

# User guide to run EROSPOT Software part 1

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

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## 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 were 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). Results are shown by the EROSPOT 3D Web App:

[www.erospot.de](http://www.erospot.de)

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

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## 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 1) 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 2, Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11). 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 12, Table 13). 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:  $t \cdot h \cdot ha / (ha \cdot MJ \cdot mm)$ .

### 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:  $\text{MJ} \cdot \text{mm}/(\text{h} \cdot \text{ha} \cdot \text{year})$ .

### 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 14).

## 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.

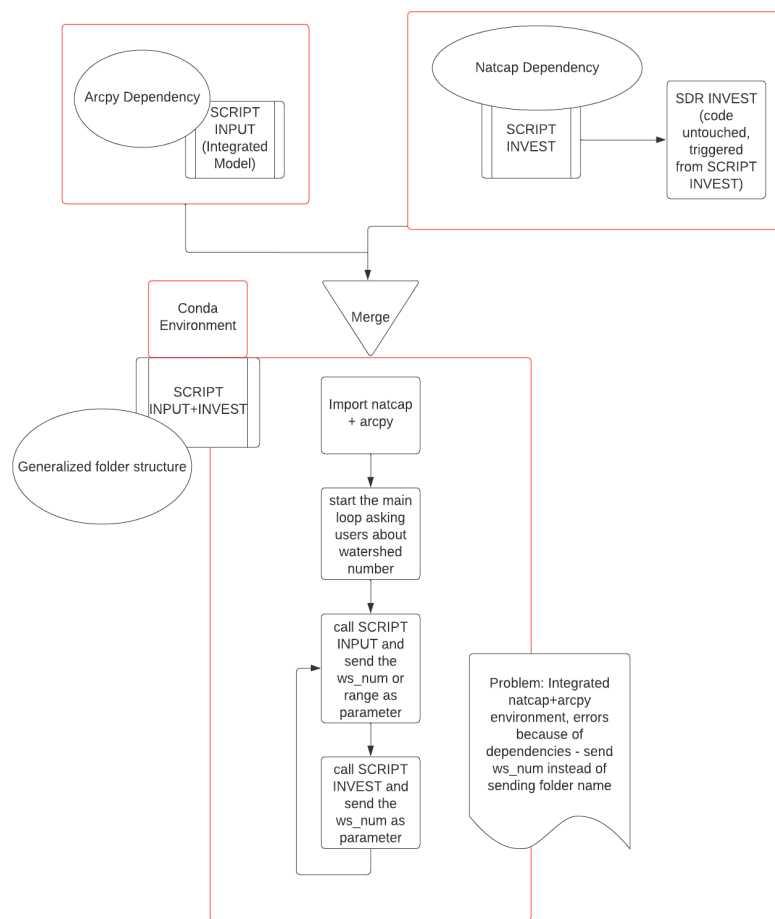


Figure 1: Initial Workflow to consolidate Arcpy dependencies and natcap packages into a single integrated Conda environment, where all dependencies are installed.

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

**Important! Keep the order of steps for installing required software (Table 1). 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 with the command in the terminal that is opened: `conda create -y -c conda-forge -n arcgis-invest python=3.9`
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.

*Table 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)	3.12
arcpy	3.0, 3.1 (same as ArcGIS)

## 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.

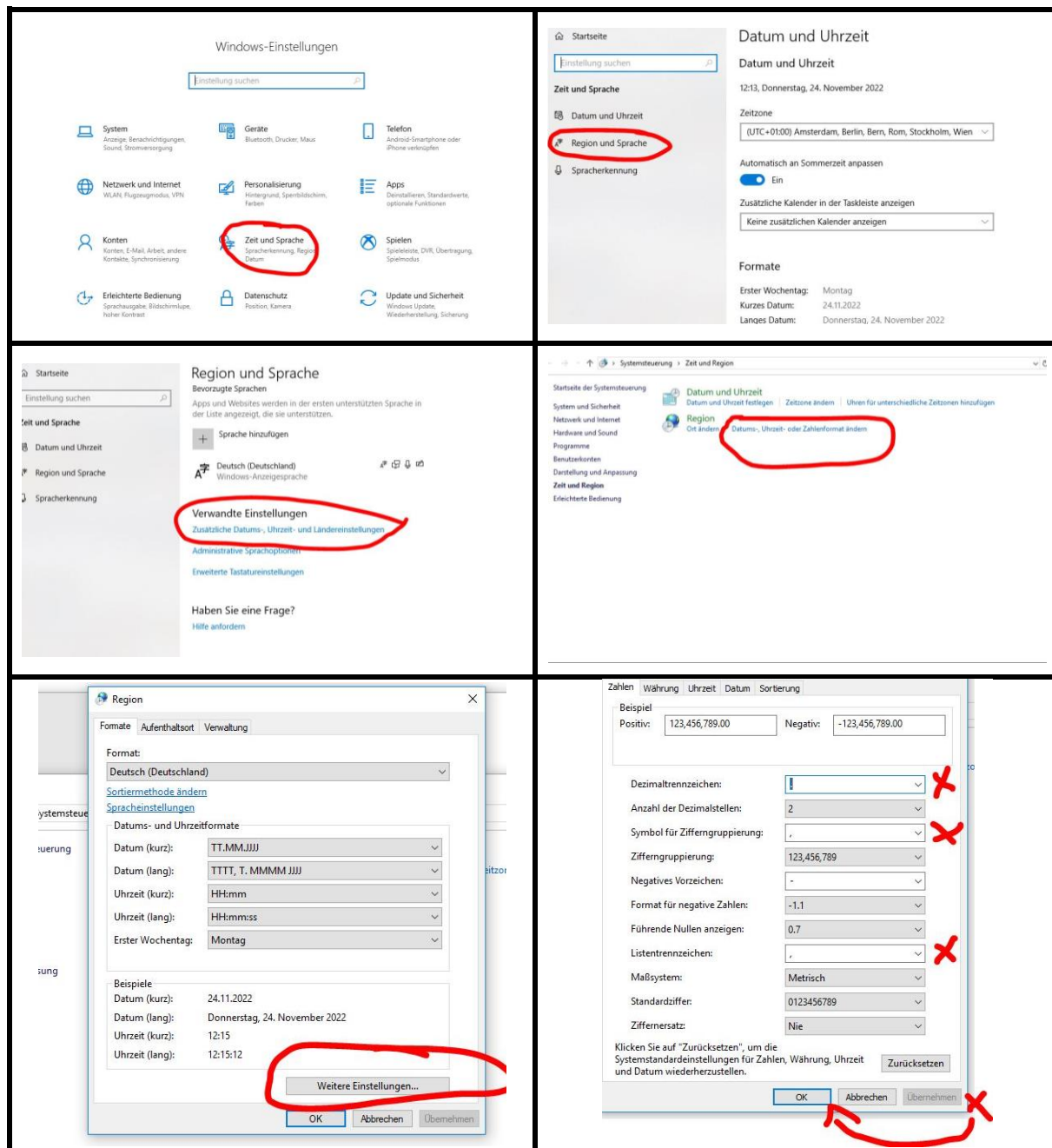


Figure 2 Workflow to change comma and point notation in windows systems.

## 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/EROSPT.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

Please report additional bugs to: [nishita.thakur@zalf.de](mailto:nishita.thakur@zalf.de) or directly to the related [GitHub repository](#).

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 1 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 2 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_Fahrtwegachse
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 3 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	DEBYBDLMCI0000ei
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 4 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 5 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 6 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 7 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 8 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	DEBYBDLMCI0000sl
HDU_X	Short	False		0
BEGINN	Text	False	20	2017-05-17T17:01:47Z
ENDE	Text	False	20	
FKT	Text	False	4	

Table 9 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 10 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 11 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	DEBYBDLMCI0001sb
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 12 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 13 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 14 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 15 ).

OB JE CTI D	beschr_inv ekos	nu_co de_inv ekos	aum_c ode_in vekos	aum_be schr_in vekos	cultur_ code_i nvekos	obart_n u_code _atkis	obart_beschr_atkis	VEG_n u_code _atkis	VEG be schr_at kis	sod_ crop_ au21	Summa ble_exis t_au21	summ able_c _au21	c_val ue_he ssen	comb i_cod e	su m_c
1	Tomaten	622	XXX		K54						0		0	622X XX	1
2						75005	AX_Gebiet_Bundesl and		na					75005	1
3						75007	AX_Gebiet_Kreis		na					75007	1
4						75006	AX_Gebiet_Regieru ngsbezirk		na					75006	1
5						75003	AX_KommunalesGe biet		na					75003	1
6						75009	AX_Gebietsgrenze		na					75009	1
7						71006	AX_NaturUmweltOd erBodenschutzrecht		na					71006	1
8						44001	AX_Fliessgewaesse r		na					44001	1
9						44006	AX_StehendesGewa esser		na					44006	1
10						44004	AX_Gewaesserachs e		na					44004	1
11						55001	AX_Gewaessermerk mal		na					55001	1
12						57001	AX_Wasserspiegelh oehe		na					57001	1
13						57003	AX_Gewaesserstati onierungsachse		na					57003	1
14						61003	AX_DammWallDeic h		na					61003	1
15						52001	AX_Ortslage		na					52001	1
16						41007	AX_FlaecheBesond ererFunktionalerPra egung		na					41007	1
17						41006	AX_FlaecheGemisc hterNutzung		na					41006	1
18						41009	AX_Friedhof		na					41009	1
19						41002	AX_IndustrieUndGe werbeflaeche		na					41002	1
20						41008	AX_SportFreizeitUn dErholungsflaeche		na					41008	1
21						41005	AX_TagebauGrubeS teinbruch		na					41005	1
22						41001	AX_Wohnbauflaech e		na					41001	1
23						51002	AX_BauwerkOderAn lageFuerIndustrieUn dGewerbe		na					51002	1
24						51006	AX_BauwerkOderAn lageFuerSportFreize itUndErholung		na					51006	1
25						51006	AX_BauwerkOderAn lageFuerSportFreize itUndErholung		na					51006	1
26						51005	AX_Leitung		na					51005	1
27						51009	AX_SonstigesBauw erkOderSonstigeEinr ichtung		na					51009	1
28						51002	AX_BauwerkOderAn lageFuerIndustrieUn dGewerbe		na					51002	1
29						51007	AX_HistorischesBau werkOderHistorische Einrichtung		na					51007	1
30						51009	AX_SonstigesBauw erkOderSonstigeEinr ichtung		na					51009	1
31						51003	AX_Vorratsbehaelter Speicherbauwerk		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, 00 1
35						43003	AX_Gehoelz		na					43003	0, 00 1
36						43005	AX_Moor		na					43005	0, 00 1
37						43006	AX_Sumpf		na					43006	0, 00 1
38						43007	AX_UnlandVegetatio nsloseFlaeche		na					43007	0, 5
39						54001	AX_Vegetationsmer kmal		na					54001	0, 00 1
40						54001	AX_Vegetationsmer kmal		na					54001	0, 00 1

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_Fahrtwegachse	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_BauwerkImGewässerbereich	na		53009	1	
53					53001	AX_BauwerkImVerkehrsbereich	na		53001	1	
54					53009	AX_BauwerkImGewässerbereich	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_BauwerkImGewässerbereich	na		53009	1	
59					53002	AX_Strassenverkehrsanlage	na		53002	1	
60	Chinaschilf (Miscanthus)	852	XXX					0	0,004	852XX	0,004
61	Chinaschilf (Miscanthus) (ÖVF)	063	XXX					0	0,004	063XX	0,004
62	Grünbrache im ökologischen Landbau (Hauptfutterfläche)	941	XXX	K41				0	0,004	941XX	0,004
63	Hutungen (Futternutzung)	454	XXX					0	0,004	454XX	0,004
64	Naturschutzflächen (keine landwirtschaftliche Verwertung)	958	XXX					0	0,004	958XX	0,004
65	Nicht bewirtschaftete Teichflächen	940	XXX					0	0,004	940XX	0,004
66	Nicht landwirtschaftliche Fläche aufgrund Maßnahme gem. Natura 2000 oder Wasserrahmenrichtlinie (Art. 32 Zb (i) VO(EU) Nr. 1307/2013)	583	XXX					0	0,004	583XX	0,004
67	Pampasgräser (Amerikanisches Pampasgras)	760	XXX	K170				0	0,004	760XX	0,004
68	Pufferstreifen und Feldrand auf Dauergrünland (ÖVF)	057	XXX					0	0,004	057XX	0,004
69	Pufferstreifen und Feldrand auf Ackerland (ÖVF)	058	XXX	K40				0	0,004	058XX	0,004
70	Sida (Virginiamalve)	804	XXX					0	0,004	804XX	0,004
71	Silphium (Durchwachsene Silphie)	802	XXX					0	0,004	802XX	0,004
72	Silphium (Durchwachsenes)	064	XXX					0	0,004	064XX	0,004

[illegible]

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

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

165	Kornblumen	775	XXX		K185	0		0,14	775X XX	0, 14
166	Reis im Trockenanbau (GPS)	188	XXX		K201	0		0,14	188X XX	0, 14
167	Rollrasen, Vegetations mappen für Dachbegrünung	702	XXX		K41	0		0,14	702X XX	0, 14
168	Erbsen (ÖVF, GPS)	210	XXX		K18	1	0,141		210X XX	0, 14 1
169	Gemenge Erbsen/Bohnen (ÖVF)	240	XXX		K41	1	0,141		240X XX	0, 14 1
170	Linsen (Speiselinse) (ÖVF)	292	XXX		K22	1	0,141		292X XX	0, 14 1
171	GPS Erbsen (ÖVF)	486	XXX			1	0,141		486X XX	0, 14 1
172	Koriander	657	XXX		K89	1	0,145		657X XX	0, 14 5
173	Rispenhirse (Panicum) Rutenhirse (GPS)	181	XXX		K12	1	0,145		181X XX	0, 14 5
174	GPS Hirse	483	XXX			1	0,145		483X XX	0, 14 5
175	Sorghumhirse (Körnersorghum) (GPS)	183	XXX		K37	1	0,148		183X XX	0, 14 8
176	GPS Körnersorghum	484	XXX			1	0,148		484X XX	0, 14 8
177	Körnermais	171	A33	Mulchsaat	K11	1	0,156	0,35	171A3 3	0, 15 6
178	Körnermais	171	B37	Mulchsaatverfahren	K11	1	0,156	0,35	171B3 7	0, 15 6
179	Mohn (Schlaf-, Back-, Klatschmohn)	706	XXX		K124	1	0,165		706X XX	0, 16 5
180	Ringelblumen (Garten-Ringelblumen)	674	XXX		K106	1	0,165		674X XX	0, 16 5
181	Silomais	411	A33	Mulchsaat	K11	1	0,166	0,35	411A3 3	0, 16 6
182	Silomais	411	B37	Mulchsaatverfahren	K11	1	0,166	0,35	411B3 7	0, 16 6
183	Brennnesseln (Gr. Brennnesseln)	709	XXX		K127	0		0,17	709X XX	0, 17
184	Ackerbohnen (ÖVF, GPS)	220	XXX		K19	1	0,178		220X XX	0, 17 8
185	GPS Ackerbohnen (ÖVF)	487	XXX			1	0,178		487X XX	0, 17 8
186	Kohl-, Steckrüben	414	XXX		K26	1	0,181		414X XX	0, 18 1
187	Runkelrübe, Futterrübe	413	XXX		K35	1	0,181		413X XX	0, 18 1
188	Zuckerrüben	603	XXX		K35	1	0,181	0,32	603X XX	0, 18 1
189	Lupinen (ÖVF, GPS)	230	XXX		K20	1	0,185		230X XX	0, 18 5
190	GPS Lupinen (ÖVF)	488	XXX			1	0,185		488X XX	0, 18 5
191	Buchweizen (GPS)	182	XXX		K13	1	0,189		182X XX	0, 18 9
192	Artischocke	861	XXX			0		0,2	861X XX	0, 2
193	Basilikum	660	XXX		K92	0		0,2	660X XX	0, 2
194	Brunnenkresse	615	XXX		K47	0		0,2	615X XX	0, 2
195	Johanniskraut (Echtes Johanniskraut)	680	XXX		K112	0		0,2	680X XX	0, 2
196	Kapuzinerkressen (Große Kapuzinerkresse)	765	XXX		K175	0		0,2	765X XX	0, 2
197	Kerbel (Kerbel/echter Kerbel, Wiesenkerbel)	652	XXX		K84	0		0,2	652X XX	0, 2
198	Melissen (Zitronenmelisse)	670	XXX		K102	0		0,2	670X XX	0, 2

199	Minzen (Pfefferminze, Grüne Minze)	672	XXX	K104	0		0,2	672X XX	0, 2
200	Sammelcode Küchenkräuter	650	XXX	K82	0		0,2	650X XX	0, 2
201	Sammelcode Samenvermehrung von Wildkräutern	690	XXX	K41	0		0,2	690X XX	0, 2
202	Taubnesseln (Weiße Taubnessel)	744	XXX	K152	0		0,2	744X XX	0, 2
203	Petroselinum (Petersilie)	659	XXX	K91	1	0,205	0,3	659X XX	0, 20 5
204	Gartenkürbisse (Cucurbita pepo) (Gartenkürbis, Steirischer Kürbis, Zucchini, Spaghettikürbis, Zierkürbis)	630	XXX	K62	1	0,225		630X XX	0, 22 5
205	Riesenkürbisse (Riesenkürbis, Hokkaidokürbis)	629	XXX	K61	1	0,225	0,24	629X XX	0, 22 5
206	Sammelcode Gemüse-Kürbisgewächse	626	XXX	K58	1	0,225		626X XX	0, 22 5
207	Sudangras	803	XXX	K37	1	0,225	0,35	803X XX	0, 22 5
208	Auberginen	623	XXX	K55	0		0,24	623X XX	0, 24
209	Bohnenkräuter	665	XXX	K97	0		0,24	665X XX	0, 24
210	Borretsch	663	XXX	K95	0		0,24	663X XX	0, 24
211	Feldsalate (Feldsalat/Ackersalat/ Rapunzel)	636	XXX	K68	0		0,24	636X XX	0, 24
212	Gartenrettiche (Weiße/Rote Rettiche, Ölrettich, Radieschen)	618	XXX	K50	0		0,24	618X XX	0, 24
213	Gemüsekohli (Kopfkohl, Wirsing, Rot-/Weißkohl, Spitzkohl, Grünkohl, Kohlrabi, Markstammkohl, Blumenkohl, Romanesco, Brokkoli, Rosenkohl, Zierkohl)	613	XXX	K45	0		0,24	613X XX	0, 24
214	Lattich (Garten-Salat/Lattich, Lollo Rosso, Romana-Salat/Römischer Salat)	637	XXX	K69	0		0,24	637X XX	0, 24
215	Löwenzahn	684	XXX	K116	0		0,24	684X XX	0, 24
216	Mangold, Rote Beete/Rote Rübe	639	XXX	K35	0		0,24	639X XX	0, 24
217	Meerrettich	646	XXX	K78	0		0,24	646X XX	0, 24
218	Melone (Citrullus, Wassermelone)	631	XXX	K63	0		0,24	631X XX	0, 24
219	Pastinaken	643	XXX	K75	0		0,24	643X XX	0, 24
220	Rodiola (Rosenwurz)	751	XXX	K159	0		0,24	751X XX	0, 24
221	Sammelcode Andere Gemüsearten – auch zur Samenvermehrung	632	XXX	K64	0		0,24	632X XX	0, 24
222	Sammelcode Gemüse	610	XXX	K42	0		0,24	610X XX	0, 24
223	Sammelcode Gemüse-	621	XXX	K53	0		0,24	621X XX	0, 24



	Nachtschatt engewächs e								
224	Sammelcod e Gemüse- Kreuzblütler	611	XXX	K43	0		0,24	611X XX	0, 24
225	Sellerie (Knollen- Sellerie, Bleich- Sellerie, Stangen- Sellerie)	641	XXX	K73	0		0,24	641X XX	0, 24
226	Senfrauke (Garten- Senfrauke, Rucola)	616	XXX	K48	0		0,24	616X XX	0, 24
227	Spinat	638	XXX	K70	0		0,24	638X XX	0, 24
228	Virginischer Tabak	705	XXX	K123	0		0,24	705X XX	0, 24
229	Zuckermelo ne (Cucumis melo)	628	XXX	K60	0		0,24	628X XX	0, 24
230	Sojabohnen (ÖVF, GPS)	330	XXX	K30	1	0,241		330X XX	0, 24 1
231	GPS Sojabohnen (ÖVF)	494	XXX		1	0,241		494X XX	0, 24 1
232	Amarant (Fuchsschw anz) (GPS)	186	XXX	K14	1	0,245		186X XX	0, 24 5
233	Körnermais	171	XXX	K11	1	0,245	0,35	171X XX	0, 24 5
234	Silomais	411	XXX	K11	1	0,252	0,35	411X XX	0, 25 2
235	Gemenge mit Silomais	412	XXX	K41	1	0,261		412X XX	0, 26 1
236	Sonnenblu men (GPS)	320	XXX	K29	1	0,261		320X XX	0, 26 1
237	Möhre (Möhre/Karo tte, Futtermöhre )	634	XXX	K66	1	0,265		634X XX	0, 26 5
238	Zichorien/W egwarten (Chicoree, Radicchio, krausblättrig e Endivie, ganzblättrig e Endivie, Zichorie)	644	XXX	K76	1	0,265		644X XX	0, 26 5
239	Erdbeeren	707	XXX	K125	0		0,29	707X XX	0, 29
240	Spargel	860	XXX		0		0,29	860X XX	0, 29
241	Brache mit Einsatz von einjährigen Blühmischu ngen	590	XXX	K40	0		0,3	590X XX	0, 3
242	Brache mit Honigpflanz en – einjährig (ÖVF)	065	XXX	K40	0		0,3	065X XX	0, 3
243	Brache mit Honigpflanz en – mehrhjährig (ÖVF)	066	XXX	K40	0		0,3	066X XX	0, 3
244	Energieblüh mischungen ohne Hanf	871	XXX	K41	0		0,3	871X XX	0, 3
245	Energiepfla nzen im Mischanbau	870	XXX	K41	0		0,3	870X XX	0, 3
246	Esparsette, Serradella kleinkörnig (ÖVF)	430	XXX	K192	0		0,3	430X XX	0, 3
247	Gemenge Leguminose n mit Stützfrucht (ÖVF, GPS)	250	XXX	K41	0		0,3	250X XX	0, 3
248	Iberischer Drachenkop f	512	XXX	K203	0		0,3	512X XX	0, 3
249	Kichererbse n	645	XXX	K77	0		0,3	645X XX	0, 3
250	Pflanzenmis chung mit Hanf	866	XXX	K41	0		0,3	866X XX	0, 3
251	Phacelia zur Samenvern ehrung	777	XXX	K187	0		0,3	777X XX	0, 3
252	Ramtilkraut	798	XXX	K195	0		0,3	798X XX	0, 3
253	Wicken (ÖVF)	221	XXX	K189	0		0,3	221X XX	0, 3

254	GPS Gemenge Körnerlegu- minoson/Gre- treide	485	XXX		0	0,3	485X XX	0, 3
255	Fenchel (Gemüsefen- chel/Körnerf- enchel)	648	XXX	K80	1	0,305	648X XX	0, 30 5
256	Bestockte Rebfläche	843	XXX		0	0,31	843X XX	0, 31
257	Hopfen	856	XXX		0	0,31	856X XX	0, 31
258	Rebschule	845	XXX		0	0,31	845X XX	0, 31
259	Tafeltraube n	848	XXX		0	0,31	848X XX	0, 31
260	Unbestockte Rebflächen	844	XXX	K40	0	0,31	844X XX	0, 31
261				43001 AX_Landwirtschaft	1012 Hopfen	0,31	43001 1012	0, 31
262				43001 AX_Landwirtschaft	1040 Rebfläc- he	0,31	43001 1040	0, 31
263	Ageratum (Gewöhnlich er Leberbalsa- m)	773	XXX	K183	0	0,32	773X XX	0, 32
264	Amplfer (Wiesen- Sauerampfe- r)	642	XXX	K74	0	0,32	642X XX	0, 32
265	Anethum (Dill, Gurkenkraut )	651	XXX	K83	0	0,32	651X XX	0, 32
266	Arnika	687	XXX	K200	0	0,32	687X XX	0, 32
267	Artemisia (Wermut, Estragon, Beifuß)	673	XXX	K105	0	0,32	673X XX	0, 32
268	Baldriane (Echter Baldrian)	679	XXX	K111	0	0,32	679X XX	0, 32
269	Bibernellen (Anis)	653	XXX	K85	0	0,32	653X XX	0, 32
270	Christophsk- räuter (Trauben- Silberkerze)	747	XXX	K155	0	0,32	747X XX	0, 32
271	Engelwurze n (Arznei- Engelwurz, Echter Engelwurz)	685	XXX	K117	0	0,32	685X XX	0, 32
272	Enziane	671	XXX	K103	0	0,32	671X XX	0, 32
273	Gartenkress- e	617	XXX	K49	0	0,32	617X XX	0, 32
274	Halskräuter (Blaues Halskraut)	758	XXX	K168	0	0,32	758X XX	0, 32
275	Kamillen (Echte Kamille)	677	XXX	K109	0	0,32	677X XX	0, 32
276	Kreuzkümm- el (Echter Kreuzkümm- el)	655	XXX	K87	0	0,32	655X XX	0, 32
277	Krokusse (Safran, Garten- Krokus)	752	XXX	K160	0	0,32	752X XX	0, 32
278	Kugelamara- nt (Echter Kugelamara- nt)	724	XXX	K132	0	0,32	724X XX	0, 32
279	Kümmel (Echter Kümmel)	654	XXX	K86	0	0,32	654X XX	0, 32
280	Lavendel (Echter Lavendel, Speik- Lavendel, Hybrid- Lavendel)	668	XXX	K100	0	0,32	668X XX	0, 32
281	Liebstöckel/ Maggikraut	658	XXX	K90	0	0,32	658X XX	0, 32
282	Lonas (Gelber Leberbalsa- m)	774	XXX	K184	0	0,32	774X XX	0, 32
283	Oregano (Echter Majoran, Oregano/Do- st/Wilder Majoran)	664	XXX	K96	0	0,32	664X XX	0, 32
284	Portulak	771	XXX	K181	0	0,32	771X XX	0, 32
285	Quinoa (Gänsefuß- Arten) (GPS)	187	XXX	K188	0	0,32	187X XX	0, 32
286	Rosmarin	661	XXX	K93	0	0,32	661X XX	0, 32

287	Salbei (Küchen-, Heilsalbei, Buntschopf- Salbei)	662	XXX	K94	0		0,32	662X XX	0, 32
288	Schafgarbe n (Gelbe Schafgarbe)	678	XXX	K110	0		0,32	678X XX	0, 32
289	Schwarze Tollkirsche	625	XXX	K120	0		0,32	625X XX	0, 32
290	Schwarzkü mmel (Echter Schwarz- kummel, Jungfer im Grünen)	656	XXX	K88	0		0,32	656X XX	0, 32
291	Schwarzwur zeln	647	XXX	K79	0		0,32	647X XX	0, 32
292	Sonstige Futterpflanz e	429	XXX	K36	0		0,32	429X XX	0, 32
293	Spanischer Pfeffer (Paprika, Chilli, Peperoni)	624	XXX	K56	0		0,32	624X XX	0, 32
294	Thymiane (Thymian, Gartenthymi an, Echter Thymian)	669	XXX	K101	0		0,32	669X XX	0, 32
295	Trüffel	865	XXX		0		0,32	865X XX	0, 32
296	Wegeriche (Spitzwegeri ch)	676	XXX	K108	0		0,32	676X XX	0, 32
297	Wolfsmilch (Weißbrand- Wolfsmilch)	755	XXX	K165	0		0,32	755X XX	0, 32
298	Salatgurke (Gurke, Salatgurke, Einlegegurk e)	627	XXX	K59	1	0,365		627X XX	0, 36 5
299	Kartoffeln	602	XXX	K38	1	0,376	0,29	602X XX	0, 37 6
300	Stärkekartof feln	601	XXX	K38	1	0,376	0,29	601X XX	0, 37 6
301	Süßkartoffel	605	XXX	K199	1	0,376		605X XX	0, 37 6
302	Ackerland aus der Erzeugung genommen	591	XXX	K40	0		0,4	591X XX	0, 4
303	Anemonen (Herbstane mone, Japanische Anemone)	790	XXX	K193	0		0,4	790X XX	0, 4
304	Astern (Sommerast er)	733	XXX	K141	0		0,4	733X XX	0, 4
305	Chrysanthe men (Garten- Chrysanthe me, Winteraster)	734	XXX	K142	0		0,4	734X XX	0, 4
306	Dahlien (Garten- Dahlie)	750	XXX	K158	0		0,4	750X XX	0, 4
307	Edelweiß (Alpen- Edelweiß)	736	XXX	K144	0		0,4	736X XX	0, 4
308	Einjähriges Silberblatt	722	XXX	K130	0		0,4	722X XX	0, 4
309	Feldritterspo rne (Gewöhnlich er Feldritterspo rn)	748	XXX	K156	0		0,4	748X XX	0, 4
310	Fettherne, Mauerpfeffe r (Sedum)	796	XXX	K194	0		0,4	796X XX	0, 4
311	Frauenmant el	681	XXX	K113	0		0,4	681X XX	0, 4
312	Galega (Geißraute)	683	XXX	K115	0		0,4	683X XX	0, 4
313	Garten- /Sommerlev koje	723	XXX	K131	0		0,4	723X XX	0, 4
314	Gartenbohne n (Garten-, Busch-, Stangen-, Feuer-, Prunkbohne ) (ÖVF)	635	XXX	K67	0		0,4	635X XX	0, 4
315	Gipskräuter (Schleierkra ut)	759	XXX	K169	0		0,4	759X XX	0, 4
316	Gladiolen (Gartengladi ole)	745	XXX	K153	0		0,4	745X XX	0, 4

317	Glanzgräser (Kanariensa at/Echtes Glanzgras)	704	XXX	K122	0	0,4	704X XX	0, 4
318	Goldlack	721	XXX	K129	0	0,4	721X XX	0, 4
319	Hasenohren (rundblättrig es Hasenohr)	729	XXX	K137	0	0,4	729X XX	0, 4
320	Hibiskus (Chinesisch er Roseneibisc h)	753	XXX	K161	0	0,4	753X XX	0, 4
321	Hyazinthe (Garten- Hyazinthe)	731	XXX	K139	0	0,4	731X XX	0, 4
322	Hyssopus (Ysop/Eisen kraut)	666	XXX	K98	0	0,4	666X XX	0, 4
323	Igniscum	805	XXX		0	0,4	805X XX	0, 4
324	Kosmeen (Gemeines Schmuckkör bchen)	761	XXX	K171	0	0,4	761X XX	0, 4
325	Lilien (Türkenbun d)	726	XXX	K134	0	0,4	726X XX	0, 4
326	Löwenmäul chen (Großes Löwenmaul)	756	XXX	K166	0	0,4	756X XX	0, 4
327	Malven (Wilde Malve)	686	XXX	K162	0	0,4	686X XX	0, 4
328	Margeriten	737	XXX	K145	0	0,4	737X XX	0, 4
329	Mariendistel n	682	XXX	K114	0	0,4	682X XX	0, 4
330	Melde (Garten- Melde)	640	XXX	K72	0	0,4	640X XX	0, 4
331	Milchstern (Kap- Milchstern)	732	XXX	K140	0	0,4	732X XX	0, 4
332	Montbretien (Garten- Montbretie)	757	XXX	K167	0	0,4	757X XX	0, 4
333	Nachtkerze n (Diptam)	762	XXX	K172	0	0,4	762X XX	0, 4
334	Narzissen/O sterglocken	727	XXX	K135	0	0,4	727X XX	0, 4
335	Nelken (Bartnelke, Land- /Ednelke)	772	XXX	K182	0	0,4	772X XX	0, 4
336	Nicht landw. genutzte Haus- und Nutzgärten	920	XXX		0	0,4	920X XX	0, 4
337	Oenothera/ Nachtkerze n (Gewöhnlich e Nachtkerze)	763	XXX	K173	0	0,4	763X XX	0, 4
338	Pfingstrosen /Päonien (Gemeine Pfingstrose, Strauch- Pfingstrose)	766	XXX		0	0,4	766X XX	0, 4
339	Rhabarber	851	XXX		0	0,4	851X XX	0, 4
340	Rohrglanzgr as	854	XXX		0	0,4	854X XX	0, 4
341	Rudbeckien (Schwarzäü gige Rudbeckie/ Sonnenhut, Leuchtender Sonnenhut, Schlitzblättri ger Sonnenhut)	738	XXX	K146	0	0,4	738X XX	0, 4
342	Sammelcod e Zierpflanzen – auch zur Samenverm ehrung	720	XXX	K128	0	0,4	720X XX	0, 4
343	Scabiosen (Samt- Skabiose, Kugel- Skabiose)	749	XXX	K157	0	0,4	749X XX	0, 4
344	Schwertlilie n (Deutsche Schwertlilie)	767	XXX	K177	0	0,4	767X XX	0, 4
345	Seidenpflanz en (Indianer- Seidenpflanz e)	730	XXX	K138	0	0,4	730X XX	0, 4
346	Silberbrand schopf (Hahnenka mm)	520	XXX	K196	0	0,4	520X XX	0, 4

347	Sonnenhut (Schmalblättriger Sonnenhut, Purpur-Sonnenhut)	675	XXX	K107	0	0,4	675X XX	0,4		
348	Spreublume n (Einjährige Papierblume)	742	XXX	K150	0	0,4	742X XX	0,4		
349	Strandflie der (Geflügelter Strandflie der)	741	XXX	K149	0	0,4	741X XX	0,4		
350	Strauch- /Bechermalv en)	754	XXX	K163	0	0,4	754X XX	0,4		
351	Strohblume n (Garten- Strohblume)	735	XXX	K143	0	0,4	735X XX	0,4		
352	Tagetes (Aufrechte Studentenbl ume, Tagetes patula, Tagetes tenuifolia)	739	XXX	K147	0	0,4	739X XX	0,4		
353	Taglilien (Essbare Tagilie)	725	XXX	K133	0	0,4	725X XX	0,4		
354	Tulpen (Garten- Tulpe)	746	XXX	K154	0	0,4	746X XX	0,4		
355	Veilchen (Horn- Veilchen, Garten- Stiefmütter chen, Wildes Stiefmütter chen)	776	XXX	K186	0	0,4	776X XX	0,4		
356	Verbenen (Echtes Eisenkraut)	667	XXX	K99	0	0,4	667X XX	0,4		
357	Vergissmein nicht (Wald- Vergissmein nicht)	770	XXX	K180	0	0,4	770X XX	0,4		
358	Wiesenknop f (Kleiner Wiesenknop f, Pimpinelle)	768	XXX	K178	0	0,4	768X XX	0,4		
359	Wucherblu men (Mutterkraut )	740	XXX	K148	0	0,4	740X XX	0,4		
360	Zieste (Deutscher Ziest)	769	XXX	K179	0	0,4	769X XX	0,4		
361	Zinnien	743	XXX	K151	0	0,4	743X XX	0,4		
362				43001	AX_Landwirtschaft	1030	Gartenb auland	0,4	43001 1030	0,4
363	Zwiebel (Speisezwie bel, Schalotte, Lauch, Knoblauch, Schnittlauch , Winterhecke nzwiebel, Bärlauch)	633	XXX	K65	1	0,415	633X XX	0,415		
364	Beihilfefähig e Ackerstreife n an Waldränder n (ÖVF)	054	XXX	K40	0	1	054X XX	0,5		
365	Bewirtschaft ete Teichfläche n	930	XXX		0	0,001	930X XX	0,001		
366	Brachliegen de Flächen (ÖVF)	062	XXX	K40	0	0,001	062X XX	0,001		
367	Landwirtsch aftliche Lagerung (z. B. unbefestigte Mieten, Stroh-, Futter- und Dunglagerpl ätze (max. 3 Jahre)) auf Ackerland	996	XXX		0	0,001	996X XX	0,001		
368	Maximal 3 Jahre nichtlandwirt schaftlich genutzte Fläche (z. B. Holzlager)	990	XXX		0	0,001	990X XX	0,001		

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

	/Ackernutzung)								
391	Streuwiesen (Streu-/Futternutzung)	458	XXX	1	1	-0,065		458X XX	- 0, 06 5
392	Weiden	453	XXX	1	1	-0,065	0,004	453X XX	- 0, 06 5
393	Wiesen (einschl. Streuobstwiesen)	451	XXX	1	1	-0,065		451X XX	- 0, 06 5
394	Silomais mit Blühstreifen/Bejagungsschneisen	410	XXX	0	0	0,252		410X XX	0, 25 2
395								combin_41001&42001	41002 42001
396									43002 42001 1100
397									43001 42001 1010
398									43001 42001 1020
399		41003	AX_Halde		0			41003	0, 5
400								43007 42001	0, 5

Table 15 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 Tillage Research* 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.