User guide to run EROSPOT Software part 1

Identification of erosion hotspots at sub-field level using high-resolution geospatial data

Authors: Marvin Melzer [a, b], Nishita Thakur [a, c], Sonoko Bellingrath-Kimura [a, b]

[a] Leibniz Centre for Agricultural Landscape Research e.V., Eberswalder Straße 84, Müncheberg D-15374, Germany
[b] Humboldt-University of Berlin, Unter den Linden 6, Berlin D-10099, Germany
[c] Justus-Liebig University, Karl-Glöckner-Straße 21 C, 35394 Gießen, Germany

Summary

Soil erosion in agriculture reduces yield potential and at the same time damages surrounding ecosystems, especially water bodies through sediment, nutrient and pesticide inputs. In the EROSPOT project, high-risk locations (hotspots) polluting water bodies through water erosion were identified on farmland at sub-field level through the automated processing of high-resolution geodata. The hotspots indicate high priority locations for erosion control and are thus of value for farmers, advisors, policy makers and society.

The method published by Melzer et al. (2023) consists of three main steps: i) preprocessing geodata at the watershed level for the erosion model InVEST SDR (Natural Capital Project 2024) ii) calculating an erosion raster by InVEST SDR, iii) identifying hotspots based on the InVEST SDR output “sed_export.tif”.

The high resolution of input data, in particular a digital elevation model (DEM) based on a 1x1 meter grid, places high demands on computing power. Analysis on large areas (federal states or nations) are requiring a division of calculations into smaller catchment areas. Given the high amount of processing steps, automation is mandatory. In addition, automation enables the rapid recalculation of outputs, e.g. to map land use scenarios or actual changes by time. The three presented steps where thus completely automated in python to calculate 1x1 meter resolution raster datasets and respective sharply delineated hotspots (vector data) for individual watersheds. The automation was adapted to datasets available in the federal state of Bavaria (south Germany) but allows nation-wide calculations (for Germany and other countries with similar data availability).

In this user guide the necessary data inputs and configurations to run the software are described.

Table of contents

1. Required Input data

Note: All input data must have the same spatial reference system! The python code of the software is adapted to **field names** and **data types** of input data related to the federal state of Bavaria (see attachments for details). Instead of modifying the python code to fit field names of data provided by other regions, it is easier to change the field names to the given ones.

1.1. Watersheds

A shape file (.shp) including the boundaries of one or several watersheds and an attribute field denoted "expl_num" where each watershed is assigned an ID. By running the software, the user is asked to insert IDs to select the watersheds to be analyzed. The current software is adapted to a dataset (Attachment, Table 2) provided by the Bavarian State Office for Environment (Bayerisches Landesamt für Umwelt).

1.2. Digital elevation model (DEM)

A raster of 1 meter resolution was used including elevation values describing the terrain. The DEM1 dataset was provided separated in .asc tile files by the Bavarian Agency for Digitisation, High-Speed Internet and Surveying (Landesamt für Digitalisierung, Breitband und Vermessung). The file names (e.g. 497_5542.asc) refer to the coordinate of the left-bottom corner of each tile. The file names are used by the EROSPOT software to select all files of the extend of a watershed that is analyzed to merge them.

Note: the file name of other datasets (e.g. of Brandenburg) could also refer to the central coordinate of a tile or another corner. In those cases, the DEM selection tool of the EROSPOT software needs to be adapted respectively.

1.3. Land use/land cover (LULC) from ATKIS and IACS (waterbodies, sealed areas and C-factors)

Two sources of data ("ATKIS Basis DLM" and "IACS") are used by the software to create LULC maps. The ATKIS (Amtliches Topographisch-Kartographisches Informationssystem; en.: Administrative Topographic-Cartographic Information System provided by the Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (AdV)) includes several shape files (.shp) about LULC such as streets, settlements, waterbodies, forests and agricultural land (Attachment, Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12). It is used by the software to create a raster of waterbodies that defines the endpoints of erosion and to create a map of sealed areas (used to modify the soil erodibility map, Chapter 3), both considered by the erosion model. The IACS (Integrated Administration and Control System) of the European Union includes the information about annual main crops of individual fields (Attachment, Table 13, Table 14). It was provided by the Bavarian State Research Center for Agriculture (Bayerische Landesanstalt für Landwirtschaft, LfL). Several years of data are combined by the software to calculate specific soil cover values of crop rotations related to the C-factor of the Revised Universal Soil Loss Equation (RUSLE).

1.4. Soil characteristics (Soil erodibility, K-factor)

A raster including information about the soil erodibility related to the K-factor of the Revised Universal Soil Loss Equation (RUSLE). In Bavaria, a dataset with a resolution of 5 meter was provided by the Bavarian State research center for Agriculture on request). The unit of raster values must fit the unit used by the InVEST Model: t · h · ha / (ha · MJ · mm).

1.5. Precipitation (Rain erosivity, R-factor)

A raster including information about the erosivity, the R-factor of the Revised Universal Soil Loss Equation (RUSLE). In Germany, a dataset with a resolution of 100 meter (Auerswald et al. 2019) is available. The unit of raster values must fit the unit used by the InVEST Model: MJ · mm/(h · ha · year).

1.6. Summable C-factors of LULC classes and crop types (C-factor)

A table includes all LULC classes of ATKIS and all crop types identified for the federal state of Bavaria, respective summable C-factors derived from Auerswald et al. (2021) and additional estimates (Attachment, Table 15).

2. Setting up the environment to run the software

Two different environments having separate dependencies are used by the software. The preprocessing model for the input data to be fed into the InVEST Model, as well as the hotspot analysis using the outputs of InVEST, are dependent on arcpy (the python library for ArcGIS) to run. The InVEST model itself is dependent on the GDAL and the natcap.invest packages. The easiest way to solve this is to write an integrated script in python, inside a conda virtual environment that has both the ArcGIS and the natcap packages installed. This virtual environment can be set up in Pycharm for the code to run.

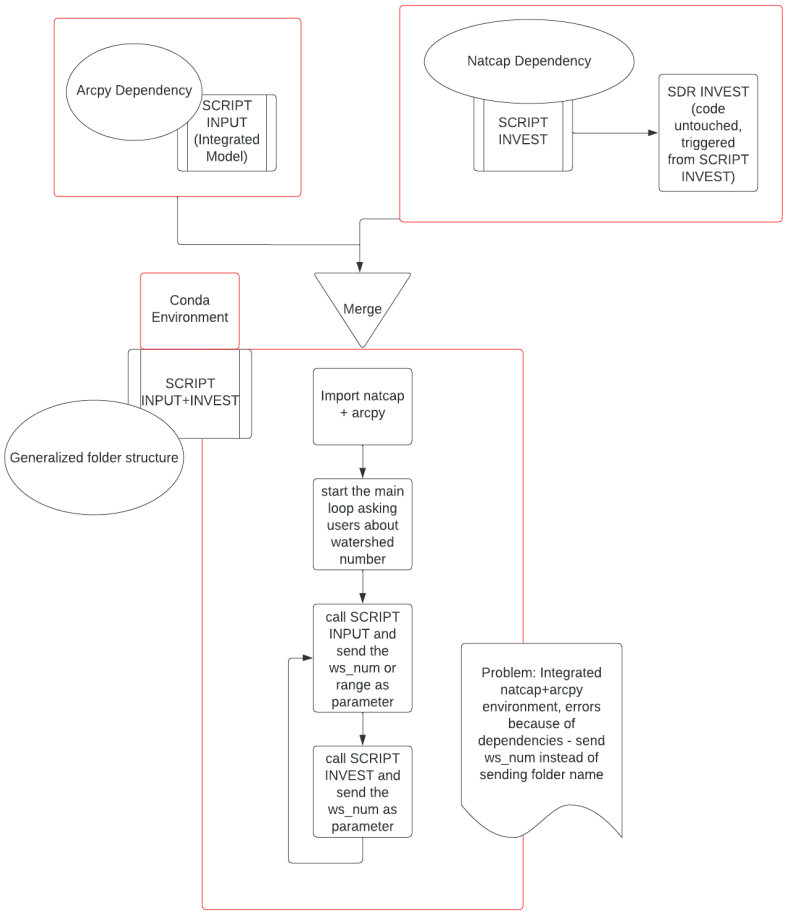

Figure 1: Initial Workflow to consolidate Arcpy dependencies and natcap packages into a single integrated Conda environment, where all dependencies are installed.

The environment and software run was tested successfully on different hardware with the following software setting (Table 1):

Table 1 Required software and tested versions.

Software	Version tested
Windows 10 / 11 (tested in both)	22H2 / 23H2
Pycharm Community	Runtime version: 17.0.5+1-b653.23 amd64, 11.0.14.1+1-b2043.25 amd64
C++ Visual Studio	2019
ArcGIS Pro (advanced license)	3.0, 3.1
Python	3.9
Anaconda3	3.9
GDAL	3.4.2
InVEST (natcap.invest)	3.11
arcpy	3.0, 3.1 (same as ArcGIS)

2.1. Creating a conda environment with ArcGIS and natcap.invest:

Important! Keep the order of steps. GDAL must be installed through conda forge, version 3.4.2 or higher first, then InVEST! Admin rights are required for installation.

2.1.1. Prioritized Workflow

1. Install ArcGIS Pro, Anaconda, etc., with the correct version and active license.
2. Go to where the ArcGIS Python library is installed on your computer. Usually the path is: "C:/ProgramFiles/ArcGIS/Pro/bin /Python/envs/arcgispro-py3".Then copy the arcgis python environment (the whole folder with the name 'arcgispro-py3')
3. Navigate to the Anaconda3 folder, and paste the arcgispro-py3 folder in the environment folder. The path is usually: C:/Users/UserName/Anaconda3/envs. Rename the pasted folder to 'arcgis-invest' and you will now see this folder as an environment in the anaconda GUI.
4. Click on the play button next to it and open the terminal associated with this environment.
5. Install GDAL with the following command in the terminal: conda install -y -c conda-forge gdal=3.4.2 (This can takes several minutes to start!)
6. Install Invest 3.12 with the command: pip install natcap.invest==3.12 (Also in the terminal, see also detailed documentation: https://invest.readthedocs.io/en/latest/installing.html)
7. Once all of the above packages are installed, open the python terminal associated with the environment and try out the import statements for both, type: import arcpy and wait for the ">>>" in the next line, then type: import natcap.invest and wait for the ">>>" in the next line. This proofs that they work without errors and everything has been installed properly. If not, please try the alternative method.

2.1.2. Alternative Workflow I (if the previous environment does not work):

1. Install ArcGIS Pro, Anaconda, etc., with the correct version and active license.
2. Open Anaconda and go to environments
3. Click on the play button near the base (root) on the anaconda GUI and select 'Open with terminal'

4. Create an environment with python 3.9 or higher with the command in the terminal that is opened: conda create -y -c conda-forge -n arcgis-invest python=3.10
5. Activate the environment with the command: conda activate arcgis-invest
6. Install GDAL version 3.4.2 with the command: conda install -y -c conda-forge gdal=3.4.2
7. Install Invest 3.12 with the command: pip install natcap.invest=3.12
8. Install ArcGIS package with the command: conda install --name arcgis-invest -c esri arcgis
9. Install arcpy with the command: conda config --add channels esri, conda install arcpy

2.1.3. Alternative Workflow II

In case the first two workflows did not work: Please contact the authors to get support.

2.2. Setting up Pycharm with the created conda environment and python scripts

Set up Pycharm as instructed in the following steps:

1. Open PyCharm and create a project and name it EROSPOT
2. Press Ctrl+Alt+S to open settings and go to Project EROSPOT -> Python Interpreter
3. Click the Python Interpreter selector and choose Interpreter Settings. Click the Add Interpreter link next to the list of the available interpreters.
4. Select Add Local Interpreter.
5. In the left-hand pane of the Add Python Interpreter dialog, select Conda Environment.
6. In the tab, select 'Use existing environment' and select the correct virtual environment (In our case it is: 'arcgis-invest' from the drop down. Now, both imports for arcpy and natcap.invest should work. For a test, create a test.py file by right clicking on the 'venv' sub-folder inside the project (or directly to the project folder if 'venv' does not exist) and type:

```
import natcap.invest
import arcpy
```

7. If no red lines appear underneath these two lines of code (you can also try running this code by right clicking and selecting run current file), your environment has been set up.
8. Copy & paste the provided **Python scripts of the EROSPOT software** to the Pycharm Project.

2.3. Changing decimal settings of windows to US standard

InVEST uses the US decimal setting to interpret numbers such as 100,000,000.45. In **countries such as Germany** the comma and point notation is changed to e.g. 100.000.000,45. This leads to an error in interpreting and storing values to the "biophysical table" of InVEST SDR followed by an error in the model run. Use this workflow to check and change (from "." to "," and vice versa) the setting in Windows: Path (see steps in Figure 2): Windows-Settings/Time and Language/Region and Language/Additional date-, time-, region- settings/change number format/additional settings.

Note: These settings do also affect other programs such as excel! A restart of windows might be mandatory to apply settings.

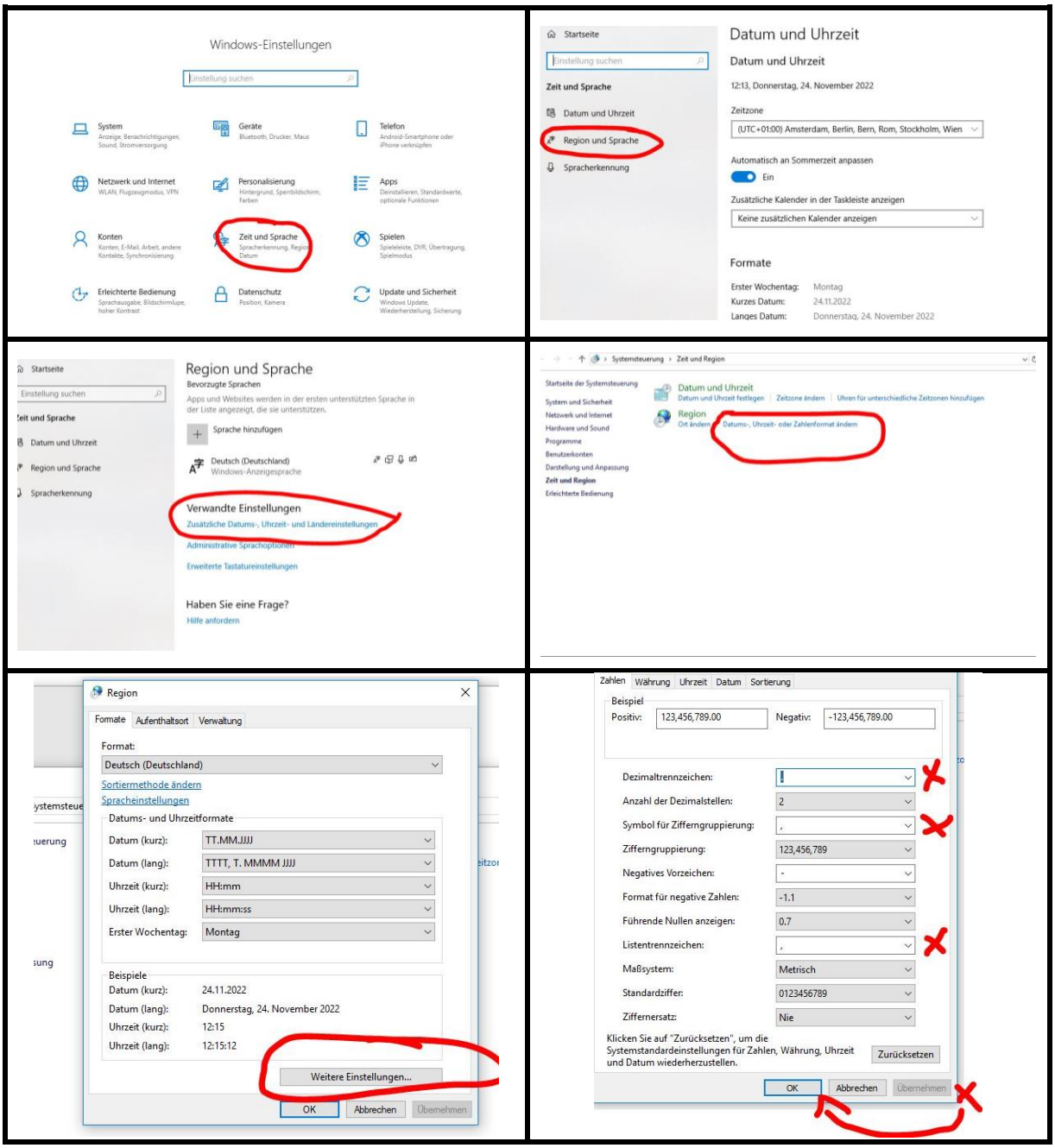

Figure 2 Workflow to change comma and point notation in windows systems.

2.4. Creating folders with data inputs and geodatabase (gdb)

The following structure of **folder paths**, **folder names** and **file names** is mandatory to run the software under the current Python code. **Note:** the Python code is adapted to file names (see below) of the federal state of Bavaria. Instead of modifying the python code to fit file names of other regions, it is easier to change the file names. Files must include the same information (field names and data types, see also Chapter 1:

1. Create an ArcGIS project called “EROSPOT” and import the watershed shape file and the table of summable C-values to the respective geodatabase of the project: “EROSPOT.gdb”. Set the watershed file name to “**ezg_by_erospot**” and the table of summable C-factors to “**sum_c_new”**) Make sure

that the watershed file includes the attribute field “expl_num” and that each watershed that should be analyzed is assigned an individual ID to that attribute field.

2. Create a main folder where inputs/outputs are stored, for example: “E:\ErospotWorkspace”. The folder path is denoted as “CentralFolderPath” in further descriptions and in the python scripts.
3. Move (cut & paste) the EROSPOT.gdb from the ArcGIS project folder to the CentralFolderPath
4. Paste the remaining input files inside the CentralFolderPath with the following structures and file names:

   CentralFolderPath/**ATKIS**/

   ver02_l
   ver01_l
   gew01_l
   veg01_f
   veg02_f
   sie02_f
   ver03_f
   ver01_f
   veg03_f
   gew01_f

   CentralFolderPath/**InVeKoS/**

   Nutzung_Aum_Bayern_2015
   Nutzung_Aum_Bayern_2016
   Nutzung_Aum_Bayern_2017
   Nutzung_Aum_Bayern_2018
   Nutzung_Aum_Bayern_2019

   CentralFolderPath/**K_Faktor_Bayern**/

   k_factor_komplett_bayern.tif

   CentralFolderPath/**R_Faktor_bayern/**

   r_factor_bayern.tif

   CentralFolderPath/**DGM1**/

   497_5542.asc
   497_5543.asc
   497_5544.asc
   497_5545.asc
   ...

5. Folders of intermediate and final outputs will automatically be created in the CentralFolderPath by the software including: “InputDataInvest”, “OutputdataInvest” and “Hotspots”. Intermediate outputs of the preprocessing and the hotspot analysis based on ArcGIS are stored in the EROSPOT.gdb. **Note:**

As the gdb was moved to the CentralFolderPath, the gdb path must be updated in the ArcGIS project to be accessible again.

2.5. Modifying the InVEST SDR python script

The InVEST SDR model calculates rain induced runoff paths and the course of permanent surface waterbodies based on a digital elevation model (DEM). Surface water bodies define the end points of sedimentation when soil relocation from farmland to water bodies is analyzed. The optional layer ‚drainage' can be integrated to the InVEST model to consider artificially drainage as points of sedimentation, not captured by the DEM analysis.

By a modification of the InVEST SDR Python code (sdr.py), the drainage layer can be used to completely replace the generated relief-based map of surface waterbodies. This approach was chosen as the ATKIS dataset provides information on current surface waterbodies, more accurate compared to the generated relief-based maps of the InVEST model. Especially in cases where the watercourse has been artificially altered and in the case of lakes or ponds, strong deviations between the ATKIS and the relief-based maps were observed.

The modification needs to be set by the following steps:

1. Open the folder "sdr" where sdr.py is stored in the conda environment. (You can search for sdr.py by opening the Pycharm project EROSPOT and search in the folder "External libraries"
2. Copy & paste sdr.py from that folder to the desktop (to avoid issues with admin rights)
3. Open the copy of sdr.py with a code editor/Pycharm. Search for lines:

```
def add_drainage_op(stream, drainage):
"""Add drainage mask to stream layer."""
return numpy.where(drainage == 1, 1, stream ")
```

4. Replace the red line with: `return drainage`
5. Save changes and paste the modified sdr.py to the folder of the original file to replace it. You may keep a copy of the original file as a backup.

2.6. Running the EROSPOT software in Pycharm:

1. Open the Pycharm project EROSPOT
2. Open the Python script EROSPOT.py
3. Set the paths for "CentralFolderPath" and "GDBPath" where the input data and EROSPOT.gdb files are stored, respectively (see Chapter 2.4). Make sure to use slash "/" (not backslash), example:

```
CentralFolderPath = "E:/ErospotWorkspace"
GDBPath = "E:/ErospotWorkspace/EROSPOT.gdb"
```

4. Save the EROSPOT.py file.
5. Run EROSPOT.py in Pycharm
6. Follow the prompt instructions: indicate the watersheds to be calculated by typing in the respective IDs.
7. After the program finished, check respective outputs in the CentralFolderPath.

3. Unsolved errors

1. A “DLL Error” occurs on some systems while running the software following the above workflows that could not be solved yet. See also similar documentation of the error: https://community.esri.com/t5/python-questions/dll-load-failed-while-importing-arcgisscripting/td-p/1266415
2. Most problems are related to gdal library which can only be solved individually for different versions. The workflows presented have been tested successfully by keeping the exact combination of versions and order of installations but might depend on additional dependencies of individual systems.

4. Attachment

Table 2 Field names and data types of the dataset "watersheds" provided by the Bavarian State Office for Environment. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
OBJECTID	OBJECTID	Object ID	False		10700
Shape	Shape	Geometry	True		Polygon
GEBKZ_K	GEBKZ_K	Text	True	20	188942
GEBKZ_06	GEBKZ_06	Text	True	20	188942
GEBKZ_S	GEBKZ_S	Long	True		6
GEWKZ_K	GEWKZ_K	Text	True	20	188942
VOLLST	VOLLST	Text	True	50	
KM2_BY	KM2_BY	Double	True		15,982
KM2	KM2	Double	True		15,982
EZG_AUSL	EZG_AUSL	Text	True	4	nein
KM2_SUM	KM2_SUM	Double	True		15,982
GEBBEZ	GEBBEZ	Text	True	254	
KM2_NBY	KM2_NBY	Double	True		0
Shape_Leng	Shape_Leng	Double	True		19217,06
expl_num	expl_num	Long	True		9
sq_km	sq_km	Long	True		16
sealed_area_ezg	sealed_area	Short	True		1
Shape_Length		Double	True		19230,4
Shape_Area		Double	True		16003941

Table 3 ATKIS dataset "ver02_l", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polyline
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	42008
OBJART_TXT		Text	False	50	AX_Fahrwegachse
OBJID		Text	False	16	DEBYBDLMCI0000aa
HDU_X		Short	False		0
BEGINN		Text	False	20	2018-11-27T15:31:20Z
ENDE		Text	False	20	
ART		Text	False	4	
BEF		Text	False	4	
BEZ		Text	False	60	
BRV		Short	False		6
FKT		Text	False	4	5211

MKG	Text	False	4
NAM	Text	False	60
STS	Text	False	20
ZNM	Text	False	60

Table 4 ATKIS dataset "ver01_l", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polyline
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	42003
OBJART_TXT		Text	False	50	AX_Strassenachse
OBJID		Text	False	16	DEBYBDLMCI0000el
HDU_X		Short	False		1
BEGINN		Text	False	20	2019-02-07T09:35:59Z
ENDE		Text	False	20	
OBJART_Z		Text	False	5	42002
OBJID_Z		Text	False	16	DEBYBDLMCI00004o
BDI		Text	False	4	
BDU		Text	False	4	1000
BEZ		Text	False	30	NES28
BFS		Text	False	4	
BRF		Float	False		5,5
BRV		Short	False		0
FKT		Text	False	4	
FSZ		Short	False		2
FTR		Text	False	4	
IBD		Text	False	4	
NAM		Text	False	60	
OFM		Text	False	4	
STS		Text	False	40	
WDM		Text	False	4	1306
ZNM		Text	False	60	
ZUS		Text	False	4	

Table 5 ATKIS dataset "gew01_l", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polyline

LAND	Text	False	3	BY
MODELLART	Text	False	20	Basis-DLM#DTK25
OBJART	Text	False	5	44004
OBJART_TXT	Text	False	50	AX_Gewaesserachse
OBJID	Text	False	16	DEBYBDLMCI0000za
HDU_X	Short	False		0
BEGINN	Text	False	20	2013-10-25T16:57:48Z
ENDE	Text	False	20	
OBJART_Z	Text	False	5	44002
OBJID_Z	Text	False	16	DEBYBDLMCI00000H
BRG	Short	False		3
FKT	Text	False	4	
FLR	Short	False		1
GWK	Text	False	20	2,44212E+18
HYD	Text	False	4	2000
IDN	Text	False	20	
NAM	Text	False	60	
SFK	Text	False	4	
WDM	Text	False	4	1340
ZNM	Text	False	60	
ZUS	Text	False	4	

Table 6 ATKIS dataset "veg01_f", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	43001
OBJART_TXT		Text	False	50	AX_Landwirtschaft
OBJID		Text	False	16	DEBYBDLMCI0001Kk
HDU_X		Short	False		0
BEGINN		Text	False	20	2018-11-27T15:31:20Z
ENDE		Text	False	20	
VEG		Text	False	4	1021

Table 7 ATKIS dataset "veg02_f", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon

LAND	Text	False	3	BY
MODELLART	Text	False	20	Basis-DLM#DTK25
OBJART	Text	False	5	43002
OBJART_TXT	Text	False	50	AX_Wald
OBJID	Text	False	16	DEBYBDLMCI0000sq
HDU_X	Short	False		0
BEGINN	Text	False	20	2018-11-27T15:31:20Z
ENDE	Text	False	20	
BEZ	Text	False	60	
NAM	Text	False	60	
VEG	Text	False	4	1100

Table 8 ATKIS dataset „sie02_f“, field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	41001
OBJART_TXT		Text	False	50	AX_Wohnbauflaeche
OBJID		Text	False	16	DEBYBDLMCI0001qa
HDU_X		Short	False		0
BEGINN		Text	False	20	2018-11-27T15:31:20Z
ENDE		Text	False	20	
AGT		Text	False	4	
BEB		Text	False	4	1000
BEZ		Text	False	60	
FGT		Text	False	4	
FKT		Text	False	4	
NAM		Text	False	100	
PEG		Text	False	4	
ZNM		Text	False	60	
ZUS		Text	False	4	

Table 9 ATKIS dataset “ver03_f”, field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25

OBJART	Text	False	5	42010
OBJART_TXT	Text	False	50	AX_Bahnverkehr
OBJID	Text	False	16	DEBYBDLMCI0000sI
HDU_X	Short	False		0
BEGINN	Text	False	20	2017-05-17T17:01:47Z
ENDE	Text	False	20	
FKT	Text	False	4	

Table 10 ATKIS dataset "ver01_f", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	42001
OBJART_TXT		Text	False	50	AX_Strassenverkehr
OBJID		Text	False	16	DEBYBDLMCI00028C
HDU_X		Short	False		0
BEGINN		Text	False	20	2017-11-30T10:17:46Z
ENDE		Text	False	20	
FKT		Text	False	4	2312
NAM		Text	False	60	
STS		Text	False	20	
ZNM		Text	False	60	

Table 11 ATKIS dataset "veg03_f", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	43003
OBJART_TXT		Text	False	50	AX_Gehoelz
OBJID		Text	False	16	DEBYBDLMCI0000yA
HDU_X		Short	False		0
BEGINN		Text	False	20	2019-02-07T09:35:59Z
ENDE		Text	False	20	
FKT		Text	False	4	
NAM		Text	False	60	

OFM	Text	False	4

Table 12 ATKIS dataset "gew01_f", field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		0
Shape		Geometry	False		Polygon
LAND		Text	False	3	BY
MODELLART		Text	False	20	Basis-DLM#DTK25
OBJART		Text	False	5	44006
OBJART_TXT		Text	False	50	AX_StehendesGewaesser
OBJID		Text	False	16	DEBYBDLMCl0001sb
HDU_X		Short	False		0
BEGINN		Text	False	20	2013-10-25T16:57:48Z
ENDE		Text	False	20	
OBJART_Z		Text	False	5	
OBJID_Z		Text	False	16	
BEZ		Text	False	60	
FKT		Text	False	4	
GWK		Text	False	20	
HYD		Text	False	4	
IDN		Text	False	20	
NAM		Text	False	60	
NTZ		Text	False	4	
SFK		Text	False	4	
TID		Text	False	4	
WDM		Text	False	4	1340
ZNM		Text	False	60	
ZUS		Text	False	4	

Table 13 IACS Bavaria 2015, field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		1234567
Shape		Geometry	False		Polygon
jahr		Long	False		2015
bnr_versch		Text	False	32	
feldstueck		Double	False		4
schlag		Text	False	2	1
nutz_code		Text	False	3	171
beschreibu		Text	False	90	Mais
flaeche		Float	False		2,8

flaeche_is	Float	False		2,8
oekologisc	Text	False	1	N
aum_code	Text	False	3	A33
aum_beschr	Text	False	90	Mulchsaat

Table 14 IACS Bavaria 2020, field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length	example
FID		Object ID	False		5
Shape		Geometry	False		Polygon
jahr		Long	False		2020
regb_name		Text	False	13	Oberbayern
regb_code		Text	False	1	1
lkr_name		Text	False	35	Ebersberg
lkr_code		Text	False	3	175
gem_name		Text	False	31	Oberpframmern
gem_code		Text	False	6	123123
gmkg_name		Text	False	30	Oberpframmern
gmkg_code		Text	False	4	8770
fid_		Text	False	16	DEBYLI123123123123
fs_nr		Long	False		6
schlag_nr		Text	False	1	1
oekol		Text	False	4	
nutz_code		Text	False	3	311
nutz_besch		Text	False	40	Winterraps
code_statu		Text	False	5	AL
fl_nutz		Double	False		0,87
fl_dif_ant		Double	False		0
gps		Long	False		0
bejag_schn		Long	False		0
hanf_zf		Long	False		0
ep_anlage		Long	False		0
honigbr_aj		Long	False		0
kup_jahr		Long	False		0
gl_vorschl		Long	False		0
gl_z_manue		Long	False		0
kup_letzt		Long	False		0
antrag		Text	False	1	B
SHAPE_Leng		Double	False		490,563327
SHAPE_Area		Double	False		8728,12878

Table 15 Table of summable C-values. This table needs to be imported to the EROSPOT.gdb as "sum_c_new". See also related field names and data types (Table 16).

OBJECTID	beschr_inv ekos	nu_code_inv ekos	aum_code_in vekos	aum_beschr_in vekos	cultur_code_i nvekos	obart_nu_code_atkis	obart_beschr_atkis	VEG_nu_code_atkis	VEG_beschr_atkis	sod_crop_au21	Summable_exist_au21	summable_c_au21	c_value_hessen	combi_code	sum_c
1	Tomaten	622	XXX		K54						0		0	622XXX	1
2						75005	AX_Gebiet_Bundesland		na					75005	1
3						75007	AX_Gebiet_Kreis		na					75007	1
4						75006	AX_Gebiet_Regierungsbezirk		na					75006	1
5						75003	AX_KommunalesGebiet		na					75003	1
6						75009	AX_Gebietsgrenze		na					75009	1
7						71006	AX_NaturUmweltOderBodenschutzrecht		na					71006	1
8						44001	AX_Fliessgewaesser		na					44001	1
9						44006	AX_StehendesGewaesser		na					44006	1
10						44004	AX_Gewaesserachse		na					44004	1
11						55001	AX_Gewaessermerkmal		na					55001	1
12						57001	AX_Wasserspiegelhoehe		na					57001	1
13						57003	AX_Gewaesserstationierungsachse		na					57003	1
14						61003	AX_DammWallDeich		na					61003	1
15						52001	AX_Ortslage		na					52001	1
16						41007	AX_FlaecheBesondererFunktionalerPraegung		na					41007	1
17						41006	AX_FlaecheGemischterNutzung		na					41006	1
18						41009	AX_Friedhof		na					41009	1
19						41002	AX_IndustrieUndGewerbeflaeche		na					41002	1
20						41008	AX_SportFreizeitUndErholungsflaeche		na					41008	1
21						41005	AX_TagebauGrubeSteinbruch		na					41005	1
22						41001	AX_Wohnbauflaeche		na					41001	1
23						51002	AX_BauwerkOderAnlageFuerIndustrieUndGewerbe		na					51002	1
24						51006	AX_BauwerkOderAnlageFuerSportFreizeitUndErholung		na					51006	1
25						51006	AX_BauwerkOderAnlageFuerSportFreizeitUndErholung		na					51006	1
26						51005	AX_Leitung		na					51005	1
27						51009	AX_SonstigesBauwerkOderSonstigeEinrichtung		na					51009	1
28						51002	AX_BauwerkOderAnlageFuerIndustrieUndGewerbe		na					51002	1
29						51007	AX_HistorischesBauwerkOderHistorischeEinrichtung		na					51007	1
30						51009	AX_SonstigesBauwerkOderSonstigeEinrichtung		na					51009	1
31						51003	AX_VorratsbehaelterSpeicherbauwerk		na					51003	1
32						51001	AX_Turm		na					51001	1
33						43001	AX_Landwirtschaft		na					43001	0,4
34						43002	AX_Wald		na					43002	0,001
35						43003	AX_Gehoelz		na					43003	0,001
36						43005	AX_Moor		na					43005	0,001
37						43006	AX_Sumpf		na					43006	0,001
38						43007	AX_UnlandVegetationsloseFlaeche		na					43007	0,5
39						54001	AX_Vegetationsmerkmal		na					54001	0,001
40						54001	AX_Vegetationsmerkmal		na					54001	0,001

41					54001	AX_Vegetationsmerkmal	na				54001	0,001
42					42009	AX_Platz	na				42009	1
43					42001	AX_Strassenverkehr	na				42001	1
44					42005	AX_Fahrbahnachse	na				42005	1
45					42003	AX_Strassenachse	na				42003	1
46					42008	AX_Fahrwegachse	na				42008	1
47					53003	AX_WegPfadSteig	na				53003	1
48					42010	AX_Bahnverkehr	na				42010	1
49					42014	AX_Bahnstrecke	na				42014	1
50					53006	AX_Gleis	na				53006	1
51					53004	AX_Bahnverkehrsanlage	na				53004	1
52					53009	AX_BauwerkImGewaesserbereich	na				53009	1
53					53001	AX_BauwerkImVerkehrsbereich	na				53001	1
54					53009	AX_BauwerkImGewaesserbereich	na				53009	1
55					53001	AX_BauwerkImVerkehrsbereich	na				53001	1
56					53002	AX_Strassenverkehrsanlage	na				53002	1
57					53004	AX_Bahnverkehrsanlage	na				53004	1
58					53009	AX_BauwerkImGewaesserbereich	na				53009	1
59					53002	AX_Strassenverkehrsanlage	na				53002	1
60	Chinaschilf (Miscanthus)	852	XXX					0	0,004	852XXX	0,004	
61	Chinaschilf (Miscanthus) (ÖVF)	063	XXX					0	0,004	063XXX	0,004	
62	Grünbrache im ökologischen Landbau (Hauptfutterfläche)	941	XXX	K41				0	0,004	941XXX	0,004	
63	Hutungen (Futternutzung)	454	XXX					0	0,004	454XXX	0,004	
64	Naturschutzflächen (keine landwirtschaftliche Verwertung)	958	XXX					0	0,004	958XXX	0,004	
65	Nicht bewirtschaftete Teichflächen	940	XXX					0	0,004	940XXX	0,004	
66	Nicht landwirtschaftliche Fläche aufgrund Maßnahme gem. Natura 2000 oder Wasserrahmenrichtlinie (Art. 32 2b (i) VO(EU) Nr. 1307/2013)	583	XXX					0	0,004	583XXX	0,004	
67	Pampasgräser (Amerikanisches Pampasgras)	760	XXX	K170				0	0,004	760XXX	0,004	
68	Pufferstreifen und Feldrand auf Dauergrünland (ÖVF)	057	XXX					0	0,004	057XXX	0,004	
69	Pufferstreifen und Feldrand auf Ackerland (ÖVF)	058	XXX	K40				0	0,004	058XXX	0,004	
70	Sida (Virginiamalve)	804	XXX					0	0,004	804XXX	0,004	
71	Silphium (Durchwachsene Silphie)	802	XXX					0	0,004	802XXX	0,004	
72	Silphium (Durchwachsene	064	XXX					0	0,004	064XXX	0,004	

	Silphie) (ÖVF)														
73	Stillgelegte Dauergrünlandflächen nach FELEG	546	XXX								0		0,004	546XXX	0,004
74	Stillgelegte Dauergrünlandflächen i. R. von AUM	567	XXX								0		0,004	567XXX	0,004
75	Wechselgrünland	428	XXX		K36						0		0,004	428XXX	0,004
76						43001	AX_Landwirtschaft	1020	Grünland				0,004	43001020	0,004
77						43001	AX_Landwirtschaft	1021	Streuobstwiese				0,004	43001021	0,004
78						43001	AX_Landwirtschaft	1022	Salzweide				0,004	43001022	0,004
79						43001	AX_Landwirtschaft	1100	Kurzumtriebsplantage				0,004	43001100	0,004
80	Baumschulen (nicht für Beerenobst)	838	XXX								0		0,03	838XXX	0,03
81	Beerenobst, z. B. Johannis-, Stachel-, Heidel- und Himbeeren	827	XXX								0		0,03	827XXX	0,03
82	Haselnüsse	833	XXX								0		0,03	833XXX	0,03
83	Kernobst z.B. Äpfel, Birnen	825	XXX								0		0,03	825XXX	0,03
84	Sonstige Dauerkulturen	850	XXX								0		0,03	850XXX	0,03
85	Sonstige Obstanlagen (z. B. Holunder, Sanddorn)	829	XXX								0		0,03	829XXX	0,03
86	Sonstige Schalenfrüchte	835	XXX								0		0,03	835XXX	0,03
87	Steinobst, z. B. Kirschen, Pflaumen	826	XXX								0		0,03	826XXX	0,03
88	Walnüsse	834	XXX								0		0,03	834XXX	0,03
89						43001	AX_Landwirtschaft	1011	Streuobstacker				0,03	43001011	0,03
90						43001	AX_Landwirtschaft	1031	Baumschule				0,03	43001031	0,03
91						43001	AX_Landwirtschaft	1050	Obst- und Nussplantage				0,03	43001050	0,03
92						43001	AX_Landwirtschaft	1051	Obst- und Nussbaumplantage				0,03	43001051	0,03
93						43001	AX_Landwirtschaft	1052	Obst- und Nussstrauchplantage				0,03	43001052	0,03
94						43001	AX_Landwirtschaft	1060	Weihnachtsbaumkultur				0,03	43001060	0,03
95	Sonnenblumen (GPS)	320	B38	Streifen-/Direktsaatverfahren	K29						1	0,04		320B38	0,04
96	GPS Sonnenblumen	493	XXX								1	0,04		493XXX	0,04
97	Körnermais	171	B38	Streifen-/Direktsaatverfahren	K11						1	0,048	0,35	171B38	0,048
98	Silomais	411	B38	Streifen-/Direktsaatverfahren	K11						1	0,05	0,35	411B38	0,05
99	Zuckerrüben	603	B38	Streifen-/Direktsaatverfahren	K35						1	0,051	0,32	603B38	0,051
100	Winterdinkel (GPS)	114	XXX		K197						0		0,07	114XXX	0,07
101	Winterdurum (Hartweizen) (GPS)	112	XXX		K1						0		0,07	112XXX	0,07
102	Wintergerste (GPS)	131	XXX		K5						1	0,07		131XXX	0,07
103	Winterhafer (GPS)	142	XXX		K7						1	0,07		142XXX	0,07

104	GPS Wintergerste	476	XXX							1	0,07		476XXX	0,07
105					43001	AX_Landwirtschaft	1014	Hanf				0,07	430011014	0,07
106	Winteremmer, Wintereinkorn (GPS)	118	XXX	K1						1	0,071		118XXX	0,071
107	Winterroggen, Winter-Waldstaudenroggen (GPS)	121	XXX	K3						1	0,071		121XXX	0,071
108	GPS Winterroggen	472	XXX							1	0,071		472XXX	0,071
109	Wintermenggetreide mit Weizen (GPS)	125	XXX	K41						1	0,073		125XXX	0,073
110	Wintermenggetreide ohne Weizen (GPS)	126	XXX	K41						1	0,073		126XXX	0,073
111	Wintertriticale (GPS)	156	XXX	K9						1	0,073		156XXX	0,073
112	GPS Wintermenggetreide mit Weizen	474	XXX							1	0,073		474XXX	0,073
113	GPS Wintermenggetreide ohne Weizen	475	XXX							1	0,073		475XXX	0,073
114	GPS Wintertriticale	481	XXX							1	0,073		481XXX	0,073
115	Sommergerste (GPS)	132	XXX	K6						1	0,076		132XXX	0,076
116	GPS Sommergerste	477	XXX							1	0,076		477XXX	0,076
117	Brauner Senf (Brauner Senf/ Sareptasenf)	614	XXX	K46						1	0,085		614XXX	0,085
118	Färberdistel	708	XXX	K126						1	0,085		708XXX	0,085
119	Krambe, Echter Meerkohl	392	XXX	K33						1	0,085		392XXX	0,085
120	Leindotter	393	XXX	K34						1	0,085		393XXX	0,085
121	Schwarzer Senf	612	XXX	K202						1	0,085		612XXX	0,085
122	Topinambur	604	XXX	K29						1	0,085	0,004	604XXX	0,085
123	Weißer Senf; Gelber Senf	619	XXX	K51						1	0,085		619XXX	0,085
124	Winterweizen (Weichweizen) (GPS)	115	XXX	K1						1	0,085		115XXX	0,085
125	GPS Winterweichweizen	470	XXX							1	0,085		470XXX	0,085
126	Sommerraps (GPS)	312	XXX	K26						1	0,087		312XXX	0,087
127	Winterraps (GPS)	311	XXX	K25						1	0,087		311XXX	0,087
128	Winterrübsen (GPS)	315	XXX	K27						1	0,087		315XXX	0,087
129	GPS Winterraps	489	XXX							1	0,087		489XXX	0,087
130	GPS Sommerraps	490	XXX							1	0,087		490XXX	0,087
131	GPS Winterrübsen	491	XXX							1	0,087		491XXX	0,087
132	Riesenweizengras (Szarvasigras)	853	XXX							0		0,1	853XXX	0,1
133	Sommerrübsen (GPS)	316	XXX	K28						0		0,1	316XXX	0,1
134	GPS Sommerrübsen	492	XXX							0		0,1	492XXX	0,1
135	Öllein, Faserflachs	341	XXX	K31						1	0,105		341XXX	0,105
136	Sommerdinkel (GPS)	120	XXX	K198						1	0,116		120XXX	0,116

137	Sommerdurum (Hartweizen) (GPS)	113	XXX		K2							1	0,116		113XXX	0,116
138	Sommeremmer, Sommereinkorn (GPS)	119	XXX		K2							1	0,116		119XXX	0,116
139	Sommermenggetreide mit Weizen (GPS)	144	XXX		K41							1	0,116		144XXX	0,116
140	Sommermenggetreide ohne Weizen (GPS)	145	XXX		K41							1	0,116		145XXX	0,116
141	Sommerroggen, Sommer-Waldstaudenroggen (GPS)	122	XXX		K4							1	0,116		122XXX	0,116
142	Sommertriticale (GPS)	157	XXX		K10							1	0,116		157XXX	0,116
143	Sommerweizen (Weichweizen) (GPS)	116	XXX		K2							1	0,116		116XXX	0,116
144	GPS Sommerweichweizen	471	XXX									1	0,116		471XXX	0,116
145	GPS Sommerroggen	473	XXX									1	0,116		473XXX	0,116
146	GPS Sommermenggetreide mit Weizen	479	XXX									1	0,116		479XXX	0,116
147	GPS Sommermenggetreide ohne Weizen	480	XXX									1	0,116		480XXX	0,116
148	GPS Sommertriticale	482	XXX									1	0,116		482XXX	0,116
149	Hanf	701	XXX		K119							1	0,117	0,07	701XXX	0,117
150	Sommerhafer (GPS)	143	XXX		K8							1	0,117		143XXX	0,117
151	GPS Sommerhafer	478	XXX									1	0,117		478XXX	0,117
152	Zuckerrüben	603	A33	Mulchsaat	K35							1	0,119	0,32	603A33	0,119
153	Zuckerrüben	603	B37	Mulchsaatverfahren	K35							1	0,119	0,32	603B37	0,119
154	Aufgeforstete Acker-/Grünlandflächen nach Art. 32 VO(EU) 1307/2013	564	XXX									0		0,13	564XXX	0,13
155	Aufgeforstete Acker-/Grünlandflächen nach Art. 32 VO(EU) 1307/2013 (ÖVF)	061	XXX									0		0,13	061XXX	0,13
156	Niederwald mit Kurzumtrieb – KUP (ÖVF)	059	XXX									0		0,13	059XXX	0,13
157	Niederwald mit Kurzumtrieb (KUP)	841	XXX									0		0,13	841XXX	0,13
158						43002	AX_Wald	1100	Laubholz					0,13	430021100	0,001
159						43002	AX_Wald	1200	Nadelholz					0,13	430021200	0,001
160						43002	AX_Wald	1300	Laub- und Nadelholz					0,13	430021300	0,001
161	Färber-Waid	703	XXX		K121							0		0,14	703XXX	0,14
162	Kleinparzellen auf Ackerland	914	XXX		K41							0		0,14	914XXX	0,14
163	Knorpelmöhren (Bischofskraut)	728	XXX		K136							0		0,14	728XXX	0,14
164	Königskerzen (Großblütige Königskerze)	764	XXX		K174							0		0,14	764XXX	0,14

165	Kornblumen	775	XXX		K185	0		0,14	775XXX	0,14
166	Reis im Trockenanbau (GPS)	188	XXX		K201	0		0,14	188XXX	0,14
167	Rollrasen, Vegetationsmappen für Dachbegrünung	702	XXX		K41	0		0,14	702XXX	0,14
168	Erbsen (ÖVF, GPS)	210	XXX		K18	1	0,141		210XXX	0,141
169	Gemenge Erbsen/Bohnen (ÖVF)	240	XXX		K41	1	0,141		240XXX	0,141
170	Linsen (Speiselinse) (ÖVF)	292	XXX		K22	1	0,141		292XXX	0,141
171	GPS Erbsen (ÖVF)	486	XXX			1	0,141		486XXX	0,141
172	Koriander	657	XXX		K89	1	0,145		657XXX	0,145
173	Rispenhirse (Panicum) Rutenhirse (GPS)	181	XXX		K12	1	0,145		181XXX	0,145
174	GPS Hirse	483	XXX			1	0,145		483XXX	0,145
175	Sorghumhirse (Körnersorghum) (GPS)	183	XXX		K37	1	0,148		183XXX	0,148
176	GPS Körnersorghum	484	XXX			1	0,148		484XXX	0,148
177	Körnermais	171	A33	Mulchsaat	K11	1	0,156	0,35	171A33	0,156
178	Körnermais	171	B37	Mulchsaatverfahren	K11	1	0,156	0,35	171B37	0,156
179	Mohn (Schlaf-, Back-, Klatschmohn)	706	XXX		K124	1	0,165		706XXX	0,165
180	Ringelblumen (Garten-Ringelblume)	674	XXX		K106	1	0,165		674XXX	0,165
181	Silomais	411	A33	Mulchsaat	K11	1	0,166	0,35	411A33	0,166
182	Silomais	411	B37	Mulchsaatverfahren	K11	1	0,166	0,35	411B37	0,166
183	Brennnessel (Gr. Brennnessel)	709	XXX		K127	0		0,17	709XXX	0,17
184	Ackerbohnen (ÖVF, GPS)	220	XXX		K19	1	0,178		220XXX	0,178
185	GPS Ackerbohnen (ÖVF)	487	XXX			1	0,178		487XXX	0,178
186	Kohl-, Steckrüben	414	XXX		K26	1	0,181		414XXX	0,181
187	Runkelrübe, Futterrübe	413	XXX		K35	1	0,181		413XXX	0,181
188	Zuckerrüben	603	XXX		K35	1	0,181	0,32	603XXX	0,181
189	Lupinen (ÖVF, GPS)	230	XXX		K20	1	0,185		230XXX	0,185
190	GPS Lupinen (ÖVF)	488	XXX			1	0,185		488XXX	0,185
191	Buchweizen (GPS)	182	XXX		K13	1	0,189		182XXX	0,189
192	Artischocke	861	XXX			0		0,2	861XXX	0,2
193	Basilikum	660	XXX		K92	0		0,2	660XXX	0,2
194	Brunnenkresse	615	XXX		K47	0		0,2	615XXX	0,2
195	Johanniskräuter (Echtes Johanniskraut)	680	XXX		K112	0		0,2	680XXX	0,2
196	Kapuzinerkressen (Große Kapuzinerkresse)	765	XXX		K175	0		0,2	765XXX	0,2
197	Kerbel (Kerbel/echter Kerbel, Wiesenkerbel)	652	XXX		K84	0		0,2	652XXX	0,2
198	Melissen (Zitronenmelisse)	670	XXX		K102	0		0,2	670XXX	0,2

199	Minzen (Pfefferminze, Grüne Minze)	672	XXX	K104	0		0,2	672XXX	0,2
200	Sammelcode Küchenkräuter	650	XXX	K82	0		0,2	650XXX	0,2
201	Sammelcode Samenvermehrung von Wildkräutern	690	XXX	K41	0		0,2	690XXX	0,2
202	Taubnesseln (Weiße Taubnessel)	744	XXX	K152	0		0,2	744XXX	0,2
203	Petroselinum (Petersilie)	659	XXX	K91	1	0,205	0,3	659XXX	0,205
204	Gartenkürbis (Cucurbita pepo) (Gartenkürbis, Steirischer Kürbis, Zucchini, Spaghettikürbis, Zierkürbis)	630	XXX	K62	1	0,225		630XXX	0,225
205	Riesenkürbis (Riesenkürbis, Hokkaidokürbis)	629	XXX	K61	1	0,225	0,24	629XXX	0,225
206	Sammelcode Gemüse-Kürbisgewächse	626	XXX	K58	1	0,225		626XXX	0,225
207	Sudangras	803	XXX	K37	1	0,225	0,35	803XXX	0,225
208	Auberginen	623	XXX	K55	0		0,24	623XXX	0,24
209	Bohnenkräuter	665	XXX	K97	0		0,24	665XXX	0,24
210	Borretsch	663	XXX	K95	0		0,24	663XXX	0,24
211	Feldsalate (Feldsalat/Ackersalat/ Rapunzel)	636	XXX	K68	0		0,24	636XXX	0,24
212	Gartenrettiche (Weiße/Rote Rettiche, Ölrettich, Radieschen)	618	XXX	K50	0		0,24	618XXX	0,24
213	Gemüsekohl (Kopfkohl, Wirsing, Rot-/Weißkohl, Spitzkohl, Grünkohl, Kohlrabi, Markstammkohl, Blumenkohl, Romanesco, Brokkoli, Rosenkohl, Zierkohl)	613	XXX	K45	0		0,24	613XXX	0,24
214	Lattich (Garten-Salat/Lattich, Lollo Rosso, Romana-Salat/Römischer Salat)	637	XXX	K69	0		0,24	637XXX	0,24
215	Löwenzahn	684	XXX	K116	0		0,24	684XXX	0,24
216	Mangold, Rote Beete/Rote Rübe	639	XXX	K35	0		0,24	639XXX	0,24
217	Meerrettich	646	XXX	K78	0		0,24	646XXX	0,24
218	Melone (Citrullus, Wassermelone)	631	XXX	K63	0		0,24	631XXX	0,24
219	Pastinaken	643	XXX	K75	0		0,24	643XXX	0,24
220	Rodiola (Rosenwurz)	751	XXX	K159	0		0,24	751XXX	0,24
221	Sammelcode Andere Gemüsearten – auch zur Samenvermehrung	632	XXX	K64	0		0,24	632XXX	0,24
222	Sammelcode Gemüse	610	XXX	K42	0		0,24	610XXX	0,24
223	Sammelcode Gemüse-	621	XXX	K53	0		0,24	621XXX	0,24

	Nachtschattengewächse								
224	Sammelcode Gemüse-Kreuzblütler	611	XXX	K43	0		0,24	611XXX	0,24
225	Sellerie (Knollen-Sellerie, Bleich-Sellerie, Stangen-Sellerie)	641	XXX	K73	0		0,24	641XXX	0,24
226	Senfrauke (Garten-Senfrauke, Rucola)	616	XXX	K48	0		0,24	616XXX	0,24
227	Spinat	638	XXX	K70	0		0,24	638XXX	0,24
228	Virginischer Tabak	705	XXX	K123	0		0,24	705XXX	0,24
229	Zuckermelone (Cucumis melo)	628	XXX	K60	0		0,24	628XXX	0,24
230	Sojabohnen (ÖVF, GPS)	330	XXX	K30	1	0,241		330XXX	0,241
231	GPS Sojabohnen (ÖVF)	494	XXX		1	0,241		494XXX	0,241
232	Amarant (Fuchsschwanz) (GPS)	186	XXX	K14	1	0,245		186XXX	0,245
233	Körnermais	171	XXX	K11	1	0,245	0,35	171XXX	0,245
234	Silomais	411	XXX	K11	1	0,252	0,35	411XXX	0,252
235	Gemenge mit Silomais	412	XXX	K41	1	0,261		412XXX	0,261
236	Sonnenblumen (GPS)	320	XXX	K29	1	0,261		320XXX	0,261
237	Möhre (Möhre/Karotte, Futtermöhre)	634	XXX	K66	1	0,265		634XXX	0,265
238	Zichorien/Wegwarten (Chicoree, Radicchio, krausblättrige Endivie, ganzblättrige Endivie, Zichorie)	644	XXX	K76	1	0,265		644XXX	0,265
239	Erdbeeren	707	XXX	K125	0		0,29	707XXX	0,29
240	Spargel	860	XXX		0		0,29	860XXX	0,29
241	Brache mit Einsaat von einjährigen Blühmischungen	590	XXX	K40	0		0,3	590XXX	0,3
242	Brache mit Honigpflanzen – einjährig (ÖVF)	065	XXX	K40	0		0,3	065XXX	0,3
243	Brache mit Honigpflanzen – mehrjährig (ÖVF)	066	XXX	K40	0		0,3	066XXX	0,3
244	Energieblühmischungen ohne Hanf	871	XXX	K41	0		0,3	871XXX	0,3
245	Energiepflanzen im Mischanbau	870	XXX	K41	0		0,3	870XXX	0,3
246	Esparsette, Serradella kleinkörnig (ÖVF)	430	XXX	K192	0		0,3	430XXX	0,3
247	Gemenge Leguminosen mit Stützfrucht (ÖVF, GPS)	250	XXX	K41	0		0,3	250XXX	0,3
248	Iberischer Drachenkopf	512	XXX	K203	0		0,3	512XXX	0,3
249	Kichererbsen	645	XXX	K77	0		0,3	645XXX	0,3
250	Pflanzenmischung mit Hanf	866	XXX	K41	0		0,3	866XXX	0,3
251	Phacelia zur Samenvermehrung	777	XXX	K187	0		0,3	777XXX	0,3
252	Ramtillkraut	798	XXX	K195	0		0,3	798XXX	0,3
253	Wicken (ÖVF)	221	XXX	K189	0		0,3	221XXX	0,3

254	GPS Gemenge Körnerleguminosen/Getreide	485	XXX							0		0,3	485XXX	0,3
255	Fenchel (Gemüsefenchel/Körnerfenchel)	648	XXX	K80						1	0,305		648XXX	0,305
256	Bestockte Rebfläche	843	XXX							0		0,31	843XXX	0,31
257	Hopfen	856	XXX							0		0,31	856XXX	0,31
258	Rebschule	845	XXX							0		0,31	845XXX	0,31
259	Tafeltrauben	848	XXX							0		0,31	848XXX	0,31
260	Unbestockte Rebflächen	844	XXX	K40						0		0,31	844XXX	0,31
261					43001	AX_Landwirtschaft	1012	Hopfen				0,31	430011012	0,31
262					43001	AX_Landwirtschaft	1040	Rebfläche				0,31	430011040	0,31
263	Ageratum (Gewöhnlicher Leberbalsam)	773	XXX	K183						0		0,32	773XXX	0,32
264	Ampfer (Wiesen-Sauerampfer)	642	XXX	K74						0		0,32	642XXX	0,32
265	Anethum (Dill, Gurkenkraut)	651	XXX	K83						0		0,32	651XXX	0,32
266	Arnika	687	XXX	K200						0		0,32	687XXX	0,32
267	Artemisia (Wermut, Estragon, Beifuß)	673	XXX	K105						0		0,32	673XXX	0,32
268	Baldriane (Echter Baldrian)	679	XXX	K111						0		0,32	679XXX	0,32
269	Bibernellen (Anis)	653	XXX	K85						0		0,32	653XXX	0,32
270	Christophskräuter (Trauben-Silberkerze)	747	XXX	K155						0		0,32	747XXX	0,32
271	Engelwurzen (Arznei-Engelwurz, Echter Engelwurz)	685	XXX	K117						0		0,32	685XXX	0,32
272	Enziane	671	XXX	K103						0		0,32	671XXX	0,32
273	Gartenkresse	617	XXX	K49						0		0,32	617XXX	0,32
274	Halskräuter (Blaues Halskraut)	758	XXX	K168						0		0,32	758XXX	0,32
275	Kamillen (Echte Kamille)	677	XXX	K109						0		0,32	677XXX	0,32
276	Kreuzkümmel (Echter Kreuzkümmel)	655	XXX	K87						0		0,32	655XXX	0,32
277	Krokusse (Safran, Garten-Krokus)	752	XXX	K160						0		0,32	752XXX	0,32
278	Kugelamarant (Echter Kugelamarant)	724	XXX	K132						0		0,32	724XXX	0,32
279	Kümmel (Echter Kümmel)	654	XXX	K86						0		0,32	654XXX	0,32
280	Lavendel (Echter Lavendel, Speik-Lavendel, Hybrid-Lavendel)	668	XXX	K100						0		0,32	668XXX	0,32
281	Liebstöckel/ Maggikraut	658	XXX	K90						0		0,32	658XXX	0,32
282	Lonas (Gelber Leberbalsam)	774	XXX	K184						0		0,32	774XXX	0,32
283	Oregano (Echter Majoran, Oregano/Dost/Wilder Majoran)	664	XXX	K96						0		0,32	664XXX	0,32
284	Portulak	771	XXX	K181						0		0,32	771XXX	0,32
285	Quinoa (Gänsefuß-Arten) (GPS)	187	XXX	K188						0		0,32	187XXX	0,32
286	Rosmarin	661	XXX	K93						0		0,32	661XXX	0,32

287	Salbei (Küchen-, Heilsalbei, Buntschopf-Salbei)	662	XXX	K94	0		0,32	662XXX	0,32
288	Schafgarben (Gelbe Schafgarbe)	678	XXX	K110	0		0,32	678XXX	0,32
289	Schwarze Tollkirsche	625	XXX	K120	0		0,32	625XXX	0,32
290	Schwarzkümmel (Echter Schwarzkümmel, Jungfer im Grünen)	656	XXX	K88	0		0,32	656XXX	0,32
291	Schwarzwurzeln	647	XXX	K79	0		0,32	647XXX	0,32
292	Sonstige Futterpflanze	429	XXX	K36	0		0,32	429XXX	0,32
293	Spanischer Pfeffer (Paprika, Chilli, Peperoni)	624	XXX	K56	0		0,32	624XXX	0,32
294	Thymiane (Thymian, Gartenthymian, Echter Thymian)	669	XXX	K101	0		0,32	669XXX	0,32
295	Trüffel	865	XXX		0		0,32	865XXX	0,32
296	Wegeriche (Spitzwegerich)	676	XXX	K108	0		0,32	676XXX	0,32
297	Wolfsmilch (Weißrand-Wolfsmilch)	755	XXX	K165	0		0,32	755XXX	0,32
298	Salatgurke (Gurke, Salatgurke, Einlegegurke)	627	XXX	K59	1	0,365		627XXX	0,365
299	Kartoffeln	602	XXX	K38	1	0,376	0,29	602XXX	0,376
300	Stärkekartoffeln	601	XXX	K38	1	0,376	0,29	601XXX	0,376
301	Süßkartoffel	605	XXX	K199	1	0,376		605XXX	0,376
302	Ackerland aus der Erzeugung genommen	591	XXX	K40	0		0,4	591XXX	0,4
303	Anemonen (Herbstanemone, Japanische Anemone)	790	XXX	K193	0		0,4	790XXX	0,4
304	Astern (Sommeraster)	733	XXX	K141	0		0,4	733XXX	0,4
305	Chrysanthemen (Garten-Chrysanteme, Winteraster)	734	XXX	K142	0		0,4	734XXX	0,4
306	Dahlien (Garten-Dahlie)	750	XXX	K158	0		0,4	750XXX	0,4
307	Edelweiß (Alpen-Edelweiß)	736	XXX	K144	0		0,4	736XXX	0,4
308	Einjähriges Silberblatt	722	XXX	K130	0		0,4	722XXX	0,4
309	Feldritterspore (Gewöhnlicher Feldritterspore)	748	XXX	K156	0		0,4	748XXX	0,4
310	Fetthenne, Mauerpfeffer (Sedum)	796	XXX	K194	0		0,4	796XXX	0,4
311	Frauenmantel	681	XXX	K113	0		0,4	681XXX	0,4
312	Galega (Geißraute)	683	XXX	K115	0		0,4	683XXX	0,4
313	Garten-/Sommerlevkoje	723	XXX	K131	0		0,4	723XXX	0,4
314	Gartenbohne (Garten-, Busch-, Stangen-, Feuer-, Prunkbohne) (ÖVF)	635	XXX	K67	0		0,4	635XXX	0,4
315	Gipskräuter (Schleierkraut)	759	XXX	K169	0		0,4	759XXX	0,4
316	Gladiolen (Gartengladiole)	745	XXX	K153	0		0,4	745XXX	0,4

317	Glanzgräser (Kanariensaat/Echtes Glanzgras)	704	XXX	K122		0	0,4	704XXX	0,4
318	Goldlack	721	XXX	K129		0	0,4	721XXX	0,4
319	Hasenohren (rundblättriges Hasenohr)	729	XXX	K137		0	0,4	729XXX	0,4
320	Hibiskus (Chinesischer Roseneibisch)	753	XXX	K161		0	0,4	753XXX	0,4
321	Hyazinthe (Garten-Hyazinthe)	731	XXX	K139		0	0,4	731XXX	0,4
322	Hyssopus (Ysop/Eisenkraut)	666	XXX	K98		0	0,4	666XXX	0,4
323	Igniscum	805	XXX			0	0,4	805XXX	0,4
324	Kosmeen (Gemeines Schmuckkörbchen)	761	XXX	K171		0	0,4	761XXX	0,4
325	Lilien (Türkenbund)	726	XXX	K134		0	0,4	726XXX	0,4
326	Löwenmäulchen (Großes Löwenmaul)	756	XXX	K166		0	0,4	756XXX	0,4
327	Malven (Wilde Malve)	686	XXX	K162		0	0,4	686XXX	0,4
328	Margeriten	737	XXX	K145		0	0,4	737XXX	0,4
329	Mariendistel n	682	XXX	K114		0	0,4	682XXX	0,4
330	Melde (Garten-Melde)	640	XXX	K72		0	0,4	640XXX	0,4
331	Milchstern (Kap-Milchstern)	732	XXX	K140		0	0,4	732XXX	0,4
332	Montbretien (Garten-Montbretie)	757	XXX	K167		0	0,4	757XXX	0,4
333	Nachtkerzen (Diptam)	762	XXX	K172		0	0,4	762XXX	0,4
334	Narzissen/Osterglocken	727	XXX	K135		0	0,4	727XXX	0,4
335	Nelken (Bartnelke, Land-/Edelnelke)	772	XXX	K182		0	0,4	772XXX	0,4
336	Nicht landw. genutzte Haus- und Nutzgärten	920	XXX			0	0,4	920XXX	0,4
337	Oenothera/ Nachtkerzen (Gewöhnliche Nachtkerze)	763	XXX	K173		0	0,4	763XXX	0,4
338	Pfingstrosen /Päonien (Gemeine Pfingstrose, Strauch-Pfingstrose)	766	XXX			0	0,4	766XXX	0,4
339	Rhabarber	851	XXX			0	0,4	851XXX	0,4
340	Rohrglanzgras	854	XXX			0	0,4	854XXX	0,4
341	Rudbeckien (Schwarzäugige Rudbeckie/ Sonnenhut, Leuchtender Sonnenhut, Schlitzblättriger Sonnenhut)	738	XXX	K146		0	0,4	738XXX	0,4
342	Sammelcode Zierpflanzen – auch zur Samenvermehrung	720	XXX	K128		0	0,4	720XXX	0,4
343	Scabiosen (Samt-Skabiose, Kugel-Skabiose)	749	XXX	K157		0	0,4	749XXX	0,4
344	Schwertlilien (Deutsche Schwertlilie)	767	XXX	K177		0	0,4	767XXX	0,4
345	Seidenpflanzen (Indianer-Seidenpflanze)	730	XXX	K138		0	0,4	730XXX	0,4
346	Silberbrandschopf (Hahnenkamm)	520	XXX	K196		0	0,4	520XXX	0,4

347	Sonnenhut (Schmalblättriger Sonnenhut, Purpur-Sonnenhut)	675	XXX	K107						0		0,4	675XXX	0,4
348	Spreublumen (Einjährige Papierblume)	742	XXX	K150						0		0,4	742XXX	0,4
349	Strandflieder (Geflügelter Strandflieder)	741	XXX	K149						0		0,4	741XXX	0,4
350	Strauch-/Bechermalven)	754	XXX	K163						0		0,4	754XXX	0,4
351	Strohblumen (Garten-Strohblume)	735	XXX	K143						0		0,4	735XXX	0,4
352	Tagetes (Aufrechte Studentenblume, Tagetes patula, Tagetes tenuifolia)	739	XXX	K147						0		0,4	739XXX	0,4
353	Taglilien (Essbare Taglilie)	725	XXX	K133						0		0,4	725XXX	0,4
354	Tulpen (Garten-Tulpe)	746	XXX	K154						0		0,4	746XXX	0,4
355	Veilchen (Horn-Veilchen, Garten-Stiefmütterchen, Wildes Stiefmütterchen)	776	XXX	K186						0		0,4	776XXX	0,4
356	Verbenen (Echtes Eisenkraut)	667	XXX	K99						0		0,4	667XXX	0,4
357	Vergissmeinnicht (Wald – Vergissmeinnicht)	770	XXX	K180						0		0,4	770XXX	0,4
358	Wiesenknopf (Kleiner Wiesenknopf, Pimpinelle)	768	XXX	K178						0		0,4	768XXX	0,4
359	Wucherblumen (Mutterkraut)	740	XXX	K148						0		0,4	740XXX	0,4
360	Zieste (Deutscher Ziest)	769	XXX	K179						0		0,4	769XXX	0,4
361	Zinnien	743	XXX	K151						0		0,4	743XXX	0,4
362					43001	AX_Landwirtschaft	1030	Gartenbauland				0,4	430011030	0,4
363	Zwiebel (Speisezwiebel, Schalotte, Lauch, Knoblauch, Schnittlauch, Winterheckenzwiebel, Bärlauch)	633	XXX	K65						1	0,415		633XXX	0,415
364	Beihilfefähige Ackerstreifen an Waldrändern (ÖVF)	054	XXX	K40						0		1	054XXX	0,5
365	Bewirtschaftete Teichflächen	930	XXX							0		0,001	930XXX	0,001
366	Brachliegende Flächen (ÖVF)	062	XXX	K40						0		0,001	062XXX	0,001
367	Landwirtschaftliche Lagerung (z. B. unbefestigte Mieten, Stroh-, Futter- und Dunglagerplätze (max. 3 Jahre)) auf Ackerland	996	XXX							0		0,001	996XXX	0,5
368	Maximal 3 Jahre nichtlandwirtschaftlich genutzte Fläche (z. B. Holzlager)	990	XXX							0		0,001	990XXX	0,001

369	Stillgelegte Ackerflächen i. R. von AUM	560	XXX	K40							0		0,001	560XXX	0,001
370	Stillgelegte Ackerflächen nach FELEG	545	XXX	K40							0		0,001	545XXX	0,001
371					43001	AX_Landwirtschaft	1010	Ackerland				1		430011010	0,4
372					43001	AX_Landwirtschaft	1200	Brachland				0,001		430011200	0,001
373	Ackergras	424	XXX	K36					1	1	−0,065	0,3		424XXX	-0,065
374	Anerkannte Almen, Alpen	455	XXX						1	1	−0,065			455XXX	-0,065
375	Christbaumkulturen außerhalb des Waldes	983	XXX						1	1	−0,065			983XXX	-0,065
376	Dauergrünland aus der Erzeugung genommen	592	XXX						1	1	−0,065			592XXX	-0,065
377	Grünlandeinsaat – Mähweiden	442	XXX	K36					1	1	−0,065			442XXX	-0,065
378	Grünlandeinsaat – Weiden	443	XXX	K36					1	1	−0,065			443XXX	-0,065
379	Grünlandeinsaat – Wiesen	441	XXX	K36					1	1	−0,065			441XXX	-0,065
380	Klee (ÖVF)	421	XXX	K190					1	1	−0,065			421XXX	-0,065
381	Kleegras, Klee-/Luzernegras-Gemisch (ÖVF)	422	XXX	K36					1	1	−0,065			422XXX	-0,065
382	Klee-Luzerne-Gemisch (ÖVF)	425	XXX	K41					1	1	−0,065			425XXX	-0,065
383	Landwirtschaftliche Lagerung (z. B. unbefestigte Mieten, Stroh-, Futter- und Dunglagerplätze (max. 3 Jahre)) auf Dauergrünland	994	XXX						1	1	−0,065			994XXX	-0,065
384	Luzerne (ÖVF)	423	XXX	K191					1	1	−0,065			423XXX	-0,065
385	Mähweiden	452	XXX						1	1	−0,065	0,004		452XXX	-0,065
386	Samenvermehrung für Gras gem. Saatgutverkehrsgesetz oder Erhaltungsmischungsverordnung	912	XXX	K41					1	1	−0,065			912XXX	-0,065
387	Samenvermehrung für Klee gem. Saatgutverkehrsgesetz oder Erhaltungsmischungsverordnung (ÖVF)	921	XXX	K190					1	1	−0,065			921XXX	-0,065
388	Samenvermehrung für Luzerne gem. Saatgutverkehrsgesetz oder Erhaltungsmischungsverordnung (ÖVF)	922	XXX	K191					1	1	−0,065			922XXX	-0,065
389	Sommerweiden für Wanderschafe	460	XXX						1	1	−0,065			460XXX	-0,065
390	Streuobstanlage (ohne Wiesen-	822	XXX						1	1	−0,065			822XXX	-0,065

	/Ackernutzung)													
391	Streuwiesen (Streu-/Futternutzung)	458	XXX					1	1	−0,065		458XXX	-0,065	
392	Weiden	453	XXX					1	1	−0,065	0,004	453XXX	-0,065	
393	Wiesen (einschl. Streuobstwiesen)	451	XXX					1	1	−0,065		451XXX	-0,065	
394	Silomais mit Blühstreifen/ Bejagungsschneisen	410	XXX					0	0	0,252		410XXX	0,252	
395						combin_41001&42001						4100242001	1	
396												43002420011100	0,5	
397												43001420011010	0,5	
398												43001420011020	0,5	
399					41003	AX_Halde			0			41003	0,5	
400												4300742001	0,5	

Table 16 Summable C-factors, field names and data types. Yellow marked fields are used for calculations and thus mandatory.

Field Name	Alias	Data Type	Allow Null	Length
OBJECTID	OBJECTID	Object ID	False	
beschr_invekos	beschr_invekos	Text	True	255
nu_code_invekos	nu_code_invekos	Text	True	255
aum_code_invekos	aum_code_invekos	Text	True	255
aum_beschr_invekos	aum_beschr_invekos	Text	True	255
cultur_code_invekos	cultur_code_invekos	Text	True	255
obart_nu_code_atkis	obart_nu_code_atkis	Long	True	
obart_beschr_atkis	obart_beschr_atkis	Text	True	255
VEG_nu_code_atkis	VEG_nu_code_atkis	Long	True	
VEG_beschr_atkis	VEG_beschr_atkis	Text	True	255
sod_crop_au21	sod_crop_au21	Long	True	
Summable_exist_au21	Summable_exist_au21	Long	True	
summable_c_au21	summable_c_au21	Text	True	255
c_value_hessen	c_value_hessen	Double	True	
comment	comment	Text	True	255
combi_code	combi_code	Text	True	255
sum_c	sum_c	Double	True	

5. References

1) Auerswald, K. Ebertseder F., Levin K., Yuan Y., Prasuhn V., Plambeck N.O., Menzel A., Kainz M.: Summable C factors for contemporary soil use. Soil and TillageResearch 213/12, S. 105155, 2021.

2) Auerswald, K.; Fischer, F. K.; Winterrath, T.; Brandhuber, R. (2019): Rain erosivity map for Germany derived from contiguous radar rain data. In Hydrology and Earth System Sciences 23 (4).

3) Melzer, Marvin; Thakur, Nishita; Ebertseder, Florian; Bellingrath-Kimura, Sonoko (2023): Identifizierung kleinräumiger Erosionshotspots unter Berücksichtigung aquatischer Ökosysteme zur Etablierung von Erosionsschutzstreifen. 43. GIL-Jahrestagung, Resiliente Agri-Food-Systeme. Bonn: Gesellschaft für Informatik e.V.. PISSN: 1617-5468. ISBN: 978-3-88579-724-1. pp. 171-182. Osnabrück. 13.-14. Februar 2023

4) Natural Capital Project (2024): InVEST. Version 3.14.1: Stanford University, University of Minnesota, Chinese Academy of Sciences, The Nature Conservancy, World Wildlife Fund, Stockholm Resilience Centre, The Royal Swedish Academy of Sciences. Available online at https://naturalcapitalproject.stanford.edu/software/invest, checked on 4/8/2024.