From field to forest: pedosphere research in Jõulumäe area

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Introduction

Understanding soil properties is important because soil directly affects plant growth, food production, and ecosystem health. Agricultural practices can change soil structure, acidity, and nutrient availability over time. Studying these changes helps us understand how human activity influences natural systems. Soil fertility is essential for sustainable farming and long-term crop productivity. If soil becomes degraded, it can reduce biodiversity and food security. By comparing forest and field soils, we can observe how land use impacts soil quality. This knowledge supports more responsible land management decisions. It also raises awareness of the environmental consequences of fertilizer use. Field research provides practical experience and improves scientific observation skills. Ultimately, studying soil helps us to better understand the connection between agriculture and environmental sustainability.

Our group conducted a field study within the GLOBE program to investigate how agricultural practices influence soil characteristics, including humus horizon thickness, soil acidity, fertility, and temperature. The field research was conducted in Leina village, southwestern Estonia, on August 17, 2025 (Figure 1).

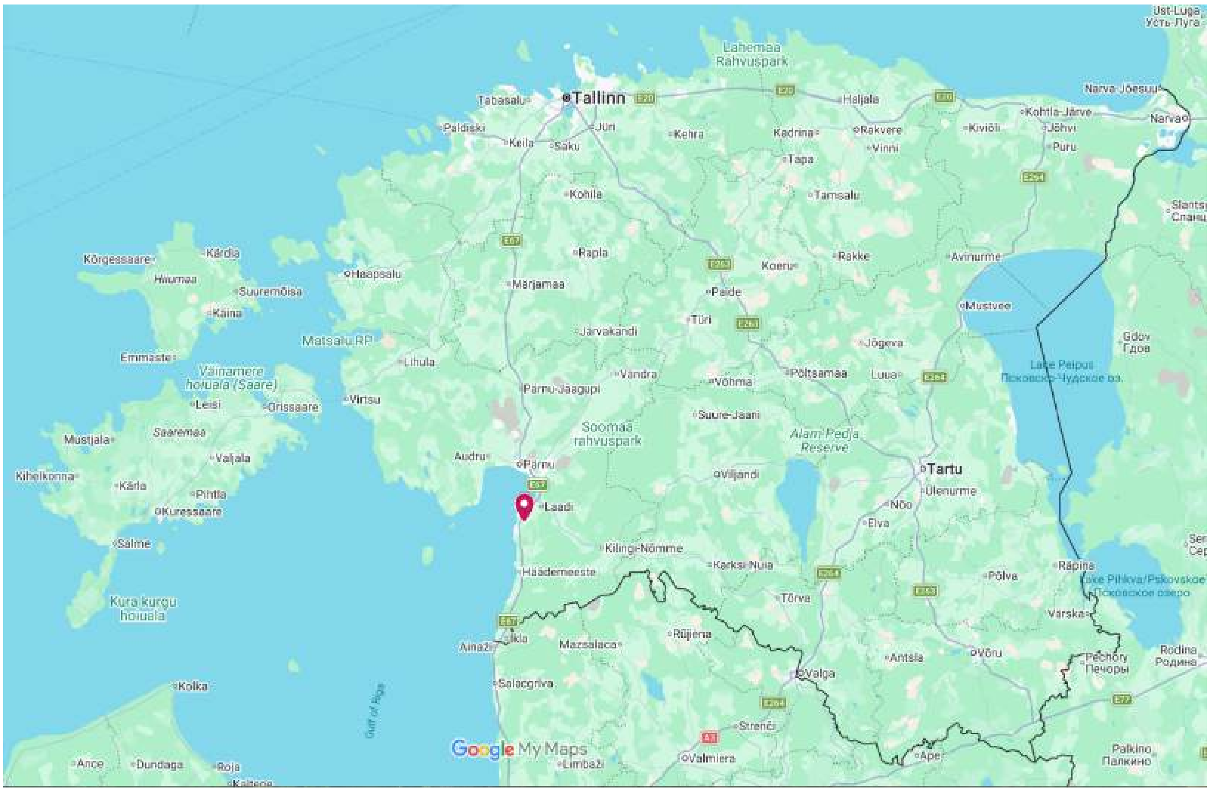

Figure 1. Location of the research site. Basemap: Google Maps

Research Questions and Hypothesis

How do the thickness of the humus horizon, soil fertility, soil acidity, and soil temperature change when moving from forested areas to agricultural fields?

Before the expedition, we proposed the following hypotheses:

1. The humus horizon is thicker in forest soil than in field soil.
2. Soil fertility is higher in agricultural fields due to fertilizer use.
3. Fertilized field soil is more alkaline than forest soil.
4. Soil temperature is higher in open fields than in forested areas and ditches.

Study Sites

Five sampling locations were selected for comparison (Figure 2):

1. A mixed deciduous forest (red)
2. An unused grass-covered field (orange)
3. A recently fertilized agricultural field/manure-treated field (green)
4. A drainage ditch (yellow)
5. The edge of a pine forest near Jõulumäe/running track (blue)

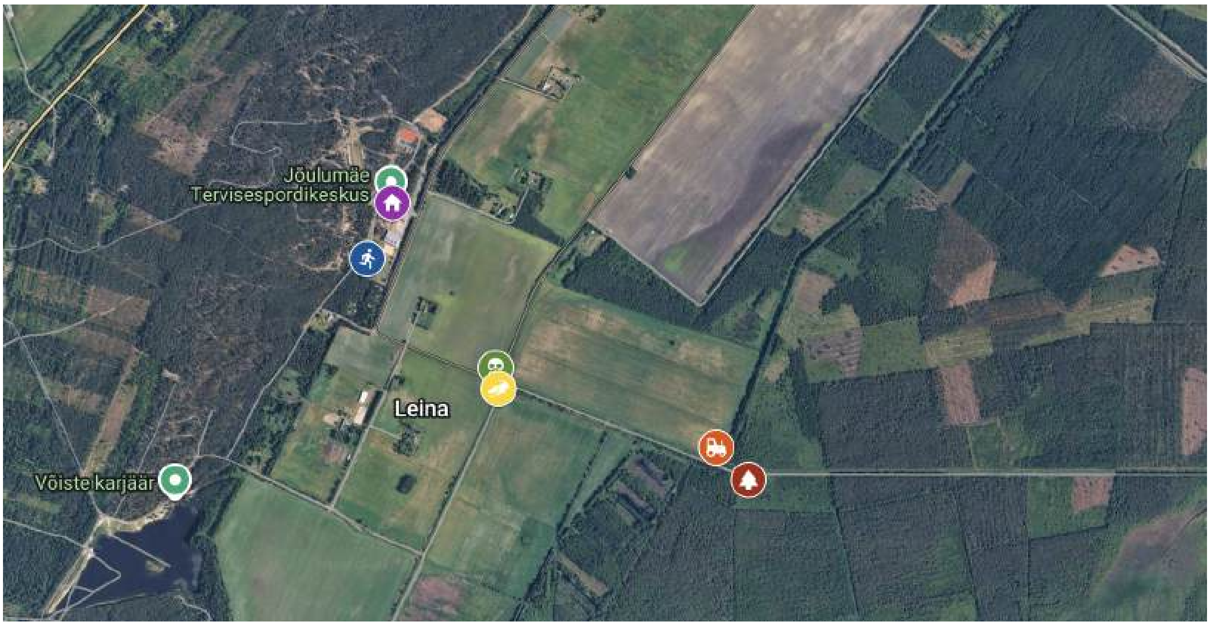

Figure 2. Locations of sampling sites. Basemap: Google Maps

The fieldwork followed the standard soil investigation protocols of the GLOBE program (GLOBE Program, 2023). The purpose of the fieldwork was to collect comparable soil data from different land-use types and to understand how soil properties change across environments.

Methods

All measurements were taken using standard GLOBE soil research tools and recorded systematically for comparison.

At each sampling site, holes were made using a shovel and a soil auger to expose the soil profile. This allowed us to observe soil, its texture and structure and make measurements - e.g. measure the thickness of the humus horizon. Boreholes were essential for identifying soil layers and collecting representative samples from different depths.

Soil temperature was measured at 5 cm and 10 cm depths using a soil thermometer. Temperature measurements help assess how land cover influences heat absorption and soil microclimate. These measurements were taken immediately after opening the borehole to ensure accuracy.

After exposing the soil profile, we identified and described soil layers based on color, texture, moisture, and composition. Observing soil parameters helps classify soil types and understand the geological, biological and chemical processes taking place underground.

Soil acidity was tested using pH indicator strips following the GLOBE soil protocol. Measuring pH is important because acidity affects nutrient availability and plant growth. In addition, soil samples were tested for free carbonates to determine the presence of mineral components that influence alkalinity (Figure 3).

Vegetation around each sampling site was recorded by identifying 3 main plant and tree species. Vegetation data provides context for interpreting soil conditions, since plant communities are closely linked to soil properties.

After measurements were completed, the soil was returned to the boreholes, and the area was fixed to minimize environmental disturbance. Ethical fieldwork practices were followed to preserve the study sites.

Soil samples were collected and dried overnight for further analysis. After drying, nitrogen (N), phosphorus (P), and potassium (K) levels were measured using an NPK soil testing kit. These measurements provided an estimate of soil nutrient availability.

Following the fieldwork, all collected data were compiled and analyzed. The results were used to create graphs and summaries for interpretation. A video report was produced to document the research process and communicate findings.

To support soil classification, we used the Republic of Estonia Land Board database to determine the soil types at our fieldwork coordinates (Republic of Estonia Land Board, 2025). This allowed us to compare our observations with official soil maps. The approximate sampling areas are shown in Figure 2.

Figure 3. Equipment in the NPK soil testing kit.

Results

The measurements revealed clear differences in soil properties between the sampling sites shown in Figures 4–8.

Figure 4. NPK soil testing kit results for the first site - deciduous forest (lehtmets).

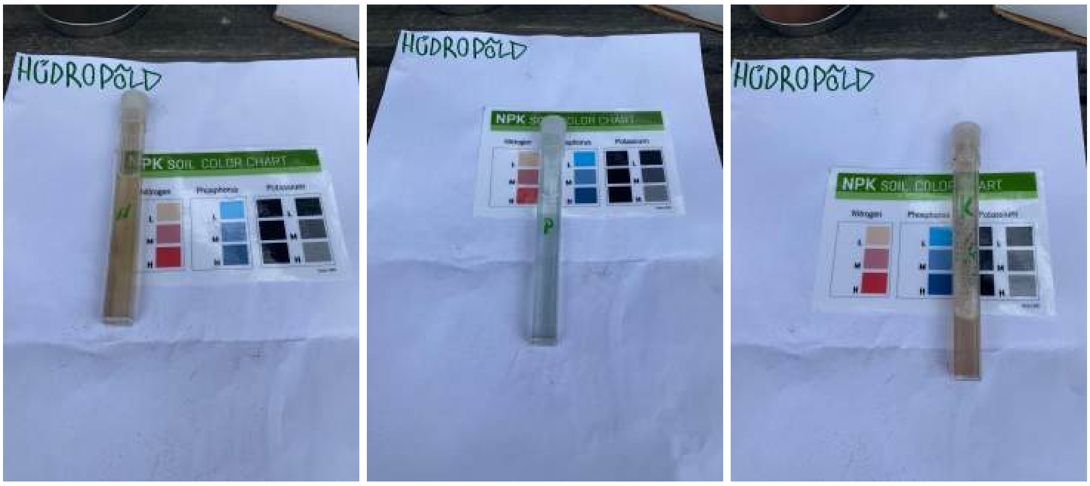

Figure 5. NPK soil testing kit results for the second site - unused grass-covered field (hüdropõld).

Figure 6. NPK soil testing kit results for the third site - manure-treated field (sõnnikuväli).

Figure 7. NPK soil testing kit results for the fourth site - drainage ditch (kraav).

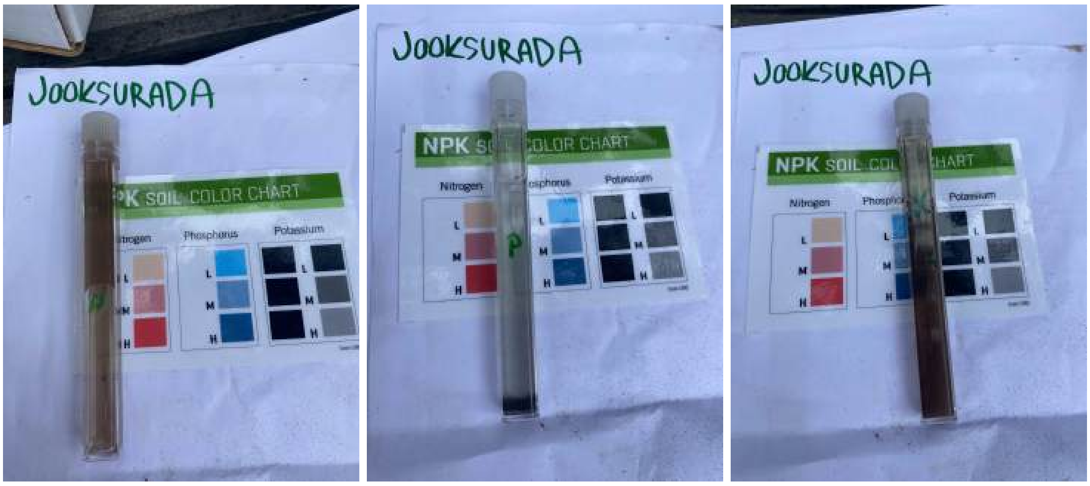

Figure 8. NPK soil testing kit results for the fifth site - running track (jooksurada).

The podzol soil near the running track (Figure 8) had the thinnest humus horizon. In the deciduous forest (Figure 4), the humus horizon measured 70 cm. When moving to the grass-covered field (Figure 5), the humus horizon increased to 85 cm, making it the thickest layer observed in our study.

In contrast, the manure-treated field (Figure 6) showed a reduced humus horizon of 17 cm. In the ditch (Figure 7), the humus horizon measured 40 cm.

Soil acidity also varied between sites. The deciduous forest soil had a pH of 5. In the grass-covered field, the first horizon also had a pH of 5, but the second horizon dropped to 4.5.

The manure-treated field showed increased alkalinity: pH 6 in the first horizon and pH 7 in the second and third horizons. In the ditch, pH was 8 in the upper horizon and decreased to 7 in the second horizon.

Temperature measurements showed that in the deciduous forest, soil temperatures were 16°C at 5 cm and 17°C at 10 cm depth. In the grass-covered field, temperatures increased to 20°C at both depths. The manure-treated field showed temperatures similar to those recorded in the study, with the highest values.

Conclusion

Three of our four set hypotheses were supported by the data.

The humus horizon was thicker in forest soil than in field soil. The studied fields were more alkaline than the forest soil. Based on temperature measurements, we confirmed that the soil temperatures were higher in open fields than in forested areas and ditches.

The hypothesis regarding soil fertility remained inconclusive, as the available tool (NPK soil kit) was not precise enough to detect measurable differences. Even when we witnessed the process of fertilization happening at the time. Future research on the same topic should include more accurate instruments and a greater number of sampling locations/depths to improve reliability and allow deeper analysis.

References

GLOBE Program. (2023). *Soil (pedosphere) investigation protocols*. The GLOBE Program. https://www.globe.gov/do-globe/globe-teachers-guide/soil

Republic of Estonia Land Board. (2025). *Estonian soil map database*. https://maaamet.ee