land	kg * ha^{-1}	
[247] Nitrogen uptake by plants/Control (unfertilized) plot	kg * ha^{-1}	
[261] Amount of N of fertilization on maize yield/Area of land	kg N * ha^{-1}	

Table 2: Farm Scale

Indicator	**Unit**	**Indicator values from**
[176] Nitrogen uptake by crops or fodder grass/ Fodder area	kg N * ha^{-1}	

References

ID	Citation	[1]Soil type/ texture
176	Moreau, P., et al. (2012). "Reconciling technical, economic and environmental efficiency of farming systems in vulnerable areas." Agriculture Ecosystems & Environment **147**: 89-99.	Deep loamy and shallow brown soils
206	Ratjen, A. M. and H. Kage (2016). "Nitrogen-limited light use efficiency in wheat crop simulators: Comparing three model approaches." Journal of Agricultural Science **154**(6): 1090-1101.	Pseudogleyic luvisol; Sandy loam to clayey loam
245	Szmigiel, A., et al. (2016). "Efficiency of nitrogen fertilization in spring wheat." International Journal of Plant Production **10**(4): 447-456.	Luvic Chernozem
246	Szulc, P., et al. (2018). "The size of the nminsoil pool as a factor impacting nitrogenutilization efficiency in maize (Zea mays L.)." Pakistan Journal of Botany **50**(1): 189-198.	Deer soil; Clay lightweight sand, shallow defaulting on light clay
247	Szulc, P., et al. (2016). "Efficiency of nitrogen fertilization based on the fertilizer application method and type of maize cultivar (Zea mays L.)." Plant Soil and Environment **62**(3): 135-142.	Luvisol; Granulometric composition of shallow, light clay sand on light clay, belonging to the good rye soil class
261	Vig, R., et al. (2012). "The efficiency of natural foliar fertilizers." Idojaras **116**(1): 53-64.	Calcareous chernozem; Mid-heavy adobe

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