

ROLE OF THE OVERSEER[®] NUTRIENT BUDGET MODEL IN NUTRIENT MANAGEMENT PLANS

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Introduction

Like any management plan, nutrient management plans should include descriptions of the nutrient resource and current practices that may affect nutrient use and nutrient flows within a farm. The plan should also include a description of production and environmental objectives that may affect nutrient use or nutrient flows within a farm. Where objectives are not being met, a description of possible scenarios to meet these objectives should be available, along with possible implications for nutrient use and farm management.

The OVERSEER[®] nutrient budget model (hereafter referred to as Overseer for simplicity) is a decision support tool (Wheeler et al., 2003, 2006) to assist farmers and consultants develop nutrient plans. Overseer has a role in the development of these plans as the data required to produce nutrient budgets also define farm nutrient resources and flows and current practices that may affect nutrient use. The model produces both production and environmental indices that can be used to help assess whether productive or environmental outcomes are being met and whether changes to nutrient management are required. When used in conjunction with other information, Overseer can be used to assess alternative nutrient management strategies to meet nutrient management plan objectives.

Overseer ground rules

When the model is used as a component in developing nutrient management plans, an understanding of the model is helpful. Like all models, the quality of the input data is important. The Overseer model requires actual farm data as assumptions are made about farm efficiency. This was done to reduce the number of inputs, and to use data that most users have or where suitable defaults are available. For example, the model uses estimates of farm productivity to calculate animal intake, rather than estimates of pasture production, utilisation, and grazing management. Using this model structure does have implications when using the model to look at mitigation options, and this is discussed more fully in the ‘Developing mitigation options’ section below.

The model assumes that good management practices such as those in the Fertiliser Code of Practice, Best Management Practices (BMPs) and Regional Council guidelines on effluent management, are followed. When these practices are not being followed, the model is likely to underestimate nutrient losses. Thus, in developing plans, a method is required to identify these breeches, and in most cases these should be remedied first as they are usually easiest to do.

The model uses long-term annual average input data and loss predictions. The variation between years in nutrient flows and losses, as affected by climatic variability, are encompassed within the long-term annual average. This reduces the need for specific daily climate data and a large amount of extra detail in the model, which is more appropriate for

detailed research models or those used by expert users. In most cases, the user does not need to specify within-year nutrient management information, although some model components account for the effects of timing on management practices (e.g. timing of fertiliser use, animal winter management and fodder crop management). Many of the effects of poor timing of application or placement of fertiliser or effluent are covered by BMP recommendations.

Data inputs

As part of the development of the Overseer model, inputs have been selected that are important for assessing nutrient flows within a paddock or farm. These inputs have been developed to be as user-friendly as possible, that is, farmers either know the information or some other calculation method or default values are supplied. Therefore, the data input requirements for the model are the minimum required to describe the nutrient resource status of the farm.

The data input requirements can be used as a method to start enquiring about factors that may affect nutrient management. For example, can different blocks be identified, why are they different, and are they managed differently? A classic example is effluent blocks, which should be soil tested separately, and have a different fertiliser policy than the rest of the farm. Another example is the impact of supplementary feed on farm nutrient flows. They are usually considered from their feed and production benefits, but on some farms, the amount of N brought in as supplement exceeds 200 or even 400 kg N/ha/yr on an area equivalent basis. The model shows the size of this import and the effect of this nutrient import is factored into the calculations. Usually, one consequence is the requirement to increase effluent block size to handle the additional excreta N and K produced.

Output indices

To assist in assessing the likely environmental impacts of a given farm set-up, a number of indices are produced, including N leaching (kg N/ha/yr), potential P runoff loss (kg P/ha/yr) and P runoff risk factors, and an estimate of N conversion efficiency. Maintenance nutrient requirements and relative yields are also given which, with assistance from a fertiliser consultant, can be converted into fertiliser requirements.

It is currently difficult to assess the impacts or the need to change based on a particular nutrient budget or index produced by the model. Where possible, comments have been added when known targets have been exceeded. Thus for N, the drinking water standard of 11.3 mg N/L is used to generate messages about the desirability of reducing N leaching. For P, a comment is generated when Olsen soil test levels are above optimum and greater than maintenance rates of fertiliser are being applied. To be used to greatest effect, model outputs need to be compared with regionally specific nutrient management targets, which in turn are based upon clearly identified catchment values. From a model development perspective, it has been difficult to program in procedures that will help induce farmer changes in practice when there are no industry or regionally specific nutrient management targets to act as triggers. The possible diverse nature of any targets, which may be different for each catchment, means that users are going to need to be aware of local council requirements or targets along with farmer requirements when formulating nutrient management plans.

Another assessment approach is to use comparative or relative changes on-farm by comparing farm nutrient inputs and outputs and environmental indices over time. Trend analysis over time can be informative and can be used as a basis to predict changes in the future. Some regional council requirements and the targets set by the Dairy Industry, which aims for a 50%

reduction in N leaching, are based on relative changes. This approach focuses on management changes over time as underlying farm site information such as soil type and average rainfall are constant. However, it does require saving farm management information and/or model outputs over time.

Some indices are useful for challenging thinking on how nutrients are used on the farm. For example, a survey of files received from commercial farms (>200 files) indicate that N conversion efficiency ranged from 19% to 53%. N conversion efficiency is calculated as product N removed/total N inputs. Generally, within a farm, N leaching tends to decrease as N conversion efficiency increases. What this index indicates is that there are two ways we may be able to tackle high N leaching – one is through reducing N intakes, which has been the traditional approach, and the other is through farm management changes that result in higher product N removal. For the same amount of N input, it can be possible to increase product N removal by options such as improved pasture management (e.g. grazing efficiency, species selection) or animal management (health, genetics, etc). These options have little to do directly with nutrient management. In reality, both product N and N inputs should be looked at. Changes in management systems to increase product N removal might be used as a substitute for N fertiliser inputs to achieve the same output, or extra income used to development mitigation options. A second index is \$ spent on fertiliser per unit production. There are good reasons why this may vary between farms, but sometimes it is another indication of some inefficiency within farms. More importantly, farmers may react to and act upon this index rather than an N conversion efficiency index.

Development of mitigation options

Within the model, there are a number of mitigation options that can be examined as management techniques to reduce N loss. Automatic scenarios for reducing N loss include winter management options such as grazing off or the use of wintering pads, changing N fertiliser application rates and times, or substituting supplements for N fertiliser. It should be noted that these mitigation options for N also result in reductions in greenhouse gas emissions. The user can also look at changing stock ratios (sheep: beef or male beef:female beef) or changing effluent block sizes. Options for nitrification inhibitors, Herd Homes, riparian strips, and wetlands are currently under development and if ready will be available for the next model update. The addition of new mitigation options is seen as a key development direction by the owners of overseer.

An important issue for developing mitigation options in farm nutrient management plans is that consideration is given to potential changes in whole farm management. For example, a key driver of N leaching is animal urine. Wheeler et al. (2006) showed that Overseer estimates urine excreta outputs using animal productivity information to get an estimate of animal N intake. The implication of this is that when the Overseer model is used to assess management options, then any changes in the farm systems that result in changes in production should be accounted for. The automatic mitigation options already in the scenario options in the model attempt to do this, and this part of the model is to be further developed.

As an example, it is feasible to add in a Herd Home in the model using a combination of a wintering pad and a feed pad. The Overseer model is then likely to report the need for increased effluent block areas due to the extra effluent produced. The subsequent associated costs of other facilities such as storage and containment facilities for bunker effluent need to be factored into the financial analysis. To assess correctly the whole system impact, consideration should be given to whether the existence of a pad system is likely to result in

management changes that may lead to different production patterns. For example, would the existence of a Herd Home lead to reduced pasture damage and hence higher annual pasture production, and hence higher animal N intake? A farmer group study in the Lake Taupo catchment indicated that grazing all animals off over winter was likely to be linked to other changes such as hard grazing of the farm in autumn (reducing the whole farm to a low pasture residue). This would result in extra excreta being added to the pasture during the most at-risk period, and hence reduce the net benefit of the wintering pad. The use of a Herd Home may be a trigger for other changes to the farm system, such as the importation of more supplementary feed. This could also result in changes in management regimes and changes in excreta ratio, particularly if high energy/low N supplements such as maize silage are used. These management decisions will all have an impact on nutrient flows and N leaching, and are thus critical issues to be considered if realistic scenarios are to be developed using the modelling tool.

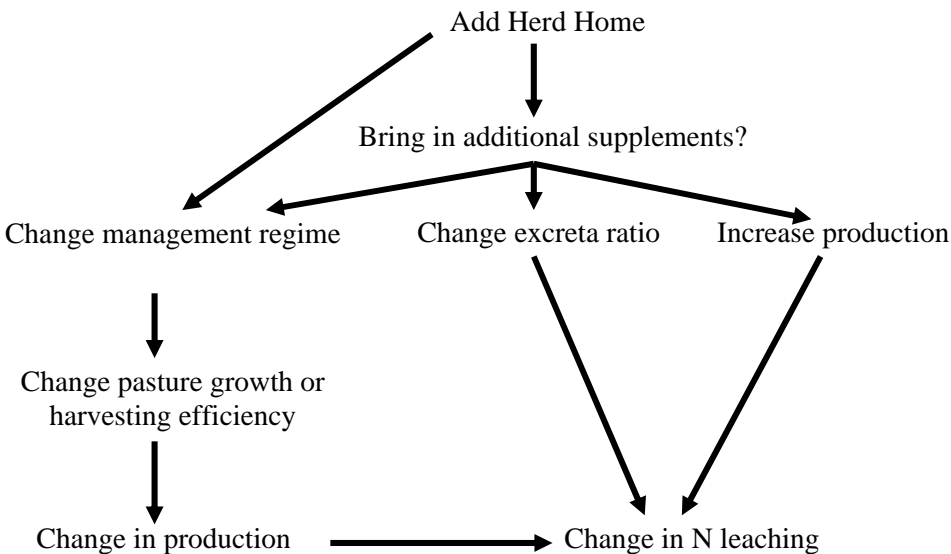


Figure 1: Possible management impacts arising from the decision to include a Herd Home on a farm.

Monaghan et al. (2007) described how Overseer could be used in conjunction with models such as Stockpol or Udder, and financial analysis, to evaluate alternative strategies for managing nutrients. A schematic diagram of how this can be done is shown in Figure 2. An iterative procedure is recommended whereby mitigation options are considered based on initial Overseer output, farm financial and management implications are investigated, and the mitigation options modified where necessary before re-running the Overseer model. Using this approach, the most cost effective nutrient management strategies can be identified (Figure 3). It is important to note that the size of the change in N leaching for any given management regime, and the change in the financial impact (EBIT), will be different for each farm (Ledgard et al. 2006).

The complexity of decision-making increases when mitigation options involve changes to landuse or changes in stock policy, as the implications for an individual farmer can sometimes be large and not easily reversed.

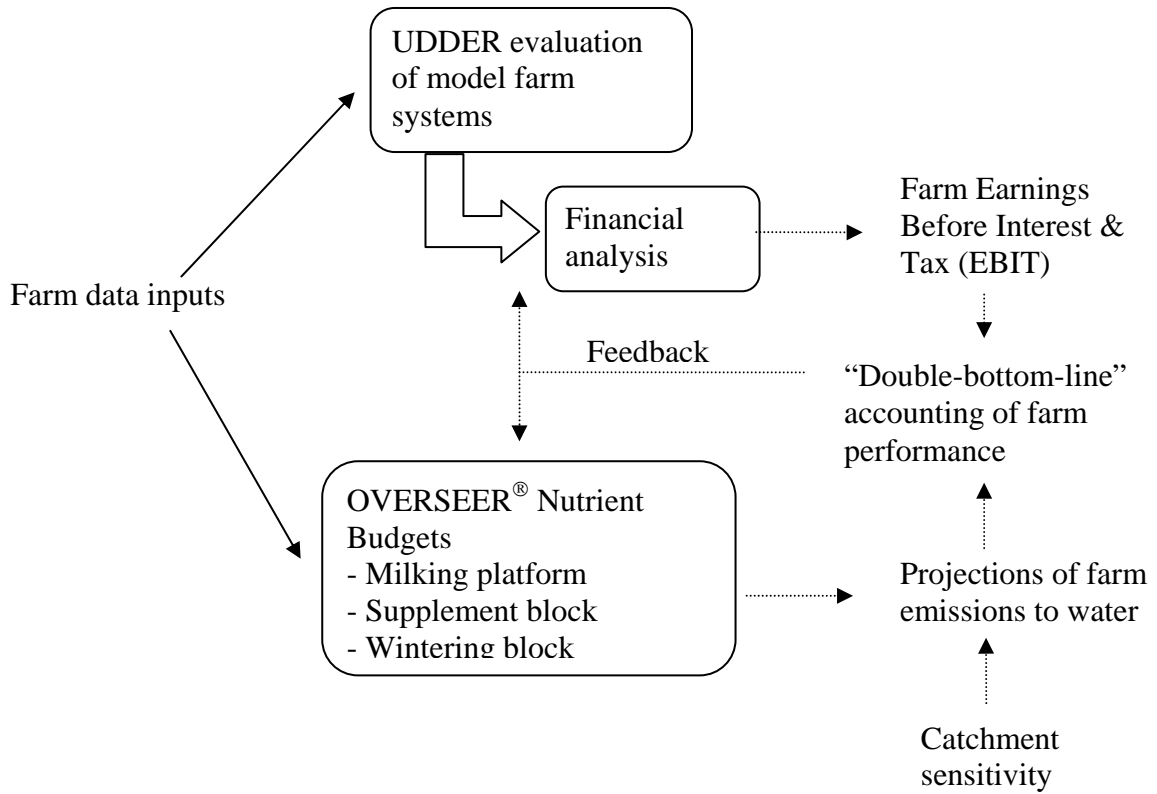


Figure 2: Schematic diagram of how the OVERSEER[®] Nutrient Budgets model can be used to evaluate the economic and environmental performance of farm systems.

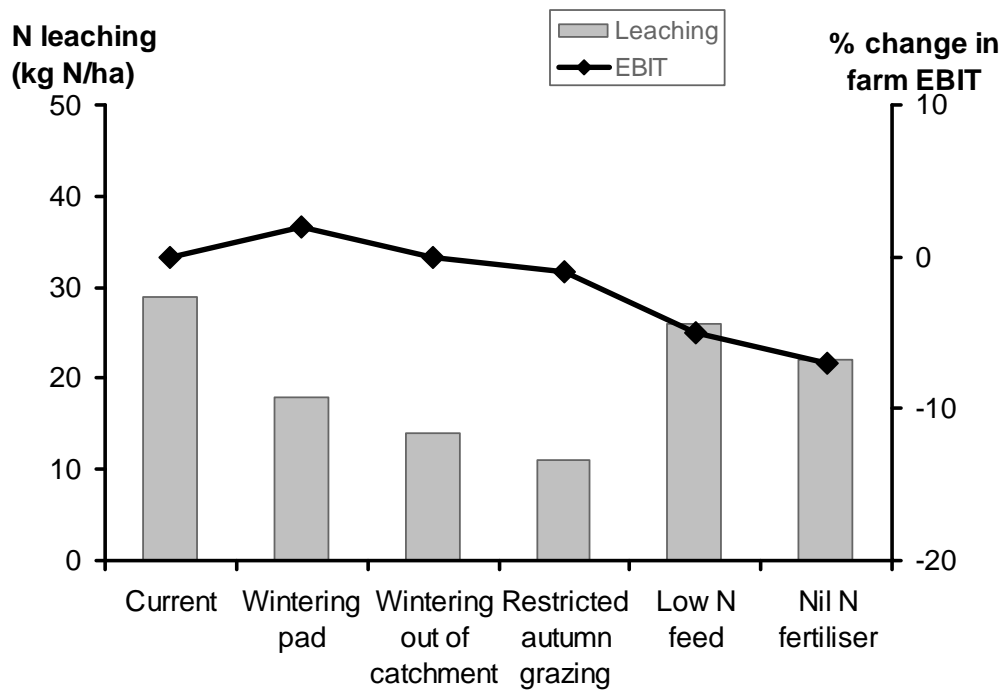


Figure 3: Example of how output from whole farm system evaluations using production, financial and environmental modelling tools can identify the cost effectiveness of a range of N mitigation options relevant to dairy farms.

Conclusion

The Overseer nutrient budget model has a key role in nutrient management planning by:

- defining key data which determines nutrient efficiency and losses.
- supplying some key indices of production and environmental status.
- helping in identifying appropriate mitigation scenarios.

When developing scenarios, it is recommended that users are familiar with assumptions used in the model, that the farm system is understood so that secondary effects can be determined, and that the nutrient mitigation option analysis is combined with other analysis to determine the full impact of a scenario on farm operations.

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