

**UNIVERSIDAD DE LA FRONTERA**

Facultad de Ingeniería y Ciencias

Doctorado en Ciencias de Recursos Naturales



**EFFECT OF TILLAGE, FERTILIZER APPLICATION AND  
CROP ROTATION ON SOIL  
PHYSICAL-CHEMICAL CHARACTERISTICS AND SOIL  
CARBON ACCUMULATION  
ON AN ANDEAN SOIL FROM ECUADOR**

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**DOCTORAL THESIS IN FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE  
DOCTOR OF SCIENCES IN NATURAL  
RESOURCES**

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**TEMUCO-CHILE**

**2021**

**“Effect of tillage, fertilizer application and crop rotation on soil physical-chemical characteristics and soil carbon accumulation on an Andean soil from Ecuador”**

Esta tesis fue realizada bajo la supervisión del director de tesis, Dr. Fernando Borie del Instituto de Agroindustria de la Universidad de la Frontera y ha sido aprobada por los miembros de la comisión examinadora.

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## Thesis summary

This thesis highlights the positive impacts of tillage methods and crop rotation patterns on soil properties in the highlands of northern Ecuador. However, the study suggests that fertilization rates had minimal influence on these properties due to the inherent nutrient levels in the soil. The research introduces an innovative crop rotation involving amaranth, a profitable and sustainable agricultural crop, which requires further investigation to determine its viability among local farmers. The data indicate that the no-tillage approach (NT) with amaranth rotation led to increased levels of organic carbon and nitrogen in the upper soil layer, suggesting faster residue decomposition. In contrast, maize rotation resulted in lower organic carbon content, indicating slower residue decomposition. Amaranth rotation demonstrated a faster humification rate compared to maize residues. The NT method also resulted in lower bulk density and higher soil water content. Soil property stratification was observed in both rotations, particularly regarding phosphorus (P) in the NT plots. Amaranth rotation showed distinct stratification compared to maize rotation, with more pronounced stratification in the latter due to the specific type of residues left on the soil surface.