# The opportunity cost of soil acidity

## An economic analysis

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http://www.dpi.nsw.gov.au/agriculture/soils/acidity

Economic returns are likely to be higher if a small amount of lime is applied regularly to prevent soil acidification. Failure to prevent acidification will result in loss of rotation gross margin due to the decline in crop yield potential and the extra cost of larger amounts of lime required to ameliorate the problem.

## Introduction

This factsheet summarises an economic analysis of approaches to manage subsoil acidity in the southern cropping region of Australia. The analysis is based on a desktop study of data from various sources such as experimental results, government and scientific publications and expert opinions. The main aim is to estimate the loss in rotation gross margin (i.e. opportunity cost) from managing soil acidity at different stages over time relative to a base case scenario where small amount of lime is applied regularly to prevent soil acidification occurring.

## Approach

The analysis estimated the financial impacts of eight scenarios for managing soil acidity in the southern NSW cropping region. The evaluation is based on a representative crop rotation used in the farming system; a five-year rotation of wheat-canola-wheat-barley-lupins. Key assumptions (without soil acidity impacts) are shown in Table 1.

**Table 1: Baseline crop yields and prices**

| Crop | Yield (t/ha) | Price ($/t) | Gross margin ($/ha) |
|---|---|---|---|
| Wheat | 4.5 | 266 | 668 |
| Canola | 2.3 | 436 | 477 |
| Barley | 4.5 | 209 | 395 |
| Lupins | 2.5 | 380 | 463 |

Scenario 1 is the base case against which the rest of the scenarios were compared. Cash flow budgeting was used to estimate the net present value (NPV) of the discounted rotation gross margin at a 7% discount rate over 75 years (Table 2). This method values future cash flows in present day dollar terms and allows scenarios to be compared. The yield response to liming, and the timing and rates of lime applied, were based on historic research and publications as well as advice from technical experts. Research has shown that yield changes are closely related to the amount of lime applied, the implementation methods used, e.g. surface application, incorporation or deep ripping. Without lime application, soil will gradually acidify, and yields will decline over time.

The analysis estimated rotation gross margins for each scenario and the loss in rotation gross margin relative to Scenario 1 (the base case). Since Scenario 1 is the practice that maintains yield potential over time, the NPVs of Scenarios 2 to 8 have lower gross margins compared to Scenario 1 and, hence, their opportunity costs are shown as losses (Table 2 and Figure 1).

**Table 2: Net present value of rotation gross margins and opportunity costs at 7% discount rate**

| Scenario | NPV of future gross margin ($/ha) | Opportunity cost (Losses in $/ha) |
|---|---|---|
| 1. Base case. Liming regularly (250 kg/ha every year or 1 t/ha every 4 years) to maintain soil pH>5.0 in the profile | $7,327 | - |
| 2. No lime applied. Soil acidity developed over time | $5,976 | $1,351 |
| 3. Surface liming to pH5.5, starting at year 26 | $6,794 | $533 |
| 4. Lime incorporated at 0-10 cm to pH5.5, starting at year 26 | $6,865 | $461 |
| 5. Surface soil acidic. Surface liming to pH5.5, starting at year 1 | $5,868 | $1,458 |
| 6. Surface soil acidic. Lime incorporated at 0-10 cm to pH5.5, starting at year 1 | $6,325 | $1,002 |
| 7. Soil acidity developed over time. Lime incorporated at 0-10 cm and deep-ripped at 10-30cm to pH5.0, starting at year 51 | $6,068 | $1,259 |
| 8. Soil acidic to depth. Lime incorporated at 0-10 cm and deep-ripped at 10-30cm to pH5.0, starting at year 1 | $1,702 | $5,625 |

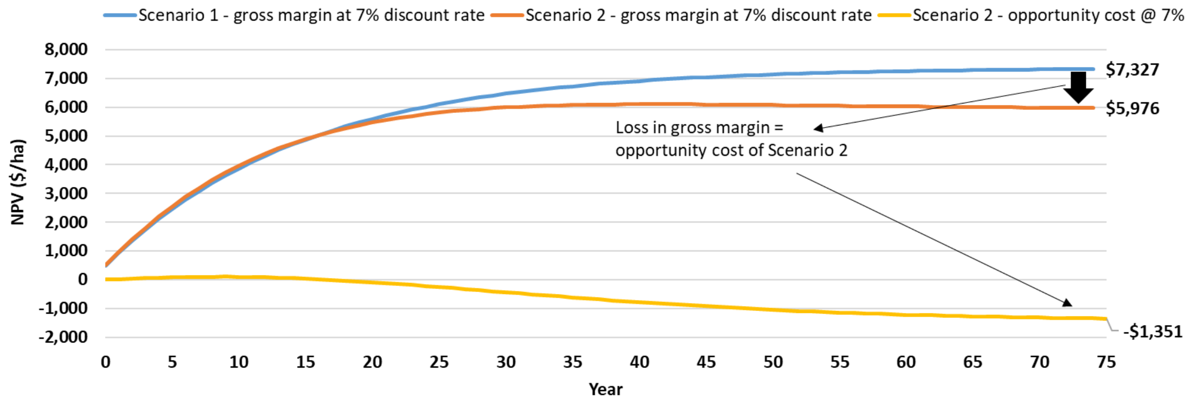


**Figure 1. Opportunity cost (losses in $/ha) of Scenario 2 compared to Scenario 1 (base case) over 75 years at 7% discount rate, using cumulative rotation gross margins**

## Results

Allowing soil to acidify has a significant impact on the future rotation gross margin. Scenario 1 returned the highest NPV of $7,327/ha (no soil acidity problem) whereas Scenario 8 had the lowest NPV of $1,702/ha (subsoil acidity already has occurred). Growers are better off preventing soil acidification by applying a small amount of lime regularly to maintain yield potential (Scenario 1).

The opportunity cost of ameliorating soil acidity depends on the stage of soil acidification, yield response to lime, quantity and timing of lime applied and application methods. Allowing soil to become acidic incurs an opportunity cost ranging from $461/ha (Scenario 4) to $5,625/ha (Scenario 8).

Incorporation of lime rather than surface application is worth the extra expense, due to the faster response of crop yields (Scenarios 4 and 6). If lime is not applied and soil acidifies, declining crop yields will result in the rotation becoming uneconomic by year 36 (Scenario 2). The NPV of the rotation gross margins and opportunity costs are higher when the discount rate is lower and crop prices are higher. The use of a higher discount rate reduced the rotation gross margin and opportunity costs for all scenarios.

## Conclusions

Based on the assumptions used in this analysis, it doesn't make economic sense to allow the soil to acidify in southern NSW cropping systems. The decline in yield potential over time cuts into profit margins, limiting the ability of the enterprise to perform at its best. In practice, the long-term decline in yield potential without lime may be masked by seasonal variability (e.g. high or low rainfall, temperature, frost) from year to year, especially in the early stages.

Economic returns are likely to be higher if a small amount of lime is applied regularly to prevent acidification. Failure to prevent soil acidification will result in long term loss of rotation gross margin due to decline in yield potential and the extra cost of larger amounts of lime required to ameliorate subsoil acidity, once it occurs.

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## Project partners and contacts

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