WP2 Climate Change Impact on the Nutrient Run-off in Drainage Basin

Responsible institution: Latvia University of Agriculture

Experience and capacities:

BAAP (Baltic Sea Agricultural Action Programme) programme. BEAROP Project, Phase I. 1993-1997. SIDA, SLU Sweden.

Drainage Basin and Load of the Gulf of Riga. 1993-1997. NorFA. Jordforsk. Norway.

- sub-project A: Soil and nutrient loss from small catchments.
- sub-project B Nutrient losses from agricultural areas with high livestock densities in Latvia

BAAP (Baltic Sea Agricultural Action Programme) programme. BEAROP project . Phase II. 2000 – 2002. SIDA, SLU Sweden.

Environmental monitoring in agriculture. Nordic – Baltic Cooperative Project. 1997– 2000. NorFA. Bioforsk. Norway.

Baltic Sea Regional Project Component 2, subtask Monitoring and assessment. 2004 – 2007. WB &GEF. SLU (HELCOM)

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WP2 Climate Change Impact on the Nutrient Run-off in Drainage Basin

Main tasks:

Latvia University

- Evaluation of the available hydrological models
- Calibration of models for 5-6 typical river basins
- Simulation of the impact of climate changes on run-off

Institute of aquatic ecology

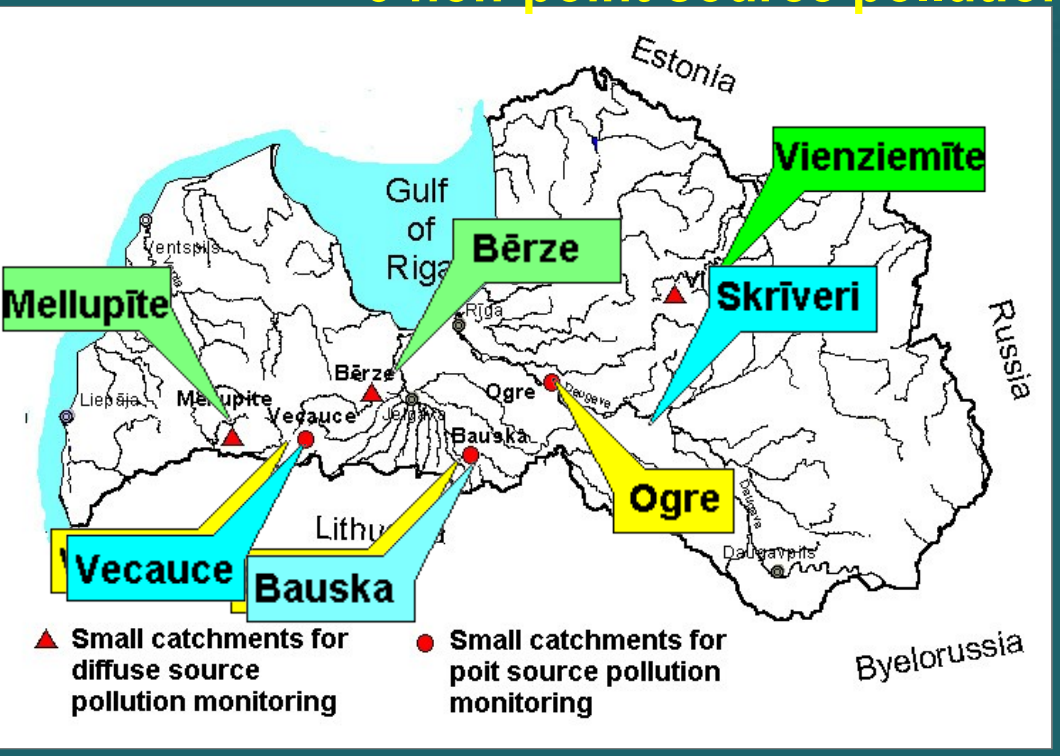
Water quality analyses

Latvia University of Agriculture

- Information inventory, data collection on annual nutrient discharges, retention data, information on agricultural practices (soil type, land use, topography, etc.) GIS format data
- Assessment of nutrient retention (Soil- field drainage-small catchment – river)
- Evaluation of the use of available water quality models (different geographical scales).
- Preliminary calibration and verification of models
- Simulation of consequences of climate change with regard on water quality (nutrients)

Latvian long term experimental sites for studying nutrient losses, nutrient turnover and model developments

3 non-point source pollution monitoring stations (sites)



Bērze (368 ha, intensive farming, cereals and sugar beets, arable land 80-90 %.). Established 1968 /1994

Mellupīte (960 ha, average intensity, arable land 60-70 %). Established 1995.

Vienziemīte (592 ha, low input agriculture, agr. land 79 %, arable land 4-5 %). Established 1948 /1994

3 point source pollution monitoring points (large animal farms):

Vecauce (1000-2000 pigs, 30 ha slurry application field)

Ogre (farm closed in 1992, heavily polluted territory)

Bauska (8000 pigs, 30 ha slurry dumping field)

3 non-point source pollution points (small catchments):

Auce (53 ha, intensive farming, cereals)

Skriveri (890 ha, average intensity of farming)

Bauska (750 ha, intensive farming, cereals, sugar beats)

Monitoring scale (non point pollution)

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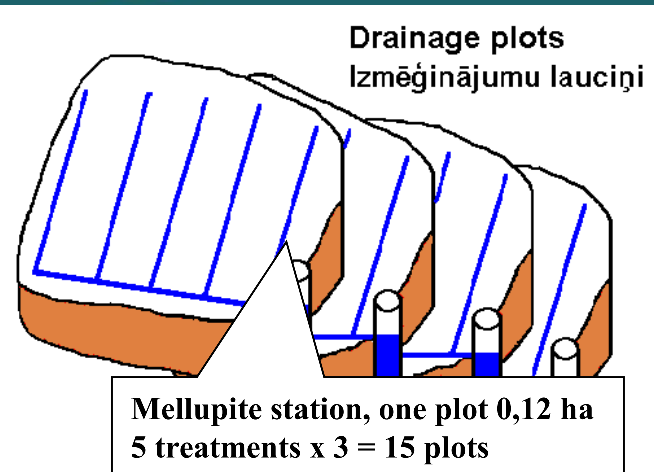
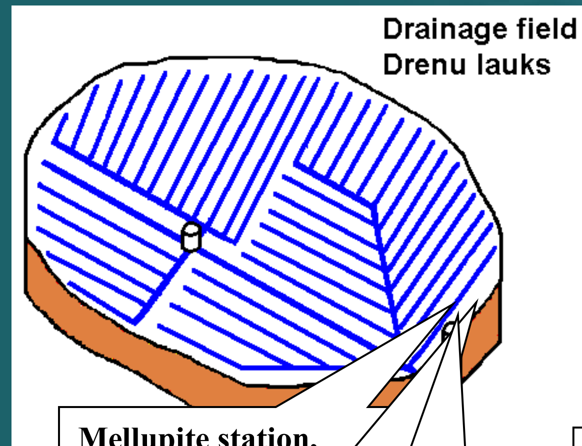
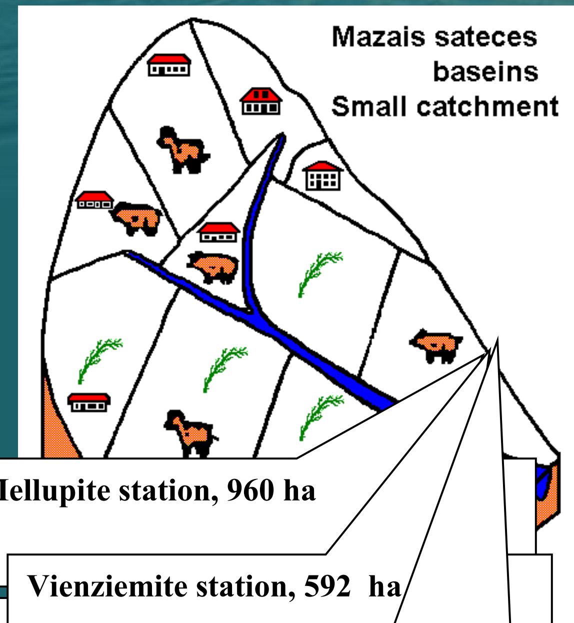






Soil, plant, nutrient and water relationships could be studied in the plot level, and nutrient leaching from soil with a different application of mineral or organic fertilisers for various crops might be examined in detail

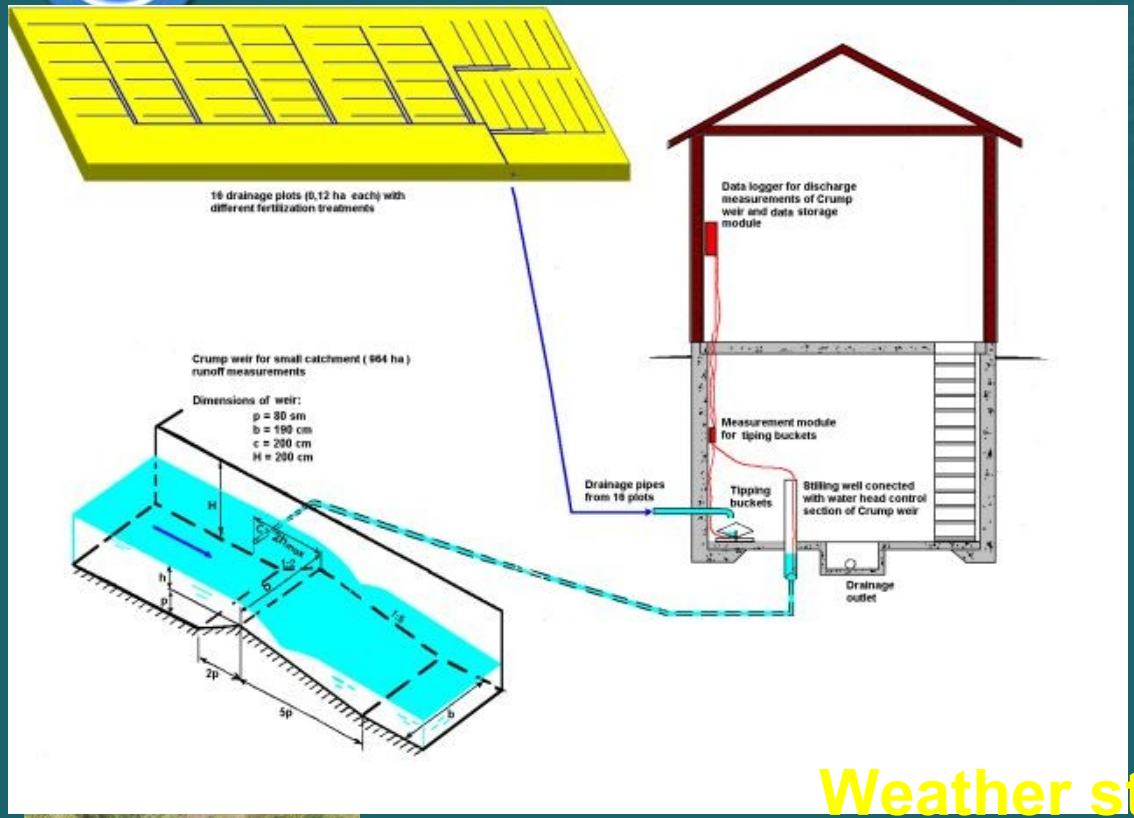
Leakage coefficients (crop, fertilization)

Nutrient losses from arable land might be measured at field level. Field scale run-off represents an integrated effect of farming practice, crop rotation, application of fertilizers etc. on the water quality

Retention soil - field

The integrated influence of nutrient run-off variations in farming practices, soil and topography within the entire catchment might be studied in a better way than in the field scale. In that scale emission rates (loads) that can contribute to the nutrient enrichment of surface water ecosystem can be examined. Retention field-catchment

Mellupīte monitoring station BEAROP. Project 1994-).



Small catchment station with inlets from plots and hydraulic structure.

H. structure – Crump weir

Tipping buckets for drainage plot measurements

Surface run-off plot

Weather station

Monitoring technology

Hydraulic structure: V – shape Crump weir in Berze station
Constructed in 2006 (BSRP, WB and GEF project)

Monitoring technology

Measurement equipment - YSI data loggers, powered from solar panels. GSM data transfer with mobile phone from stations to university PC

Continuous recording of data with data loggers (signals from sensors every 3 min),

Automatical flow proportional water sampling in all measurement points (signals from logger)

Ground water monitoring

Shallow ground water monitoring since 2005:

10 wells in 3 monitoring sites are equipped with YSI mini data loggers (t^o, water level sensors)

Depth of the wells is 4-6 m and 14-18 m (unconfined and confined aquifers)

Modeling of water balance: surface runoff, drainage run-off , leakage to the ground water

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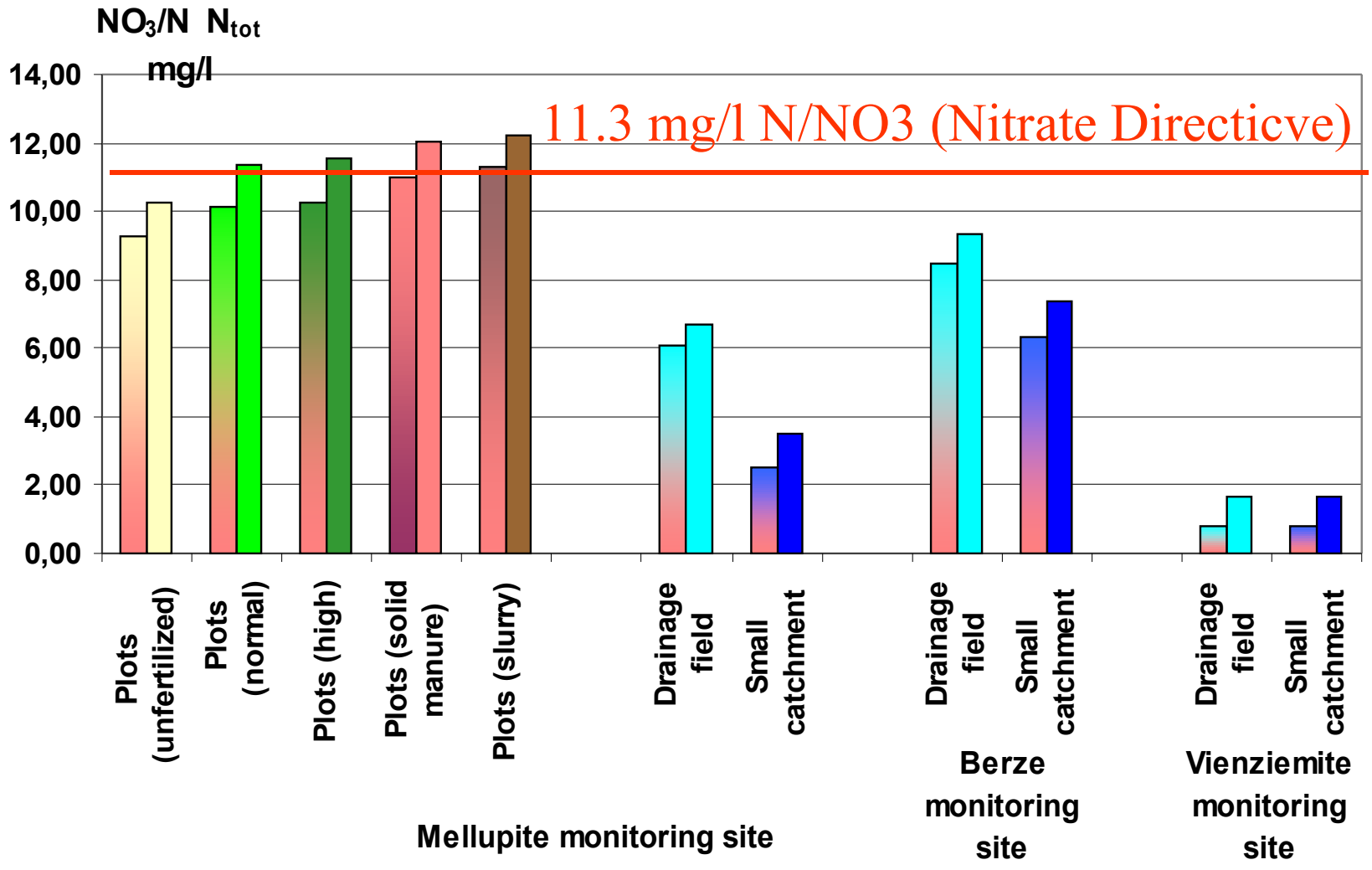
Monitoring results 1994-2006
Average concentrations of the nitrogen in run-off



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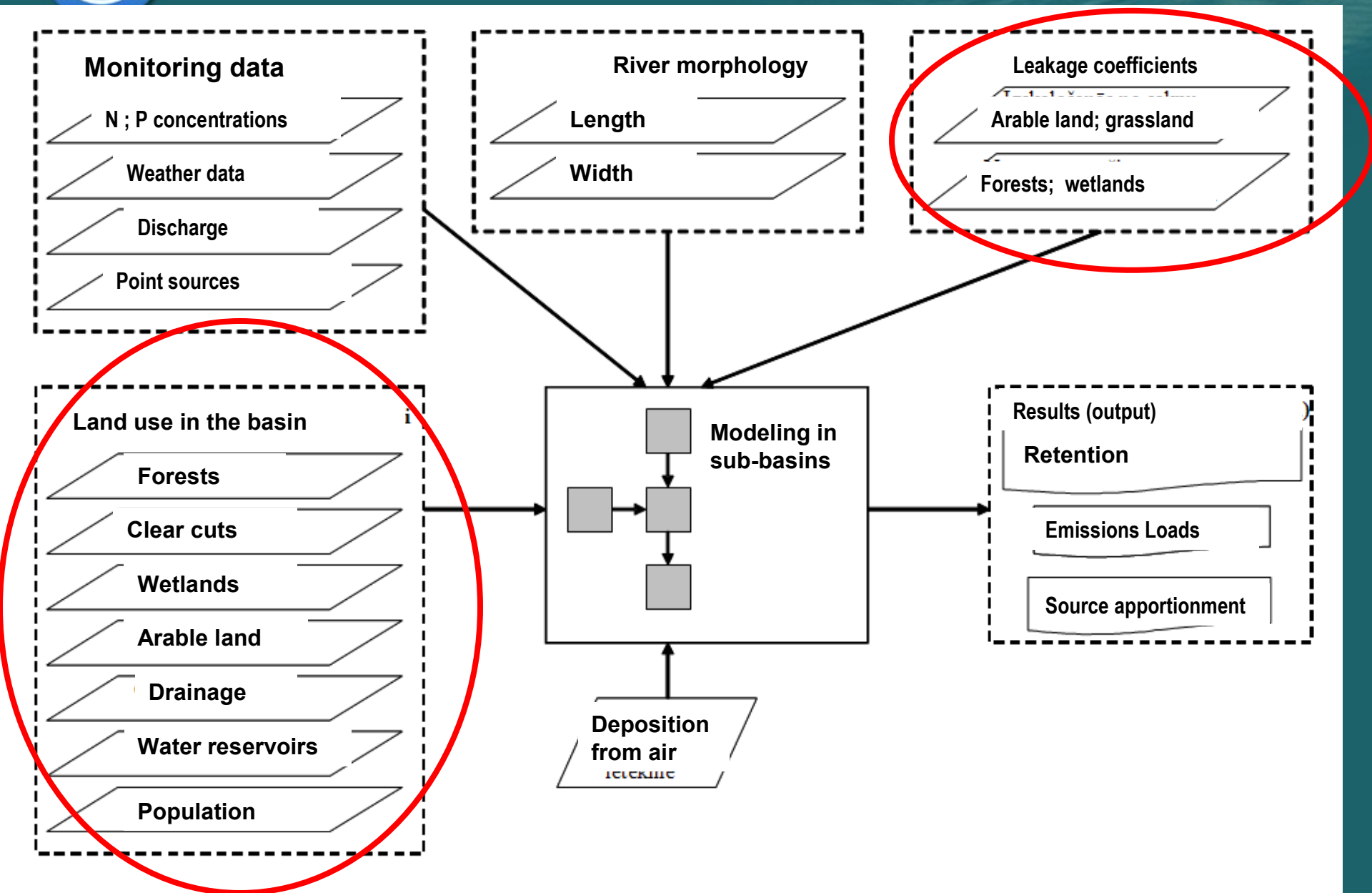
Preliminary results of water quality modeling

Application of Fyris model (SLU, Sweden) (2005-2007)

Source oriented modelling approach

Total Load= Point Sources $_{\text{Measured/estimated load}}$ **+ Diffuse Sources** $_{\text{Measured/estimated load}}$ **+ Retention**

FYRIS model input data and outputs



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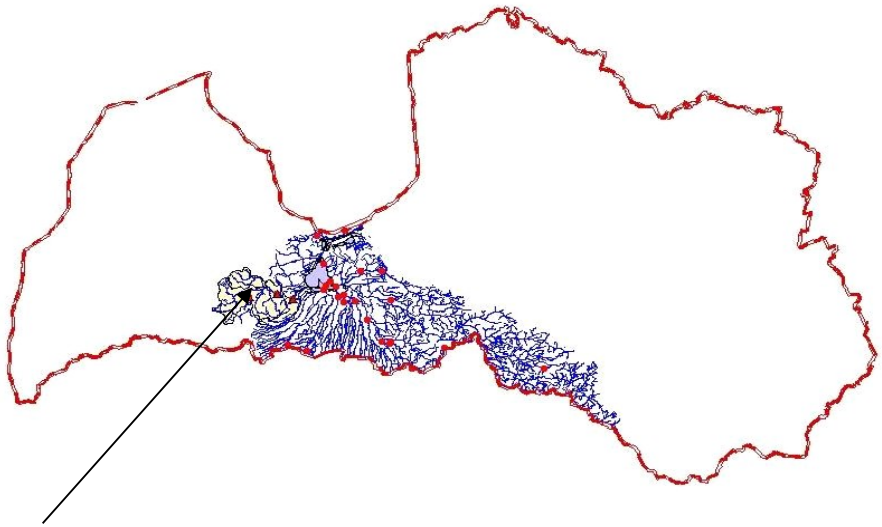
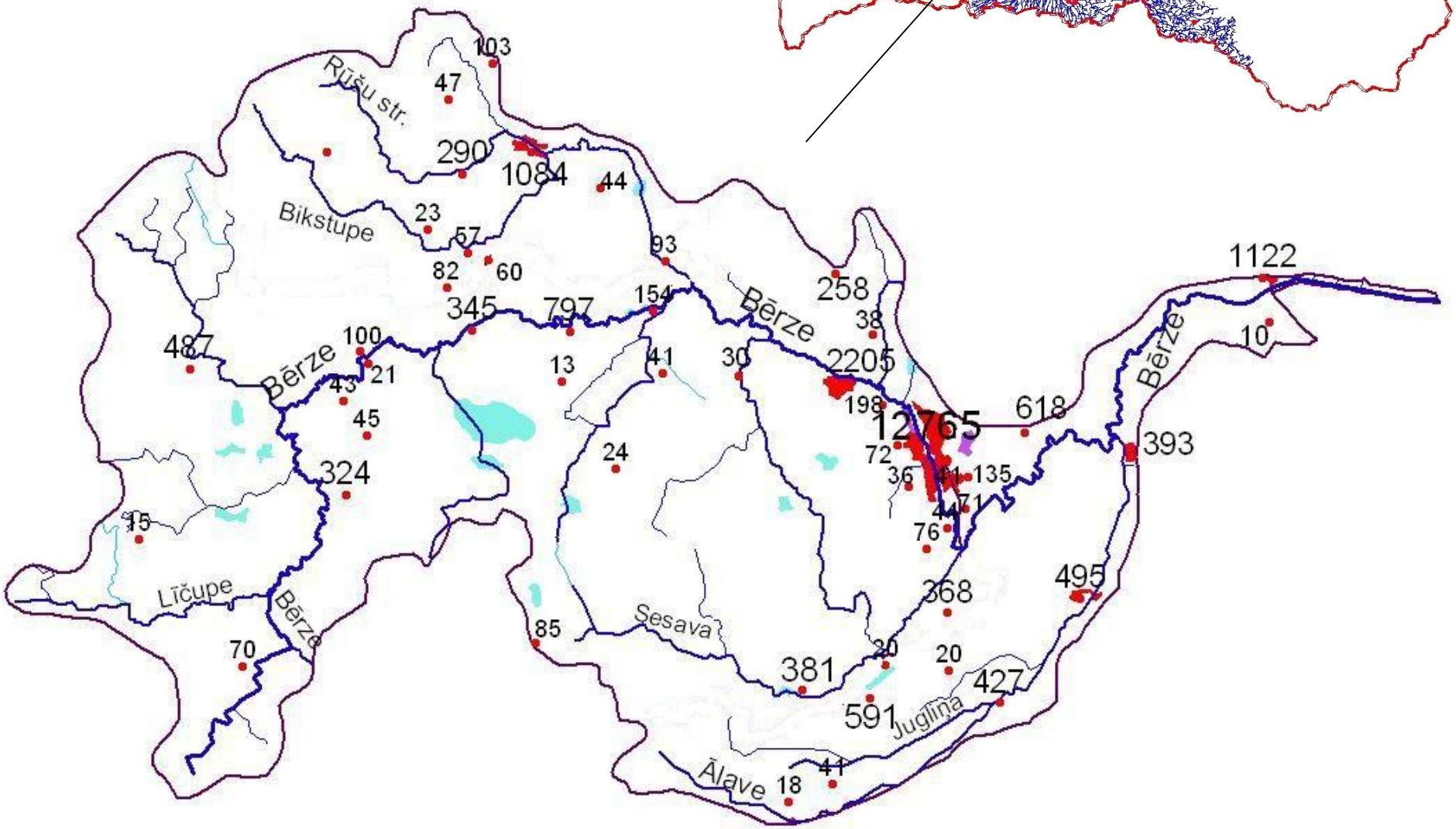
Berze River basin (904 km²)





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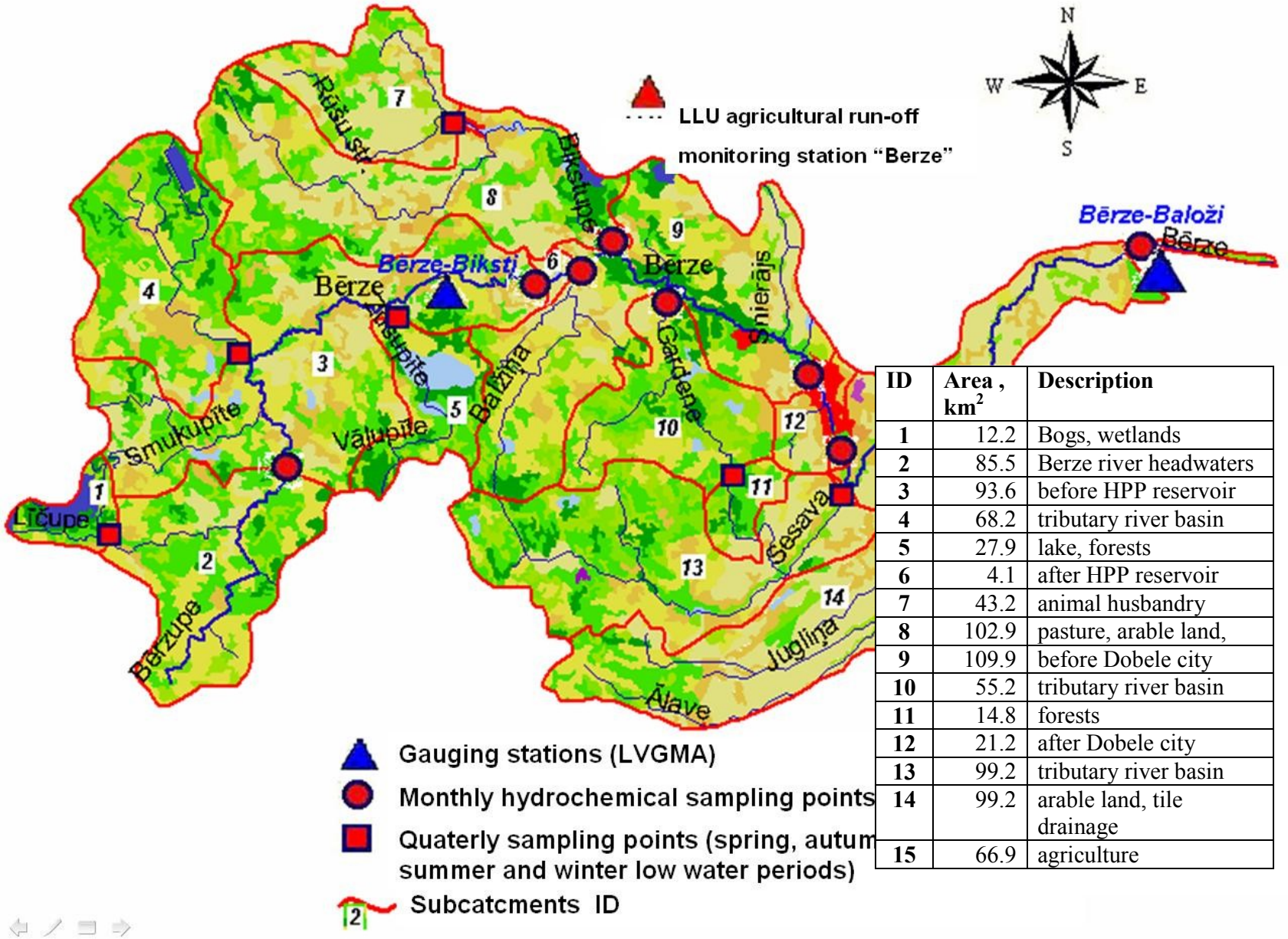
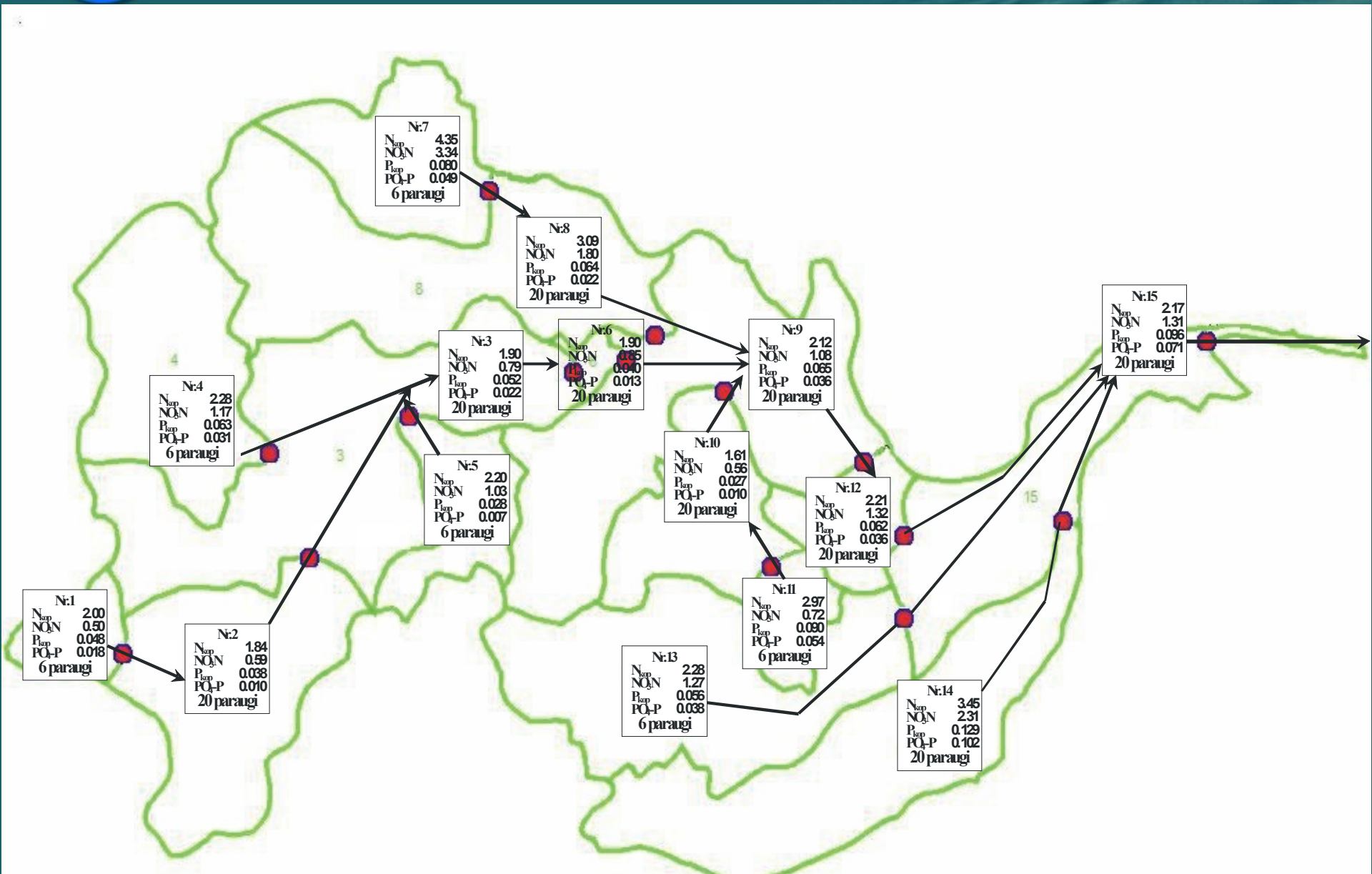
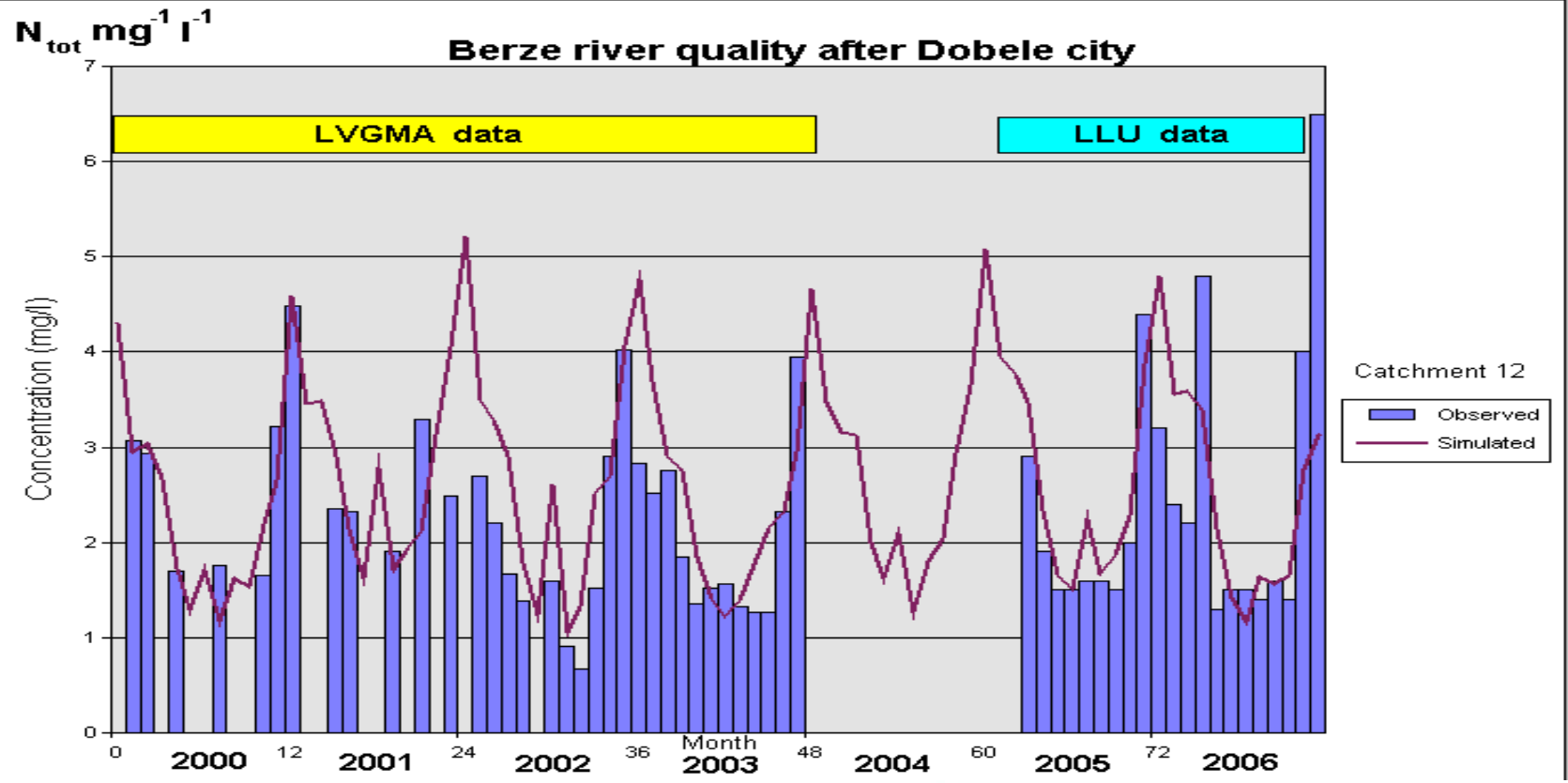


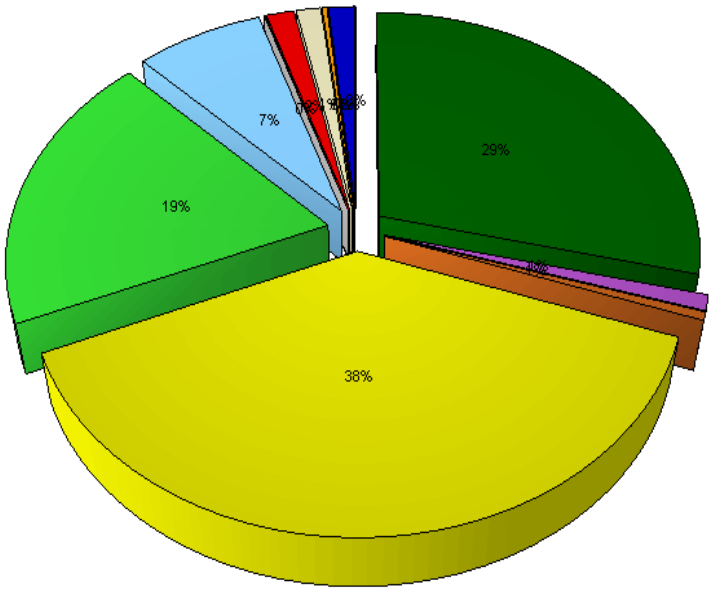
ID	Area , km^2	Description
1	12.2	Bogs, wetlands
2	85.5	Berze river headwaters
3	93.6	before HPP reservoir
4	68.2	tributary river basin
5	27.9	lake, forests
6	4.1	after HPP reservoir
7	43.2	animal husbandry
8	102.9	pasture, arable land,
9	109.9	before Dobele city
10	55.2	tributary river basin
11	14.8	forests
12	21.2	after Dobele city
13	99.2	tributary river basin
14	99.2	arable land, tile drainage
15	66.9	agriculture

Water quality monitoring programme in the 15 sub-catchments (since 2005)

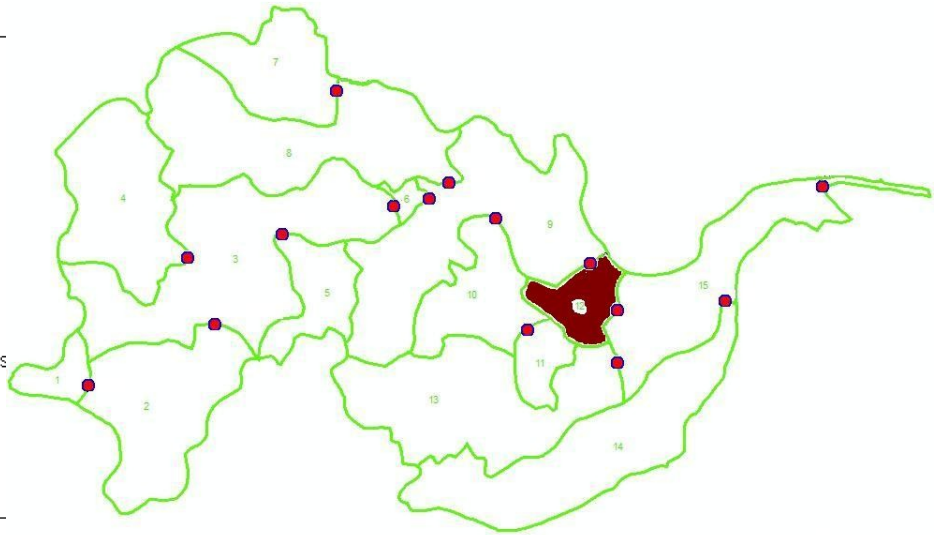


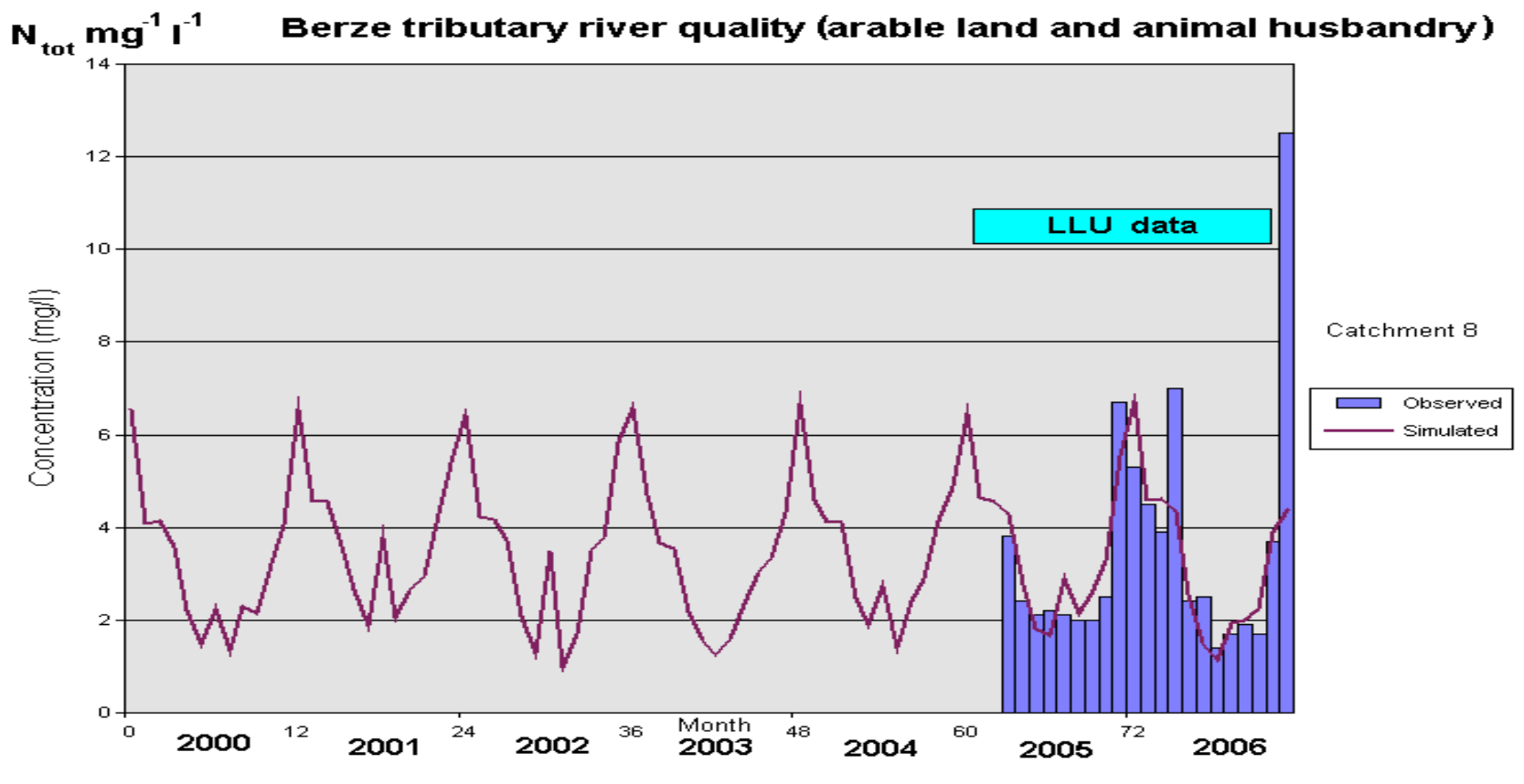

N_{tot} mg^{-1} l^{-1}
Berze river quality after Dobele city
LVGMA data
LLU data
Concentration (mg/l)
Month
0
2000
12
2001
24
2002
36
2003
48
2004
60
2005
72
2006
Catchment 12
Observed
Simulated


Manual Calibration
Monte Carlo
Settings
c0: 0.3199
kvs: 1.2886
Eff: 0.4312
r: 0.6628
Concentrations
- Time series
- Sim VS Meas
Mass flow rates
- Time series
- Sim VS Meas
<
Plot
>


29%
19%
7%
38%


Mountain
Forest
Clearcut
Mire
Arable
Pasture
Open
Built
Urban
Major point sources
Households
Minor1
Minor2
Lake deposition




N_{tot} mg^{-1} l^{-1}
Berze tributary river quality (arable land and animal husbandry)
LLU data
Catchment 8
Observed
Simulated
Concentration (mg/l)
Month
0
2
4
6
8
10
12
14
0
12
24
36
48
60
72
2000
2001
2002
2003
2004
2005
2006


Manual Calibration
Monte Carlo
Settings
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Plot
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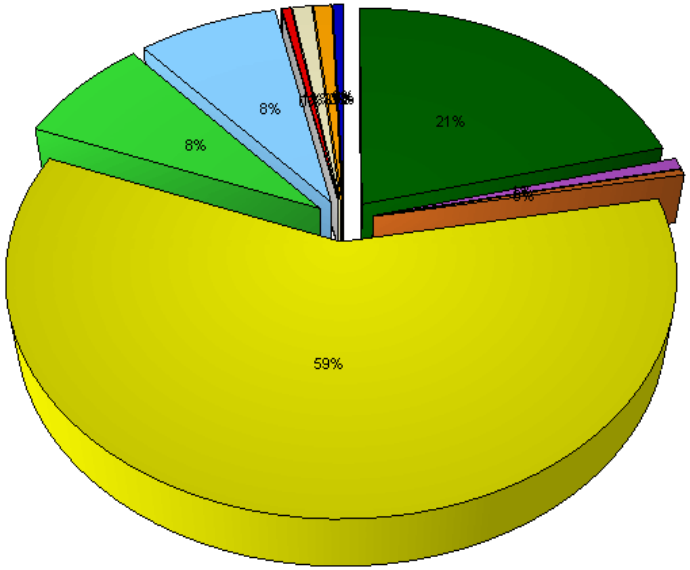
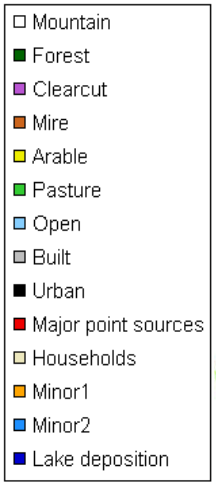
Run


21%
8%
8%
59%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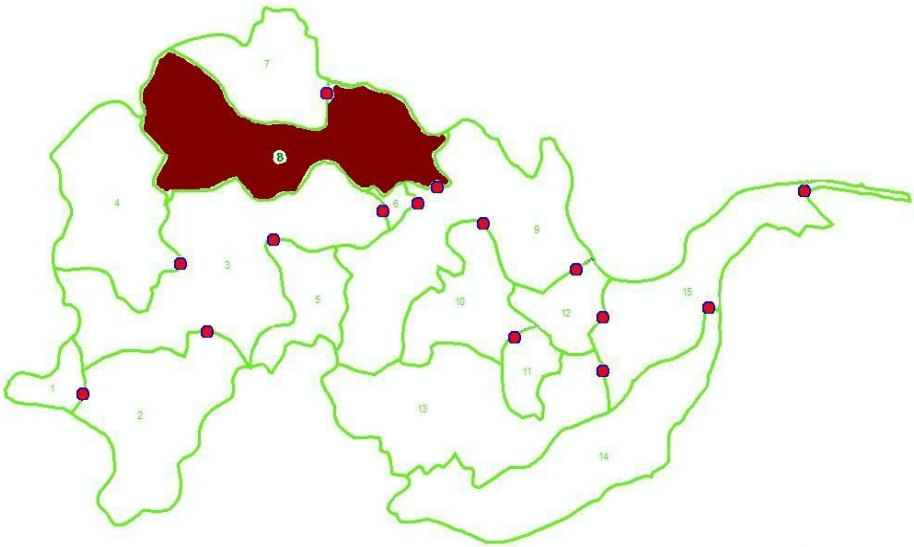

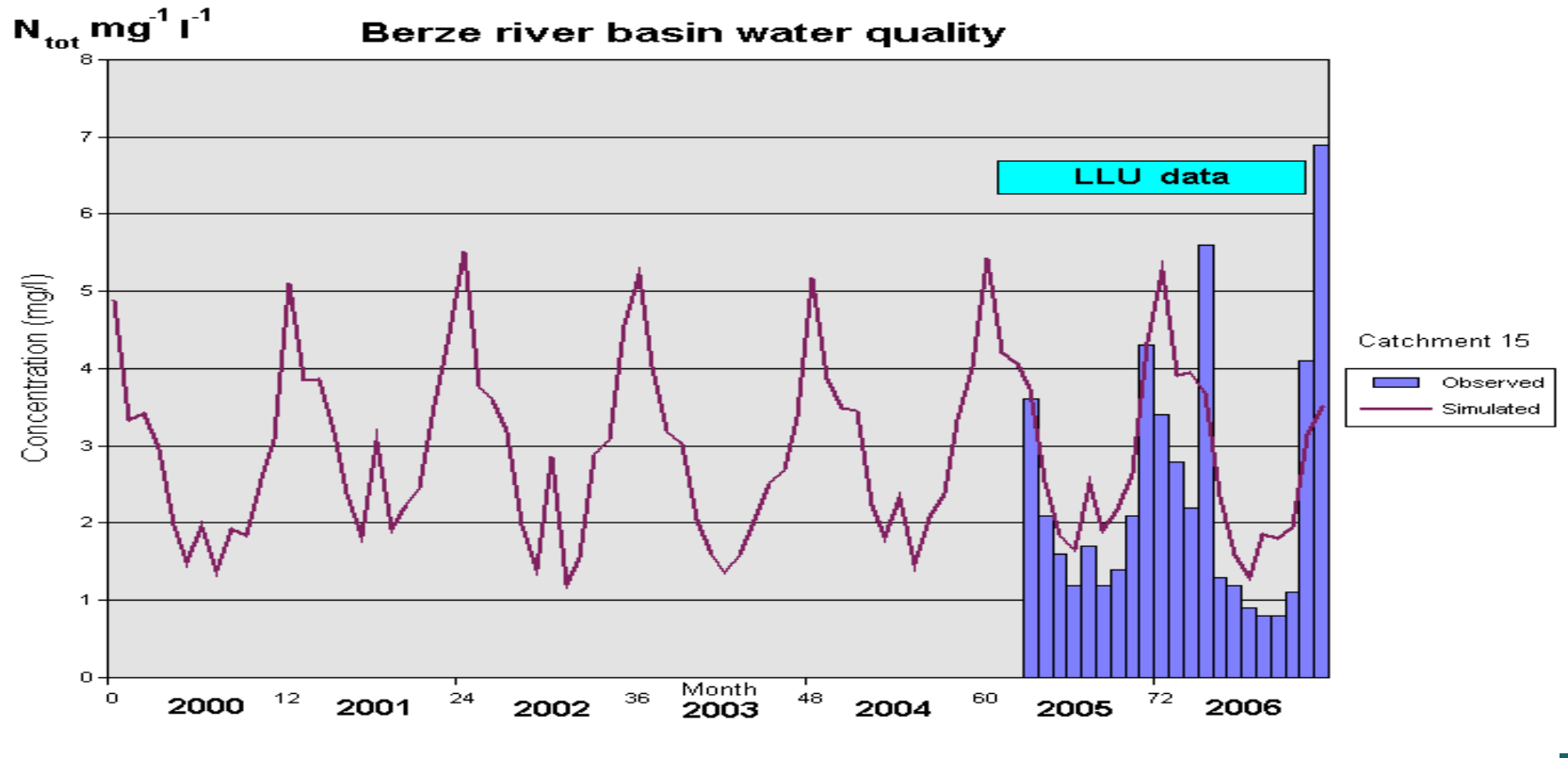

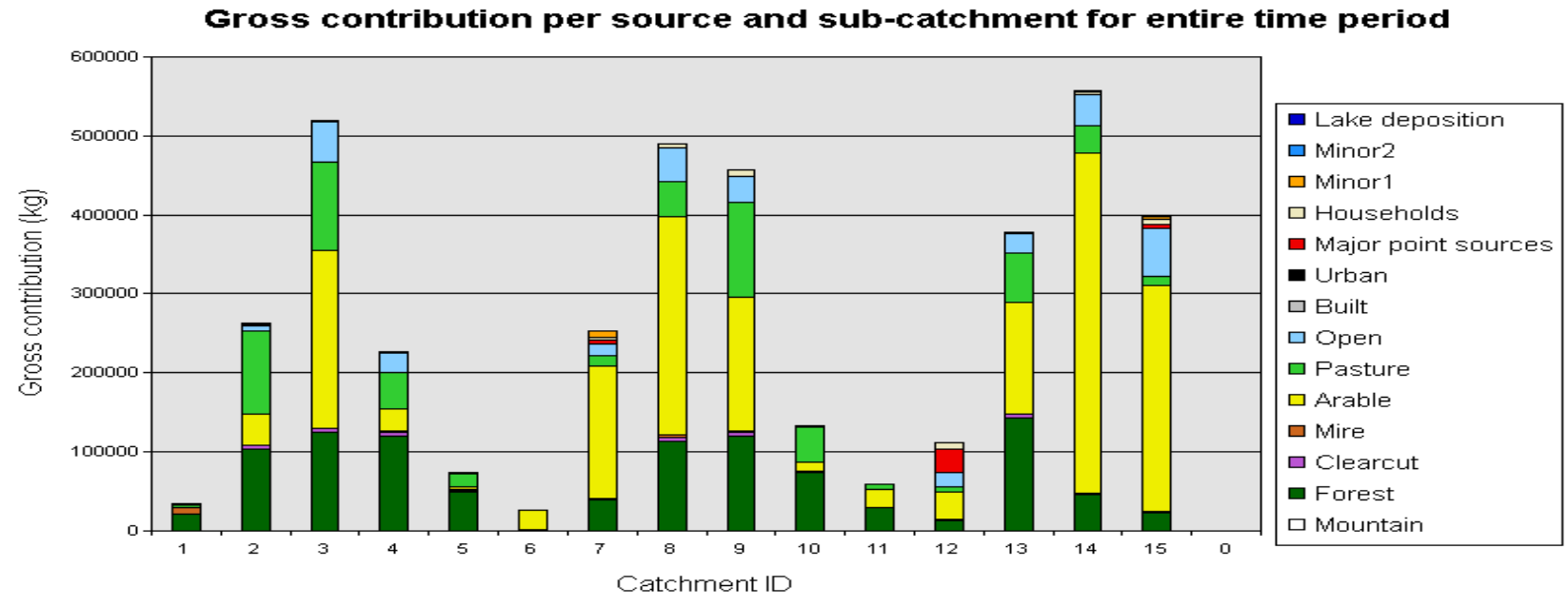

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Monte Carlo
Settings

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Concentrations
- Time series
- Sim VS Meas
Mass flow rates
- Time series
- Sim VS Meas

< Plot >

Run

Quality of modeling results?

Gaps and week points:

- **Short time series of water quality data**
- **Slow and recourses consuming data collection (GIS maps)**
- **Lack of agricultural statistics in national, regional, river catchments' level**

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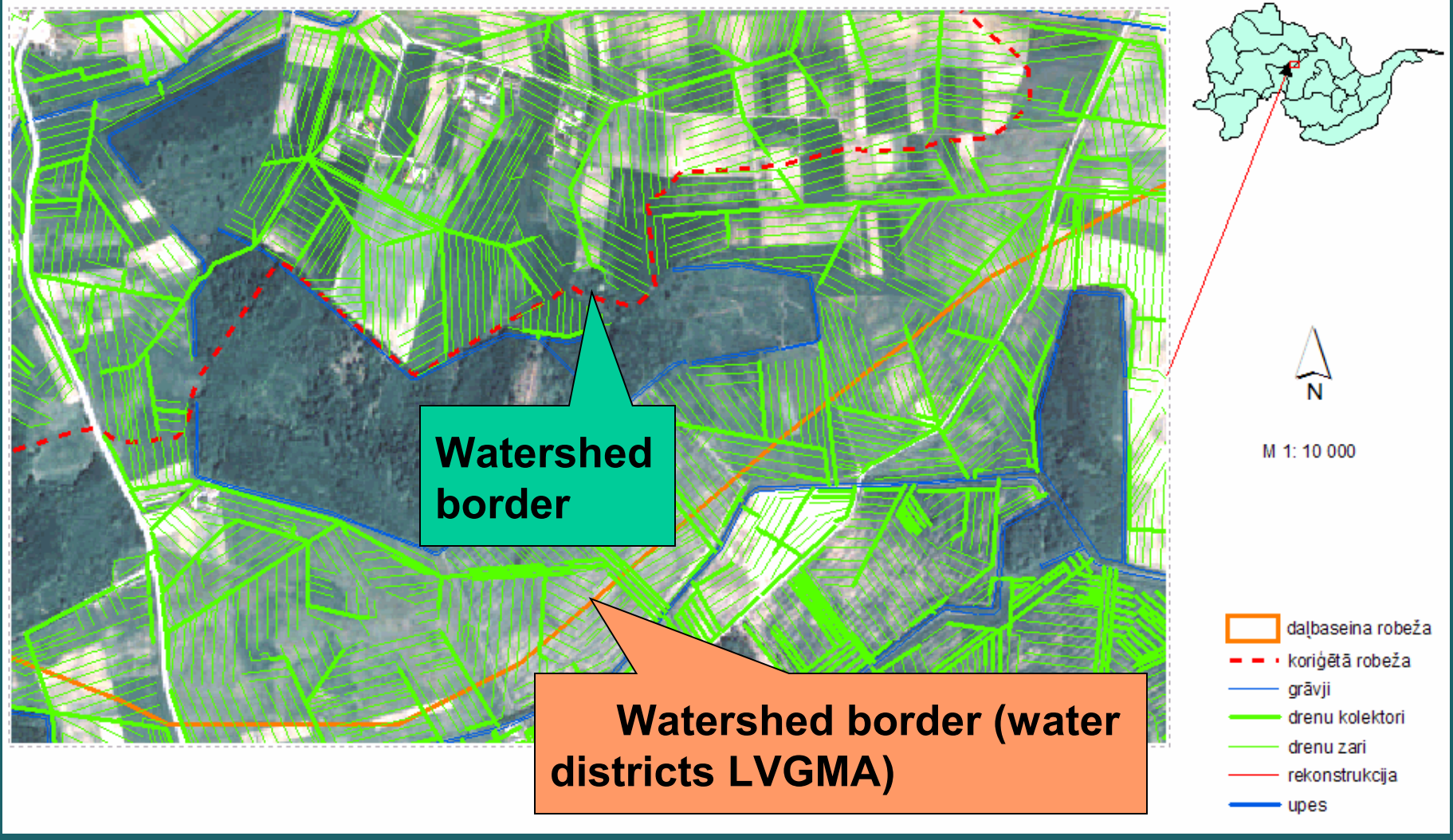
Establishment of the correct watershed borders for sub-catchments



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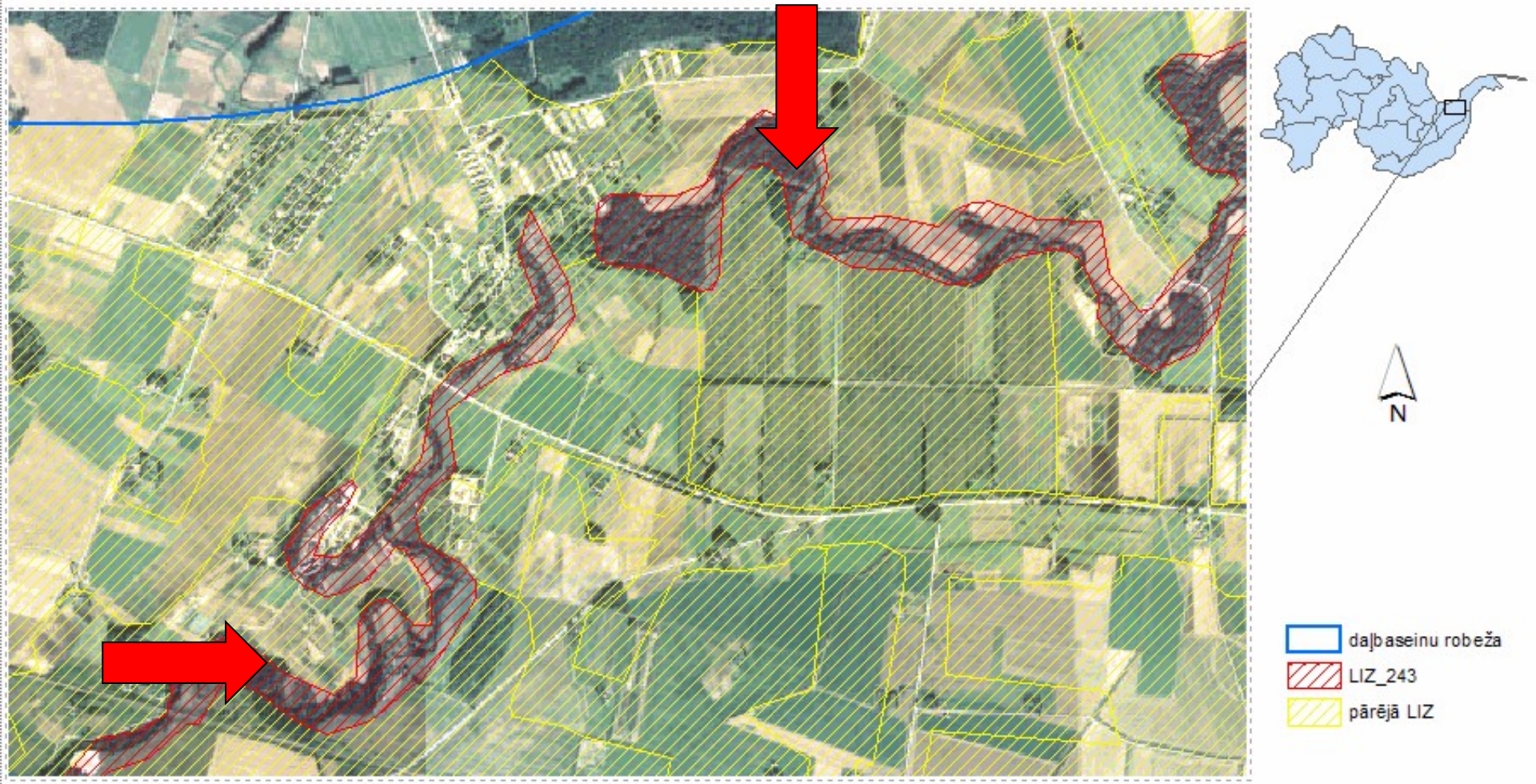
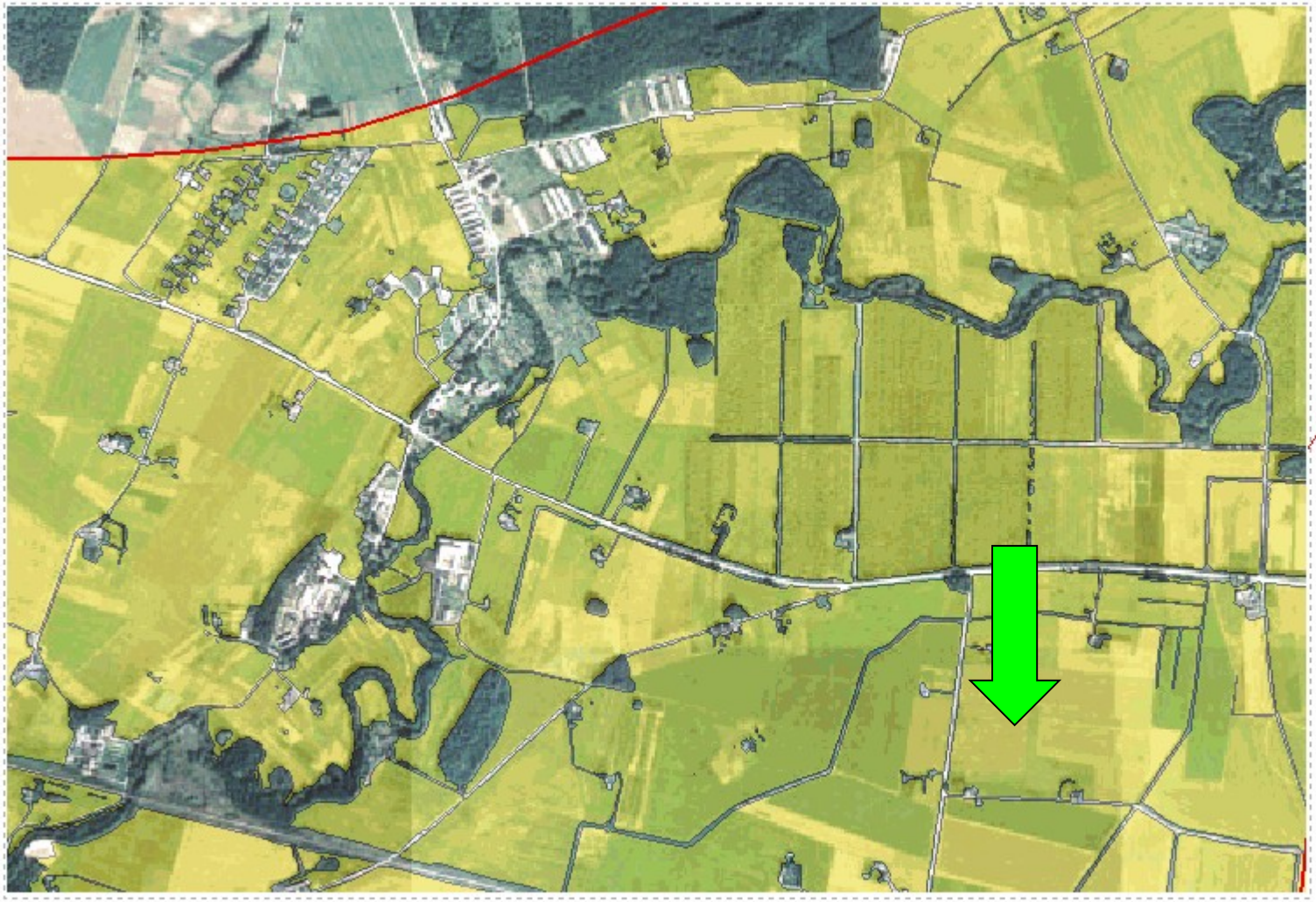
Land use areas (CLC2000 interpretation)



Agricultural land area (field register for EU payments)



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Thank you for attention