

**Overlay of Copernicus HRL data layers with current European High Nature Value estimate (2012): technical summary on use of HRLs on grassland (GRA), tREE cover density (tcd) and water anD wetness (waw), and imperviousness (IMP)**

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## INTRODUCTION

This brief paper is part of a set of technical documents that review options for improving the EU-level methodology for estimating the distribution and trend of High Nature Value (HNV) farmland established by JRC and EEA during the course of 2005-08. Increased information about HNV farmland and newly available data sets, allow the JRC and the EEA to update the existing methodology. The ongoing methodological review aims to combine the land cover approach with farming activity data sets and high-resolution satellite data to better represent agricultural land use intensity and landscape structures.

This technical paper summarizes work by ETC/ULS partners (in particular GISAT, CZ) that analysed the potential of High Resolution Layers (HRLs) for a possible update and fine-tuning of the JRC/EEA HNV farmland estimate. The analysis took two different approaches:

1. exclusion of areas that were incorrectly included (mostly based on geometric refinement)
2. inclusion of areas in the CLC estimate of HNV farmland estimated that were wrongly excluded for thematic or geometric reasons

Four currently available HRLs were included in the analysis: Tree Cover Density (TCD), Grassland (GRA), Water and Wetness (WAW) and Imperviousness (IMP). A summary of all analytical layers used for the study can be found in Table 8 in the annex. The analysis was done by either looking at a single HRL layer in relation to CLC data or by combining different HRLs to better identify likely areas for inclusion in, or exclusion from, the current HNV layer. As shown in Table 1, the CLC classes level 3 were therefore used in combination with either one or combined HRLs, depending on the conclusiveness of the different HRL data sets.

Table 1 Examples of possible inclusion and exclusion to current HNV layer

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **HRL** | | | | | **indicating** |
| **Possible exclusion from HNV layer** |  |  | WAW  (perm. water) |  |  |  |  | water surface |
| IMP |  |  |  |  | sealed surfaces |
| **CLC** | **Level 3** |  |  | TCD |  |  | no agricultural use |
| **Possible inclusion in HNV layer** | **CLC** | **Level 3** | WAW  (temp. wet) | and | TCD <30 | and | GRA | extensiveagricultural use |

For exclusion, HRL WAW and HRL IMP provide clear cases of areas that are not under agricultural land use and that therefore can be removed from the HNV layer. Since IMP is a continuous measure of sealed surface area in a given grid cell, the approach to be employed requires the selection of a relevant threshold (which has been set at 30%). From HRL WAW areas representing permanent water are used for exclusion.

The other HRLs, i.e. TCD, GRA and temporary WAW, need to be used in combination and in relation to CLC classes to provide a meaningful interpretation of likely HNV status. They represent patterns that cannot simply be “added or removed” from/to the HNV layer. By combining various TCD percentiles in combination with different types of CLC classes (representing fairly uniform agricultural use or mixed landscape types) areas that are unlikely to be farmland are indicated. As such areas are not of relevance for HNV farmland, these are foreseen to be excluded in the update of the HNV ‘map’.

For inclusion, the overlap of the Temporal WAW component with Grassland HRL represents temporary wet areas, which may indicate low intensity grassland areas outside the current HNV ‘map’. They might be of high relevance for inclusion to the HNV layer.

The following sections set out some key examples for those approaches taken in this analysis and provide a summary that describes the sets of decision rules for using HRL data sets for improving the current HNV farmland layer.

## EXCLUSION OF HRL WAW

This section discusses the possible exclusion of areas identified by the HRL WAW from the current HNV layer. As permanent water is obviously not related to HNV farmland, areas which are part of HRL WAW Permanent Water should be removed from the current HNV ‘map’. Further WAW components as Temporary water and Temporary wetness are also considered.

An example of the analysis is given in Figure 1, describing the structure and composition of WAW within the current HNV CLC estimate. The higher the Permanent water share, the larger the area potentially to be removed from areas classified as HNV. The share of Permanent Water reaches maximal 3% in some countries, but mostly has a much smaller share. Thus, the HNV area potentially to be excluded due to the Permanent water WAW HRL is rather limited - both in relative shares and absolute extent. The exclusion of permanent water areas from the existing HNV layer can therefore be considered as having a low impact even though not negligible.

On the other hand, Temporal Wet (i.e. the temporary Water and Wetness components of WAW) areas inside HNV are less likely proper exclusion candidates, as temporarily wet areas are often a component of extensively farmed land. Such areas are mostly covered by CLC classes 322 (Moors and heathland), 242 (Complex cultivation patterns) and 243 (Land principally occupied by agriculture, with significant areas of natural vegetation), all of which are potential HNV farmland areas.

**Figure 1 Percentage distribution of HRL permanent WAW Classes per country within HNV**

## EXCLUSION OF HRL IMP

The non-suitability of impervious areas within the current HNV mask for farming purposes provides a clear case for exclusion, such that no additional combinations with other HRLs are needed. It is proposed, therefore, to exclude areas identified by HRL IMP with a threshold of >30% from the future JRC/EEA HNV farmland estimate.

## APPLICATION OF HRL TCD

Discussed here is the use of HRL TCD for identifying areas with high tree coverage like forest patches. They represent abandoned or not farmed areas and can thus not be considered to be part of HNV farmland. Given the complexity of capturing such trends in relation to different types of CLC classes (representing fairly uniform agricultural use or mixed landscape types) different thresholds were tested.

As shown in Figure 2, there is a significant share of areas with medium (30-80%) or high (>80%) TCD in the current HNV layer. These areas may have a large share of forest areas instead of farmland and need to be considered for exclusion. A comparison of different thresholds has been used for the possible exclusion of areas. Thresholds of 30% and 70% TCD were finally settled on as the most relevant ones for the two types of CLC classes mentioned above. As seen in Figure 2, the higher the High and Medium share, the larger the area potentially to be excluded from the HNV layer. Given the high share of these TCD categories in some countries the uniform use of a 30% threshold would lead to a significant amount of HNV areas to be excluded.

 Figure 2 Percentage distribution of HRL TCD density classes per country within HNV layer

On the other hand, a 70% threshold affects only a limited area, though it might represent highly relevant areas, such as forest patches. However, by choosing a rather high threshold, areas with little current agricultural use and unlikely to be of importance for HNV are excluded. Generally, only a small share of HNV farmland would be affected.

The final proposed solution was to apply different thresholds to different CLC classes found inside the HNV layer. CLC classes for which the >30% TCD is applied are rather uniform classes and classes that are expected to have no or little tree cover, e.g. 231 (Pastures) and 322 (Moors and heathland). Whereas a >70% TCD threshold was applied to CLC classes that contain mainly heterogeneous areas including shrubs and herbaceous vegetation, e.g. 243 (Land principally occupied by agriculture, with significant areas of natural vegetation), or represent mixed agricultural landscapes, such as 242 (Complex cultivation patterns). For CLC class 324 (Transitional woodland shrub) the threshold is proposed to be 50%.

## APPLICATION OF HRL GRA

This section discusses the possible use of HRL GRA for inclusion of areas that were so far not identified as potential HNV farmland areas by the CLC selection rules. A case for exclusion cannot be derived from the single application of GRA as it does not provide any thematically specific information, such as grassland vegetation structure or species richness, that would allow its use for judging whether individual grassland patches have HNV characteristics. HRL GRA is therefore used in combination with other HRLs, in particular Temporal WAW and TCD to identify grassland patches for potential inclusion.

### Inclusion of HRL Grassland

HRL Grassland represents a potentially relevant data source for a possible HNV update as it provides geometrically much more accurate information about the distribution of grassland areas than the related CLC classes (231 and 321). However, the actual land use of areas included in the HRL GRA definition can vary significantly and no further specification between extensive and intensive grassland is provided. Thus, not all areas within HRL GRA will be relevant to the HNV concept. Since the HRL does not yield biodiversity-relevant information on its own, combinations with other HRLs and CLC classes are needed to discuss a possible inclusion.

### Inclusion of HRL Grassland AND Temporal WAW

By overlapping HRL GRA with the Temporal wet component of WAW an analysis of occurrences of this combination outside the current HNV estimate can be made. These areas are often covered by CLC classes not or only partly declared as HNV, e.g. in Sweden Class 322 (Moors and heathland) and 324 (Transitional woodland-shrub) are not considered HNV farmland. Given the fact, that extensive grazing might take place on those areas, they represent potential candidates for the extension of the current HNV area estimate. Likewise, class 211 (Non-irrigated arable land) is not declared HNV in many countries. However, due to the Minimal mapping Unit (MMU) of 25 ha, small areas of temporary wet grassland are often included in CLC 211. As shown in Figure 3, the relative share of overlaps between HRL GRA and Temporal wet WAW outside HNV differ significantly in the different countries, reaching a share of up to 58% of grassland in Temporal wet WAW. Therefore, this inclusion is considered relevant for the foreseen update of the JRC/EEA HNV approach.

**Figure 3 Relative share of HRL GRA in Temporary wet WAW outside current HNV per country**

## SUMMARY AND CONCLUDING RECOMMENDATIONS

This section summarizes and compares the most promising options for updating the JRC/EEA HNV farmland area estimate by using different HRL data sets. A full overview of potential areas for exclusion is described in Table 6 in the annex, while areas to be included are listed in Table 7 in the annex, structured according to the most relevant CLC classes.

Discussed here are the candidates with the highest significance, also summarized in Tables 2 to 4. For each category the proposed condition or threshold for relevant HRLs are indicated. For some of the CLC classes a stepwise threshold is given to compare the influence of most relevant TCD threshold levels. Additionally, the total area in km2 and the percentage impact compared to current total HNV area are provided. Tables 6 and 7 provide further detail and additional notes estimating its marginable (M), negligible (N) or significant (S) significance, based on the percentage of share to be removed from or included in the current HNV farmland estimate. Negligible and marginable areas are for efficiency reasons proposed to be disregarded.

Please note that the proposed exclusion of HRL IMP in the future HNV layer with a threshold of >30% (indicating areas unlikely to be farmland) is not summarized in the tables, nor further discussed in this section.

*Exclusion of areas based on HRL Permanent water WAW*

In most CLC classes, areas inside HNV farmland covered by permanent water are either negligible or marginal (see table 6 in annex), though obviously not used as farmland. However, as summarized in table 2, for certain classes significant proportions of permanent water are proposed to be excluded in the future update of the JRC/EEA HNV farmland area estimate.

Table 2 Summary of Exclusion candidates when HRL Permanent water WAW

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Level 1** | **Level 2** | **CLC** | **Level 3** | **WAW** | | | |
| **WAW** | **Total Area (km2)** | **% of HNV** | **Exclusion of WAW** |
| Agri cultural areas | Arable land | 211 | Non-irrigated arable land | perm. water | 582 | 0.07 | √ |
| 213 | Rice fields | perm. water | 919 | 0.1 | √ |
| Permanent crops | 222 | Fruit trees & berry plantations | perm. water | 53 | 0.01 | √ |
| 223 | Olive groves | perm. water | 12 | 0 | √ |
| Pastures | 231 | Pastures | perm. water | 2588 | 0.29 | √ |
| Heterogeneous agricultural areas | 241 | Annual crops associated with permanent crops | perm. water | 3 | 0 | √ |
| 242 | Complex cultivation patterns | perm. water | 599 | 0.07 | √ |
| 243 | Land principally occupied by agriculture, with significant areas of natural vegetation | perm. water | 1918 | 0.21 | √ |
| Forest and semi natural areas | Scrub and/or herbaceous vegetation associations | 322 | Moors and heathland | perm. water | 23934 | 2.68 | √ |
| 323 | Sclerophyllous vegetation | perm. water | 80 | 0.01 | √ |
| 324 | Transitional woodland-shrub | perm. water | 333 | 0.04 | √ |
| Open spaces with little or no vegetation | 333 | Sparsely vegetated areas | perm. water | 1407 | 0.16 | √ |
| Wet lands | Inland wetlands | 411 | Inland marshes | perm. water | 2462 | 0.28 | √ |
| 412 | Peat bogs | perm. water | 8792 | 0.98 | √ |
| Maritime Wetlands | 421 | Salt Marshes | perm. water | 904 | 0.1 | √ |

*Exclusion of areas based on HRL TCD:*

As discussed above, different thresholds for TCD were tested in this analysis. Table 3 shows an overview of the CLC classes and the corresponding TCD threshold proposed to be excluded. The full list can be found in Table 6 in the annex. For CLC classes naturally containing a higher share of trees as part of their land cover, e.g. 243 or 324, higher thresholds of >50%/>70% or >80% are proposed. In CLC classes like 321 or 322, where woody vegetation likely indicates abandonment, areas with a threshold of >30% are suggested to be excluded from a future update of the HNV area estimate.

The areas concerned are often in upland regions, though no pattern for environmental zones stratification is recognizable. In case of CLC 242 (Complex cultivation patterns) countries with typical complex landscapes are mainly affected, namely areas of Balkan, Romania, Poland and South France. On the other hand, the geographic extent for 243 is more widespread, but still focused on southern Europe.

As a relevant aspect regarding tree and forest formations also the patch size was considered (small landscape elements as a symptomatic component of HNV farmland vs. large patches as not cultivated/grazed land). However rather than the patch size itself, additional characteristics are needed (e.g. proximity to forest). The upcoming HRL Small Woody Features may be of relevance, once available.

Table 3 Summary of Exclusion candidates when HRL TCD>30-50% and their possible impact on future HNV area estimates (S=significant)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **TCD** | | | | |
| **Level 2** | **CLC** | **Level 3** | **TCD** | **Total Area (km2)** | **% of HNV  (without TR)** | **Exclusion of TCD** | **Comments for TCD** |
| Pastures | 231 | Pastures | >30 | 23128 | 2.59 | √ | **S** |
| Heterogeneous agricultural areas | 243 | Land principally occupied by agriculture, with significant areas of natural vegetation | *>50* | *31670* | *3.54* | not applied | **S** |
| *>60* | *22282* | *2.49* | not applied | **S** |
| >70 | 13667 | 1.53 | √ | **S** |
| Scrub and/or herbaceous vegetation associations | 321 | Natural grasslands | >30 | 12764 | 1.43 | √ | **S** |
| 322 | Moors and heathland | >30 | 29787 | 3.33 | √ | **S** |
| 324 | Transitional woodland-shrub | >50 | 13805 | 1.54 | **√** | **S** |

*Inclusion of areas based on combination of HRL Temporal wetness WAW and HRL TCD<30% and HRL GRA:*

From the Inclusion perspective, Grassland from HRL with an overlap of Temporal wet WAW areas outside current HNV farmland are potential candidates. Such patches often occur in CLC classes which are not or only partly declared as HNV by the countries. . The affected CLC classes are 242, 243 and 322 (which are generally extensively managed), but also class 211. Despite the fact that class 211 (non-irrigated arable land) is not considered HNV in many countries, it may contain small areas of temporary wet and grassland areas that are not visible in CLC due to the MMU of 25 ha. Generally, all these candidates cover rather negligible small areas with less than 0.1% of total HNV area, as indicated in Table 4. A statistical review with regards to mountain areas or bio-geographical areas did not show any relevant patterns.

On the other hand, HRL GRA shows a high share outside of the current HNV mask for some countries, so it was decided to consider also negligible areas for future inclusion. In this regard it is important to consider that only grassland patches which are mixed with generally extensively used CLC classes are naturally relevant to the HNV concept However, the inclusion of a grassland patches inside CLC 211 is a different case, as grassland patches within arable land are expected to be often used intensively or to be abandoned. It is proposed, therefore, to include such grassland patches only as potential medium nature value areas (MNV) in the overall HNV estimate.

**Table 4 Summary of Inclusion candidates when HRL temporal WAW and HRL GRA or TCD (N=Negligible)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CLC** | **Level 3** | **WAW** | **AND/OR** | **TCD** | **AND/OR** | **GRA** | **Total area (km2)** | **% of HNV** | **Comment** | **Mainly affected** |
| (without TR) |
| 211 | Non-irrigated arable land | temp. wet | and | < 30 | and | 1 | 613 | 0.07 | **N** | SW, NO, PO, UK, FI |
| 242 | Complex cultivation patterns | temp. wet | and | < 50 |  |  | 225 | 0.03 | **N** |  |
| 243 | Land principally occupied by agriculture, with significant areas of natural vegetation | temp. wet | and | <50 |  |  | 215 | 0.02 | **N** |  |
| 322 | Moors and heathland |  |  | < 30 | and | 1 | 907 | 0.1 | **N** |  |

*Summary of final proposal:*

Concluding, the proposed changes to the current HNV layer can be summarised as follows:

1. Exclusion of HRL permanent water and HRL IMP with a threshold >30%.
2. For HRL TCD proposed exclusions relate to high tree cover density applied with different thresholds in different types of CLC classes (see Table 5).
3. Inclusions, where a combination of HRL GRA, TCD and Temporary WAW indicates likely extensive use leading to probable presence of high nature value (see Table 5).
4. Inclusion as medium nature value in the case of a combination of Temporary WAW and GRA in class 211 (due to higher probability of intensive or abandoned use of such patches).

Table 5 Summary of proposed exclusion and inclusion rules due to HRL

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CLC** | **Class** | **Exclusion rules for TCD** | **Inclusion** | |
| **Inclusion rules** | **Intensity**  **level** |
| 211 | Non-irrigated arable land |  | WAW = temp. wet AND TCD < 30 AND GRA = 1 | 2 (medium) |
| 213 | Rice fields |  |  |  |
| 221 | Vineyards |  |  |  |
| 222 | Fruit trees and berry plantations |  |  |  |
| 223 | Olive groves |  |  |  |
| 231 | Pastures | exclusion when TCD > 30 % |  |  |
| 241 | Annual crops associated with permanent crops |  |  |  |
| 242 | Complex Cultivation pattern | exclusion when TCD > 70 % | WAW = temp. wet AND TCD < 50 | 1 (low) |
| 243 | Land principally occupied by agriculture, with significant areas of natural vegetation | exclusion when TCD > 70 % | WAW = temp. wet AND TCD < 50 | 1 (low) |
| 321 | Natural grassland | exclusion when TCD > 30 % |  |  |
| 322 | Moors and heathland | exclusion when TCD > 30 % | TCD < 30 AND GRA = 1 | 1 (low) |
| 323 | Sclerophyllous vegetation |  |  |  |
| 324 | Transitional woodland-scrub | exclusion when TCD > 50 % |  |  |
| 333 | Sparsely vegetated areas |  |  |  |
| 411 | Inland marshes |  |  |  |
| 412 | Peat bogs |  |  |  |
| 421 | Salt marshes |  |  |  |

The following overall conclusions can be drawn:

* The HRL layers have been useful in refining the current JRC/EEA HNV farmland estimate, both by adding geometric precision (e.g. via exclusion of sealed areas via the HRL IMP) and by additional thematic information (e.g. via the HRLs GRA and WAW combined)
* The refinement approach has used both exclusion and inclusion based on different HRLs, and targeted on selected CLC classes in most cases.
* Exclusion leads to the majority share of corrections (around 6.5% of the original HNV area estimate), based mainly on geometric exclusion of areas due to substantial presence of trees (.e. TCD), sealed areas (IMP) and permanent water (WAW), which were excluded if they passed certain thresholds (variable, decided based on expert judgement and statistical tests).
* The use of inclusion is more difficult as it requires the combination of various HRLs based on agronomic and ecological assumptions, and leads to far less area change.
* Future HRLs can further improve the utility of this approach, in particular the Small Woody Features (SWF) HRL.

## ANNEX

Table 6 Overview of Exclusion candidates and their possible impact on HNV update (N=negligible, M=Marginal, S=significant)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **WAW** | | | | | **TCD** | | | | | | |
| **Level 1** | **Level 2** | **CLC** | **Level 3** | **WAW** | **Total Area (km2)** | **% of HNV** | **Exclusion of WAW** | **AND/OR** | **TCD** | **Total Area (km2)** | **% of HNV  (without TR)** | **Exclusion of TCD** | **Comments for TCD** | **Mainly affected** |
| Agri cultural areas | Arable land | 211 | Non-irrigated arable land | perm. water | 582 | 0.07 | √ | or | >30 | 1926 | 0.22 |  | **M** |  |
| 213 | Rice fields | perm. water | 919 | 0.1 | √ | or | >30 | 34 | 0 |  | **N** |  |
| Permanent crops | 221 | Vineyards | perm. water | 29 | 0 |  |  |  |  |  |  |  |  |
| 222 | Fruit trees & berry plantations | perm. water | 53 | 0.01 | √ |  |  |  |  |  |  |  |
| 223 | Olive groves | perm. water | 12 | 0 | √ |  |  |  |  |  |  |  |
| Pastures | 231 | Pastures | perm. water | 2588 | 0.29 | √ | or | >30 | 23128 | 2.59 | √ | **S** | FR, RO, PO, DE, AT |
| Heterogeneous agricultural areas | 241 | Annual crops associated with permanent crops | perm. water | 3 | 0 |  | or | >50 | 344 | 0.04 |  | **N** | IT, PT, ES, CY, ME |
| √ | >60 | *219* | *0.02* |  | **N** |  |
|  | >70 | *109* | *0.01* |  | **N** |  |
|  | >80 | *35* | *0* |  | **N** |  |
| 242 | Complex cultivation patterns | perm. water | 599 | 0.07 |  | or | >50 | 5006 | 0.56 |  | **M** | BE, FR, IT, HR, RO |
| √ | *>60* | *3127* | *0.35* |  | **M** |  |
|  | *>70* | *1685* | *0.19* |  | **M** |  |
|  | *>80* | *624* | *0.07* |  | **N** |  |
| 243 | Land principally occupied by agriculture, with significant areas of natural vegetation | perm. water | 1918 | 0.21 |  | or | >50 | 31670 | 3.54 |  | **S** | IT, NO, FR, BG, GR |
| √ | *>60* | *22282* | *2.49* |  | **S** |  |
|  | *>70* | *13667* | *1.53* | √ | **S** |  |
| 244 | Agro-forestry areas | perm. water | 19 | 0 |  |  |  |  |  |  | no TCD threshold |  |
| Forest and semi natural areas | Scrub and/or herbaceous vegetation associations | 321 | Natural grasslands | perm. water | 2002 | 0.22 |  | or | >30 | 12764 | 1.43 | √ | **S** | ES, FR, IT, RO, BG |
| 322 | Moors and heathland | perm. water | 23934 | 2.68 | √ | or | >30 | 29787 | 3.33 | √ | **S** | NO, ES, FR, PT, IT |
| 323 | Sclerophyllous vegetation | perm. water | 80 | 0.01 | √ |  |  |  |  |  | no TCD threshold |  |
| 324 | Transitional woodland-shrub | perm. water | 333 | 0.04 | √ | or | >50 | 13805 | 1.54 | **√** | **S** |  |
| Open spaces with little or no vegetation | 333 | Sparsely vegetated areas | perm. water | 1407 | 0.16 | √ | or | >30 | 1642 | 0.18 |  | **M** | IT, NO, AL, ES, FR |
| Wet-lands | Inland wetlands | 411 | Inland marshes | perm. water | 2462 | 0.28 | √ |  |  |  |  |  |  |  |
| 412 | Peat bogs | perm. water | 8792 | 0.98 | √ |  |  |  |  |  |  |  |
| Maritime Wetlands | 421 | Salt Marshes | perm. water | 904 | 0.1 | √ |  |  |  |  |  |  |  |

Table 7 Overview of Inclusion candidates and their possible impact on HNV update (N=negligible, M=Marginal, S=significant)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Level 1** | **Level 2** | **CLC** | **Level 3** | **WAW** | **AND/OR** | **TCD** | **AND/OR** | **GRA** | **Total area (km2)** | **% of HNV** | **Comment** | **Mainly affected** |
| (without TR) |
| Agricultural areas | Arable land | 211 | Non-irrigated arable land | temp. wet | and | < 30 | and | 1 | 613 | 0.07 | **N** | SW, NO, PO, UK, FI |
| 213 | Rice fields |  |  |  |  |  |  |  |  |  |
| Permanent crops | 221 | Vineyards |  |  |  |  |  |  |  |  |  |
| 222 | Fruit trees & berry plantations |  |  |  |  |  |  |  |  |  |
| 223 | Olive groves |  |  |  |  |  |  |  |  |  |
| Pastures | 231 | Pastures | temp. wet | and | < 30 |  |  | 685 | 0.08 | **N** | DE, UK, IR, FR, LV |
| Heterogeneous agricultural areas | 241 | Annual crops associated with permanent crops | temp. wet | and | < 50 |  |  | 1 | *0* | **N** |  |
| 242 | Complex cultivation patterns | temp. wet | and | < 50 |  |  | 225 | *0.03* | **N** |  |
| 243 | Land principially occupied by agriculture, with significant areas of natural vegetation | temp. wet | and | <50 |  |  | 215 | *0.02* | **N** |  |
| 244 | Agro-forestry areas |  |  |  |  |  |  |  |  |  |
| Forest and semi natural areas | Scrub and/or herbaceous vegetation associations | 321 | Natural grasslands | temp. wet | and | < 30 | and | 1 | 18 | 0 | **N** | SW, UK, NL |
| 322 | Moors and heathland |  |  | < 30 | and | 1 | 907 | 0.1 | **N** |  |
| 323 | Sclerophyllous vegetation |  |  | < 30 | and | 1 | 262 | 0.03 | **N** | Only southern Europe |
| 324 | Transitional woodland-shrub |  |  | < 30 | and | 1 | 6011 | 0.67 | **M** | SW, ES, IT, FI, FR |
| Open spaces with little or no vegetation | 333 | Sparsely vegetated areas |  |  | < 30 | and | 1 | 935 | 0.1 | **N** | mainly Alps, Scandinavian mountains, Dinaric Alps |
| Wetlands | Inland wetlands | 411 | Inland marshes |  |  | < 30 | and | 1 | 34 | 0 | **N** | Danube Delta |
| 412 | Peat bogs |  |  | < 30 | and | 1 | 61 | 0.01 | **N** | IR, GB |
| Maritime wetlands | 421 | Salt marshes |  |  | < 30 | and | 1 | 2 | 0 | **N** |  |

Table 8 Summary of analytical layers used for the study including HNV, HRL, CLC and ancillary layers (all included as JEDI dimension within EEA CWS)

|  |  |  |  |
| --- | --- | --- | --- |
| **HRL's (all part of testing HNV\_HRL\_cube, 1km)** |  |  |  |
|  |  |  |  |
| **GRA** | **HRL Grassland** | categorical, binary | 0/1 |
| *GRASSLAND - GRA\_2015\_100m\_eu\_03035\_V1\_2.tif TIF 100m* |  |  |  |
| *Grassland (1)/noGrassland(0)* |  |  |  |
|  |  |  |  |
| **IMP** | **HRL Imperviousness** | continuous | 0-100 |
| *IMD\_2015\_100m\_eu\_03035\_d02\_full.tif TIF 100m* |  |  |  |
| *Degree of imperviousness* |  |  |  |
| *Ranges: 0 NoSealing, 1-10 Lowest density, 10-30 Low density, 30-80 Medium density, 80-100 High density* | | | |
|  |  |  |  |
| **TCD** | **Tree Cover Density** | continuous | 0-100 |
| *TCD\_2015\_100m\_eu\_03035\_d04\_full.tif TIF 100m* | | | |
| *Tree Canopy coverage* |  |  |  |
| *Ranges: 0 NoForest, 1-10 Lowest density, 10-30 Low density, 30-80 Medium density, 80-100 High density* | | | |
|  |  |  |  |
| **WAW** | **Water and Wetness** | categorical | 0-4 |
| *WAW\_2015\_100m\_eu\_03035\_d02\_full.tif TIF 100m* | | | |
| *NoWater/Wet (0), Permanent Water(1), Temporary Water(2), Permanent Wetness(3), Temporary Wetness(4)* | | | |
|  |  |  |  |
| **HNV** | **High Nature Value farmland** | categorical, binary | 0/1 |
| *hnv-farmland-100m\_ac\_2012.tif TIF 100m* | | | |