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**THE EFFECTS OF TILLAGE PRACTICES AND
CROPPING PATTERN ON NONPOINT
SOURCE POLLUTION AND SOIL QUALITY**

A THESIS
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ABSTRACT

Soil erosion is one of the most serious environmental problems facing world agriculture. In New Zealand, with the current low financial returns from pastoral-based farming, land which was previously unaffected by soil erosion is being intensively farmed and therefore becoming more susceptible to soil erosion and nonpoint source pollution.

Adoption of soil resource management and agricultural practices that seek to conserve soil and water resources and minimise environmental degradation is attracting overwhelming interest among scientists and general public. Therefore, the main objective of this study was to assess the effects of selected tillage practices on soil physical properties, soil and water runoff, and water quality under selected cropping pattern.

Experiments were conducted on a Ohakea silt loam comparing crop production (barley and oats double crop rotation) using conventional tillage (MP), no-tillage (NT), and pasture (P) (as a control treatment) and assess their impact on erosion and selected soil properties. It was expected that this relatively heavy soil type would be sensitive to cultivation management systems and was therefore suitable for a comparison of tillage methods. The treatments were arranged in a randomised complete block (RCB) design with four blocks of three treatments.

In the field experiment, soil bulk density, water content, infiltrability, penetration resistance and earthworm populations were measured during two cropping seasons after barley and oats crops harvest in March and August 1996 respectively. Generally, these soil properties were significantly ($P \leq 0.05$) affected by tillage practices. Soil water content, infiltrability, and earthworm populations were similar in the NT and P treatments, but significantly higher

than those found in the MP treatment. Conversely, soil bulk density at 0 - 50 mm depth was in the order of MP > NT > P.

In the laboratory experiment, soil and water runoff, leachate volume, pH and nutrient losses from soil erosion were measured under a rainfall simulator. "Rainfall" intensity used was at an average application rate of 50 mm/hr for one hour, simulating a rainstorm. Mean data from the two experiments suggested that the surface water runoff and soil sediment in runoff were higher in the MP treatment than in the NT and P treatments, and were in the order of MP > NT = P and in a ratio of 4:1:1 and 30:1:1 respectively. Conversely, the volumes of water leachate were higher for the NT and P treatments than for the MP treatment, and in a ratio of 4:1:1 respectively. Soil pH from both water runoff and leachate was at an average of 7.4 and 7.2 respectively, but not different among the three treatments. Nutrient losses in surface water runoff were found to be significantly higher ($P \leq 0.05$) in the MP treatment (N=1.45 mg/m², P=1.02 mg/m², and K=8.3 mg/m²) than those with the NT (N=0.76 mg/m², P=0.65 mg/m², and K=6.8 mg/m²). Nutrient losses from NT and pasture treatments were similar.

One year's data including two cropping seasons indicate that conventional tillage practices can result in high surface runoff and sediment loss and adversely affect runoff water quality. Such tillage practices are likely to lead to unsustainable land resource management and decreasing crop yields. On the other hand, conservation tillage practices such as no-tillage and continuous pasture cover reduced soil and water erosion, improved soil physical properties and runoff water quality, and conserved land resources leading to enhanced land productivity and agricultural sustainability.

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