ECOLOGICAL AND GEOGRAPHICAL ZONING OF INDUSTRIAL DEVELOPMENT POTENTIAL BASED ON MOSS BIOMONITORING DATA: THE CASE OF THE RYAZAN REGION

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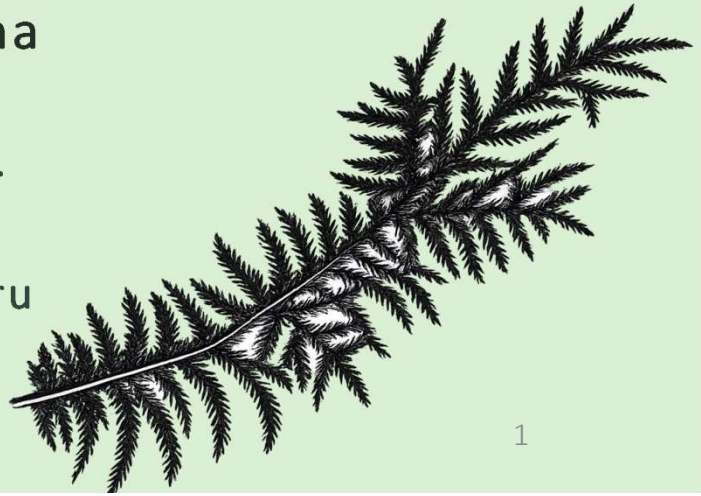


Figure 1.

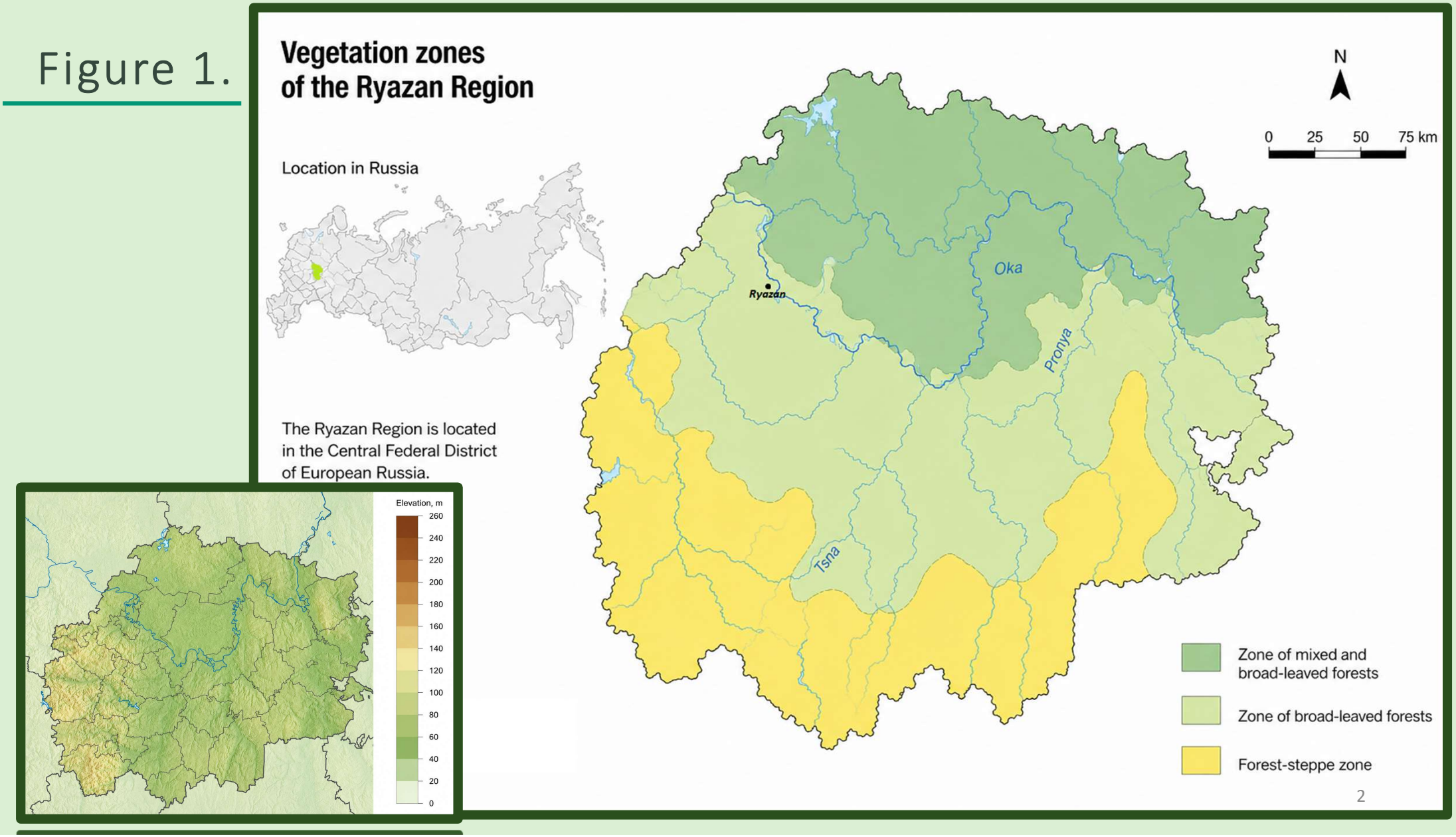
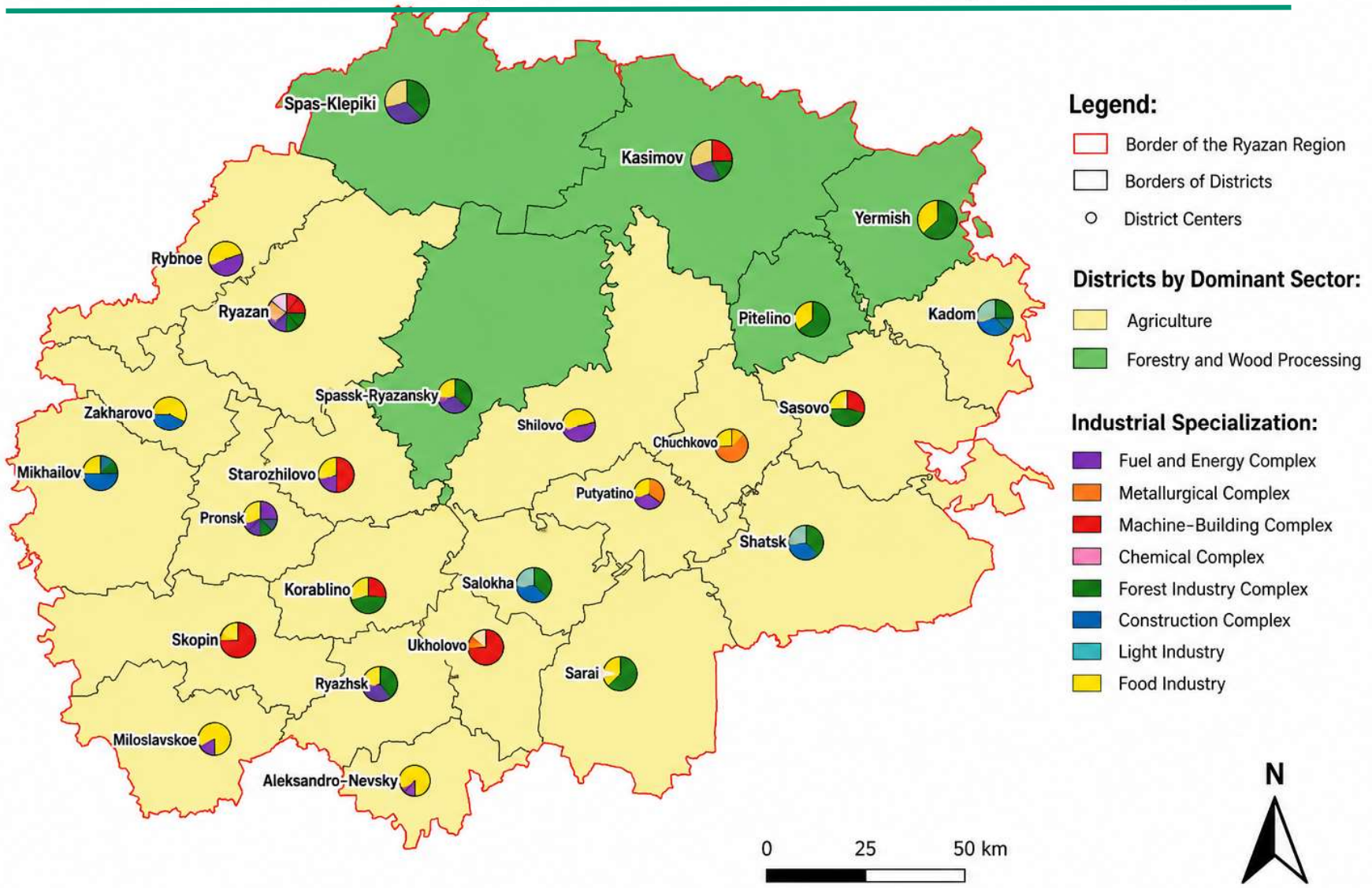
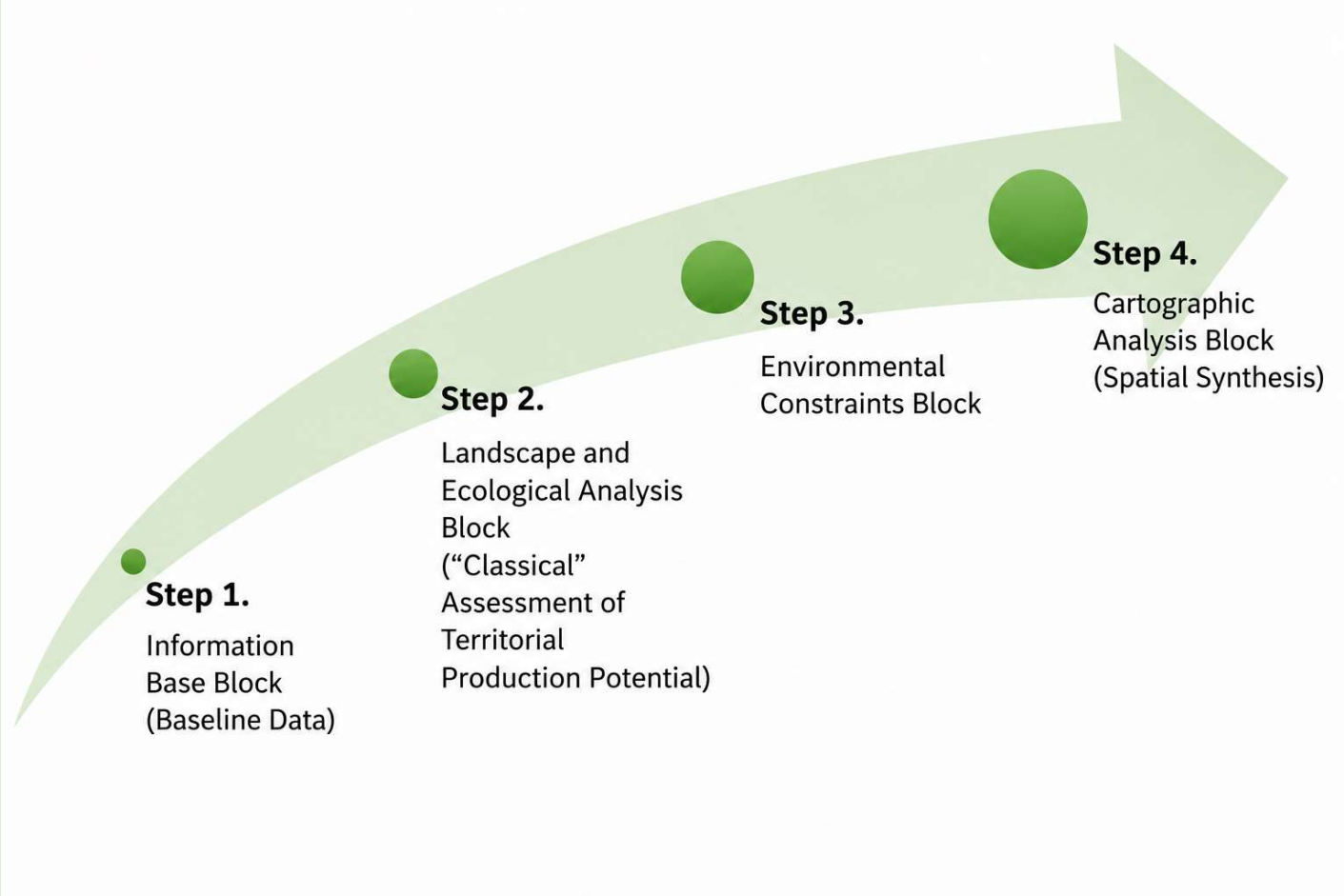

Vegetation zones
of the Ryazan Region
Location in Russia
The Ryazan Region is located
in the Central Federal District
of European Russia.
N
0 25 50 75 km
Oka
Ryazán
Pronya
Tsna
Zone of mixed and
broad-leaved forests
Zone of broad-leaved forests
Forest-steppe zone
Elevation, m
260
240
220
200
180
160
140
120
100
80
60
40
20
0

Figure 2 Industrial Specialization of the Ryazan Region



The aim of the study

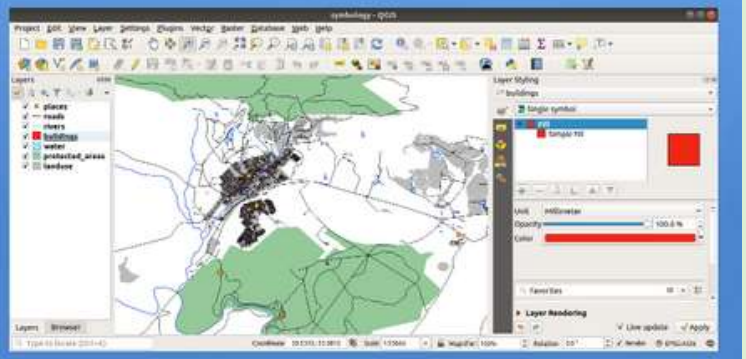


developing a framework for ecological and geographical analysis of territories

The Material and Methods

QGIS Desktop

Географическая информационная система



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27 December 2024 10:00

Interactive version of the report



Figure 3.SWOT analysis of regional infrastructure, compiled by the author, 2026

Sampling

The predominant moss species in the samples are…



Pleurozium schreberi
(22 samples)



Hypnum cupressiforme
(16 samples)



Sciuro-hypnum sp.
(17 samples)



Hylocomium splendens
(4 samples)



Plagiothecium sp.
(3 samples)



Ptilium sp.
(1 sample)

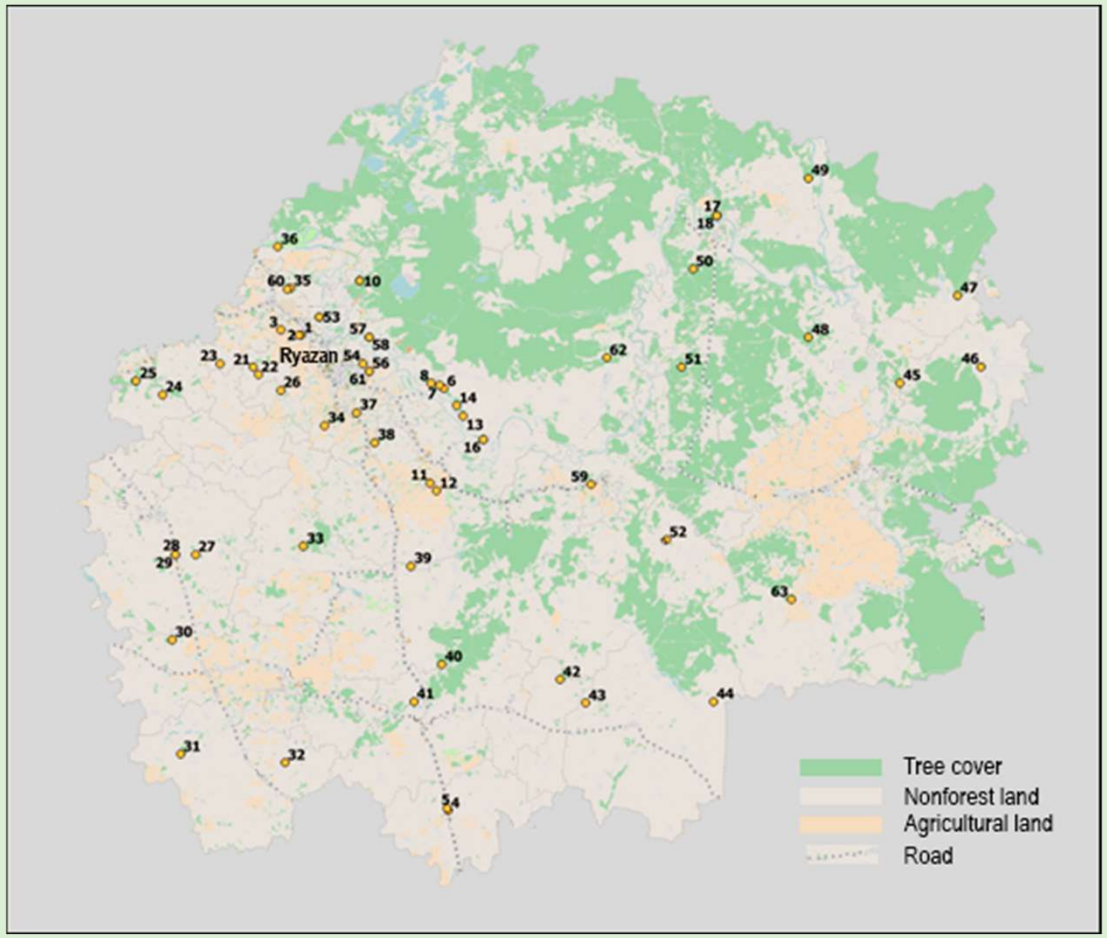
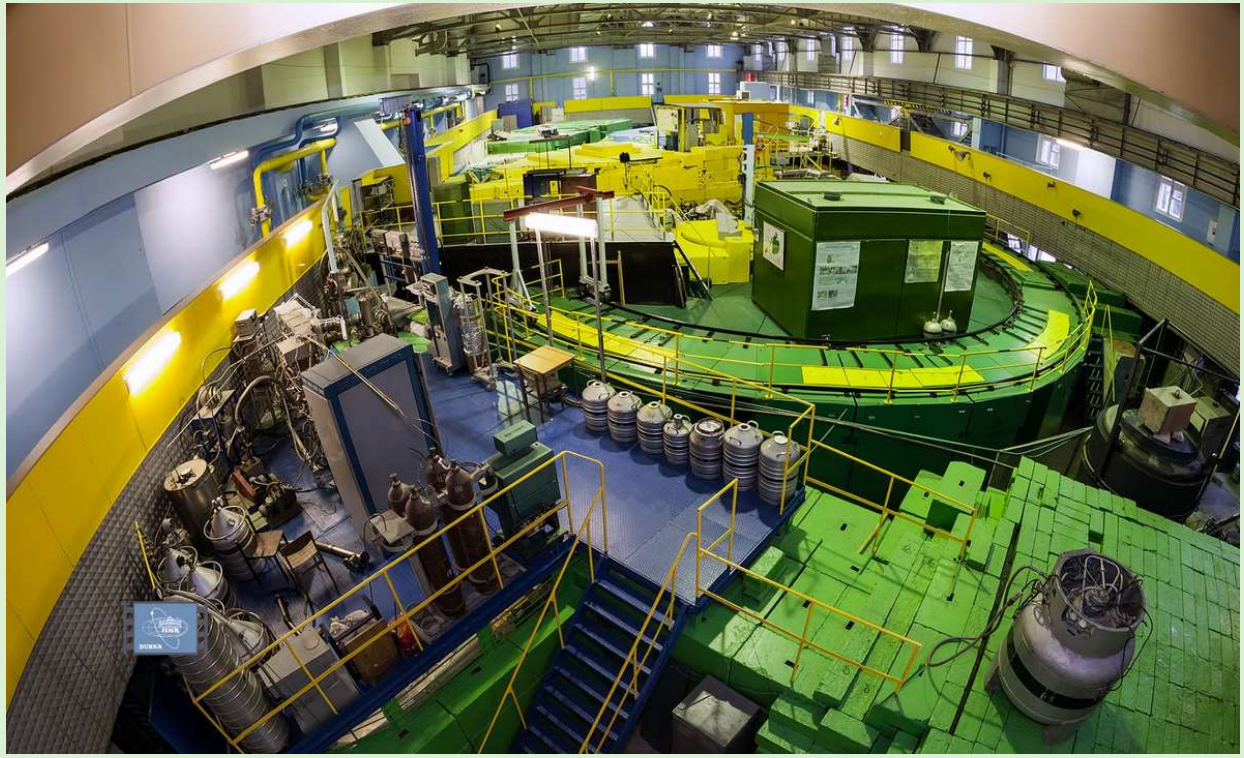
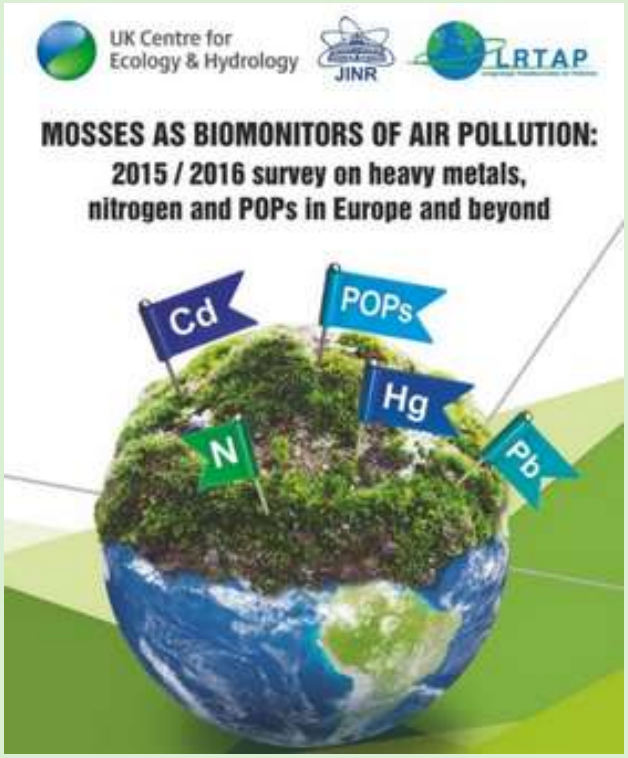


Figure 4. The sampling network

Analytical Research in the Sector of Neutron Activation Analysis and Applied Research (SNAAPI)





Na, Mg, Al, S, Cl, K, Ca, Sc, Ti, Cr, Fe, Ni, V, Mn, Co, Zn, As, Se, Br, Rb, Sr, Zr, Mo, Sb, I, Cs, Ba, La, Ce, Nd, Sm, Eu, Gd, Tb, Tm, Yb, Hf, Ta, W, Au, Th, and U.

Table 1. Element content (mg/kg) in Ryazan' moss samples and comparison with other territories (median, min-max value spread)

	Ryazan' region (Present work) (n=63)	Belarus (n=86)	Moscow Region (n=156)	Vladimir region (n=73)	Norway (n= 229)
Element	Median (min-max)	Median (min-max)	Median (min-max)	Median (min-max)	Median (min-max)
V	**3.42 (0.74 – 28.1)**	1.33 (0.40 – 9.52)	1.9 (0.32 – 5.3)	1.9 (0.95 – 6.3)	1.2 (0.3 – 14)
Cr	**4.03 (1.3 – 56.1)**	1.2 (0.18– 11.61)	2.63 (1.01 – 7.5)	2.5 (1.3 – 7)	0.7 (0.2 – 17)
Fe	**1360 (311 – 15700)**	394 (166 – 2243)	690 (254 – 2270)	500 (250 – 1600)	310 (78 – 8125)
Co	**0.79 (0.19 – 7.6)**	0.25 (0.11 – 7.02)	0.38 (0.11 – 1.07)	0.38 (0.18 – 0.86)	0.2 (0.06 – 23)
Ni	**4.06 (1.16 – 22.3)**	1.25 (0.55 – 5.65)	2.87 (0.46 – 6.3)	2.8 (1.24 – 5.7)	1.1 (0.4 – 550)
Zn	50.8 (21.6 – 194)	31.3 (17.6 – 65.1)	**57 (1.3–145)**	48 32–98	31(8 – 409)
As	**0.65 (0.33 – 5.11)**	0.15 (0.05 – 0.49)	0.18 (0.03 – 0.49)	0.16 (0.01 – 0.5)	0.13 0.04 – 4.72
Sr	**25.8 (8.32 – 106)**	9.2 (3.7 – 65.9)	15.3 (4.2 –30,5)	13 (6.1 – 66)	136 (3.8 – 60)
Sb	**0.25 (0.1 – 13.2)**	0.11 (0.04 – 0.23)	**0.23 (0.005 – 1.13)**	0.15 (0.073 – 0.43)	0.07 (0.007 – 0.38)
U	**0.12 (0.03 – 1.45)**	0.05 (0.01 – 0.41)	0.052 (0.003–0.16)	0.04 (0.01 – 0.17)	0.006 (0.002 – 0.08)

Blinova E. et al. Moss technique used to monitor the atmospheric deposition of trace elements on the territory of the Ryazan Region, Russia //Atmosphere. – 2024. – V. 15. – №. 11. – C. 1304.

The results map

Legend:

- Boundary of Ryazan Oblast
- Boundary of districts of Ryazan Oblast
- Cities of regional significance
- Forests of Ryazan Oblast
- Key ornithological territories of Ryazan Oblast
- Automobile roads
- Railways

Main enterprises of Ryazan Oblast:

1. Priprovskiy Non-Ferrous Metals Plant
2. Ryazan Oil Refining Company
3. Ryazan Leather Manufacturing Company
4. Ryazan Confectionery Factory
5. Teplopressmash
6. State Ryazan Instrument-Making Plant
7. Metals and Alloys Plant
8. Skopin Foundry Plant
9. Ryazan Accumulator Plant
10. Ryazan Pipe Plant
11. Ryazhsk Auto Components Plant
12. Radist Plant
13. Ryazan GRES (Thermal Power Plant)
14. Mikhailovcement
15. Istinsky Machine-Building Plant
16. Elatoma Instrument-Making Plant
17. Sasovsky Machine-Building Plant
18. "Krasnoye Znamya" Factory
19. JSC "FosAgro"
20. Vamin Agro
21. Kogotkovsky Feed Mill
22. Sotsialinsky Sugar Plant

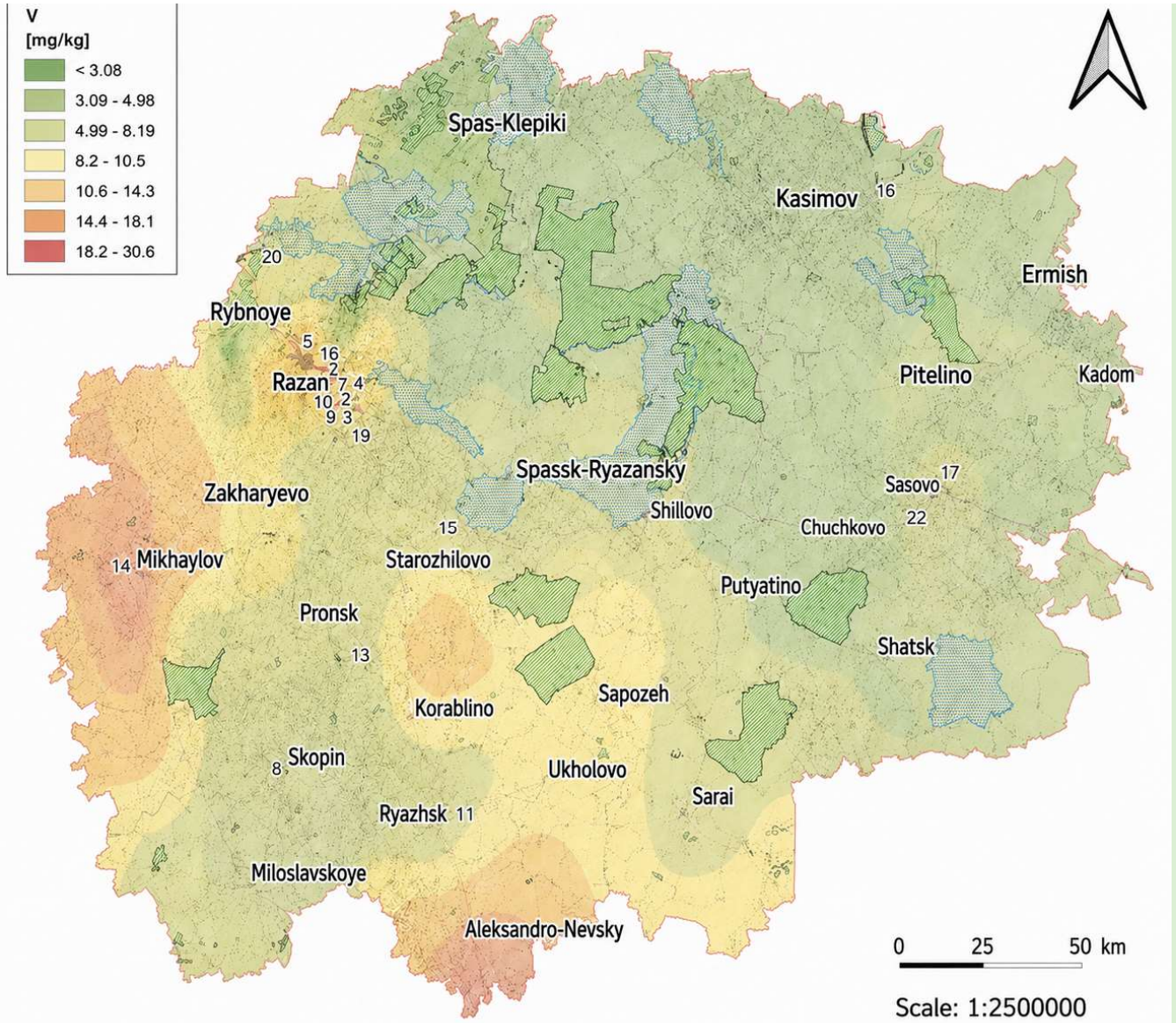
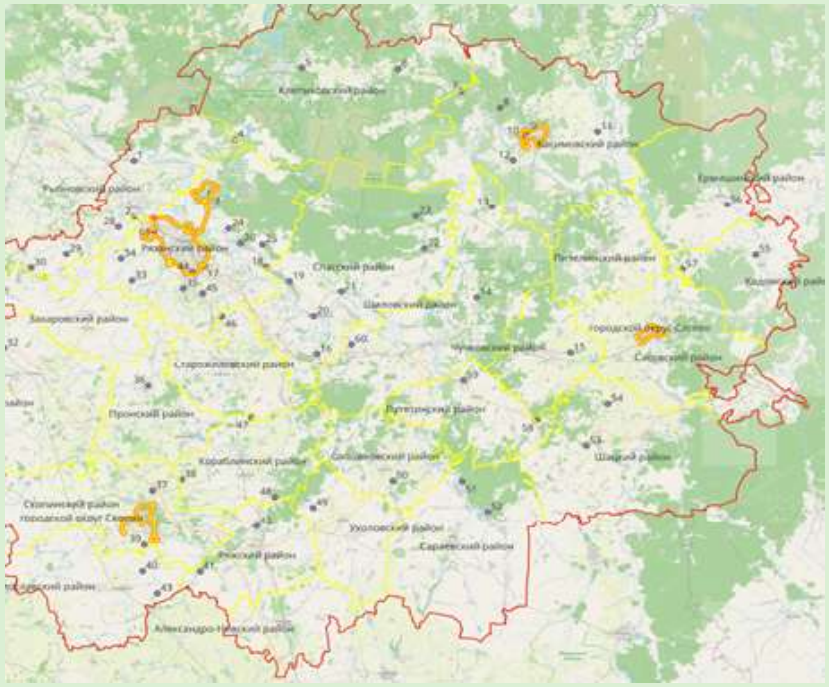


Figure 4. **Ecological and geographical analisys**

Measurements of the gamma radiation equivalent dose rate at 61 locations distributed across the territory of the Ryazan' Region



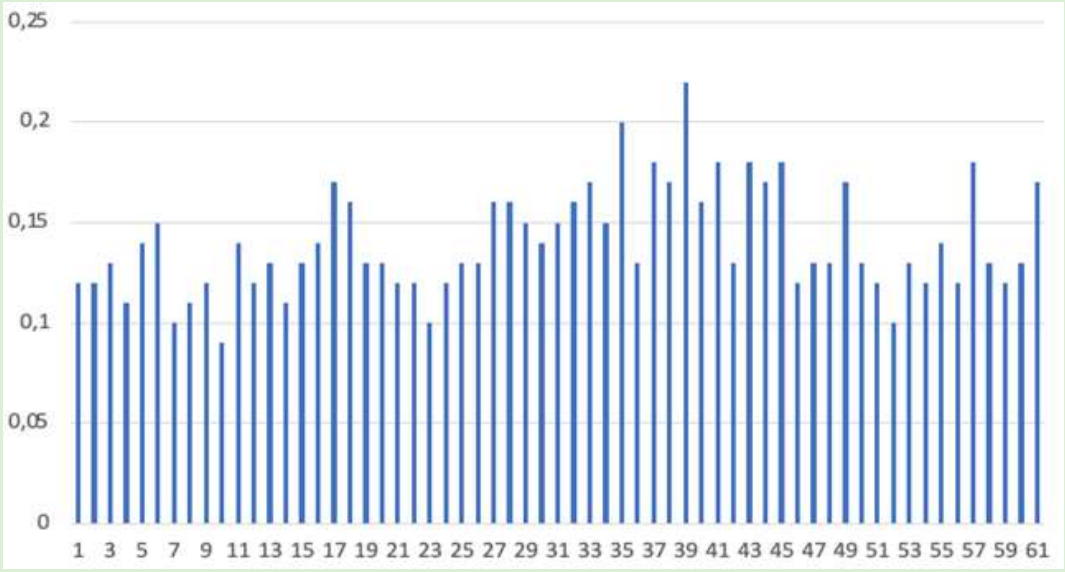
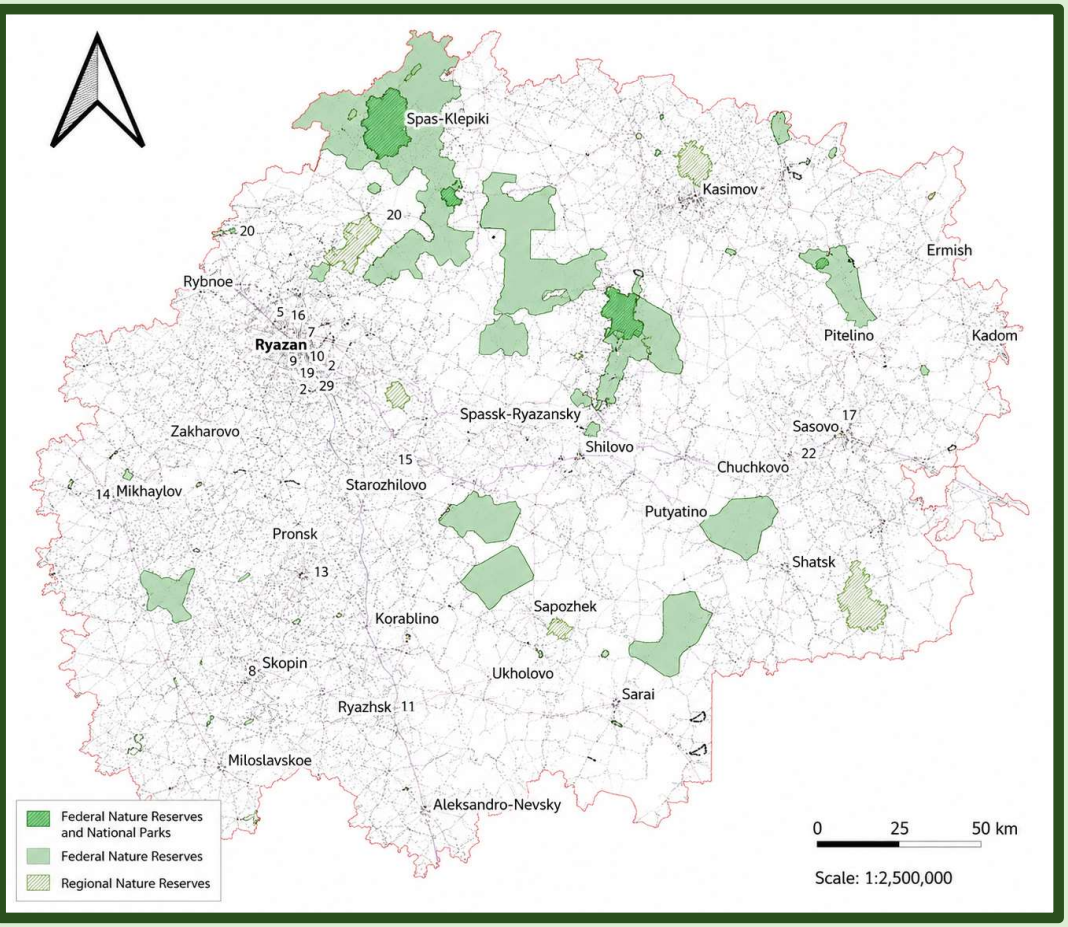


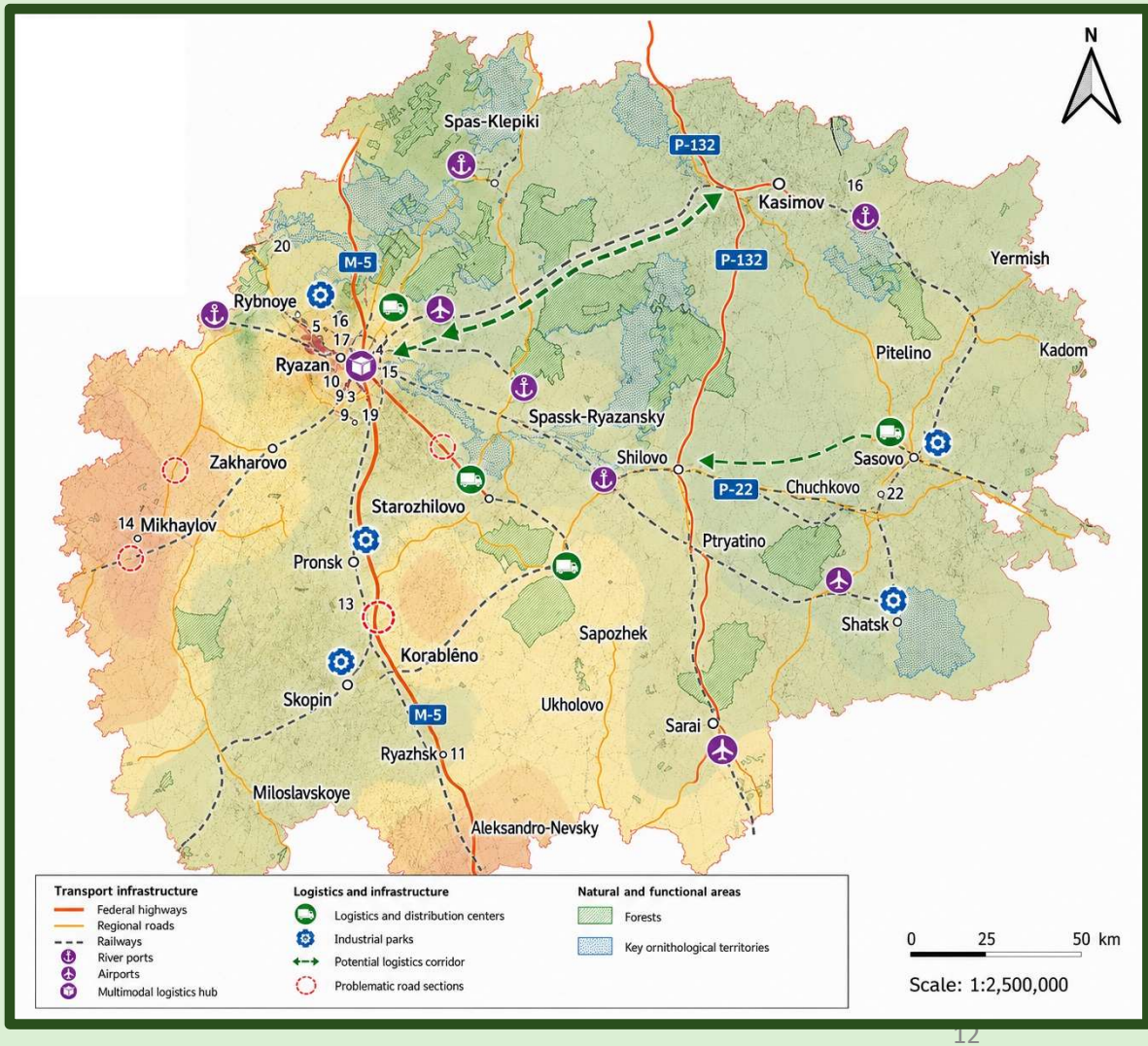
Figure 5. The average level of radiation exposure at measurement points in the territory of the Ryazan Region (average values of the ambient dose equivalent rate of gamma radiation, in units of equivalent dose: 0.14 ± 0.027 μSv/h).

Table 2. Potential and limitations of the Ryazan region's territory by pollution zones, compiled by the authors, 2025

Pollution Zone	Geography	Opportunities	Restrictions
High	Mikhaylov, southern area	Low; harmful industries prohibited	SanPiN compliance, EIA, environmental assessment
Medium	Novomichurinsk, Ryazhsk, Sasovo	Possible with limitations	Impact assessment, environmental monitoring
Low	Kasimov, Spas-Klepiki, Shatsk	Low; harmful industries prohibited	Minimal

The developed map can support decisions in regional development programs and spatial planning





Acknowlegments

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Thank you for your attention!

