# Potential use of Riparian Zones to map and monitor vegetation along streams and waterways

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Photo: W. Dramstad

# Vegetation along streams and waterways

- Transitional areas between land and freshwater
- Distinctive hydrology, soil and biotic conditions
- Strongly influenced by the water and its flow
- Ecosystem services
  - flood control
  - bank stabilization
  - chemical filtration
  - habitat for wildlife
  - recreation

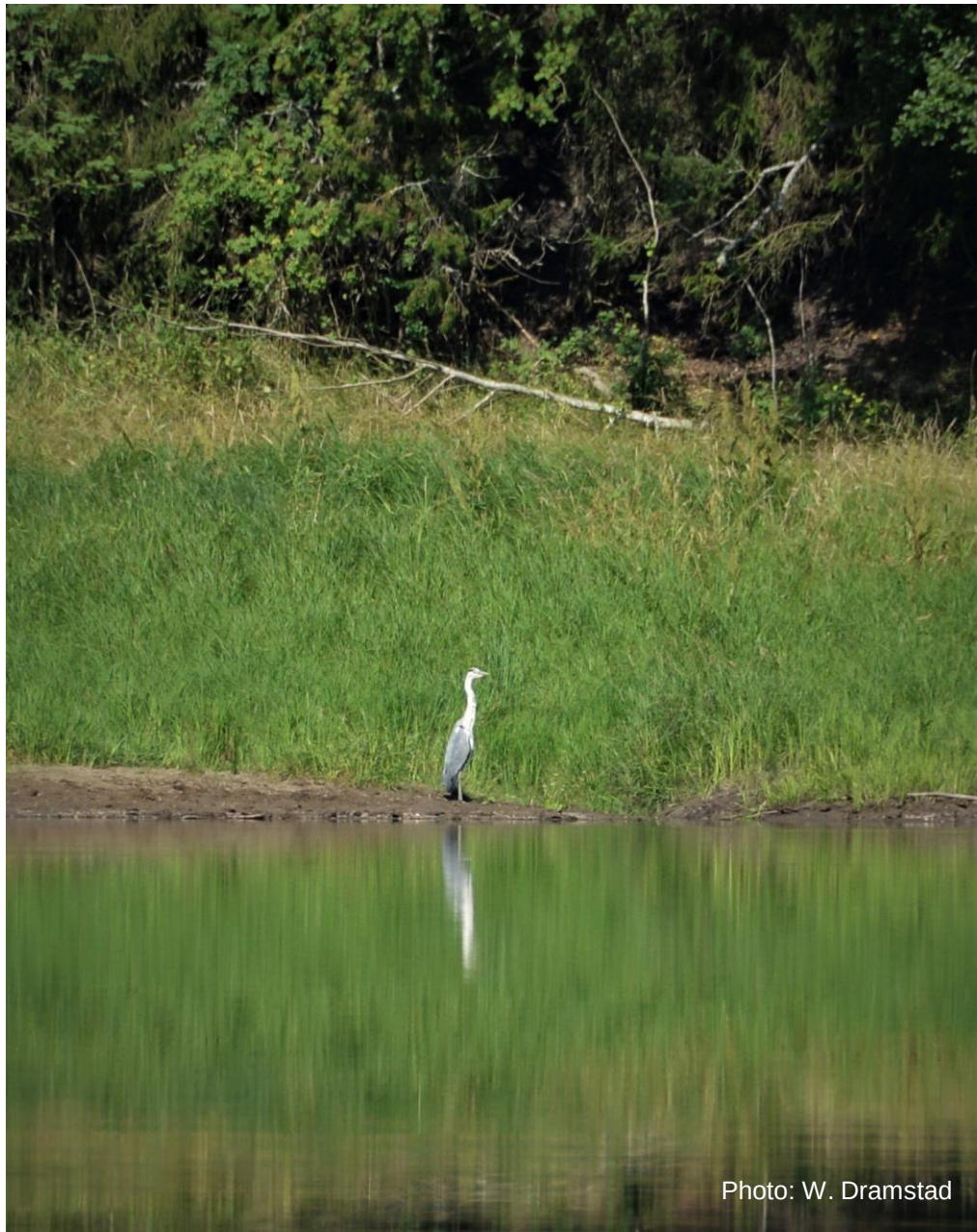
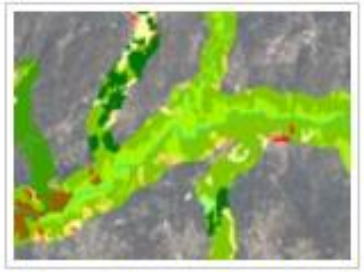


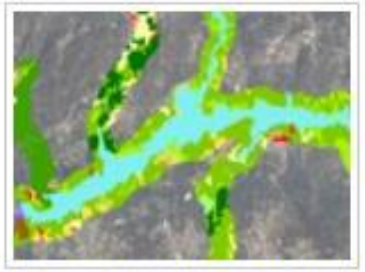
Photo: W. Dramstad

# Vegetation along streams and waterways

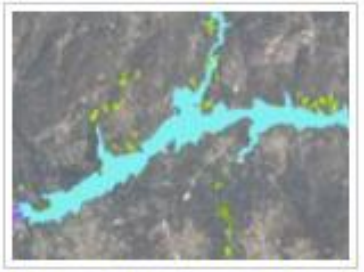
## Riparian Zones (RZ)



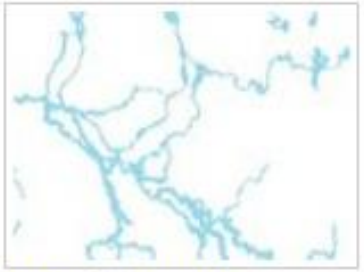
RZ Land Cover/ Land Use 2012



RZ Land Cover/ Land Use 2018



RZ Land Cover/ Land Use Change 2012-2018



Delineation of Riparian Zones

Copernicus Priority Area Monitoring product

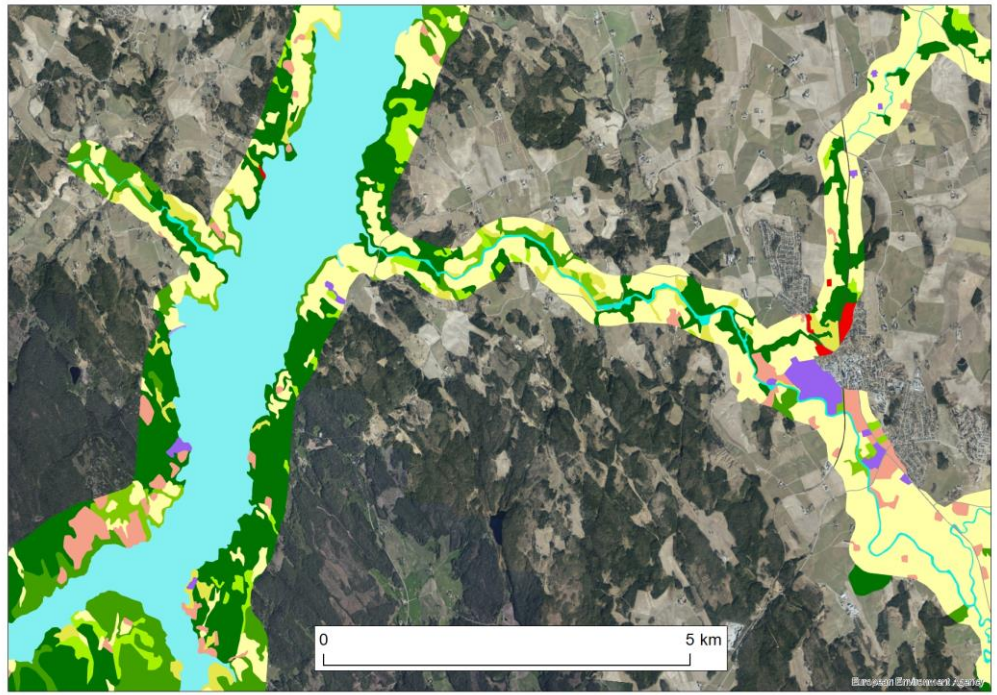
Aims to support the objectives of European legal acts and policy initiatives:

- EU Biodiversity Strategy
- Habitats and Birds Directives
- Water Framework Directive

# Methods

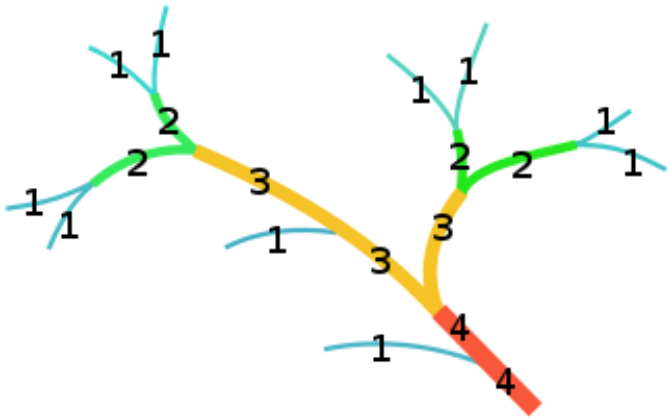
- **Riparian Zones** (RZ) and change between 2012 and 2018
- verify and assess relevance for environmental monitoring

  - aerial photos from 2012 & 2018
  - overlay RZ 2018 with national datasets
    - Norway: AR18x18 sample squares mapped in the field
    - Poland: topographic map BDOT10K and LUCAS
  - national flood maps
  - Small Woody Features (Poland)
  - Assess relevance of RZ for monitoring in relation to policies
  - Report: Deliverable 5.2 (available on request)



# Vegetation along streams and waterways

- Riparian LC/LU based on 2.5 m spatial resolution satellite imagery from ESA Data Warehouse
- MMU 0.5 ha
- 55 thematic classes, harmonized with MAES, Corine & NATURA 2000
- Zones modelled around Strahler level 2-9 rivers (derived from EU-Hydro)




| Riparian Zones 2018 classes | | Poland | | Norway | |
|---|---|---|---|---|---|
| | | Area (km²) | Percentage | Area (km²) | Percentage |
| 1. | Urban | 3 195 | 8.8 | 1 047 | 2.6 |
| 2. | Cropland | 9 834 | 27.1 | 2 499 | 6.2 |
| 3. | Woodland and forest | 7 674 | 21.2 | 16 175 | 40.3 |
| 4. | Grassland | 11 004 | 30.3 | 545 | 1.4 |
| 5. | Heathland and scrub | 11 | 0.0 | 4 126 | 10.3 |
| 6. | Open spaces with little or no veg. | 45 | 0.1 | 2 382 | 5.9 |
| 7. | Wetland | 1 128 | 3.1 | 2 535 | 6.3 |
| 8. | Water | 3 365 | 9.3 | 10 877 | 27.1 |
| | | Sum 36 257 | | Sum 40 186 | |

# Comparing RZ with national ortophotos

## RZ change layer from 2012 to 2018

2012 8100: Natural and semi-natural water courses

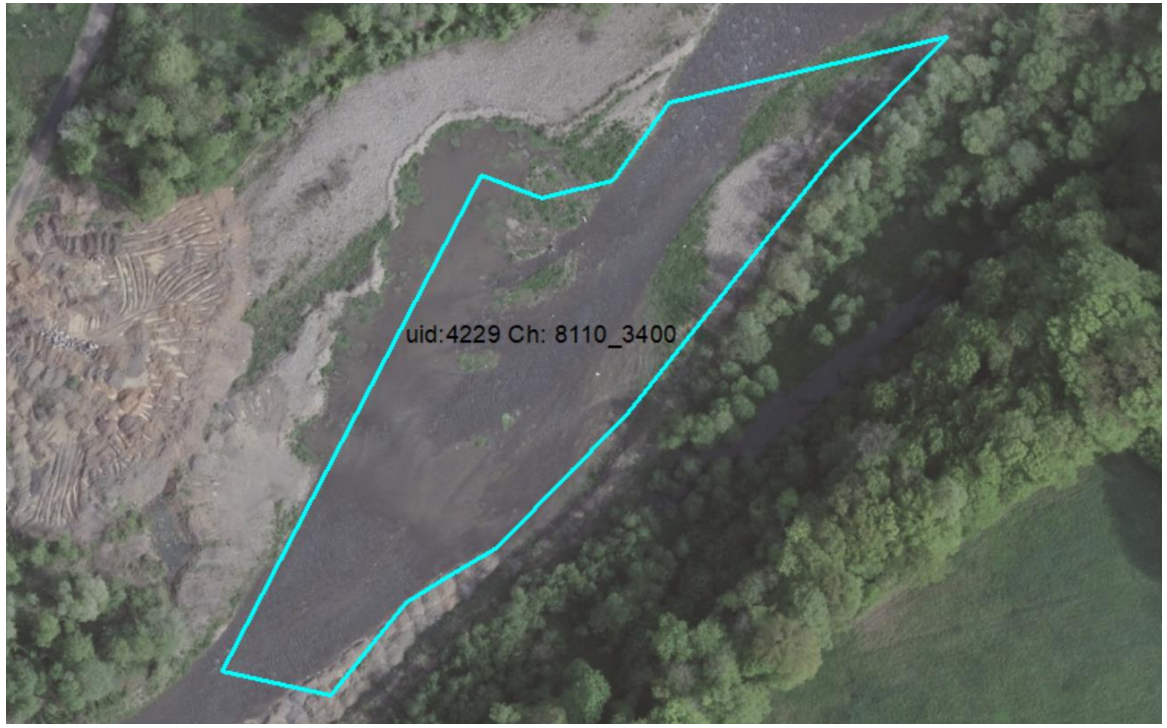

2019 3.400 Transitional woodland and scrub


Aerial photos from 2012 do not agree with the RZ change

# Comparing RZ with national ortophotos

## RZ change layer from 2012 to 2018

2013 8100: Natural and semi-natural water courses




2019 3.400 Transitional woodland and scrub


Aerial photos from 2013 are a better match with the RZ change

## Lack of time stamp makes verification difficult

# Example: a meandering river

1. Change of **riverbanks (6220)** into **transitional woodland and scrub (3400)**

| 2013 | 2017 | 2018 | 2019 |
|---|---|---|---|
|  |  |  |  |
| Delineation: partially correct<br>Classification: partially correct | Delineation: correct<br>Classification: correct | Delineation: partially correct<br>Classification: incorrect | Delineation: incorrect<br>Classification: incorrect |



- No photo available from 2012
- Based on 2013 photo, the polygon delineation and classification are partly correct (but include water)
- In the 2018 photo, the change is to bare ground rather than scrub
- The 2017 situation is a better match, although the area marked as change looks more like rough grassland than scrub

# Accuracy of LC/LU in the Riparian Zones

**Producer accuracy**: how often features in the national dataset are correctly shown on the RZ map.

- when features in the national dataset are <u>not</u> in the correct class on the RZ map, this is omission error

**User accuracy**: how often the class on the RZ map is present in the national dataset.

- when the RZ map shows a feature that is <u>not</u> in the national dataset, this is commission error.

| Riparian Zones 2018 (RZ 2018) | LUCAS | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Artificial Land (A00) | Cropland (B00) | Woodland (C00) | Shrubland (D00) | Grassland (E00) | Bare land and lichens/ moss (F00) | Water areas (G00) | Wetlands (H00) | |
| Urban | 139 | 15 | 41 | 3 | 108 | 13 | 2 | 0 | 321 |
| Cropland | 18 | 565 | 21 | 5 | 168 | 11 | 1 | 2 | 791 |
| Woodland and forest | 7 | 7 | 394 | 9 | 43 | 0 | 2 | 6 | 468 |
| Grassland | 17 | 58 | 63 | 30 | 573 | 3 | 8 | 58 | 810 |
| Heathland and scrub | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Open spaces with little or no vegetation | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 3 |
| Wetland | 1 | 0 | 6 | 2 | 37 | 0 | 3 | 33 | 82 |
| Water | 2 | 0 | 2 | 0 | 7 | 1 | 76 | 4 | 92 |
| Total | 184 | 645 | 528 | 49 | 939 | 28 | 92 | 103 | 2568 |

Eg. Urban:
PA = 139 of 184 = 76 %
UA = 139 of 321 = 43 %

# Accuracy of LC/LU in the Riparian Zones

- Both Poland and Norway: Good accuracy for Water, Cropland and Woodland/forest.
- Misclassifications between Cropland and Grassland are understandable: managed grassland can be similar to cultivated forage crops.
- Urban was overestimated in RZ (high commission error): misclassification of the most common land type (Grassland in Poland, Woodland/forest in Norway).
- At a detailed level in Poland, Mineral extraction and Green urban were very much underestimated.
- For both: very high accuracy for Woodland/forest in general, but forest types were mixed up (coniferous was best).
- For both: very low accuracy for Heathland/scrub and Open spaces with little or no vegetation

Norway: Producer accuracy

| AR18x18 | Riparian Zones | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Urban | Crop-land | Wood-land & forest | Grass-land | Heath-land & scrub | Open space with little/no vegetation | Wet-land | Water | |
| Built-up areas | 75.6 | 5.3 | 8.2 | 6.0 | 1.0 | 1.3 | 1.4 | 1.2 | 100.0 |
| Cultivated land | 5.3 | 78.2 | 6.0 | 10.1 | 0.0 | 0.0 | 0.1 | 0.2 | 100.0 |
| Pastures | 7.9 | 28.2 | 25.5 | 33.1 | 3.4 | 0.0 | 1.3 | 0.7 | 100.0 |
| Boreal deciduous forest | 1.8 | 1.6 | 79.9 | 0.9 | 9.2 | 1.4 | 3.7 | 1.5 | 100.0 |
| Broad-leafed deciduous forest | 4.8 | 1.2 | 89.4 | 2.8 | 0.0 | 0.0 | 0.0 | 1.8 | 100.0 |
| Pine forest | 2.0 | 0.6 | 90.5 | 0.5 | 1.0 | 1.1 | 3.3 | 1.0 | 100.0 |
| Spruce forest | 1.9 | 1.6 | 91.7 | 1.1 | 1.5 | 0.2 | 0.9 | 1.1 | 100.0 |
| Peatland forest | 0.3 | 0.8 | 69.2 | 0.9 | 3.6 | 3.6 | 20.0 | 1.7 | 100.0 |
| Alpine meadow communities | 0.0 | 0.0 | 5.2 | 1.1 | 71.9 | 7.3 | 9.9 | 4.6 | 100.0 |
| Alpine heath communities | 0.0 | 0.0 | 12.9 | 0.0 | 59.8 | 18.2 | 8.1 | 1.0 | 100.0 |
| Non-forested dry land below the treeline | 0.2 | 0.2 | 12.1 | 4.3 | 42.3 | 25.6 | 12.6 | 2.8 | 100.0 |
| Snow-bed vegetation | 0.0 | 0.0 | 0.0 | 0.0 | 64.4 | 23.5 | 10.0 | 2.0 | 100.0 |
| Non-productive areas | 0.5 | 0.0 | 17.4 | 0.6 | 26.0 | 49.5 | 0.8 | 5.2 | 100.0 |
| Wetlands | 0.0 | 0.1 | 19.6 | 0.1 | 16.3 | 2.0 | 59.3 | 2.5 | 100.0 |
| Freshwater | 0.0 | 0.1 | 1.9 | 0.1 | 0.7 | 0.6 | 0.6 | 95.9 | 100.0 |
| Total | 2.7 | 6.1 | 40.8 | 1.6 | 12.1 | 4.0 | 8.0 | 24.7 | 100.0 |

Norway: User accuracy

| AR18x18 | Riparian Zones | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Urban | Crop-land | Wood-land & forest | Grass-land | Heath-land & scrub | Open space with little/no vegetation | Wet-land | Water | |
| Built-up areas | 54.8 | 1.7 | 0.4 | 7.3 | 0.2 | 0.6 | 0.3 | 0.1 | 1.9 |
| Cultivated land | 12.9 | 83.2 | 1.0 | 40.5 | 0.0 | 0.0 | 0.1 | 0.1 | 6.4 |
| Pastures | 3.3 | 5.2 | 0.7 | 23.3 | 0.3 | 0.0 | 0.2 | 0.0 | 1.1 |
| Boreal deciduous forest | 12.0 | 4.6 | 34.0 | 9.7 | 13.2 | 6.1 | 8.0 | 1.1 | 17.4 |
| Broadleaved deciduous forest | 0.5 | 0.1 | 0.6 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| Pine forest | 7.1 | 0.9 | 21.4 | 3.2 | 0.8 | 2.7 | 4.0 | 0.4 | 9.6 |
| Spruce forest | 8.1 | 3.1 | 25.9 | 8.1 | 1.4 | 0.7 | 1.3 | 0.5 | 11.5 |
| Peatland forest | 0.5 | 0.5 | 7.1 | 2.4 | 1.2 | 3.7 | 10.5 | 0.3 | 4.2 |
| Alpine meadow communities | 0.0 | 0.0 | 0.2 | 0.9 | 7.9 | 2.5 | 1.7 | 0.2 | 1.3 |
| Alpine heath communities | 0.0 | 0.0 | 3.1 | 0.0 | 48.7 | 44.7 | 10.0 | 0.4 | 9.9 |
| Non-forested dry land below the treeline | 0.1 | 0.0 | 0.2 | 2.2 | 2.8 | 5.2 | 1.3 | 0.1 | 0.8 |
| Snow-bed vegetation | 0.0 | 0.0 | 0.0 | 0.0 | 8.8 | 9.8 | 2.1 | 0.1 | 1.7 |
| Non-productive areas | 0.2 | 0.0 | 0.6 | 0.5 | 2.8 | 16.0 | 0.1 | 0.3 | 1.3 |
| Wetlands | 0.1 | 0.2 | 3.8 | 0.3 | 10.5 | 4.0 | 58.5 | 0.8 | 7.9 |
| Freshwater | 0.5 | 0.5 | 1.1 | 1.0 | 1.4 | 4.0 | 2.0 | 95.6 | 24.7 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100 |

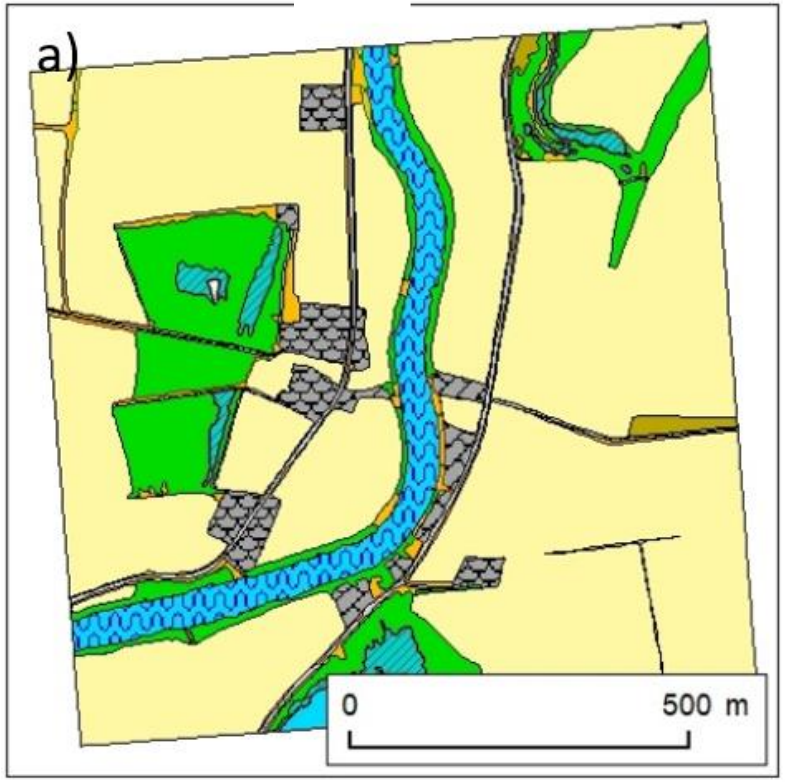
# Agri-environmental policy

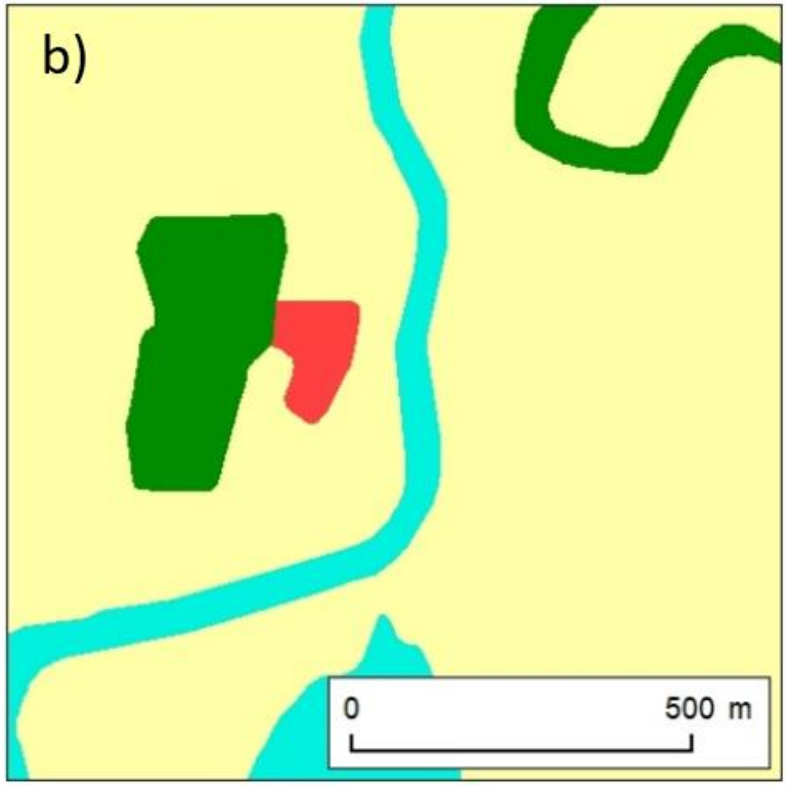
In Norway, a requirement to receive agri-environmental subsidies is to keep a vegetation zone of at least 2 m between agricultural land and waterways with steady water flow – the minimum mapping unit in RZ is currently too large to detect this.

Photo: W. Dramstad

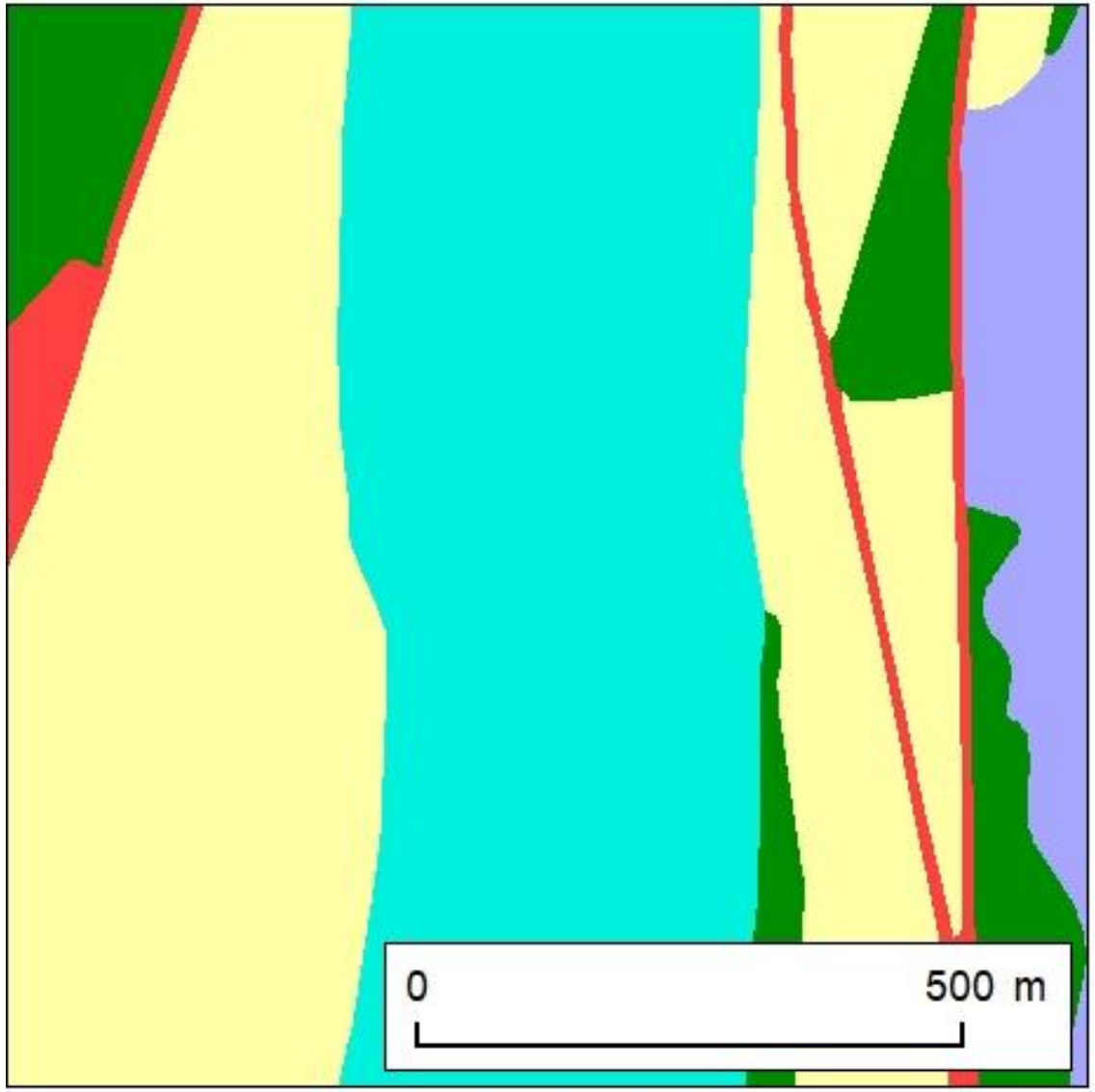
# Comparison with Norwegian 3Q Monitoring

- Norwegian Monitoring Programme 3Q
- The visual comparison of a) 3Q map, b) Riparian Zone map and c) orthophoto
- Narrow bands of vegetation along the river are not captured in RZ



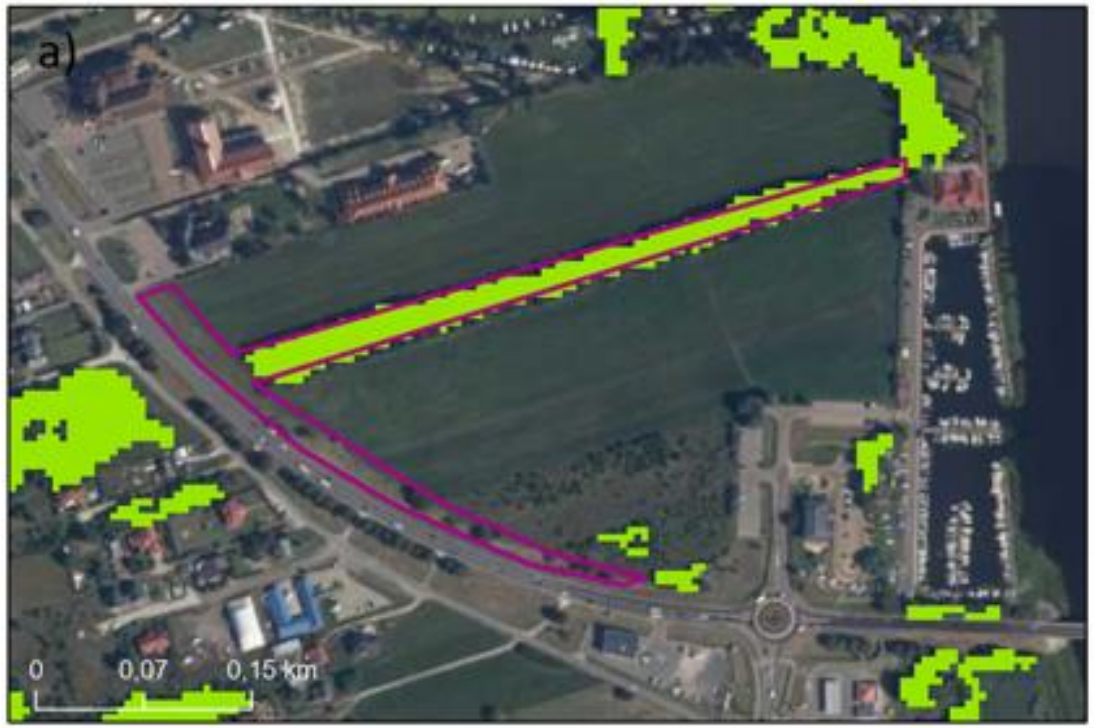

# Riparian Zone and orthophoto




# Small Woody Features in RZ (Poland)

- SWF are important Ecological Focus Areas in Polish agricultural landscapes
- 35 % of RZ “Lines of trees and scrub” were NOT included in HRL-SWF
  = low user accuracy… if HRL-SWF is correct

3.5 RZ Lines of trees
Small Woody Feature

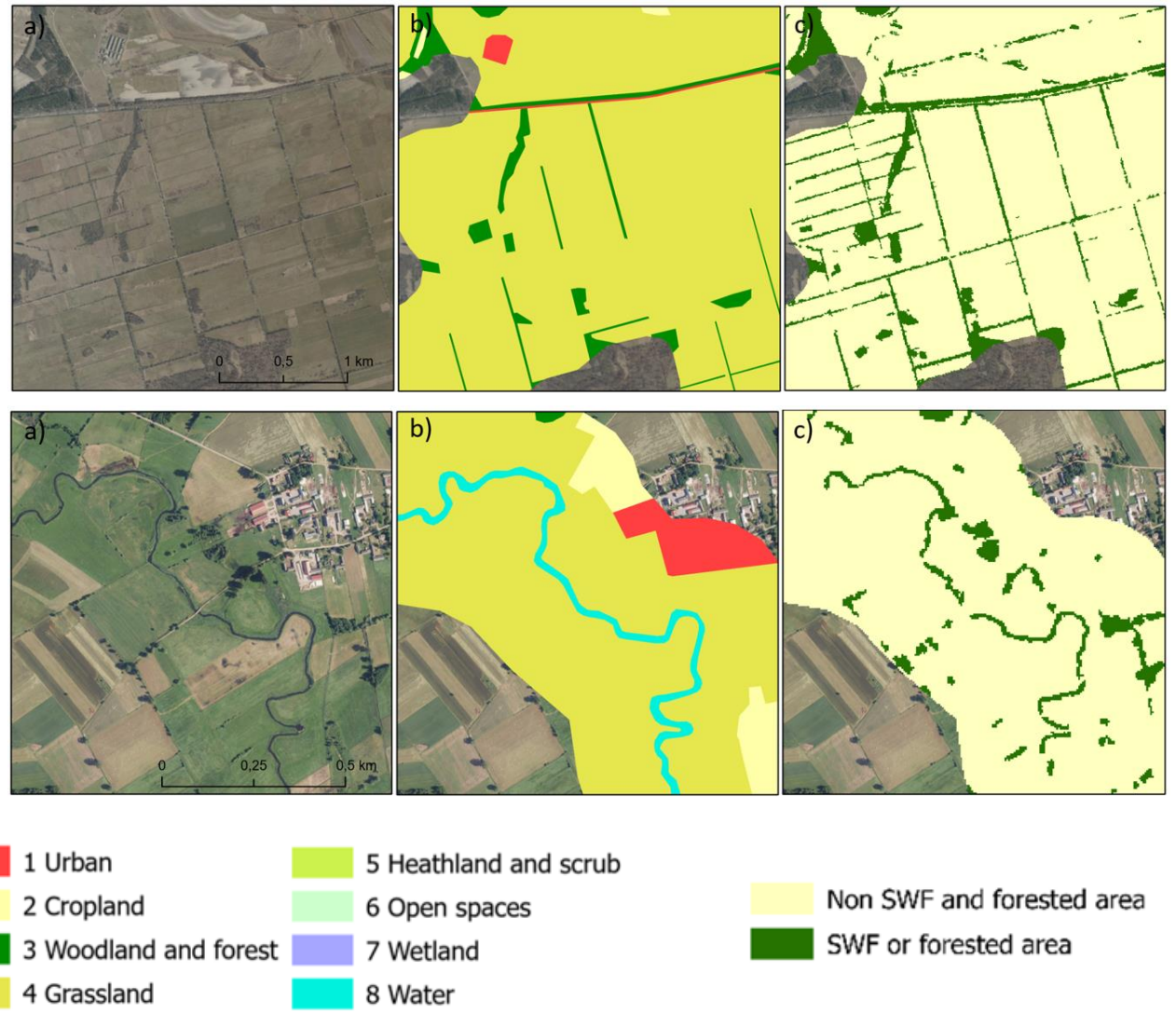



# Small Woody Features in RZ (Poland)

Producer accuracy

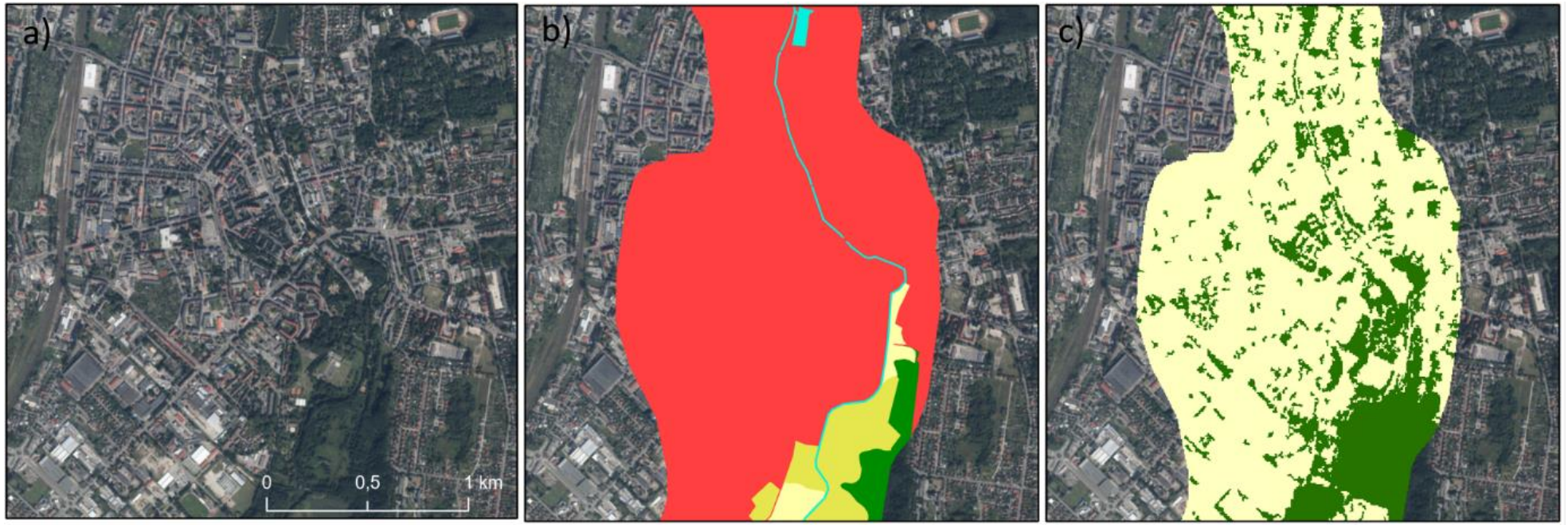
| Riparian Zones | | Small Woody Features (SWF) and/or Forest mask (FM) | |
|---|---|---|---|
| | | Non-SWF and non-FM | SWF or FM |
| 1 | Urban | 10.3 | 4.7 |
| 2 | Cropland | 35.2 | 5.1 |
| 3 | Woodland and forest | 3.1 | 70.6 |
| 4 | Grassland | 35.6 | 16.1 |
| 5 | Heathland and scrub | 0.0 | 0.0 |
| 6 | Open spaces with little or no vegetation | 0.2 | 0.0 |
| 7 | Wetland | 3.6 | 1.7 |
| 8 | Water | 12.0 | 1.7 |
| | **Total** | 100.0 | 100.0 |

- 70 % of SWF fell on Woodland
- 16 % on grassland and 5 % on cropland
- But also 1.7 % on Water…



# Small Woody Features in RZ (Poland)

- 14 % of the urban area was covered by SWF
- This is useful information

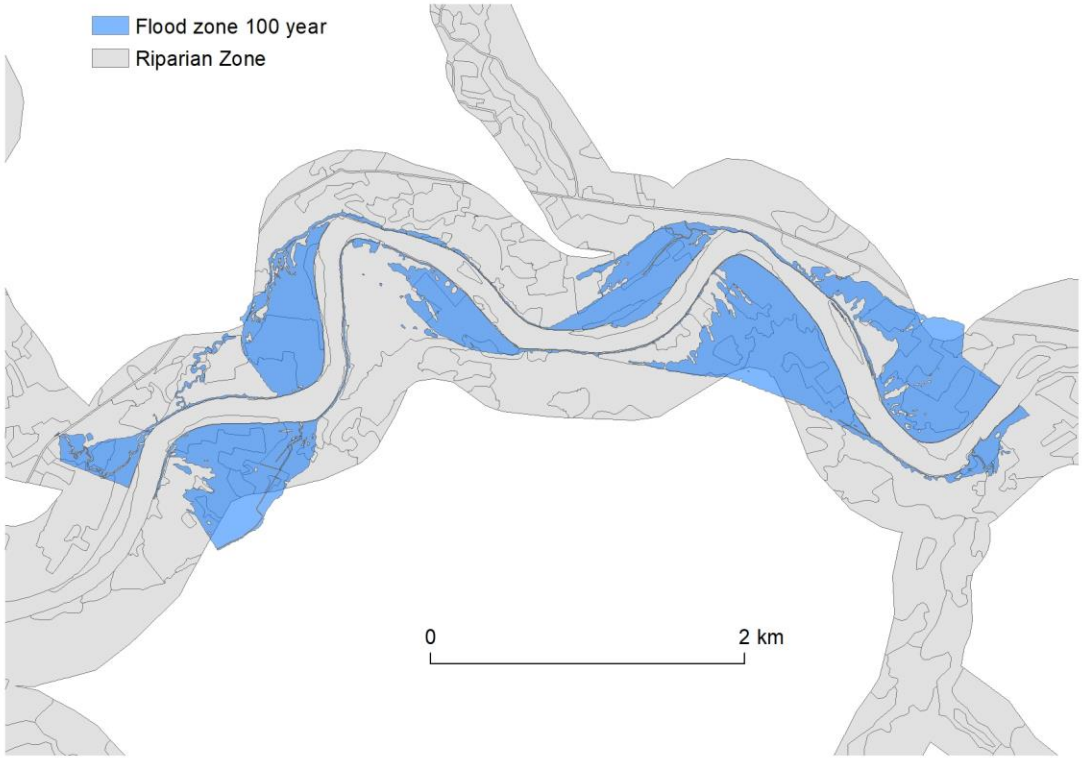


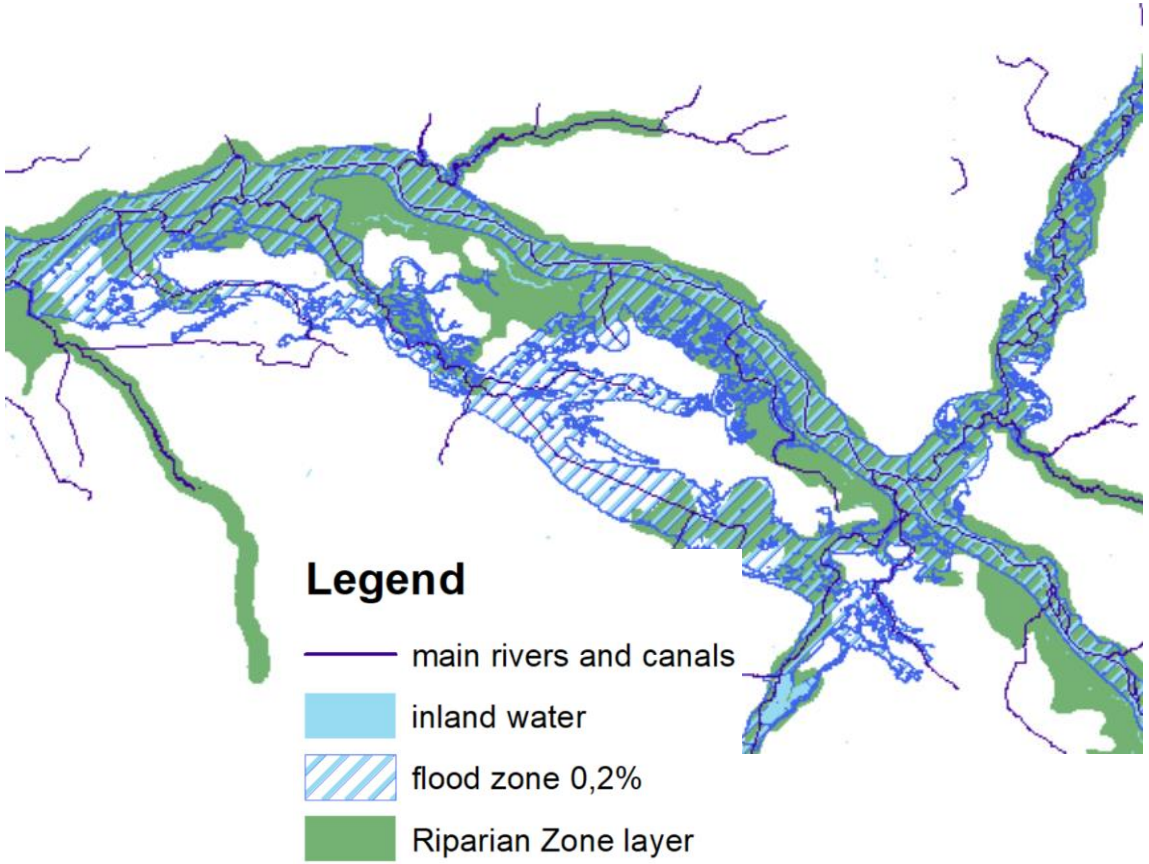

1 Urban
2 Cropland
3 Woodland and forest
4 Grassland
5 Heathland and scrub
6 Open spaces
7 Wetland
8 Water

Non SWF and forested area
SWF or forested area

# National flood zone maps

Riparian Zones did not match Norwegian or Polish flood zone maps




- Much RZ area is not in national flood zone maps
- Some flood zone areas are not included in RZ

# Limitations

- It was unclear which version of the guidelines was used for which dataset - uncertainty about how the classes were created.
- The content of each class, especially those related to wetlands, water-dependent ecosystems and natural grassy and scrubby areas are not precise and can open for different interpretations.
- Uncertain semantic content of LC/LU classes together with uncertain feasibility to distinguish certain characteristics based on the applied methodology create sources of error and make verification difficult.
- The fact that the data were taken from a reference period of three or four years and lack time stamps made proper verification impossible.

# Summary

- Before the RZ datasets can be used in monitoring, they must be verified as reflecting the true situation
- An extra challenge with river systems is that they are dynamic and alter their course over time – high frequency is needed
- Small woody features are not accurately mapped in RZ, an integration with (a verified) SWF could improve the product in urban and agricultural areas


**ENHANCING THE USER UPTAKE OF LAND COVER / LAND USE INFORMATION DERIVED FROM THE INTEGRATION OF COPERNICUS SERVICES AND NATIONAL DATABASES (InCoNaDa)**

Deliverable 5.2

Report on the potential use of Riparian Zones to map and monitor vegetation along streams and waterways.

| | | |
|---|---|---|
| Deliverable | D5.2 | |
| Work Package / WP leader | 5 / Norwegian Institute of Bioeconomy Research (NIBIO) | |
| Due date | | |
| Authors | NIBIO: Wendy Fjellstad, Svein Olav Krøgli, Linda Aune-Lundberg<br>IGIK: Milena Chmielewska, Agata Hościło | |
| Distribution | | NCBR: |
| Issue | | |
| Revision | | |
| Date | | |

# Conclusion

- Good data are needed to assess the success of environmental policies in Riparian Zones
- Consistency, high resolution, regularly updated, quickly available
- LC/LU is not regularly updated in national data, or only for a small sample. Nationwide data, even if not perfect, would be very useful if calculated consistently from one time to the next and capturing real change