

Arable crop production

Responsible partner: FAUNS

Actuality: November 2021

Interpretation

The indicator describes the usable ecosystem service taking into account the site conditions (potential yield, flooding regime) on the existing arable land in the form of yields for crops. It indicates the level of arable yields to be expected in the floodplain segments or compartments with reference to their size. For this purpose, the share of arable land in the reference area is multiplied by the respective potential yield, corrected for average losses due to flooding risk, and the result is then classified using the potential yield scale.

The human input of artificial operating resources is not taken into account here; only the natural site conditions are included. The level of the indicator reflects the possibilities of agricultural production, as e.g. wheat cultivation is only possible with high and very high yield potential.

The risk of flood-related yield losses in the recent floodplain can be considered either by an official flooding risk map indicating floodings during the agricultural growing season, or based on empirical knowledge about crop yield losses in the past years. As an example, a 50% crop loss every 5 years due to flooding may be considered as a 10% reduction of average annual crop yield due to the flooding risk.

References

Stahl, H., Zacharias, S. & Röhrich, C. (2005). Veränderte Landnutzungssysteme in hochwassergefährdeten Gebieten. Schriftenreihe der Sächsischen Landesanstalt für Landwirtschaft, Heft 12, 10.Jg. Sächsische Landesanstalt für Landwirtschaft, Fachbereich Pflanzliche Erzeugung, Dresden

ZALF e.V. (2010). MinHorLam. Minderung von Hochwasserrisiken durch nicht-strukturelle Landnutzungsmaßnahmen in Abflussbildungs- und Überschwemmungsgebieten – eine transdisziplinäre Studie zur Effektivität solcher Maßnahmen – Ergebnisbericht

■ Original approach according to River Ecosystem Service Index (RESI) (Podschun et al., 2018)

Class	Abbr.	Description		Spatial reference	
Provisioning	ACI	Used arable crops (e.g. cereals, root crops, vegetables, fruit)		Floodplain segment or compartment <input checked="" type="checkbox"/> former floodplain <input checked="" type="checkbox"/> active floodplain <input type="checkbox"/> river	
Variable	Abbr.	Unit	Variable description	Data basis	Comment
Reference areas (segment- or compartment)	A_{Seg} A_{Comp}	ha	Calculation of the area	- Floodplain segment - Floodplain compartment	
Arable land in the floodplain segment (separated into active and former floodplain)	AL_{act} AL_{for}	ha	Calculation of area: Arable land within the reference areas	- Corine Landcover Classification (CLC) - National Land Cover Model - Optionally aerial photographs	
Site-specific yield potential for agricultural use	YP	dt/ha	Weighting of arable land according to yield potential	- Agricultural site mapping (describing the value of the site for agricultural use, mainly depending on soil type)	Classification might differ between countries

Flood-induced yield loss	YL_{Fl}	constant	Risk of flooding and yield loss in the active floodplain	- Flood hazard maps HQ ₅ , HQ ₁₀ , HQ ₂₀ - Water level data	Estimate
Calculation					
Calculation steps			Indicator		
<ol style="list-style-type: none"> 1. Determination of the reference area size for each segment or compartment j (GIS) 2. Identification of all arable land i within the reference areas j from land use data (GIS) with differentiation according to location (active or former floodplain) 3. Intersection of arable land with agricultural site mapping or with data on yield potential (GIS) 4. Determination of the relevant flood probability for the active floodplain from water level records (tide gauge data) or flood hazard maps (simplified procedure) 5. Calculation of the indicator for each reference area 6. Classification of the resulting arable crop yield into 5 classes 			<p>Calculation of potential yields of arable land within the river-floodplain segments (for j =river-floodplain segments)</p> $ACI(j) = \sum_{i=1}^n (i) \frac{AL_{for i} * YP_i}{A_{seg j}} + \frac{AL_{act i} * YP_i}{A_{seg j}} * YL_{Fl}$ <p>j = 1, 2, ...m Floodplain segments/compartments i = 1, 2, ...n Partial area within segments/compartments</p>		
ACI	> 40 dt/ha	> 30 – 40 dt/ha	> 20 - 30 dt/ha	> 10 – 20 dt/ha	≤ 10 dt/ha
Evaluation Class	5	4	3	2	1
Qualitative Evaluation	Very high yields	High yields	Average yields	Low yields	Very low yields

■ Adaption for Danube-wide application

Class	Abbr.	Description		Spatial reference	
Provisioning	ACI	Used arable crops (e.g. cereals, root crops, vegetables, fruit)		Floodplain segment or compartment <input checked="" type="checkbox"/> former floodplain <input checked="" type="checkbox"/> active floodplain <input type="checkbox"/> river	
Variable	Abbr.	Unit	Variable description	Data basis	Comment
Reference areas (Segment- or compartment)	A_{Seg} A_{Comp}	ha	Calculation of the area	- Floodplain segment - Floodplain compartment	
Arable land in the floodplain segment (separated into active and former floodplain)	AL_{act} AL_{for}	ha	Calculation of area: Arable land within the reference areas	- Corine Landcover Classification (CLC)	
Site-specific yield potential for agricultural use	YP_i	Ordinal (1-5)	Weighting of arable land according to yield potential	- Agricultural site mapping (describing the value of the site for agricultural use, mainly depending on soil type)	Classification might differ between countries
Flood-induced yield loss	YL_{Fl}	constant	Yield loss in the active floodplain to flooding	- Flood hazard maps HQ ₅ , HQ ₁₀ , HQ ₂₀	Estimate

Calculation						
Calculation steps				Indicator		
<ol style="list-style-type: none"> 1. Determination of the reference area size for each segment or compartment j (GIS) 2. Identification of all arable land i within the reference areas j from land use data (GIS) with differentiation according to location (active or former floodplain) 3. Intersection of arable land with data on yield potential (GIS) 4. Determination of the relevant flood probability for the active floodplain from flood hazard maps (simplified procedure) (GIS) 5. Calculation of the indicator for each reference area 6. Classification of the resulting arable crop index into 5 classes 				<p>Calculation of potential yields of meadows and pastures within the river-floodplain segments (for j = river-floodplain segments)</p> $ACI(j) = \sum_{i=1}^n (i) \frac{AL_{for i} * YP_i}{A_{seg j}} + \frac{AL_{act i} * YP_i}{A_{seg j}} * YL_{FI}$ <p>j = 1, 2, ...m Floodplain segments/compartments i = 1, 2, ...n Partial area within segments/compartments</p>		
ACI	> 0.8 of max (ACI)	0.8-0.6 of max(ACI)	0.6-0.4 of max(ACI)	0.4-0.2 of max(ACI)	< 0.2 of max (ACI)	0
Evaluation Class	5	4	3	2	1	0
Qualitative Evaluation	Very high yields	High yields	Average yields	Low yields	Very low yields	No agriculture

■ Data sources

Data set	Data type	Spatial reference	Spatial resolution	Source	Creation date	Comments
A_{Seg} , A_{Comp}	polygons			river-floodplain segments (1-10 km)	2021	
AL_{Act} , AL_{For}	polygons	International		CLC_2018		
YP classes	polygons			National soil datasets for Austria, Slovenia, and Serbia, SGDB for the other countries		YP is a relative value based on the official fertility classification of soils, which ranges from 1 = very low to 5 = very high Classification based on soil expert opinion and https://esdac.jrc.ec.europa.eu/public_path/shared_folder/dataset/45_biomass_prod/SoilProd_model_soiltype_tables.xlsx
YL_{FI} classes	polygons			National datasets (Romania, Austria, Germany, Hungary, Slovenia), http://www.geo.u-szeged.hu/dfgis/ for Serbia		YL_{FI} is defined as the averaged annual yield loss due to flooding. Calculation was not performed for AFP where is missing data about flooding probability (Croatia, Bulgaria, Slovenia (Sava))