

# Analysis of environmental and economic efficiency using a farm population micro-simulation model

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## Abstract

New Zealand's success in raising agricultural productivity has been accompanied by higher input use, leading to adverse effects on the environment. Until recently, analysis of farm performance has tended to ignore such negative externalities. The current emphasis on environmental issues has led dairy farmers to target improvements in both environmental performance and productivity. Therefore, measuring the environmental performance of farms and integrating this information into farm productivity calculations should assist in making informed policy decisions which promote sustainable development. However, this is a challenging process since conventional environmental efficiency measures are usually based on simple input and output flows but nitrogen discharge is a complex process affected by climate, pasture composition, cow physiology and geophysical variability. Furthermore, the outdoor pastoral nature of New Zealand farming means that it is difficult to control input and output flows, particularly of nitrogen. We present a novel approach to measure the environmental and economic efficiency of farms, using the Overseer nutrient budget model and spatially micro-simulated virtual population data. The empirical analysis is based on dairy farms in the Karapiro catchment, where nitrogen discharge from dairy farming is a major source of nonpoint pollution.

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## 1. Modeling environmental performance

New Zealand's success in raising agricultural productivity has been accompanied by higher input use, leading to adverse effects on the environment. Until recently, analysis of dairy farm performance in New Zealand has often ignored undesirable effects on the environment [13,14,17]. The eco efficiency study by Basset Mens et al. [3] provides a notable exception by identifying farms which were both economically and environmentally efficient. This was achieved by including nitrogen discharges into the analysis of farm production and financial performance. This paper extends this approach and provides separate measures of economic, environmental and joint economic and environmental performance.

The current emphasis on environmental issues has led dairy farmers to target improvements in both environmental performance and productivity. Therefore, measuring the environmental performance of farms and integrating this

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