

UNIVERSIDADE FEDERAL DO ESPÍRITO SANTO
CENTRO DE CIÊNCIAS AGRÁRIAS
PROGRAMA DE PÓS-GRADUAÇÃO EM PRODUÇÃO VEGETAL

KARGEAN VIANNA BARBOSA

**USING DIGITAL MAPPING AND ARTIFICIAL INTELLIGENCE TO PREDICT SOIL QUALITY
IN THE CENTRAL PORTION OF THE ITAPEMIRIM RIVER BASIN, SOUTHEASTERN BRAZIL**

ALEGRE/ES
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Tese apresentada a Universidade Federal do Espírito Santo como parte das exigências do Programa de Pós-graduação em Agronomia, para obtenção do título de Doctor Scientiae em Agronomia, na área de concentração em Solo e Água e Interação com Plantas.

Orientador: Prof. Dr. Diego Lang Burak.

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ABSTRACT

BARBOSA, Kargean Vianna. EVALUATION AND MODELING OF SOIL QUALITY PARAMETERS IN THE CENTRAL PORTION OF THE ITAPEMIRIM RIVER BASIN USING MULTIVARIATE AND MACHINE-LEARNING TECHNIQUES Doctorate (Post-Graduate in Agronomy) – Federal University of Espírito Santo, Alegre-ES. Advisor: Diego Lang Burak

Set against the backdrop of the Itapemirim River Basin, this multifaceted research delves deep into the geochemical intricacies, predictive modeling, and agricultural potential of the region's soils. Chapter one embarks on a geochemical exploration, emphasizing the significance of environmental quality, particularly in the context of trace elements arising from anthropogenic or geogenic activities. Through a rigorous analysis of soil samples in regions marked by bimodal magmatism, the study establishes correlations between trace elements and soil components, pointing to the potential influence of geological processes on soil quality. Chapter two shifts' gears, leveraging the combined power of Sentinel-2 and Landsat-8 satellite datasets, processed via the Google Earth Engine platform. Machine-learning algorithms, from Decision Trees to Gradient Boosting, are employed to predict Soil Organic Carbon (SOC) and Total Nitrogen (TN) concentrations, with particular emphasis on low-intervention pasturelands in southeast Brazil. The findings accentuate the efficacy of machine learning models, especially when paired with high-resolution satellite data. In the final chapter, a revolutionary approach to Multicriteria Analysis Modelling is unveiled. This hybrid methodology marries the deterministic nature of algebraic map procedures with the predictive prowess of machine learning, culminating in a comprehensive Farming Favorability Index (FFI) for the region. The results offer a granular insight into the areas primed for agriculture, with the accompanying uncertainty map serving as a cautionary tale.