

Effect of Vineyard Management Style on Soil Organic Carbon:Nitrogen Ratio in Croatia

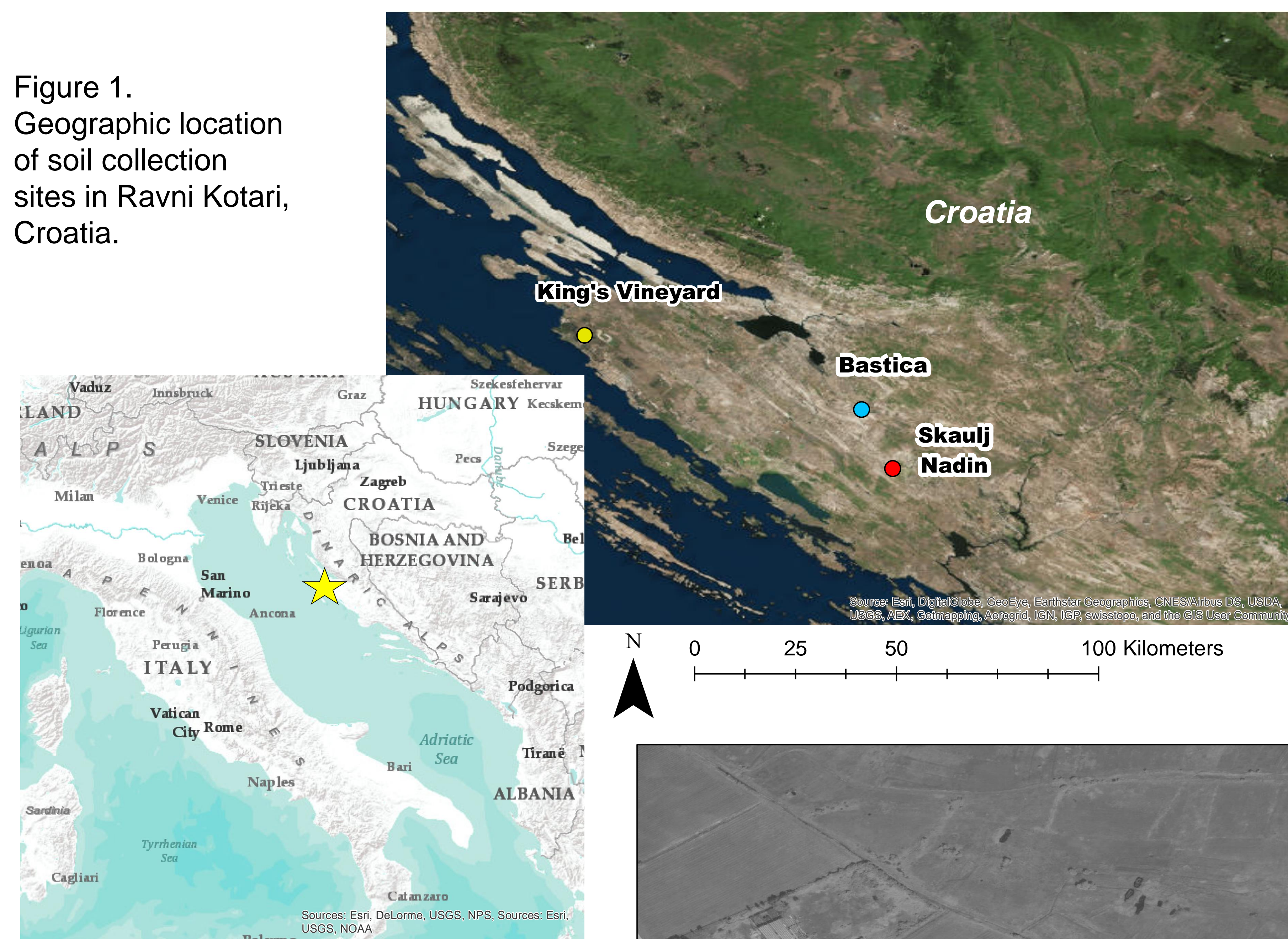
Lydia Palumbo

Earth and Environmental Science Departments, Furman University, Greenville, SC 29613

Abstract

Soil degradation, especially the loss of organic carbon, in the Mediterranean region may pose significant threats to the region's wine industry. However, little is known about the condition of the Mediterranean agricultural soils associated with viticulture in Croatia. Four vineyards under different management styles were studied in Ravni Kotari, Croatia, to compare the effect of soil management on the content of soil organic carbon (SOC) and nitrogen (SON) and the C:N ratio of soil organic matter. The four vineyards were characterized by calcareous clay loams, which pose challenges for viticulture because grapes require well-drained soils. Calcite was removed from soils prior to analyzing SOC and SON. In the non-carbonate fraction, SOC ranged from 0.43-4.5% and SON ranged from 0.04-0.37% for depths to 18 cm. No-till, crushed stone soil with conventional management had the highest SOC and SON and the highest C:N ratio (15:1) with the best soil structure. Tilled soils had intermediate SOC and SON that did not decrease with depth and the lowest C:N ratios, but organic management had higher SOC and SON content and a higher C:N ratio (11:1) than conventional (10:1). No-till soils had the lowest overall SOC and SON content, but a higher C:N ratio (12:1) than tilled soils. However, SOC and SON decreased rapidly with depth. Preliminary analyses suggest that, based on SOC and SON, tilled organic and crushed stone soils had the highest quality.

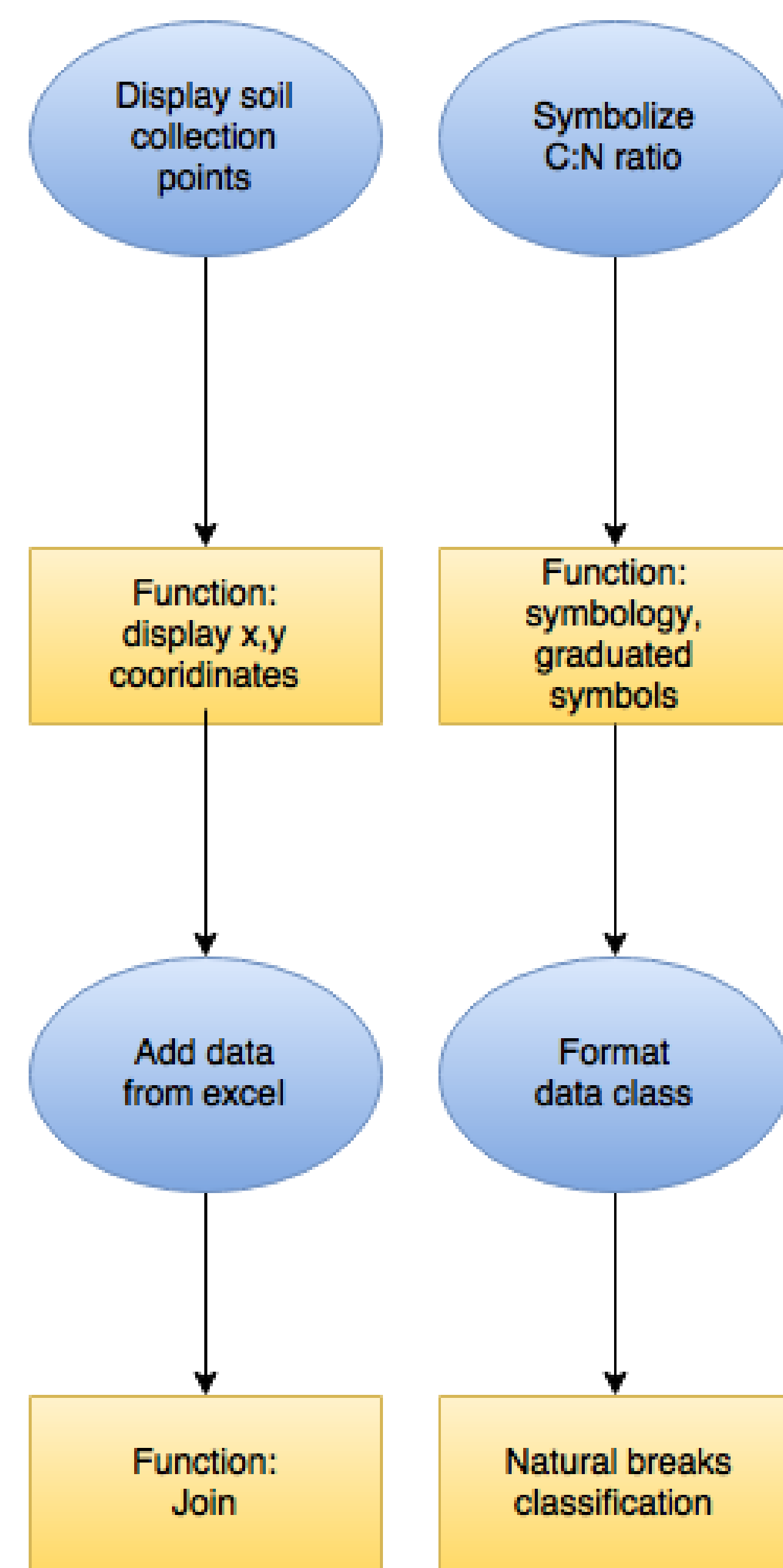
Figure 1. Geographic location of soil collection sites in Ravni Kotari, Croatia.



Conclusion

A low C:N ratio is an important indicator of soil quality because it indicates more equal levels of C and N available to plants throughout the soil profile with depth. King's vineyard has the highest C:N ratio while Nadin has the lowest C:N ratio on average. This indicates that tilled soils (including Skaulj) have lower ratios and therefore better soil quality according to this indicator. C:N ratio variability within vineyards did not significantly change – indicating that management style is the most important factor affecting C:N. These results are surprising given that King's vineyard had the best soil structure on observation yet had the least desirable C:N ratio. On the other hand, the tilled soils had more clay content and held more moisture which is undesirable in vineyards. However, they had better C:N ratios. Therefore, these findings indicate that tilling leads to improved soils according to the C:N indicator.

Methods



Carbon:Nitrogen ratio

- 9.57 - 10.00
- 10.01 - 11.73
- 11.74 - 13.30
- 13.31 - 15.46
- 15.47 - 17.02

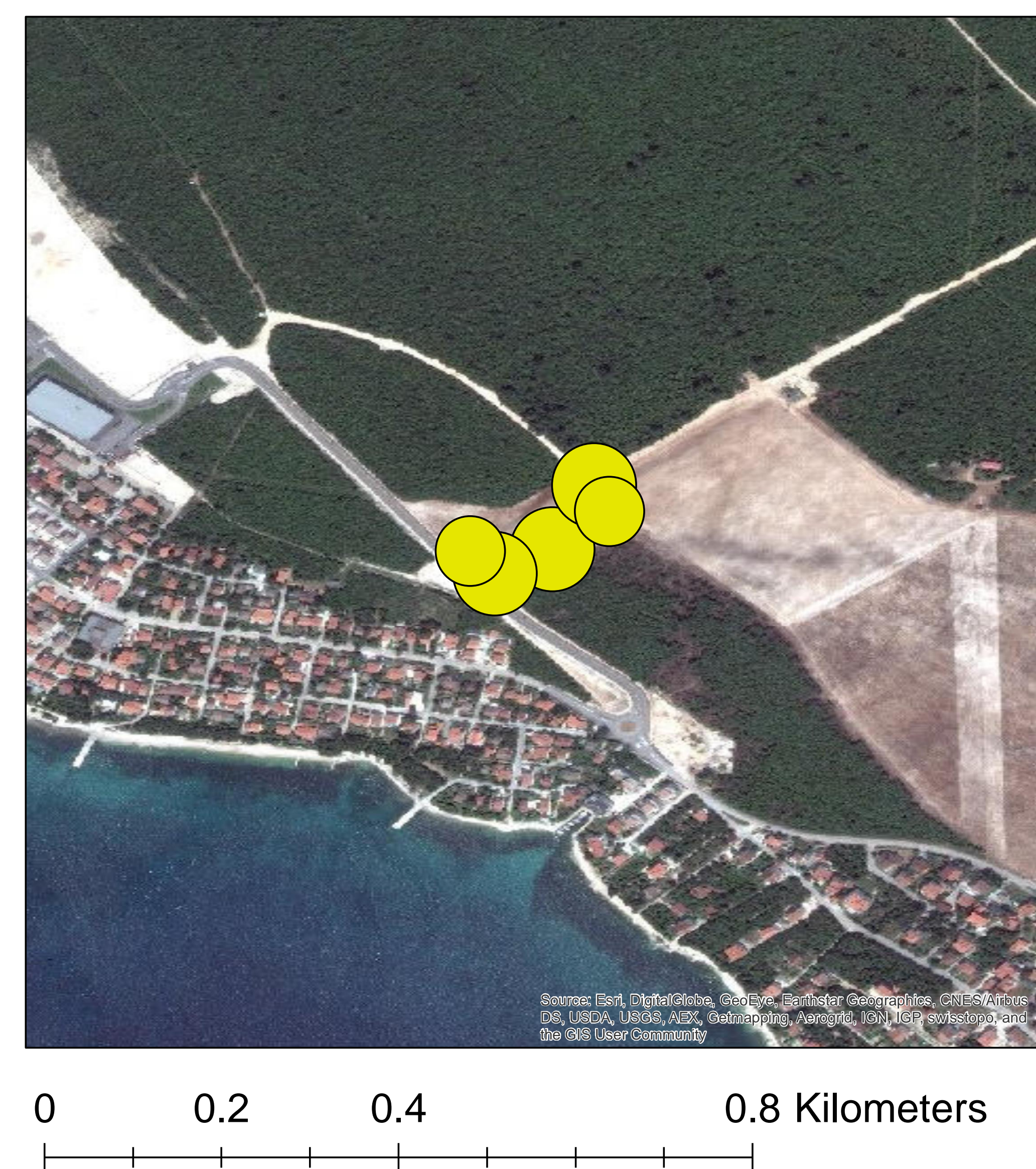


Figure 2. **King's** vineyard practicing no-till. Soil is covered in crushed limestone rock. Average organic carbon to nitrogen ratio is 15.93 with a range of 14.43 – 17.02. This vineyard is located on the coast..



Figure 3. **Bastica** Vineyard's practicing soil tilling. Average organic carbon to nitrogen ratio is 12.11 to a soil depth of 10cc with a range of 11.13-13.00. Grass is the primary ground cover.

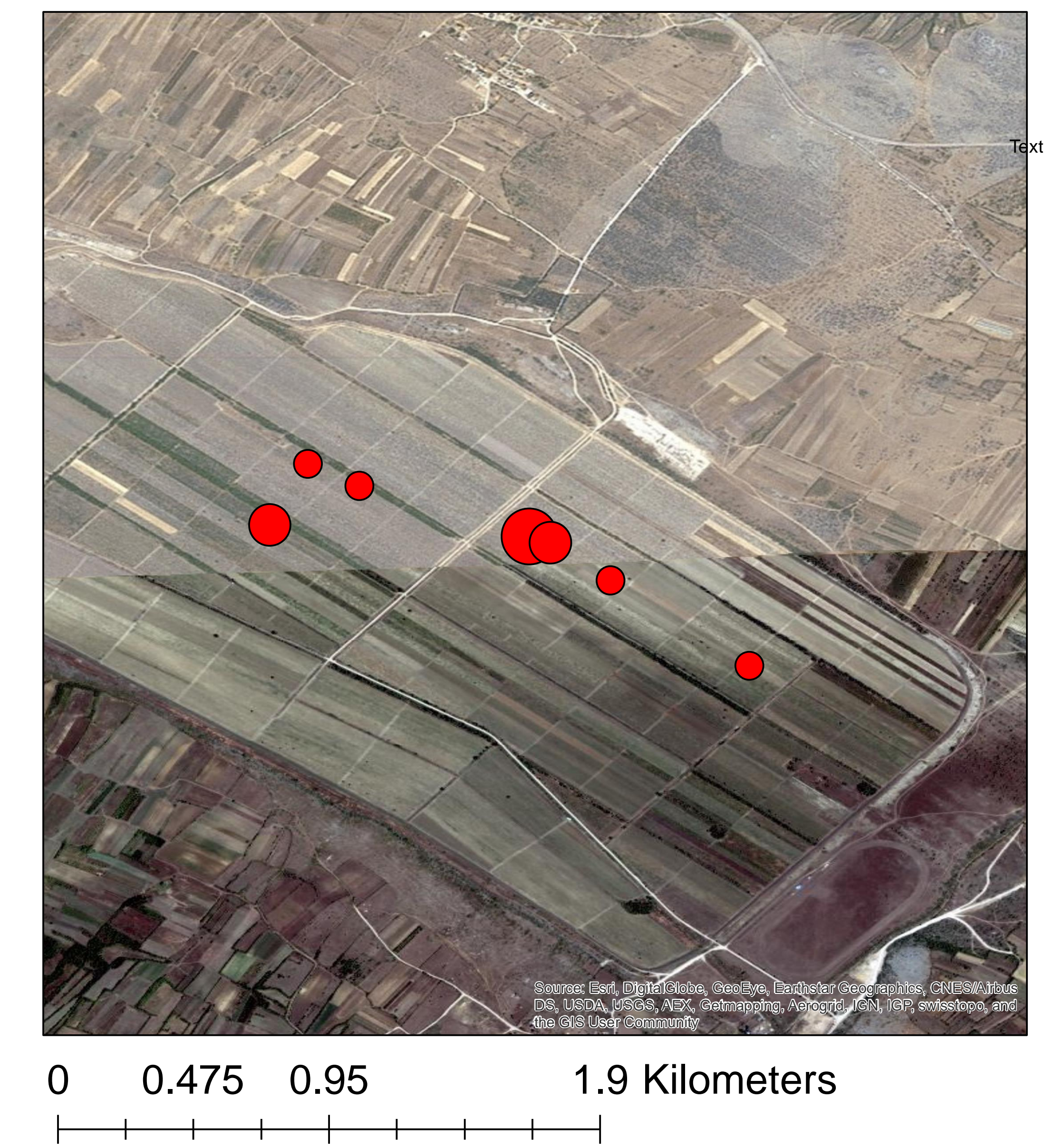


Figure 4. **Skaulj** and **Nadin** vineyards practicing soil tilling. There is no ground cover. Soil is calcareous and clay rich. Skaulj's average organic carbon to nitrogen was 11.15 with a range from 9.87-13.30. Nadin's average C:N ratio was 9.75 with a range from 9.92-9.57.

References and Data Sources

Palumbo, L., Andersen, C.B., Brkljaca, M., and Lewis, G. (2015) [soil organic carbon and nitrogen in vineyards as an indicator of soil quality] Unpublished raw data.

Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community